



USER INSTRUCTIONS

Limitorque MX

Electronic Actuator

FCD LMENIM2314-00 – 07/08

Maintenance and Spare Parts



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1 Introduction

1.1 Premise

The Flowserve Limitorque MX actuator components are separated into subassembly groupings. This manual covers the removal and remounting procedures for each subassembly group. Use these instructions when disassembly is required for service, maintenance, or parts replacement.

1.2 Procedure Emphasis

Please refer to the following methods used to emphasize text throughout this manual. Safety warnings, cautions, and notes present material that is important to user safety. Be sure to read any safety notices you see, as they could prevent equipment damage, personal injury, or even death to you or a co-worker.

Safety notices are presented in this manual in three forms:

☠ WARNING: Refers to personal safety. Alerts the user to potential danger. Failure to follow warning notices could result in personal injury or death.

⚠ CAUTION: Directs the user's attention to general precautions that, if not followed, could result in personal injury and/or equipment damage.

NOTE: Highlights information critical to the user's understanding of the procedure.

Bold text stresses attention to the details of the procedure.

1.3 Important Notes and Warning Statements

Please read this Maintenance and Spare Parts Manual carefully and completely before attempting to store or perform maintenance on your MX valve actuator. Further installation, setup, and operation instructions are available in the Installation and Operation manual (LMENIM2306) located in the actuator terminal compartment at shipment.

- ☠ **WARNING: Be aware of electrical hazards within the actuator and high-pressure hazards of the attached valve or other actuated device when installing or performing maintenance on your MX actuator. Failure to observe these precautions could result in serious bodily injury, damage to the equipment, or operational difficulty.**

- ☠ **WARNING: Do not manually operate actuator with devices other than installed handwheel and declutch lever. Using additive force devices (cheater bars, wheel wrenches, pipe wrenches, or other devices of this nature) on the actuator handwheel or declutch lever may cause serious personal injury and/or damage to the actuator or valve.**

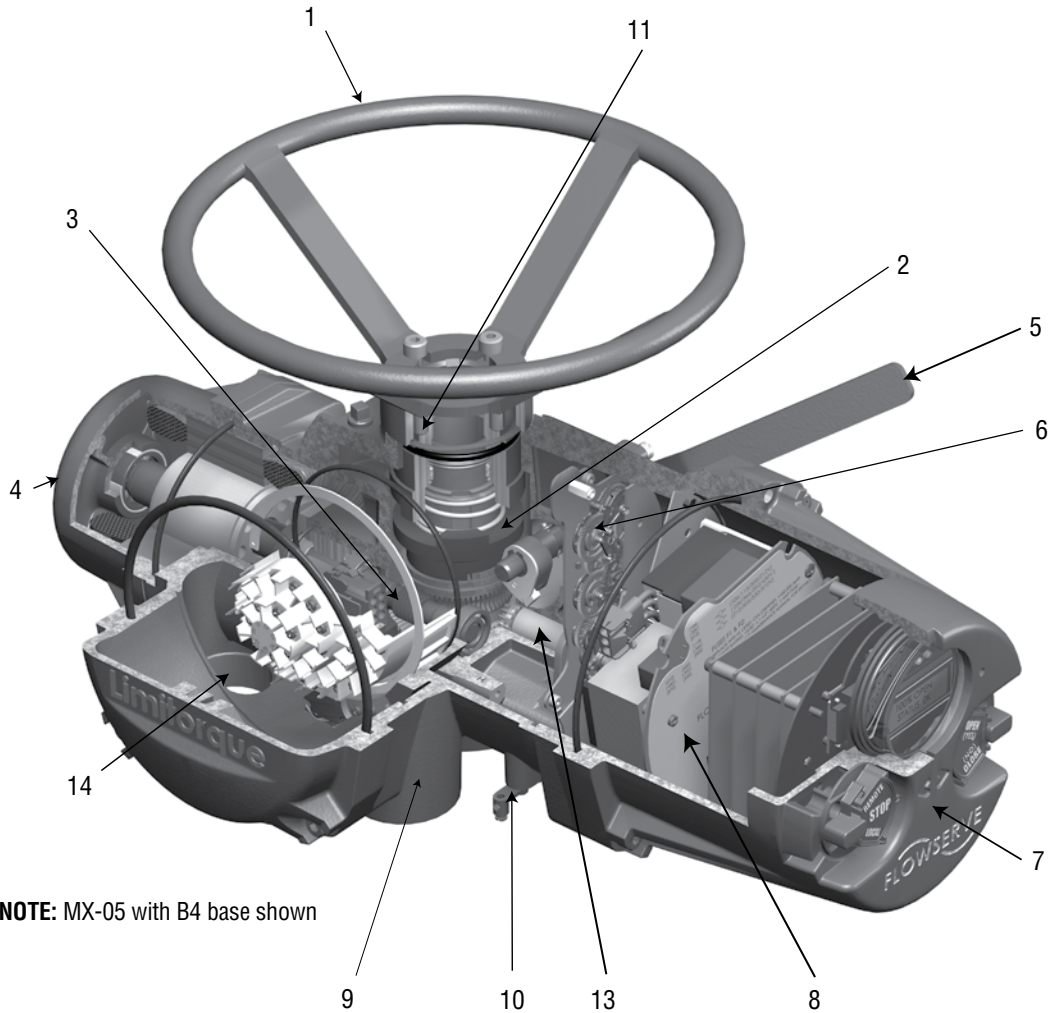
1.4 Reference Documents

- Protection, Control and Monitoring features of MX Electric Actuators (Bulletin LMENTB2300)
- MX Control, Performance and Value in Multi-turn Electric Valve Actuators (Bulletin LMENBR2302)
- MX Installation Manual (Bulletin LMENIM2306)

The latest revisions to these documents are available on-line from Flowserve Limitorque's website, www.flowserve.com or at www.limitorque.com

2 MX Actuator Subassembly

Figure 2.1 – Typical MX Actuator



NOTE: MX-05 with B4 base shown

2.1 MX Actuator Subassembly Components

Table 2.1 – MX Actuator Subassembly Components

No.	Description
1	Top-mounted handwheel
2	Drive sleeve
3	Worm shaft
4	Motor
5	Declutch lever
6	Encoder
7	Control panel (CP)
8	Control module
9	Optional bases
	Thrust base type
	• A1 = Standard thrust base
	• A1E = Extended-reach thrust base
10	Baseplate-type B4 with stem nut options type:
	• B4 = stem nut with variable bore and key
	• B4E = extended-reach stem nut with variable bore and key
	• BL = splined stem nut (SAE or Involute)
11	Handwheel adapter/handwheel worm gear
12	Side-mounted handwheel (not shown, but available for the MX-10, -20,-85, -140, and -150)
13	Encoder drive cartridge
14	Terminal block

2.1.1 Product Description

Your MX actuator controls the opening and closing travel of valves and other actuated devices. OPEN and CLOSED limits are protected by an absolute encoder that provides optical sensing of valve position and measures valve position in both motor and handwheel operation. No battery or backup power supply is required. Output torque is derived from motor speed, temperature, and voltage. If the preset torque is exceeded, the motor shuts off. As a result of this reliable and advanced protection technology, all valve and other actuated devices are protected from potential damage from overload, improper seating, and foreign obstructions.

A range of control and network options is available and can be easily added to the control capabilities already available on a standard actuator. Contact your local Limitorque distributor or Limitorque sales office for further information.

2.1.2 Storage

Storage Recommendations

Your MX actuator is double-sealed and weatherproof as shipped, providing all compartment covers and cable entry plugs are left intact. Actuators should be stored in a clean, dry, protected warehouse until ready for installation. If actuators must be stored outdoors, they should be stored off the ground, high enough to prevent being immersed in water or buried in snow.

If your unit incorporates a rising stem application, it may be shipped with a plastic cap over the drive sleeve. If so, install a pipe plug or protective stem cover to protect the drive sleeve from possible corrosion.

Preferred Storage Orientation

Your MX actuator should be stored with the motor and terminal compartment in the horizontal position to obtain optimum service life.

2.1.3 Unit Weights

Table 2.2 – Unit weights

Unit	lb.	kg
MX-05	52	24
MX-10	65	29
MX-20	109	49
MX-40	133	60
MX-85	259	117
MX-140	300	136
MX-150	410	186

NOTE: Weights include stem nut and lubricant.

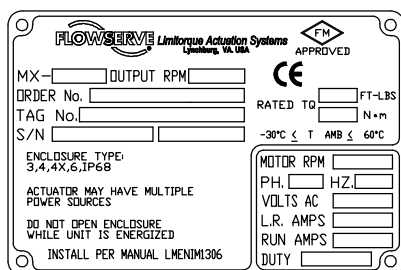
2.2 Product Identification

2.2.1 Initial Inspection and Recording Suggestions

Upon receipt of the actuator, several steps should be initially followed to ensure condition of equipment and to establish proper record keeping.

1. After removing the actuator from the shipping carton or skid, thoroughly examine it for any physical damage which may have occurred during shipment. If you note any damage, immediately report the damage to the transport company and call Limitorque for further assistance.
2. A nameplate with important information is attached to each actuator. Record the following information for use when you need to contact Limitorque with any questions about your actuator:
 - Unit type/size
 - Flowserve Limitorque order number
 - Serial number

Figure 2.2 – MX Nameplate



2.3 Maintenance

2.3.1 Recommended Maintenance

Under normal operating conditions, the MX is a maintenance-free actuator. Therefore, for normal applications, no formal actuator maintenance is required although visual inspection for oil leakage and excessive noise is recommended every 1 million drive sleeve turns or every 3000 cycles. When conditions are severe due to frequent operation or high temperatures, inspect the oil level and oil quality more often. Replace any seals that permit oil leakage or water ingress. When installing pipe plugs, use PTFE tape or paste to achieve a proper seal.

2.3.2 Unit Lubrication

Check for proper oil level every 1 million drive sleeve turns (reference Installation and Operation Manual - Diagnostics Section to learn how to view drive sleeve turns data). Change oil every 6000 unit cycles or if water or other foreign material is found during oil inspection.

Oil Level Inspection and Fill Criteria

(Reference Table 2.3 for oil capacities when mounted in varying positions)

- Actuator viewed in upright position (top-mounted handwheel up)

Oil level should be approximately 1 inch (25.4 mm) below the outer surface of the housing at the oil fill port.

NOTE: Do not overfill with oil because oil will expand during actuator operation. Actuators are shipped with an oil volume suitable for any mounting position. When checking the factory-supplied oil level, excess oil may drain from the highest oil fill port due to the various mounting orientations of each application.

- Actuator viewed in side-mounted position (terminal compartment up). Oil level should be up to the bottom of the oil fill plug.
- Actuator viewed in all other positions than described previously should have the oil capacities maintained. Fill through the highest oil fill port until the oil is at a level that will contact the bottom of the pipe plug when installed in oil fill port.

Figure 2.3 – Oil Fill/Plug Locations (MX-05 through -40)

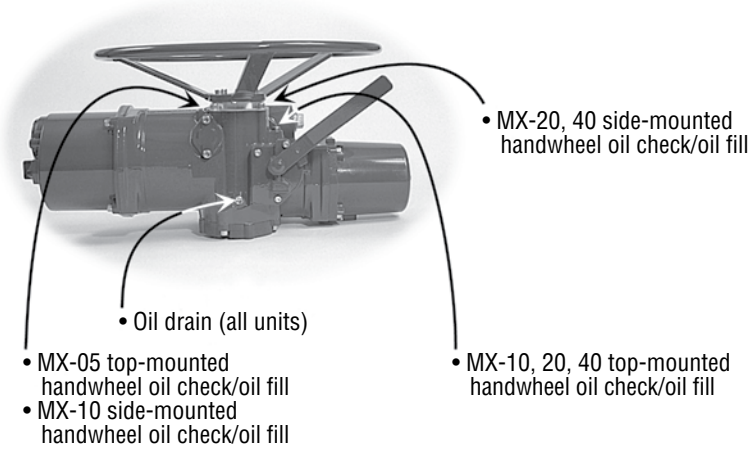
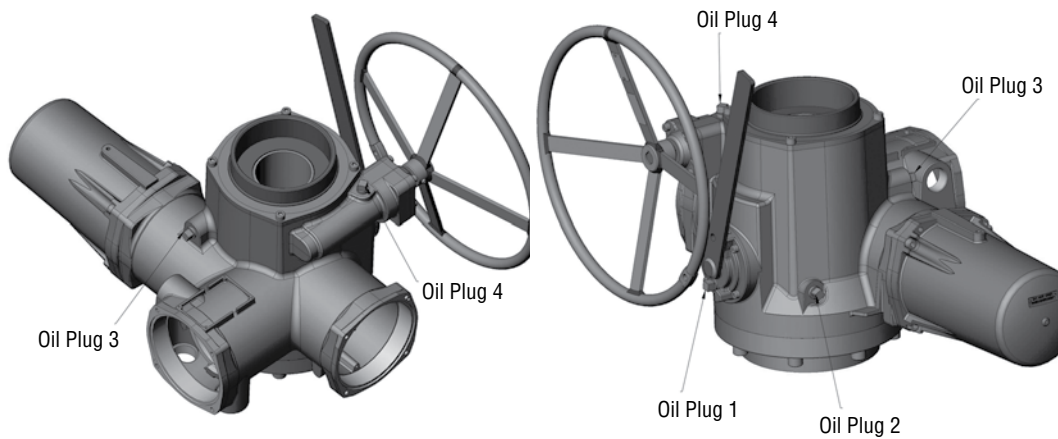


Figure 2.4 – Oil Fill and Drain Locations (MX-85, -140, and -150)



Lubrication Data

- Oil Specifications: MX actuators are oil-filled using Mobil SHC-632, which is a synthetic oil suitable for ambient temperatures of -22°F to 250°F (-30°C to 120°C). For extreme low temperature conditions, alternative lubricants are available - consult factory for further information.

Table 2.3 – MX-05 and -10 Oil Capacities when using Oil Fill/Plug Ports

Nominal Oil Capacities	oz.	liters
MX-05	10	0.3
MX-10	16	.05
MX-20		
Top-mounted handwheel with handwheel up	38	1.1
Top-mounted handwheel with terminal compartment up	47	1.4
Side-mounted handwheel with terminal compartment up	43	1.3

MX-40		
Top and side-mounted handwheel with handwheel up	40	1.2
Top-mounted handwheel with terminal compartment up	53	1.6
Side-mounted handwheel with terminal compartment up	53	1.6
MX-85, -140, and -150		
All Configurations	192	5.7

2.3.3 O-Ring and Lubrication

O-rings and seals should be replaced any time an actuator is disassembled. Lubricate with a substance that is compatible with Buna N seals.

2.4 Subassembly Removal and Remounting Procedures

This manual divides each MX actuator subassembly into a Removal and Remounting procedure. Use the following procedures to remove subassemblies for inspection, repair or replacement. Some subassemblies require prior subassembly removal before allowing the desired subassembly removal. Note the First Remove instructions at the beginning of each subassembly removal procedure. Remove these subassemblies first, and then remove the desired subassembly according to the instructions. Once removed, evaluate subassembly components to determine requirement for a new subassembly. If a new subassembly is required, see Section 2.5. Once components have been identified and replaced, remount following the appropriate Remounting procedures.

2.5 How to Order Replacement Subassemblies

2.5.1 Replacement Parts

Replacement parts are sold in modular subassemblies; therefore, when part replacement is required, order parts at the subassembly levels as shown in this manual. Parts may be ordered from your local Limitorque representative (see www.flowserve.com) or direct from the factory:

Telephone: 1-434-528-4400

Fax: 1-434-845-9736

Please have the following information, found on the actuator nameplate, available to help us facilitate your order:

- Unit type/size
- Limitorque order number
- Serial number

2.5.2 Return Procedure

When parts are identified for warranty or other component replacement, a Return Material Authorization (RMA) must be obtained from Flowserve. Contact factory for a RMA number (see contact information in section 2.5.1). All returned parts must be accompanied by documentation with the following information to obtain credit for returned goods:

- Return Material Authorization (RMA)
- Unit type/size
- Flowserve Limitorque order number
- Serial number

Return parts to the address listed below:

Limitorque Actuation Systems
5114 Woodall Road
Lynchburg, VA 24502



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3

Remove Actuator from Mounting Adapter

3.1 Actuator Removal with Type B1/B4/B4E Base (Torque)

3.1.1 Removal (Type B1/B4/B4E Base)

STEP 1

- ⚠ WARNING: Hazardous Voltage! Turn off all power sources to actuator before removing actuator from mounting plate. Power sources may include main power or control power. If necessary, disconnect incoming power leads L1, L2, L3, and control wiring from the terminal block.**

Remove the bolts that secure the actuator to the mounting adapter. If type B1 or B4E base is used in addition to the standard type B4 or B4E baseplate, you may leave the B1 base attached to the mounting adapter and remove the actuator only. Or if required, you may remove the bolts that mount type B1 base to mounting adapter. This will allow actuator removal along with optional B1 base.



STEP 2

⚠ WARNING: Potential high-pressure vessel! Before disassembling your actuator, ensure that the valve or other actuated device is isolated and is not under pressure.

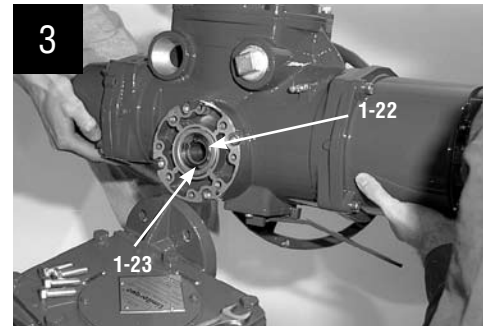
Lift actuator from mounting adapter.



3.1.2 Remounting (Type B1/B4/B4E Base)

STEP 3

Ensure stem nut (#1-22) is secured inside actuator drive sleeve with retaining ring (#1-23). Lower the actuator onto the mating component, making sure to align stem nut key and keyway with mating component.



STEP 4

Ensure that the actuator and mounting adapter flange mating holes are aligned correctly.



STEP 5

⚠ WARNING: Hazardous Voltage! Turn off all power sources before rewiring incoming power leads L1, L2, L3, and control wiring in the terminal block.

Secure the actuator to the mounting adapter with mounting bolts.

**STEP 6**

Reconnect incoming power leads L1, L2, L3, and control wiring to the terminal block. Restore power source when ready for operation.

3.2 Actuator Removal with Type A1/A1E Base (Thrust)

NOTE: Two procedure options are available for removing the actuator and thrust base:

1. Remove actuator from thrust base, leaving thrust base mounted to mounting flange or removing thrust base separately.
2. Remove actuator and thrust base as a unit from mounting flange.

3.2.1 Removal (Type A1/A1E Base) Actuator Removal Separate from Thrust Base

STEP 1

⚠ WARNING: Hazardous Voltage! Turn off all power sources to actuator before removing actuator from mounting plate. Power sources may include main power or control power. If necessary, disconnect incoming power leads L1, L2, L3, and control wiring from the terminal block.

Remove the bolts (#10-10) that secure the actuator to the thrust base assembly (#10).



STEP 2

⚠ WARNING: Potential high-pressure vessel! Before disassembling your actuator, ensure that the valve or other actuated device is isolated and is not under pressure.

Lift actuator from thrust base assembly (#10).



STEP 3

⚠ WARNING: Potential for actuated device to change position! The thrust base will maintain position only if non-backdriving thread lead is used. Ensure proper thread lead is used in your application before allowing thrust base to be used for maintaining position when actuator is removed.

Thrust base removal (if required)

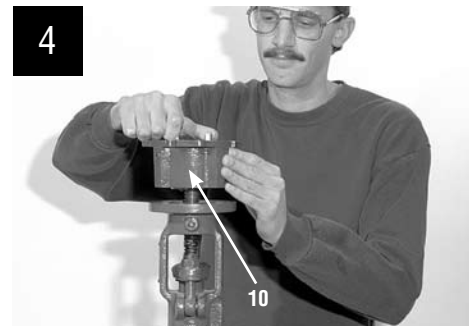
The valve position will be maintained if a locking thread lead is used on the valve stem. If thrust base removal is required, use the following removal procedure.

Remove the bolts that secure the thrust base to the mounting adapter.



STEP 4

Rotate the thrust base (#10) until it feeds off the threaded stem.



**3.2.2 Remounting (Type A1/A1E Base)
Actuator Remounting Separate from Thrust Base**

STEP 5

Thrust base remounting (if required)

Ensure the thrust base stem nut has the two lugs positioned upward to engage with the drive sleeve slots when actuator is reinstalled onto thrust base. Thread thrust base back onto mounting adapter.



STEP 6

Secure thrust base to mounting adapter with mounting bolts.



STEP 7

Actuator remounting

Lower the actuator onto the thrust base, making sure thrust nut lugs align and properly engage with drive sleeve slots.



STEP 8

Install bolts (#10-10) to secure the actuator to the thrust base assembly (#10).



STEP 9

⚠ WARNING: Hazardous Voltage! Turn off all power sources before rewiring incoming power leads L1, L2, L3, and control wiring in the terminal block.

Reconnect incoming power leads L1, L2, L3, and control wiring to the terminal block. Restore power source when ready for operation.

3.2.3 Removal (Type A1/A1E Base) Actuator and Thrust Base as a Unit

STEP 1

- ⚠ **WARNING: Hazardous Voltage!** Turn off all power sources to actuator before removing actuator from mounting plate. Power sources may include main power or control power. If necessary, disconnect incoming power leads L1, L2, L3, and control wiring from the terminal block.

Actuator and thrust base removal

Remove the bolts that secure the actuator and thrust base (#10) to the mounting adapter.



STEP 2

- ⚠ **WARNING: Potential high-pressure vessel!** Before disassembling your actuator, ensure that the valve or other actuated device is isolated and is not under pressure.

Declutch the actuator to manual mode.



STEP 3

Rotate the handwheel until the actuator lifts off the threaded stem.



3.2.4 Remounting (Type A1/A1E Base) Actuator and Thrust Base as a Unit

STEP 4

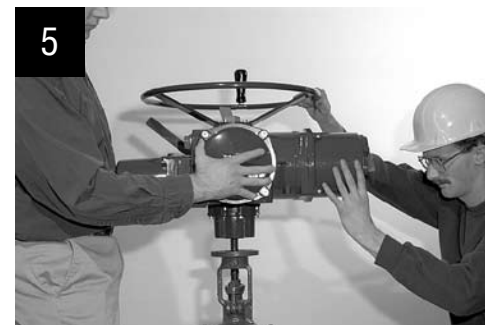
Actuator and thrust base remounting

Declutch the actuator to manual mode. Lift actuator up to the threaded stem and carefully align threads with thrust base threaded stem nut.



STEP 5

Rotate the handwheel to lower the actuator along the threaded stem and onto the mounting adapter plate.



STEP 6

Install the mounting bolts to secure the actuator and thrust base (#10) to the mounting adapter.



STEP 7

⚠ WARNING: Hazardous Voltage! Turn off all power sources before rewiring incoming power leads L1, L2, L3, and control wiring in the terminal block.

Reconnect incoming power leads L1, L2, L3, and control wiring to the terminal block. Restore power source when ready for operation.

4 Mechanical Assemblies

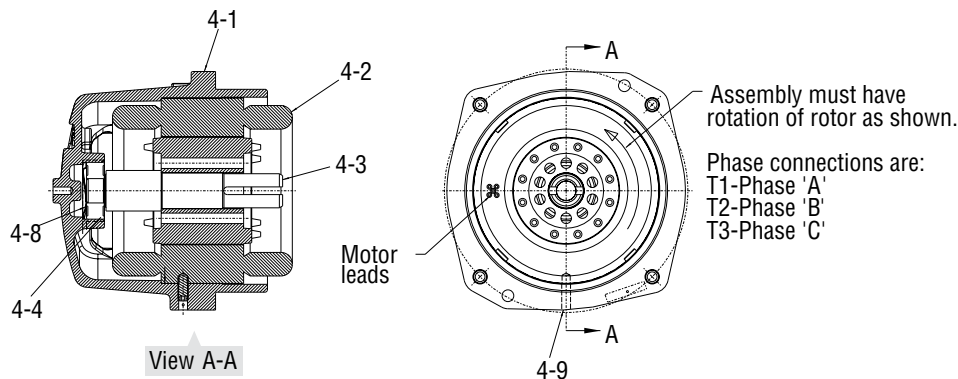
4.1 Motor

NOTE: Proper motor testing is required when replacing motor. Consult your Limitorque representative or the Limitorque factory to replace with correct motor.

Table 4.1 – Motor Parts List

Part Number	Description	Qty.
4-1	Motor cover	1
4-2	Stator	1
4-3	Rotor assembly	1
4-4	Bearing	1
4-8	Bearing preload spring	1
4-9	Setscrew	1

Figure 4.1 – Motor (MX-05, -10, -20, and -40)



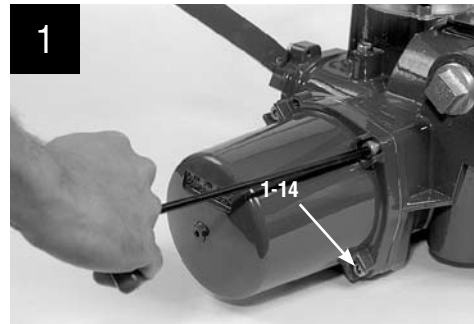
4.1.1 Removal

STEP 1

⚠ WARNING: Hazardous Voltage! Turn off all power sources to actuator before removing motor assembly. Power sources may include main power or control power.

Using an M6 hex key, remove the four M8 screws (#1-14) that mount the motor assembly to the MX-05 through MX-40 actuator.

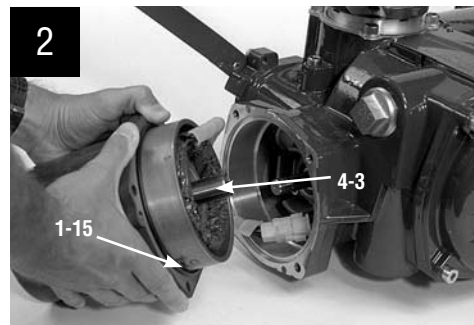
MX-85 requires an M8 hex key and uses an M10 screw.



STEP 2

⚠ CAUTION: The rotor is not connected to the motor housing; when removing the motor, ensure the rotor is carefully removed and not dropped from the motor housing.

Withdraw the complete motor (subassembly #4), including the rotor (#4-3), until the wiring harness is accessible. Note the O-ring (#1-15) on the spigot/pilot of the motor assembly; replace at remounting.



STEP 3

Disconnect the motor power plug from the motor power socket connector.

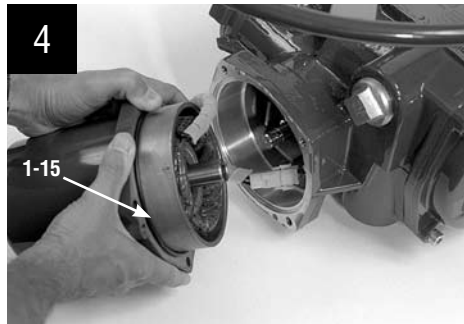


4.1.2 Remounting

STEP 4

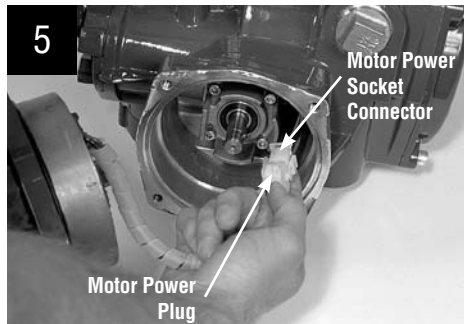
⚠ WARNING: Hazardous Voltage! Turn off all power sources to actuator before removing motor assembly. Power sources may include main power or control power.

Lightly lubricate the O-ring (#1-15) that is installed around the motor spigot/pilot (subassembly #4).



STEP 5

Hold the motor assembly (housing/stator/rotor) close to the actuator housing and reconnect the motor power plug to the motor power socket connector.



STEP 6

Coil the spiral-wrapped motor power wiring inside the motor cavity and around the motor bearing housing to ensure that it does not come into contact with the rotor shaft.

MX-05 through -40 motor wiring will wrap around about 360°. MX-85/140/150 motor wiring will wrap around about 180°.



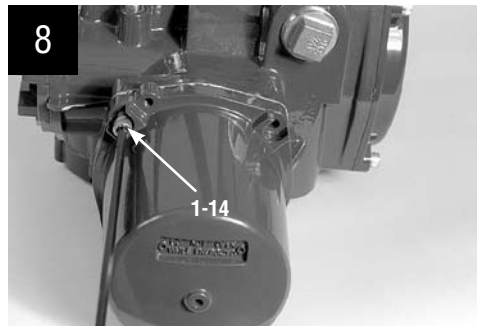
STEP 7

Push the rotor shaft onto the protruding worm shaft, aligning the rotor shaft slots with the worm shaft pin. Slide the motor housing spigot/pilot into the actuator housing.



STEP 8

Fit the four screws (#1-14) into the motor subassembly mounting holes and tighten.

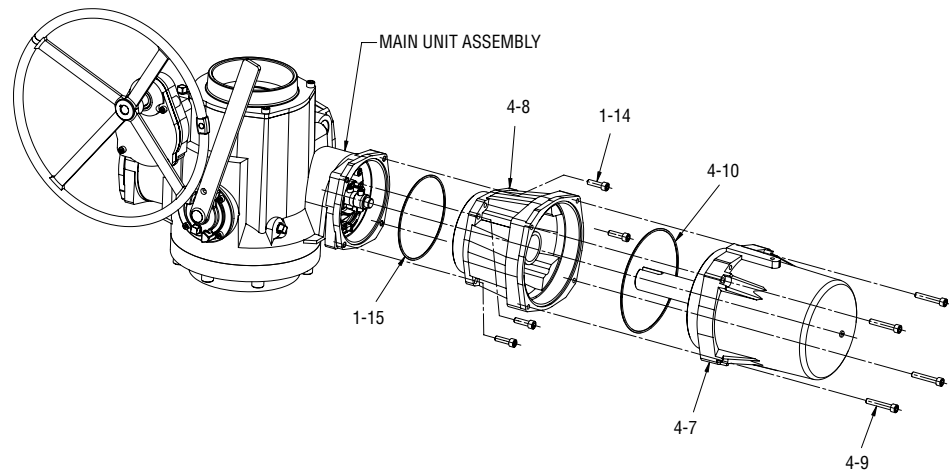


4.1.3 Removal and mounting of MX-140 motor (40 RPM and greater)

Table 4.2 – Motor Parts List

Part Number	Description	Qty.
1-14	Socket head cap screw	4
1-15	O-ring	1
4-7	Motor	1
4-8	Adapter, motor	1
4-9	Socket head cap screw	4
4-10	O-ring	1

Figure 4.2 – Motor and Adapter (MX-140)



STEP 1

Remove the four (4) socket head cap screws (#4-9) from the motor. Exercise caution as the motor is heavy and the motor leads may be compromised during disassembly.

STEP 2

Remove the motor leads plug from the motor contactor seal assembly.

STEP 3

Remove the four (4) socket head cap screws (#1-15) from the motor adapter. Ensure the motor leads have been previously disconnected.

4.1.4 Remounting

Follow steps in Section 4.1.3 in reverse order. Ensure O-rings were not damaged in disassembly. If necessary, replace.

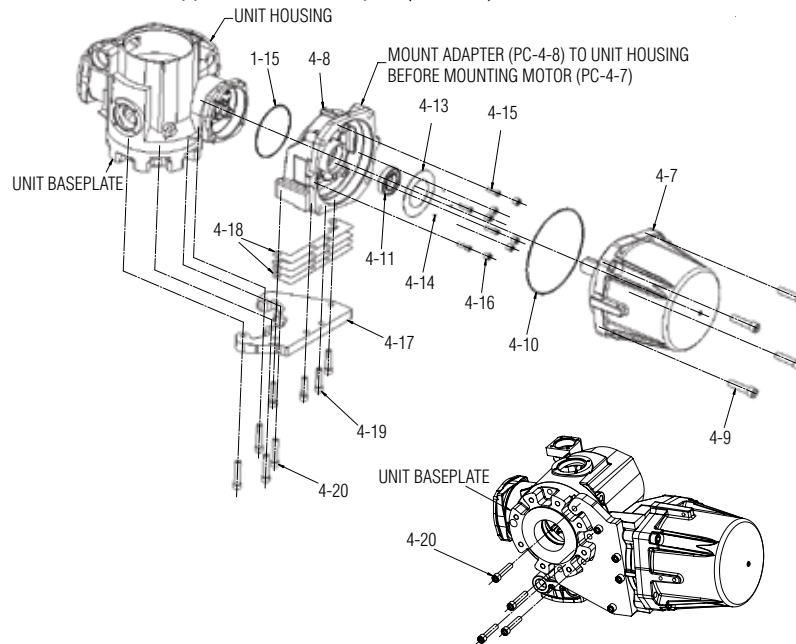
4.1.5 Mounting of MX-150 motor

The assembly of the MX-150 motor is a two-phase process. Phase 1 includes the mounting of the motor support plate (#4-17), motor adapter (#4-8), and selection of a quantity of shims required to offset any gap between the motor support plate and the motor support. Phase two includes removal of the motor support plate, reinstallation with the shims in place and final tightening of all mounting screws.

Table 4.3 – Motor Parts List

Part Number	Description	Qty.
1-15	O-ring	1
4-7	Motor	1
4-8	Motor adapter	1
4-9	Socket head cap screws	4
4-10	O-ring	1
4-11	Shielded ball bearing	1
4-13	Plate, wiring shield	1
4-14	Socket head cap screws	3
4-15	Socket head cap screws	4
4-16	Pipe plug	6
4-17	Plate, motor support	1
4-18	Shims	AS REQ'D
4-19	Socket head cap screws	4
4-20	Socket head cap screws	4

Figure 4.3 – Motor, Support Plate and Adapter (MX-150)



STEP 1

Install support plate (4-17) to unit base plate using socket head cap screws (#4-20).

STEP 2

Place the lead seal connector through the slot in the adapter (#4-8). Install the adapter loosely to unit housing using screws (#4-15). Rotate adapter until gap is uniform with plate (#4-17). Tighten screws (#4-15).

STEP 3

Measure gap and select the shim (#4-18) total thickness to be at least the gap plus up to .1mm (.004 inch). Shims are .1mm (.004 inch) each.

STEP 4

Remove plate (#4-17), install shims (#4-18), reinstall plate to base of unit, tighten screws (#4-20). Then install and tighten screws (#4-19) with shims in place.

NOTES:

1. Pipe plugs (#4-16) must be installed with tape or pipe sealant over the four (4) mounting screws (#4-15) and the two (2) jacking tap holes.
2. When mounting motor (#4-7) leads must be placed behind plate (#4-13).

3. Take care not to damage either the O.D. on adapter to I.D on housing and the O.D. on motor to I.D. on adapter to protect flame path for hazardous certifications.

4.2 Declutch

Table 4.4 – Declutch Parts List (MX-05 and -10)

Part Number	Description	Qty.
5-1	Declutch cover	1
5-2	Declutch shaft	1
5-3	Declutch cam	1
5-4	Declutch spring	1
5-5	Cam spring	1
5-6	Declutch latch	1
5-7	Latch spring	1
5-8	Cam plate	1
5-9	Retaining ring	2
5-10	Socket head cap screw	1
5-11	O-ring	1
5-12	Socket head cap screw	2
5-13	Dowel pin	1
5-14	Roll pin	1
5-15	O-ring	1

Figure 4.4 – Declutch (MX-05 and -10)

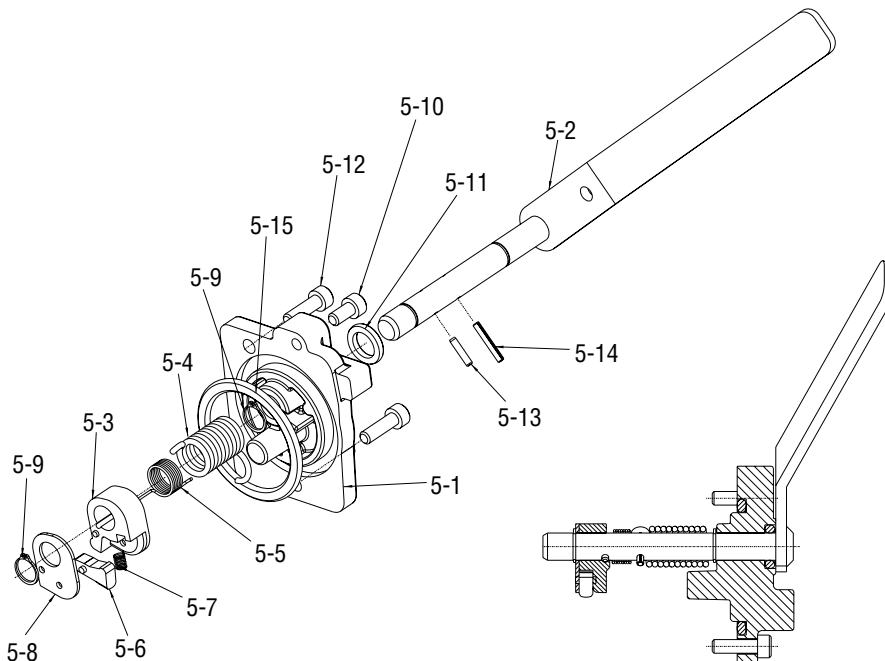


Table 4.5 – Declutch Parts List (MX-20 and -40)

Part Number	Description	Qty.
5-1	Declutch cover	1
5-2	Declutch shaft	1
5-3	Declutch cam	1
5-4	Declutch spring	1
5-5	Cam spring	1
5-6	Declutch latch	1
5-7	Latch spring	1
5-8	Cam plate	1
5-9	Retaining ring	2
5-10	Socket head cap screw	1
5-11	O-ring	1
5-12	Socket head cap screw	2
5-13	Dowel pin	1
5-14	Roll pin	1
5-15	O-ring	1
5-16	Dowel pin	1

Figure 4.5 – Declutch (MX-20 and -40)

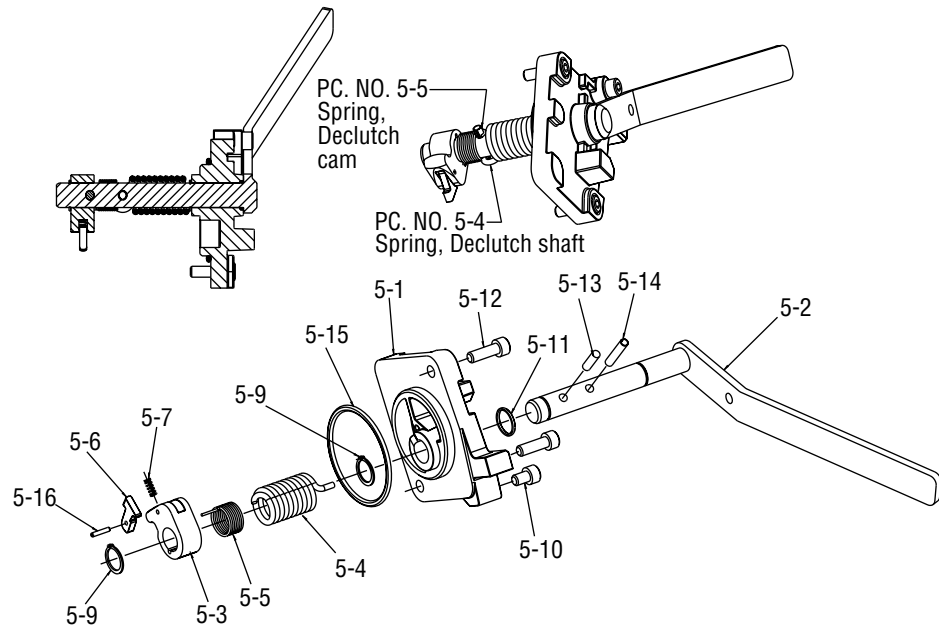
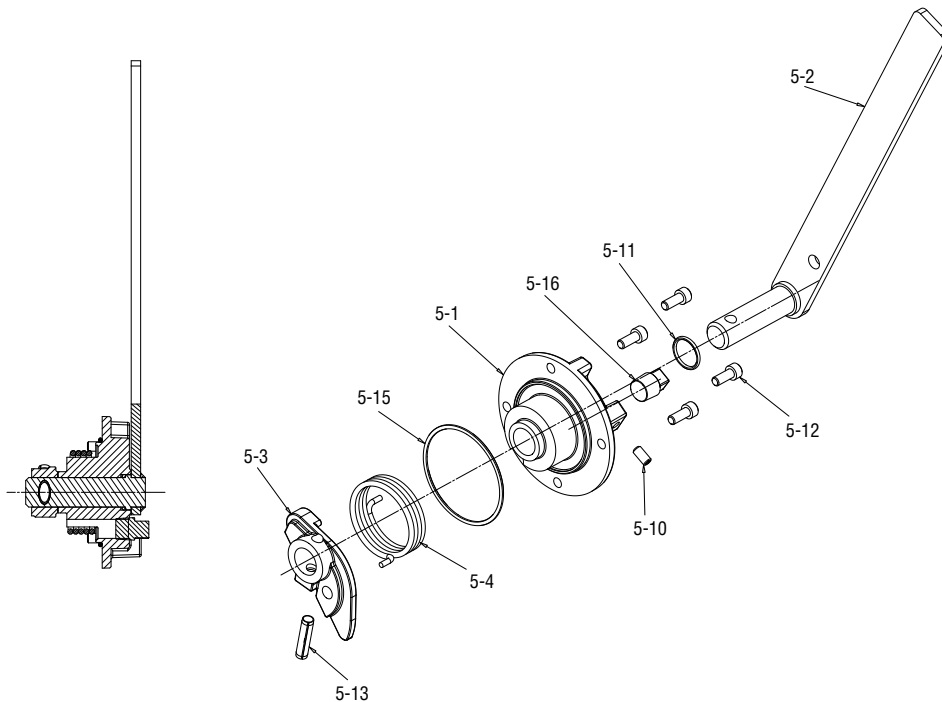


Table 4.6 – Declutch Parts List (MX-85, -140, and -150)

Part Number	Description	Qty.
5-1	Declutch cover	1
5-2	Declutch shaft	1
5-3	Declutch cam	1
5-4	Declutch spring	1
5-9	Retaining ring	2
5-10	Socket head set screw	1
5-11	O-ring	1
5-12	Socket head set screw	2
5-13	Spiral pin	1
5-15	O-ring	1
5-16	Pipe plug	1

Figure 4.6 – Declutch (MX-85, -140, and -150)



4.2.1 Removal

NOTE: The MX-05, -10, -85, -140, and -150 declutch assembly may be removed and remounted without other subassembly removal.

NOTE: The MX-20 and -40 declutch assembly may be removed without other subassembly removal, but remounting requires removing the following subassemblies:

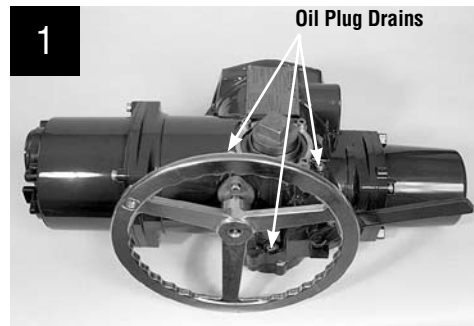
1. Handwheel (Subassembly #13)
2. Handwheel adapter (Subassembly #12)
3. Clutch and clutch ring (Subassembly #16)

STEP 1

⚠ WARNING: Potential to operate while dangerous mechanical parts are exposed during subassembly removal. To prevent injury, turn off all power sources to actuator before removing side-mounted and top-mounted handwheel assembly. Power sources may include main power or control power.

NOTE: Oil removal is not necessary on MX-05, -10, -85, -140, and -150 if actuator is mounted with declutch lever up.

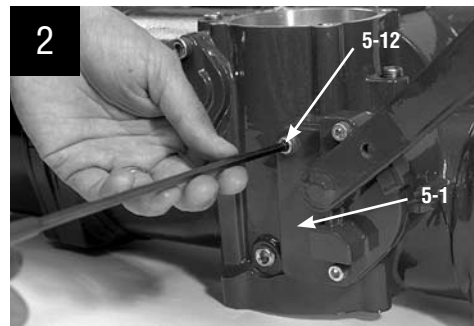
Drain oil from actuator using the lowest of three plugs in your application mounting orientation.



STEP 2

⚠ WARNING: Potential to operate while dangerous mechanical parts are exposed during subassembly removal. To prevent injury, turn off all power sources to actuator before removing declutch assembly. Power sources may include main power or control power.

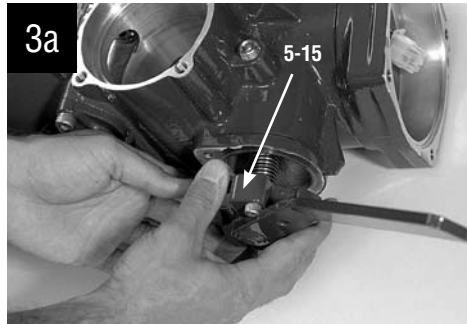
Using a 5 mm (MX-05 and -10) or 6 mm (MX-20, -40, -85, -140, and -150) hex key, remove the two M6 (MX-05 and -10) screws (#5-12), M8 (MX-20 and -40) or the four M8 (MX-85, -140, and -150) screws that retain the declutch assembly cover (#5-1) on the actuator housing.



STEP 3

Withdraw the complete declutch assembly, slightly twisting if necessary, to remove. Note the O-ring (#5-15) with the declutch assembly cover (#5-1). Replace at remounting.

Picture 3a is typical MX-05 through -40. Picture 3b is typical MX-85/140/150.



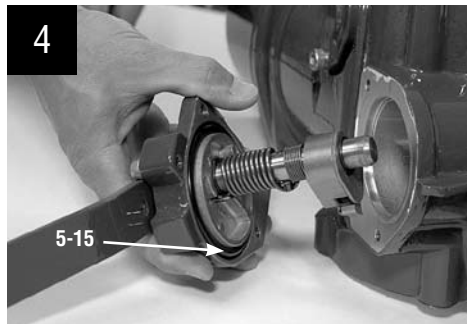
4.2.2 Remounting

STEP 4

(MX-20 and -40 only) Remove the following subassemblies before remounting the declutch assembly. (See corresponding referenced sections for removal information.)

1. Handwheel (subassembly #13). (See Section 4.3.1.)
2. Handwheel adapter (subassembly #12). (See Section 4.13.1.)
3. Clutch and clutch ring (subassembly #16). (See Section 4.15.1.)

Lightly lubricate the O-ring (#5-15) and fit it to the inner race of the declutch cover (#5-1).



STEP 5

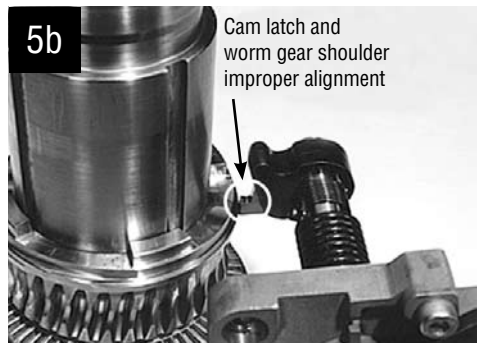
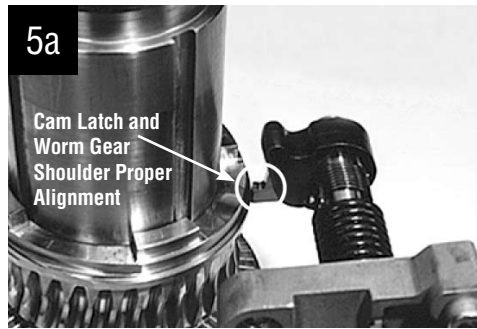
▲ CAUTION: (MX-20 and -40 only) To create proper mating between the cam latch (#5-6) and the shoulder on the worm gear, ensure cam latch is positioned below the worm gear shoulder (see Picture 5a).

TIP: (MX-20 and -40 only) - Picture 5a shows proper alignment between the cam latch (#5-6) and the shoulder on the worm gear.

TIP: (MX-20 and -40 only) - Picture 5b shows improper alignment between the cam latch (#5-6) and the shoulder on the worm gear. Improper alignment could cause the cam latch to be broken off by the worm gear lug.

TIP: (MX-85, -140, and -150 only) - Picture 5c shows proper alignment between the cam and the clutch ring roller.

Fit the complete declutch assembly into the actuator housing, slightly twisting if necessary, to remount into actuator. See picture 5d.



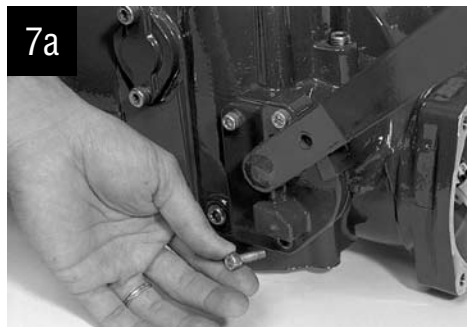
STEP 6 (MX-85, -140, AND -150 ONLY)

Set screw adjustment. Install drive sleeve, baseplate, clutching and handwheel worm gear components. Assure the clutch lugs are fully engaged to the motor worm gear lugs before the adjustment. With declutch lever resting on cap pad (not the set screw) place declutch cap assembly (1-4) into housing without mounting screws. Rotate cap assembly clockwise until declutch cam is resisted by the roller, clutch ring and clutch combination. Holding the declutch lever, rotate the set screw clockwise through declutch cap, (this will rotate the cap counterclockwise) until the cap mounting holes are inline with the taps in the housing. Install declutch assembly mounting screws. Then rotate set screw counterclockwise ¼ turn, plus or minus ⅛ turn. Adjustment is complete.

STEP 7

Fit the two M6 (MX-05 and -10) screws (#5-12), M8 (MX-20 and -40) screws to retain the declutch assembly cover (#5-1) on the housing. Tighten using a 5 mm (MX-05 and -10) or 6 mm (MX-20, -40 and -85) hex key. Picture 7a shows the two screws for the MX-20 and -40. Picture 7b shows the four screws for the MX-85.

See picture 7a for MX-05, -10, -20 and -40. See picture 7b for MX-85, -140, and -150.



STEP 8 (MX-20 AND -40 ONLY)

Remount the following subassemblies after remounting the declutch assembly.

(See corresponding referenced sections for remounting information.)

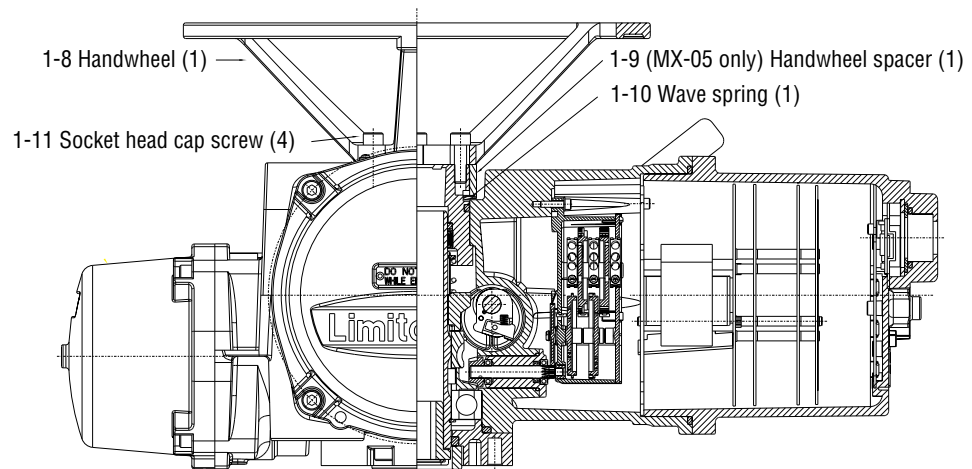
1. Handwheel (subassembly #13). (See Section 4.3.2.)
2. Handwheel adapter (subassembly #12). (See Section 4.4.2, 4.4.3, and 4.5.3.)
3. Clutch and clutch ring (subassembly #16). (See Section 4.15.2.)

4.3 Top-Mounted Handwheel (MX-05, -10, -20, and -40)

Table 4.7 – Top-Mounted Handwheel Parts List (MX-05, -10, -20, and -40)

Part Number	Description	Qty.
1-8	Handwheel	1
1-9	Handwheel Spacer (MX-05 only)	1
1-10	Wave Spring	1
1-11	Socket head cap screw	4

Figure 4.7 – Top-Mounted Handwheel (MX-05, -10, -20, and -40)



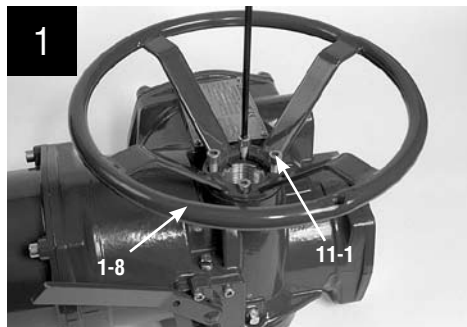
⚠ WARNING: Do not manually operate the actuator with devices other than the installed handwheel and declutch lever. Using force beyond the ratings of the actuator and/or additive forces such as cheater bars, wheel wrenches, pipe wrenches, or other devices on the actuator handwheel or declutch lever may cause serious personal injury and/or damage to the actuator and valve.

4.3.1 Removal

STEP 1

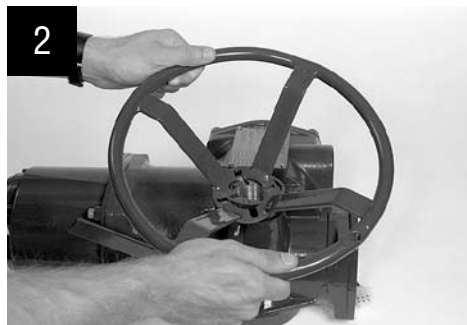
⚠ WARNING: Potential to operate while dangerous mechanical parts are exposed during subassembly removal. To prevent injury, turn off all power sources to actuator before removing top-mounted handwheel assembly. Power sources may include main power or control power.

Using a 6 mm (MX-05 and -10) hex key or 8 mm (MX-20 and -40) hex key, remove the four screws (#1-11) that secure the handwheel (#1-8) to the handwheel adapter assembly (#1-1).



STEP 2

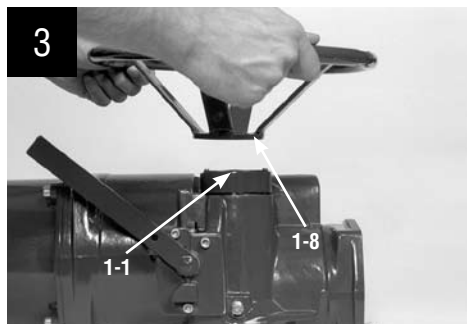
Lift the handwheel (#1-8) off the handwheel adapter (#1-1).



4.3.2 Remounting

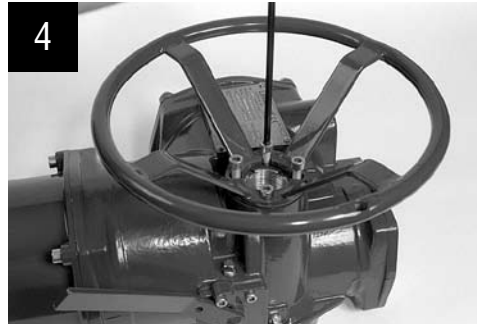
STEP 3

Install handwheel (#1-8) onto handwheel adapter assembly (#1-1).



STEP 4

Align the handwheel slots with the mounting holes. Fit the four screws (#1-11) in handwheel mounting holes and tighten.

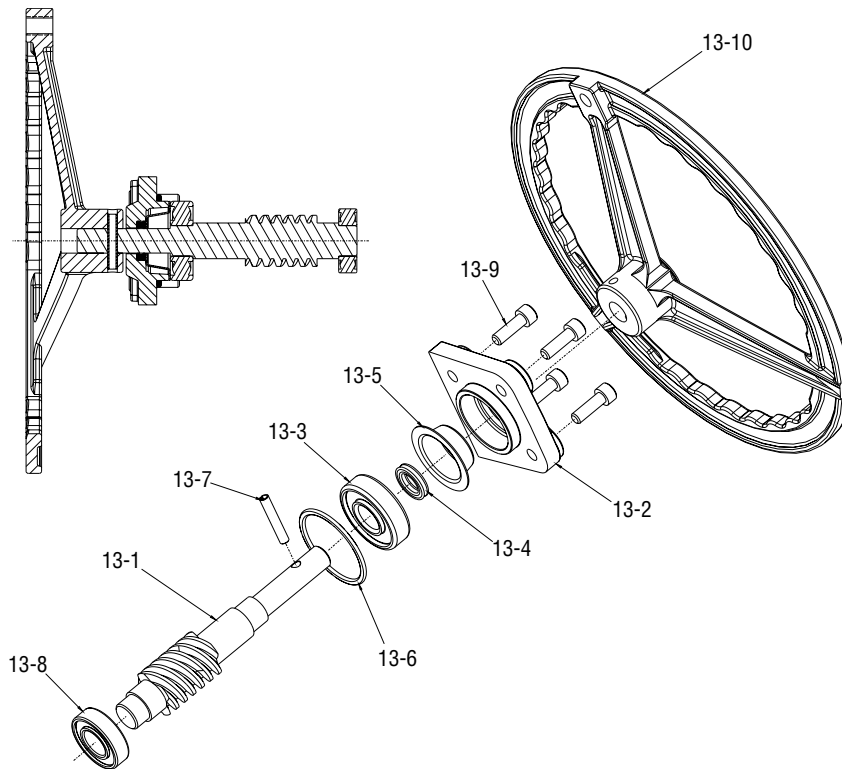


4.4 Side-Mounted Handwheel Without Spur Gear Attachment (MX-10, -20, -85, -140, and -150)

Table 4.8 – Side-Mounted Handwheel Parts List (MX-10 and -20)

Part Number	Description	Qty.
13-1	Handwheel wormshaft	1
13-2	Handwheel worm cap	1
13-3	Ball bearing	1
13-4	Quad ring	1
13-5	Seal retainer	1
13-6	O-ring	1
13-7	Roll pin	1
13-8	Ball bearing	1
13-9	Socket head cap screw	2 (MX-10), 4 (MX-20)
13-10	Side-Mounted handwheel	1

Figure 4.8 – Side-Mounted Handwheel (MX-10 and -20)



⚠ WARNING: Do not manually operate the actuator with devices other than the installed handwheel and declutch lever. Using force beyond the ratings of the actuator and/or additive forces such as cheater bars, wheel wrenches, pipe wrenches, or other devices on the actuator handwheel or declutch lever may cause serious personal injury and/or damage to the actuator and valve.

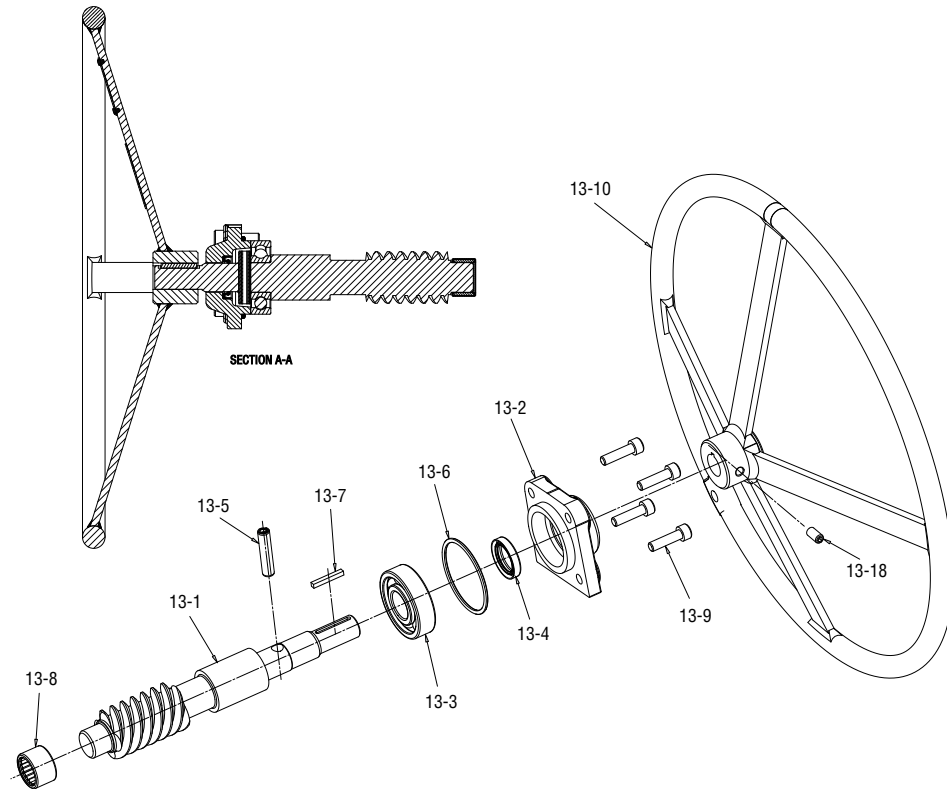
4.4.1 Side-Mounted Handwheel Without Spur Gear Attachment (MX-85, -140, and -150)

Table 4.9 – Side-Mounted Handwheel without Spur Gear Attachment Parts List (MX-85, -140, and -150)

Part Number	Description	Qty.
13-1	Handwheel wormshaft	1
13-2	Handwheel worm cap	1
13-3	Ball bearing	1
13-4	Quad ring	1
13-5	Roll pin	1
13-6	O-ring	1
13-7	Key	1
13-8	Needle bearing	1
13-9	Socket head cap screw	4
13-10	Side-Mounted handwheel	1
13-18	Socket head set screw	1

⚠ WARNING: Do not manually operate the actuator with devices other than the installed handwheel and declutch lever. Using force beyond the ratings of the actuator and/or additive forces such as cheater bars, wheel wrenches, pipe wrenches, or other devices on the actuator handwheel or declutch lever may cause serious personal injury and/or damage to the actuator and valve.

Figure 4.9 – Side-Mounted Handwheel (MX-85, -140, and -150)



4.4.2 Removal of Side-Mounted Handwheel (MX-10, -20, -85, -140, and -150)

NOTES: The MX-10 and -20 handwheel is mounted with a roll pin (13-7). If removal of the handwheel from the worm shaft is necessary, remove the handwheel and worm shaft assembly from unit before removing roll pin. Removing the roll pin before disassembly of worm shaft will damage the ball bearing (13-3).

The MX-85, -140, and -150 handwheel is mounted with a key (13-7) and a set screw (13-18). See pictures a and b.



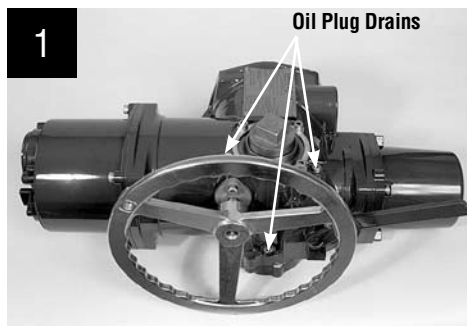
4.4.3 Removal

STEP 1

⚠ WARNING: Potential to operate while dangerous mechanical parts are exposed during subassembly removal. To prevent injury, turn off all power sources to actuator before removing side-mounted handwheel assembly. Power sources may include main power or control power.

Drain oil from actuator using the lowest of three plugs in your application mounting orientation.

NOTE: Oil removal is not necessary if the actuator is mounted on valve or other device with the drive sleeve in a vertical position.

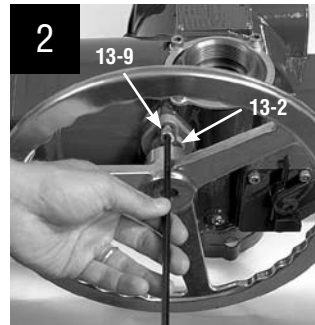


STEP 2 (MX-10 AND -20)

▲ CAUTION: Be aware of inner bearing (#13-8) when removing the side-mounted handwheel. It may stay in the actuator housing or come out with the side-mounted handwheel assembly. Ensure it is inserted back in actuator housing before remounting side-mounted handwheel assembly.

TIP: (MX-85, -140, and -150 only) Needle bearing (#13-8) is pressed into housing.

Using a 6 mm hex key, remove the M8 screws (#13-9) from the handwheel worm shaft cap (#13-2).

**STEP 3**

Rotate the handwheel assembly clockwise (CW) to withdraw the complete subassembly (#13) from the actuator housing.



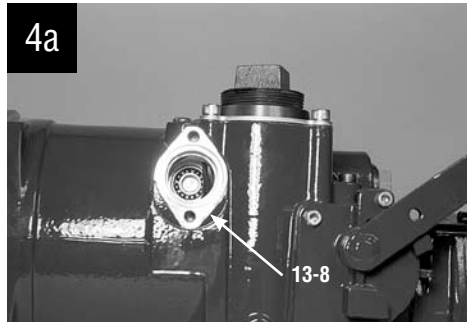
4.4.4 Remounting

STEP 4

Check that bearing (#13-8) is correctly in place in the actuator housing.

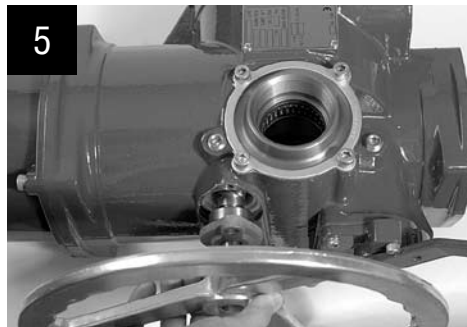
The MX-10 and -20 is a slip fit (4a).

The MX-85, -140, and -150 is a press fit (4b).



STEP 5

Insert the complete subassembly into the actuator housing, rotating counterclockwise (CCW) to properly mesh the gearing. Ensure the end of the worm shaft is seated in the inner bearing (#13-8).



STEP 6

Position the worm shaft cap (#13-2) back on the actuator housing. Using a 6 mm hex key, fit the (#13-9) screws onto the worm shaft cap to secure side-mounted assembly to the actuator housing.



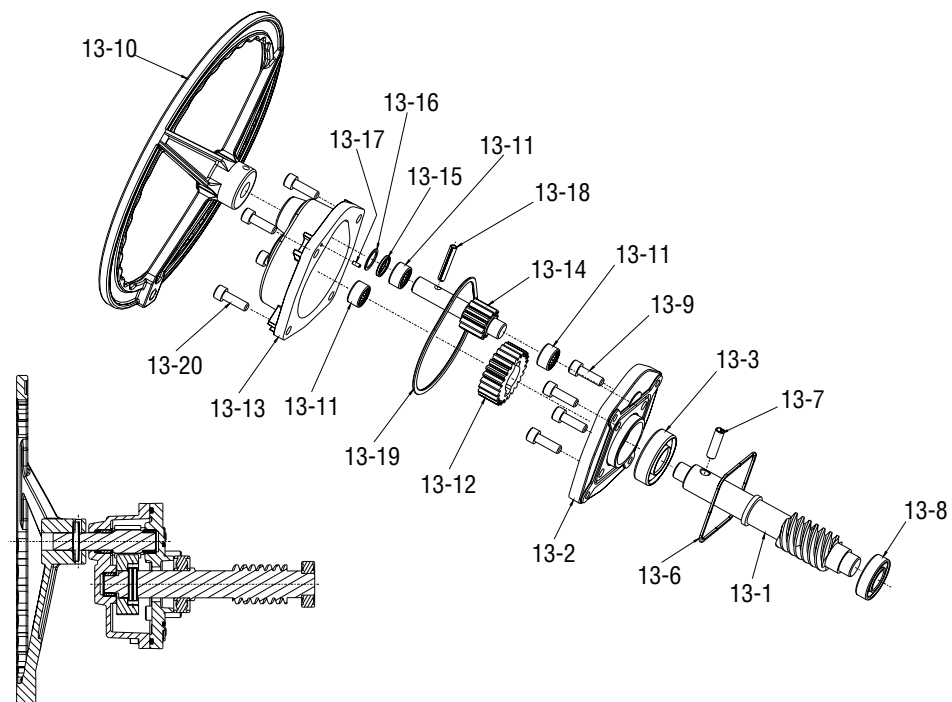
4.5 Side-Mounted Handwheel With Spur Gear Attachment (MX-40, -85, -140, and -150)

Table 4.10 – Side-Mounted Handwheel Parts List (MX-40)

Part Number	Description	Qty.
13-1	Handwheel worm shaft	1
13-2	Spur adapter plate	1
13-3	Ball bearing	1
13-6	O-ring	1
13-7	Roll pin	1
13-8	Ball bearing	1
13-9	Socket head cap screw M8x25	4
13-10	Side-Mounted handwheel	1
13-11	Needle bearing	3
13-12	Handwheel input gear	1
13-13	Spur adapter cap	1
13-14	Handwheel input pinion	1
13-15	Quad ring	1
13-16	O-ring spacer	1
13-17	Dowel pin	1
13-18	Roll pin	1
13-19	O-ring	1
13-20	Socket head cap screw M8x20	4

⚠ WARNING: Do not manually operate the actuator with devices other than the installed handwheel and declutch lever. Using force beyond the ratings of the actuator and/or additive forces such as cheater bars, wheel wrenches, pipe wrenches, or other devices on the actuator handwheel or declutch lever may cause serious personal injury and/or damage to the actuator and valve.

Figure 4.10 – Side-Mounted Handwheel with SGA (MX-40)



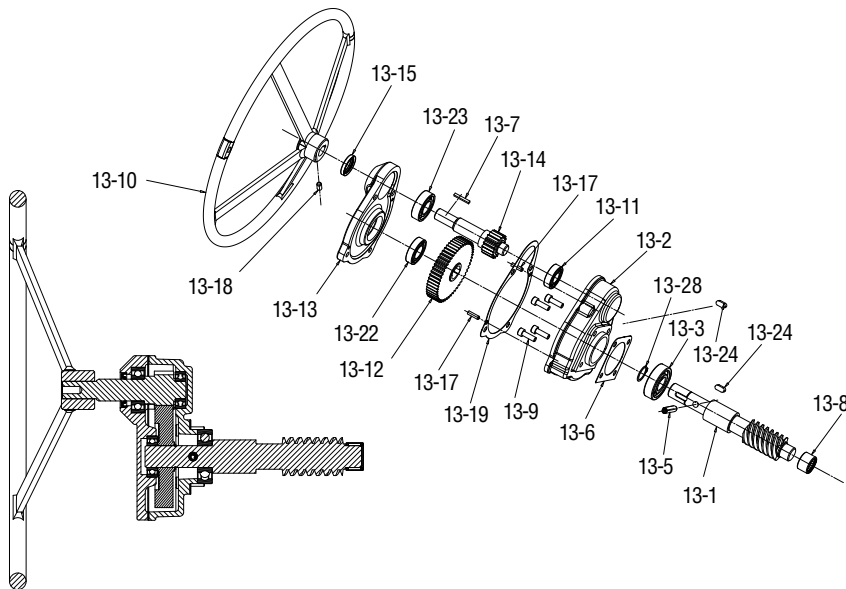
4.5.1 MX-85, -140, and -150 Handwheel with SGA

Table 4.11 – Side-Mounted Handwheel Parts List (MX-85, -140, and -150)

Part Number	Description	Qty.
13-1	Handwheel worm shaft	1
13-2	Spur adapter plate	1
13-3	Ball bearing	1
13-5	Spiral pin	1
13-6	Gasket	1
13-7	Key	1
13-8	Needle bearing	1
13-9	Socket head cap screw M8x25	4
13-10	Side-Mounted handwheel	1
13-11	Ball bearing	1
13-12	Handwheel input gear	1
13-13	Spur adapter cap	1
13-14	Handwheel input pinion	1
13-15	Oil seal	1
13-17	Dowel pin	1
13-18	Set screw	1
13-19	Gasket	1
13-20	Socket head cap screw M8x20	4
13-22	Ball bearing	1
13-23	Ball bearing	1
13-24	Key	2
13-28	Retaining ring	1

⚠ WARNING: Do not manually operate the actuator w/ devices other than the installed handwheel and declutch lever. Using force beyond the ratings of the actuator and/or additive forces such as cheater bars, wheel wrenches, pipe wrenches, or other devices on the actuator handwheel or declutch lever may cause serious personal injury and/or damage to the actuator and valve.

Figure 4.11 – Side-Mounted Handwheel With SGA (MX-85, -140, and -150)



4.5.2 Removal of Handwheel

NOTES: The MX-40 handwheel is mounted with a roll pin (#13-7). If removal of the handwheel from the worm shaft is necessary, remove the handwheel and worm shaft assembly from unit before removing roll pin. Removing the roll pin before disassembly of worm shaft will damage the ball bearing (#13-3).

The MX-85, -140, and -150 handwheel is mounted with a key (#13-7) and a set screw (#13-18). See pictures a and b.



STEP 4

Remove the four M6 screws (#13-9) from the worm shaft plate (#13-2).

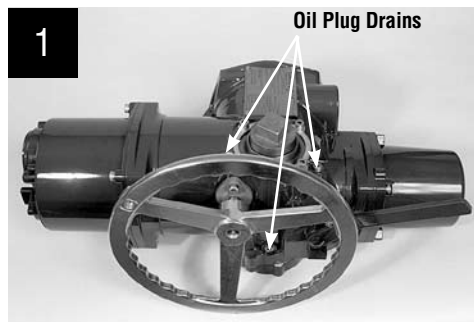
4.5.3 Removal

STEP 1

⚠ WARNING: Potential to operate while dangerous mechanical parts are exposed during subassembly removal. To prevent injury, turn off all power sources to actuator before removing side-mounted handwheel assembly. Power sources may include main power or control power.

NOTE: Oil removal is not necessary if the actuator is mounted on valve or other device with the drive sleeve in a vertical position.

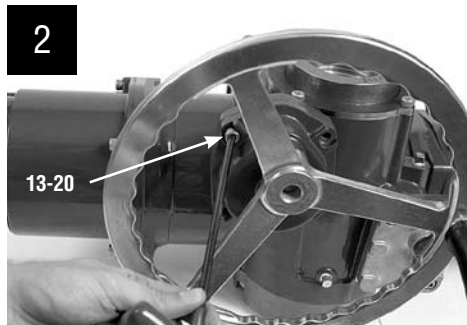
Drain oil from actuator using the lowest of three plugs in your application orientation.



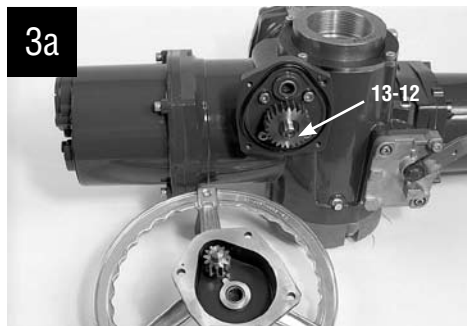
STEP 2

▲ CAUTION: Be aware of inner bearing (#13-8) when removing the side-mounted handwheel. It may stay in the actuator housing or come out with the side-mounted handwheel assembly. Ensure it is inserted back in actuator housing before remounting side-mounted handwheel assembly.

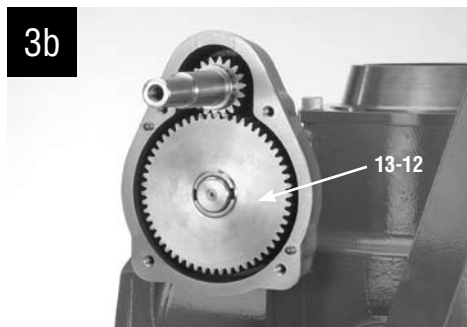
Remove the four screws (#13-20) from the handwheel spur gear cap (#13-13).

**STEP 3**

Remove handwheel spur gear cap assembly. Note when assembly is removed, the spur gear (#13-12) is loose in spur gear cap. Remove spur gear.



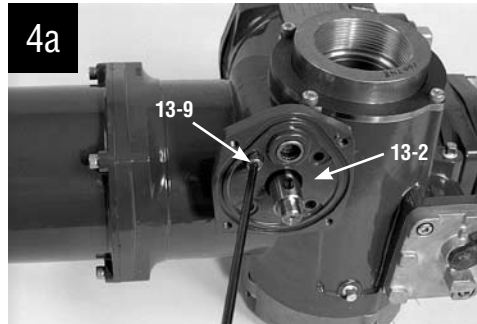
MX-40



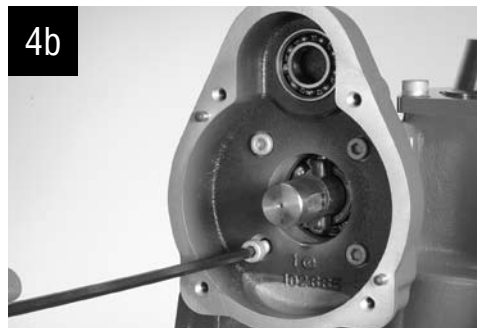
MX-85/140/150

STEP 4

Remove the four M6 screws (#13-9) from the worm shaft plate (#13-2).



MX-40



MX-85/140/150

STEP 5

Removing worm shaft assembly.

MX-40: Remove adapter plate and worm assembly together (5a).

MX-85/140/150: Remove adapter plate, then remove worm assembly (5b).

NOTE: When removing the side-mounted handwheel, the inner bearing (#13-8) should remain in place in the housing.

Rotate the handwheel assembly clockwise (CW) to withdraw the complete worm shaft plate subassembly.



MX-40



MX-85/140/150

STEP 6

If needed, remove the handwheel worm gear assembly (#12-1). (See Section 4.14.1 for removal procedure.)



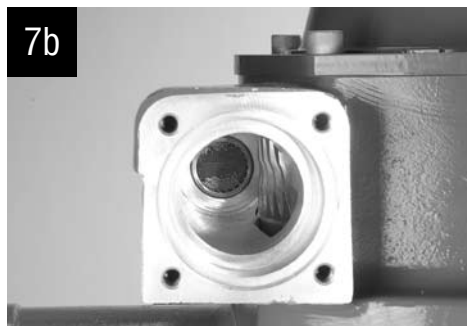
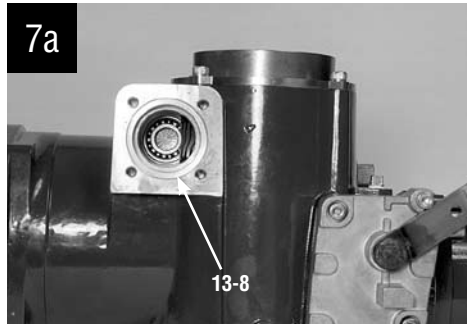
4.5.4 Remounting

STEP 7

Check that bearing (#13-8) is correctly in place in the actuator housing.

MX-40 is slip fit in housing (7a).

MX-85 is press fit in housing (7b).

**STEP 8**

If previously removed, install handwheel worm gear assembly (#12-1). (See Section 4.14.2 for remounting procedure.)



STEP 9

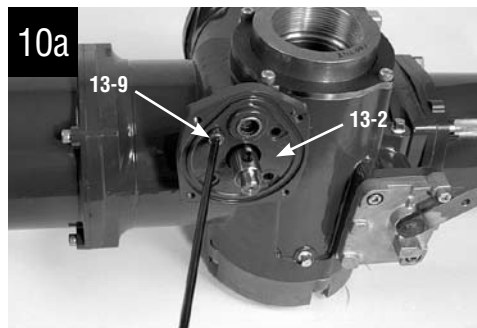
Ensure O-ring (MX-40) (#13-6) is in place on worm shaft plate.

MX-40, -85, -140, and -150: Insert worm shaft assembly into actuator housing. Rotate assembly in counterclockwise (CCW) direction to properly mate with handwheel worm gear assembly (#12-1)(9b).



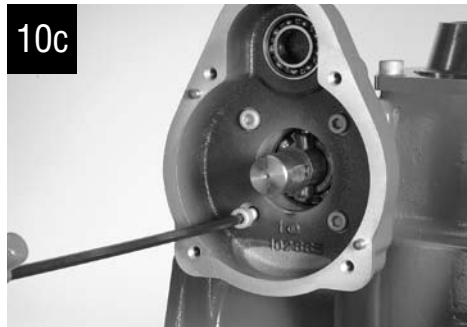
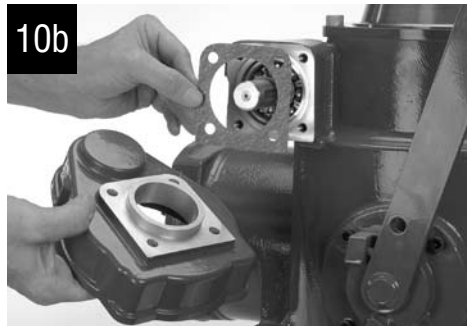
STEP 10A - MX-40

Secure with four M8 screws (#13-9) to secure the adapter plate (#13-2).



STEP 10A AND B - MX-85, -140, AND -150

Ensure gasket (#13-6) is placed on adapter (#13-2) and install adapter to housing and secure with four M8 screws (#13-9).

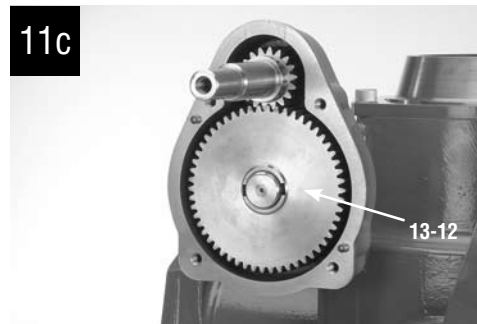
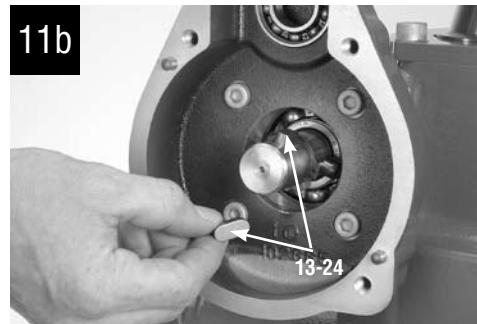
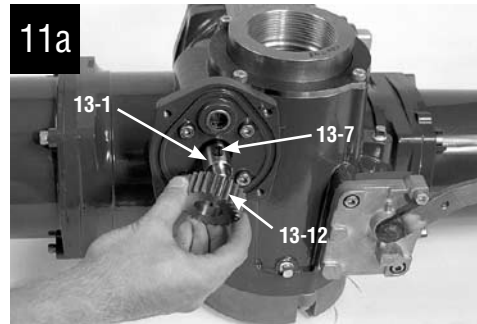


STEP 11**MX-40 (11a)**

Fit gear (#13-12) onto end of worm shaft (#13-1). Ensure gear slot is fitted into pin (#13-7).

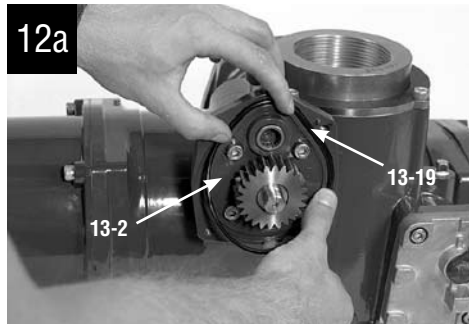
MX-85, -140, and -150 (11b and 11c)

Fit gear (#13-12) onto end of worm shaft. Ensure both keys (#13-24) are in place in worm shaft.



STEP 12A - MX-40

Ensure O-ring (#13-19) is in place on worm shaft plate (#13-2).



STEP 12B - MX-85, -140, AND -150

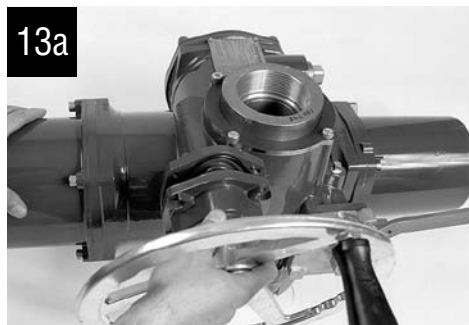
Ensure gasket (#13-19) is in place on adapter (#13-2).



STEP 13A - MX-40

Check that quad ring (#13-15), spacer (#13-16) and needle bearing (#13-11) are correctly placed in plate (#13-2) and cap (#13-13).

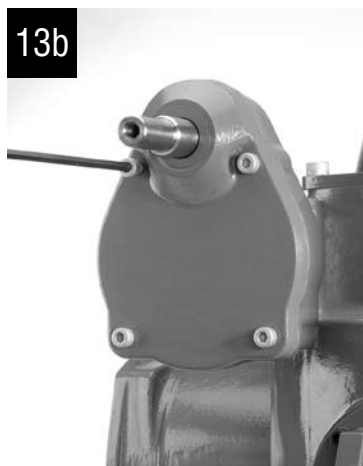
Install handwheel spur cap assembly, secure with screws (#13-20).



STEP 13B - MX-85, -140, AND -150

Check that seal (#13-15), and ball bearings (#13-11, 13-22, and 13-23) are correctly placed in adapter (#13-2) and cap (#13-13).

Install handwheel spur cap assembly. Secure with screws (#13-20). Remount handwheel (#13-10) if removed with key (#13-7) and set screw (#13-18).



4.6 Converting Top-Mounted Handwheel to Side-Mounted Handwheel (MX-10, -20, and -40)

4.6.1 Removing Top-Mounted Handwheel

⚠ WARNING: Do not manually operate the actuator with devices other than the installed handwheel and declutch lever. Using force beyond the ratings of the actuator and/or additive forces such as cheater bars, wheel wrenches, pipe wrenches, or other devices on the actuator handwheel or declutch lever may cause serious personal injury and/or damage to the actuator and valve.

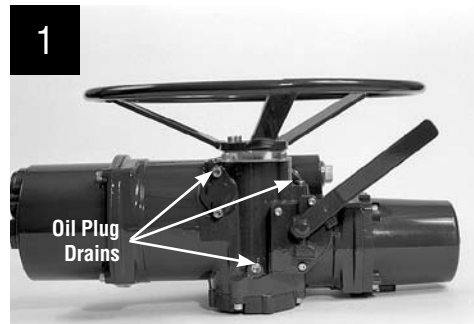
STEP 1

⚠ WARNING: Potential to operate while dangerous mechanical parts are exposed during subassembly removal. To prevent injury, turn off all power sources to actuator before removing side-mounted and top-mounted handwheel assembly. Power sources may include main power or control power.

Drain oil from actuator using the lowest of three plugs in your application mounting orientation.

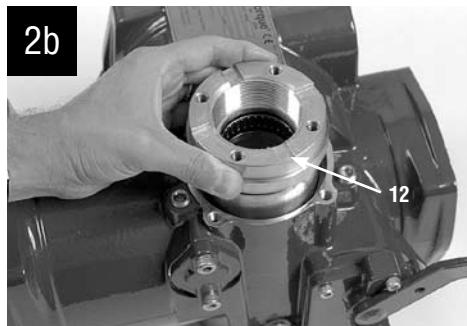
NOTE: Oil removal is not necessary if actuator is mounted on valve or other device with the drive sleeve in a vertical position.

NOTE: MX-10 shown.



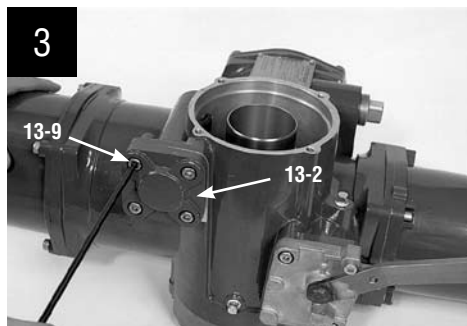
STEP 2

Remove top-mounted handwheel assembly (#1) and handwheel adapter assembly (#12-1) using disassembly instructions detailed in Sections 4.3.1 and 4.13.1 respectively.



STEP 3

Using a 6 mm hex key, remove the M8 screws (#13-9) from the handwheel worm shaft cap (#13-2).



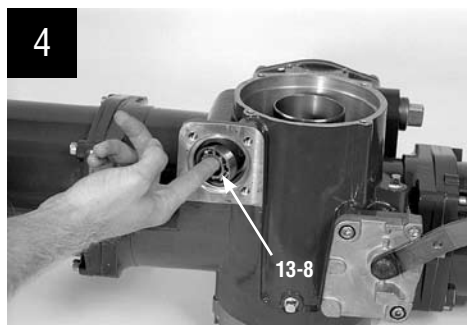
4.6.2 Installing Side-Mounted Handwheel

STEP 4

Install bearing (#13-8) from side-mounted handwheel adapter kit into the actuator housing.

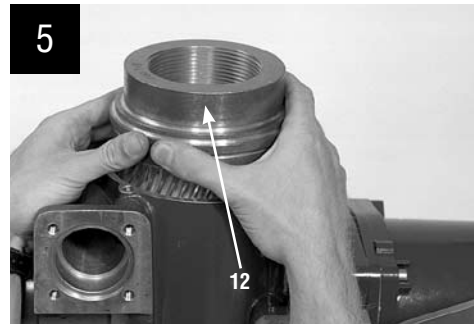
MX-10, -20 and -40: the bearing is a slip fit into the housing.

MX-85, -140, and -150: the bearing is a press fit into the housing.

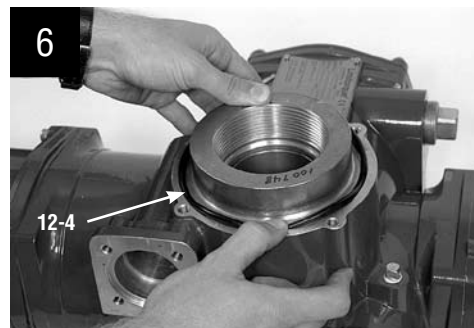


STEP 5

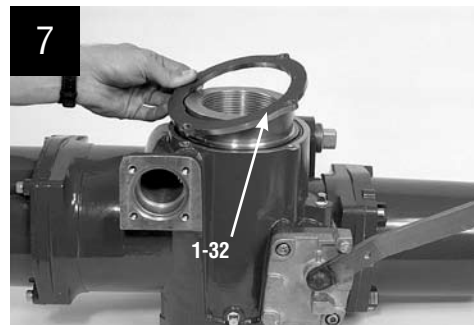
Replace the handwheel adapter (#12-5) with the handwheel worm gear (#12-1) that is included in the side-mounted handwheel adapter kit.

**STEP 6 (MX-20 AND -40 ONLY)**

Place the O-ring (#12-4) around the handwheel adapter; pressing the O-ring into the slot between the handwheel worm gear adapter assembly (#12-1) and the actuator housing (approximately every 15° to 30° until O-ring seats into slot).

**STEP 7**

Place the retainer plate (#1-32) on the top of the actuator housing. Align the mounting taps and secure with screws (#1-33).

**STEP 8**

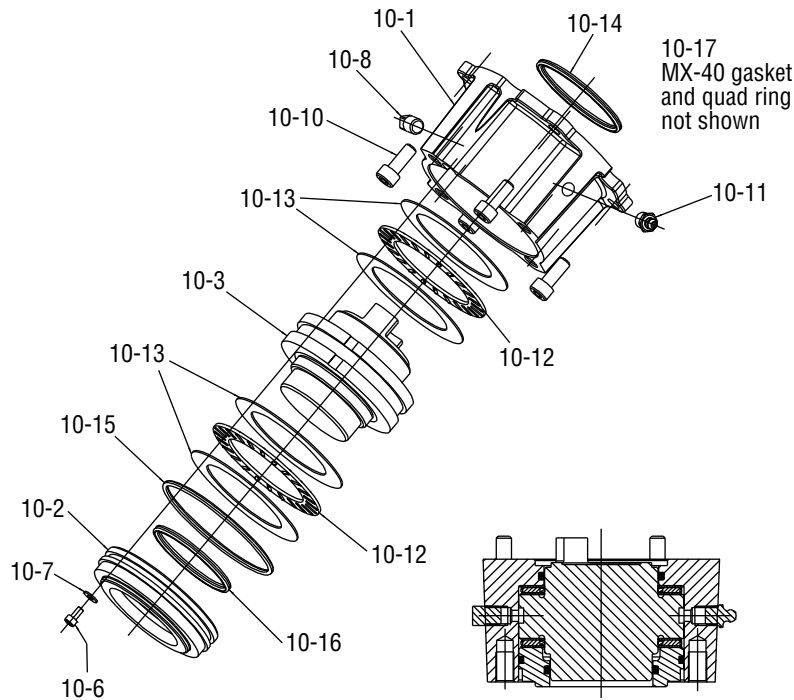
Complete the remounting procedure for side-mounted handwheel assembly #13A (MX-10 and -20) or #13B (MX-40) as detailed in Section 4.4.3 or Section 4.5.3.

4.7 Thrust Base Type A1/A1E

Table 4.12 – Type A1 Thrust Base Parts List (MX-05, 10, -20, and -40)

Part No.	Description	Quantity			
		(MX-05)	(MX-10)	(MX-20)	(MX-40)
10-1	Thrust base housing	1	1	1	1
10-2	Thrust pilot (Threaded on MX-40)	1	1	1	1
10-3	Thrust nut (A1 or A1E)	1	1	1	1
10-6	Socket head cap screw	1	1	1	N/A
10-7	Washer	1	1	1	N/A
10-8	Pipe plug	1	1	N/A	N/A
10-10	Socket head cap screw	4	4	4	4
10-11	Grease fitting	1	1	1	1
10-12	Thrust bearing	2	2	2	2
10-13	Thrust washer	4	4	4	4
10-14	Quad ring	1	1	1	N/A
10-15	O-ring	1	1	1	1
10-16	Quad ring	1	1	1	1
10-17	Gasket	N/A	N/A	N/A	1

Figure 4.12 – Type A1 Thrust Base (MX-05, -10, -20, and -40)



▲ CAUTION: The MX-05 through -40 A1/A1E thrust base contains lubrication. Ensure that a quality Lithium-based lubricant is used when reassembling the thrust base.

Table 4.13 – Type A1 Thrust Base Parts List (MX-85)

Part Number	Description	Qty.
10-1	Thrust base housing	1
10-2	Thrust base mounting flange	1
10-3	Thrust nut (A1 or A1E)	1
10-10	Socket head cap screw	4
10-11	Grease fitting	1
10-12	Thrust bearing	2
10-13	Thrust washer	4
10-14	Quad ring	2
10-15	O-ring	1
10-17	Socket head cap screw	6

Figure 4.13 – Type A1 Thrust Base (MX-85) - F16 Flange

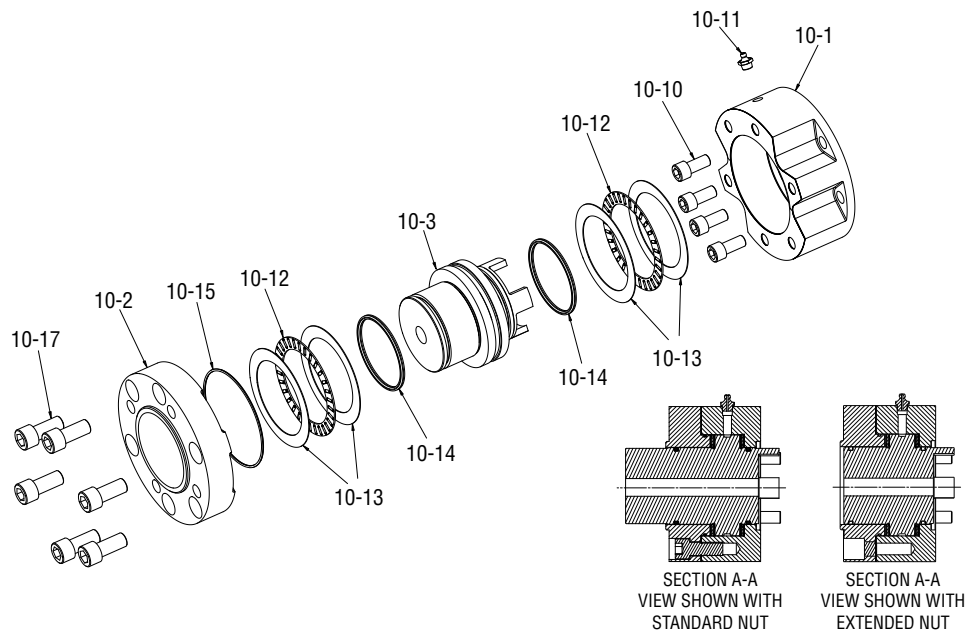
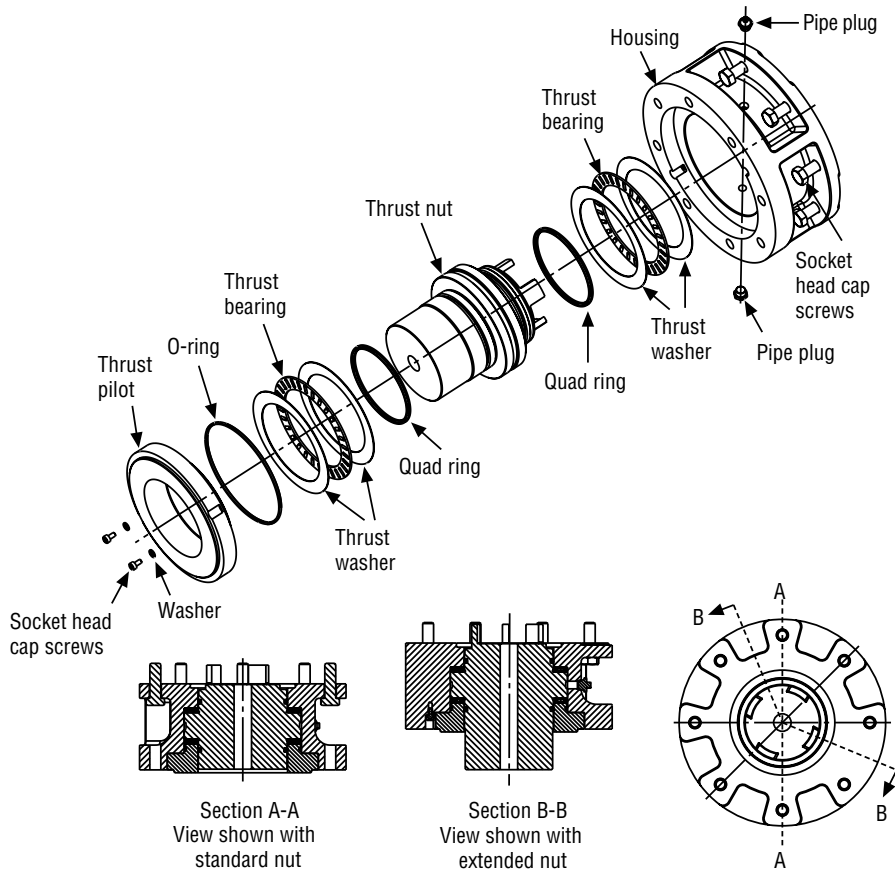


Table 4.14 – Type A1 Thrust Base Parts List (MX-85, -140, and -150) - F25 Flange

Part Number	Description	Qty.
10-1	Thrust Base Housing	1
10-2	Thrust Base Plate	1
10-3	Thrust Nut	1
10-10	Socket Head Cap Screws	4
10-11	Pipe Plug	1
10-12	Thrust Bearing	2
10-13	Thrust Washer	4
10-14	Quad Ring	2
10-15	O-ring	1
10-17	Socket Head Cap Screws	6

Figure 4.14 – Type A1 Thrust Base (MX-85, -140, and -150) - F25 Flange



4.7.1 Removal

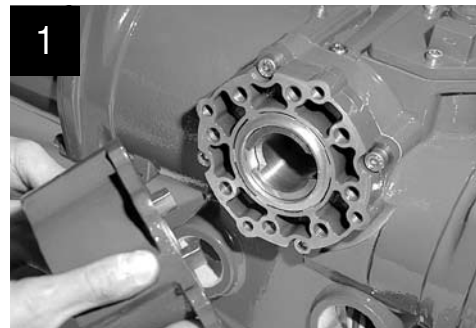
First Remove

1. Remove actuator from mounting adapter.

STEP 1

⚠ WARNING: Potential to operate while dangerous mechanical parts are exposed during subassembly removal. To prevent injury, turn off all power sources to actuator before removing thrust base assembly. Power sources may include main power or control power.

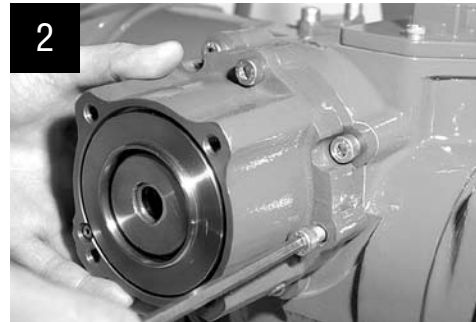
Remove the four screws (#10-10) and pull the thrust base assembly off the actuator.



4.7.2 Remounting

STEP 2

Secure the thrust base with the four screws (#10-10).

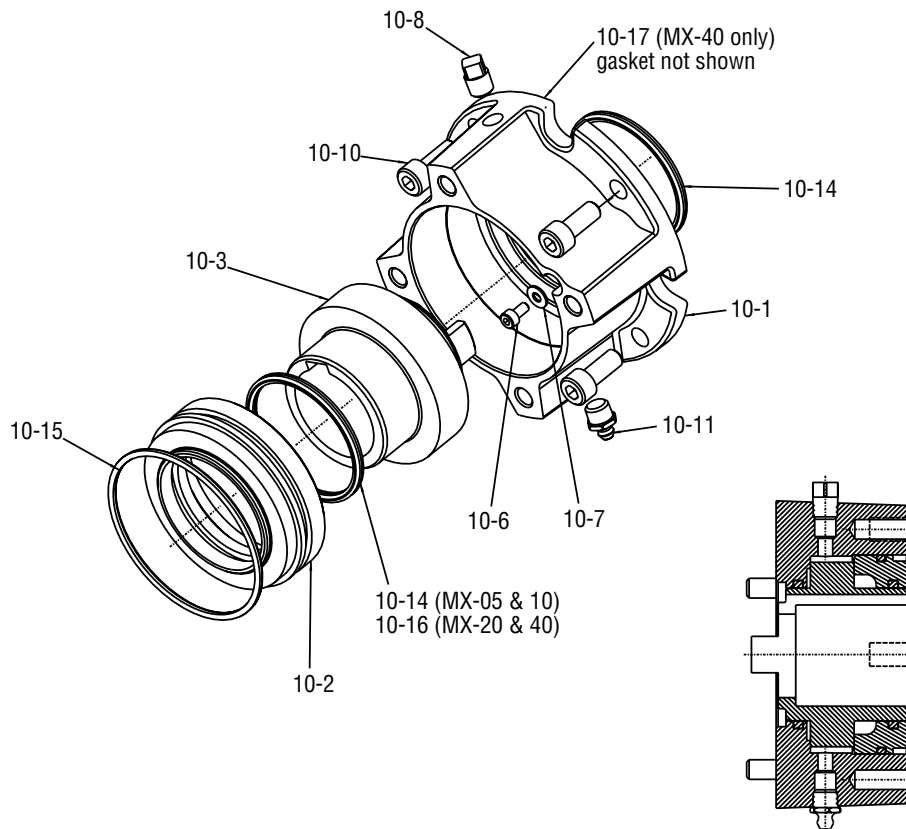


4.8 Torque Base Type B1

Table 4.15 – Type B1 Torque Base Parts List (MX-05, -10, -20, and -40)

Part Number	Description	Quantity			
		MX-05	MX-10	MX-20	MX-40
10-1	Torque housing	1	1	1	1
10-2	Torque/thrust pilot	1	1	1	1
10-3	Torque nut (B1)	1	1	1	1
10-6	Socket head cap screw	1	1	1	N/A
10-7	Washer	1	1	1	N/A
10-8	Pipe plug	2	2	N/A	N/A
10-10	Socket head cap screw	4	4	4	4
10-11	Grease fitting	1	1	1	1
10-14	O-ring	2	2	1	N/A
10-15	O-ring	1	1	1	1
10-16	O-ring	N/A	N/A	1	1
10-17	Gasket	N/A	N/A	N/A	1

Figure 4.15 – Type B1 Torque Base (MX-05, -10, -20, and -40)




4.8.1 Removal

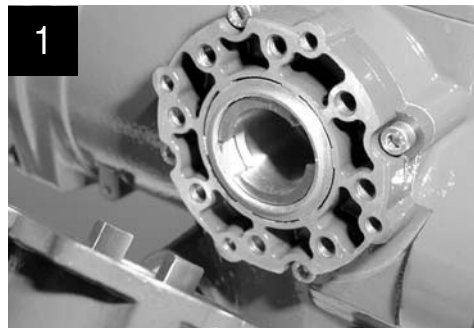
First Remove

1. Remove actuator from mounting adapter.

STEP 1

 **WARNING: Potential to operate while dangerous mechanical parts are exposed during subassembly removal. To prevent injury, turn off all power sources to actuator before removing torque base assembly. Power sources may include main power or control power.**

Remove the four screws (#10-1) and pull the torque base assembly off the actuator.



4.8.2 Remounting

STEP 2

Secure the torque base with the four screws (#10-1).



4.9 Baseplate Type B4

Table 4.16 – Type B4 Baseplate Parts List

Part Number	Description	Quantity	
		MX-05, -10, -20 and -40	MX-85/140/150
11-1	Baseplate	1	1
11-2	Pilot	1	N/A
11-3 Seal (85/140/150)	Quad ring	1	1
11-4	O-ring	1	1
11-5	Socket head cap screw	4	8

Figure 4.16 – Type B4 Baseplate (MX-05, -10, -20, and -40)

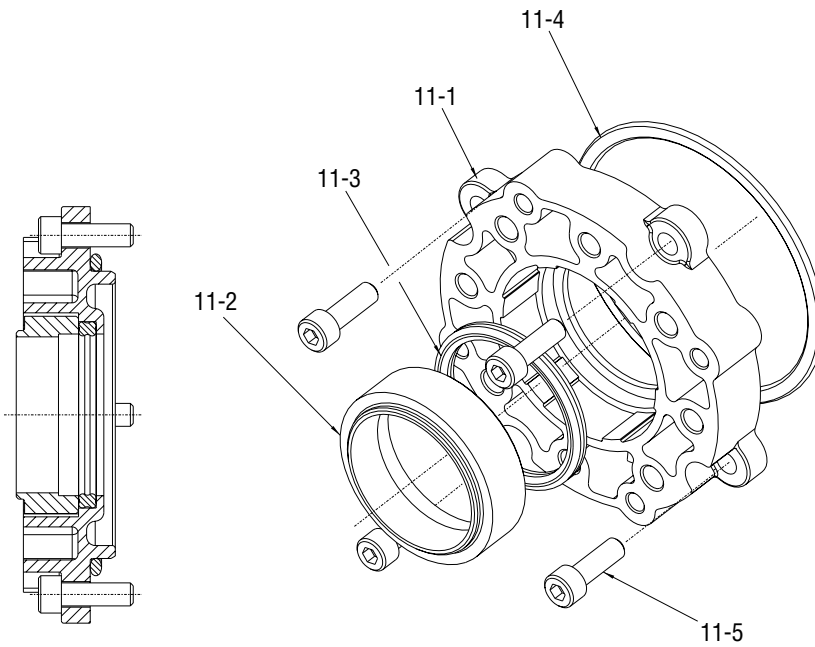
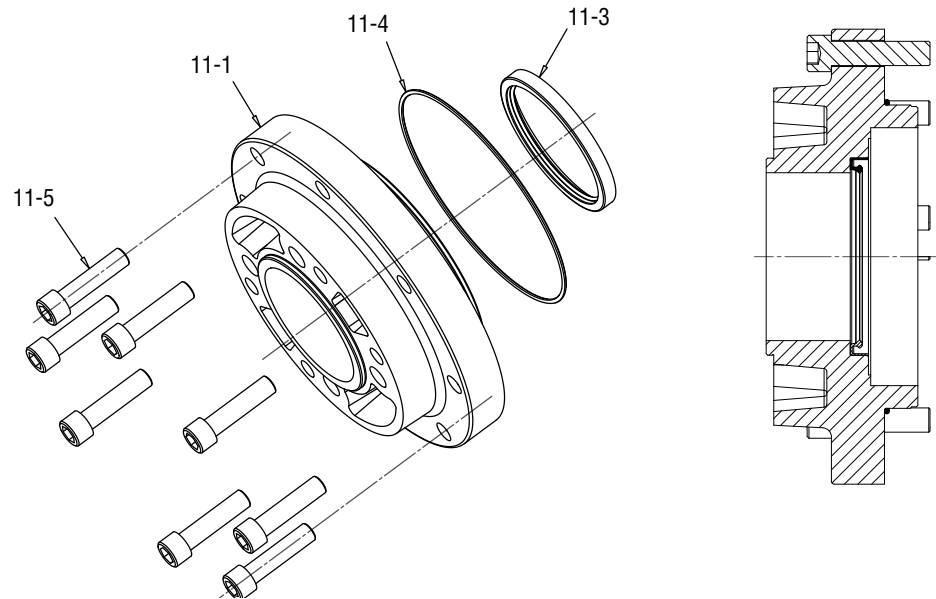


Figure 4.17 – Type B4 Baseplate (MX-85, -140, and -150)



Stem Nuts (B4, B4E, and BL): Various stem nuts are used with the B4 baseplate:

1. B4 stem nut with variable bore and key
2. B4E stem nut for extended reach and variable bore and key
3. BL stem nut (6 or 36 splines)

The B4 stem nut is secured by a snap ring and the B4E and BL stem nuts are secured by a spiral-wound ring. Reference the MX Installation Manual, LMENIM2306 for more information about stem nut options.

4.9.1 Removal

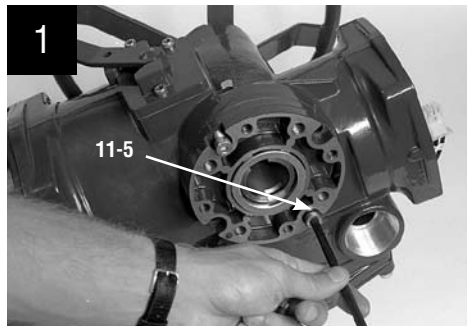
First Remove

1. Remove actuator from mounting adapter.
2. Drain oil.
3. Remove thrust base (subassembly #10) if fitted.
4. Remove stem nut.

STEP 1

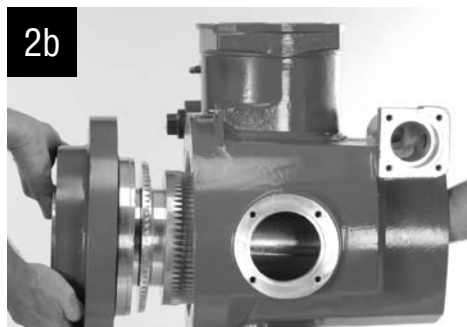
- ⚠ **WARNING:** Potential to operate while dangerous mechanical parts are exposed during subassembly removal. To prevent injury, turn off all power sources to actuator before removing base plate assembly. Power sources may include main power or control power.

Using a hex key, remove the four or eight screws (#11-5).

**STEP 2**

- ⚠ **WARNING:** MX-85, -140, and -150. If handwheel worm gear assembly has previously been removed, the drive sleeve assembly may slip and fall out of housing. Hold drive sleeve assembly in from opposite end. See Section 4.12.1 and 4.12.2 for optional removal and remounting.

Pull the baseplate (#11-1) off the drive sleeve.



4.9.2 Remounting

STEP 3

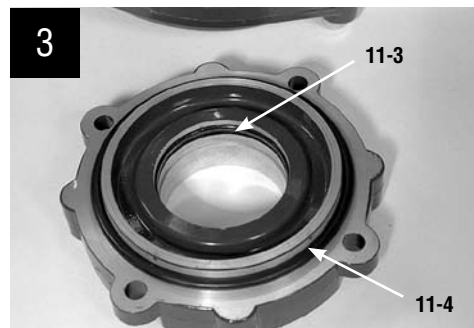
▲ CAUTION: To ensure actuator is fully secured on mounting plate, ensure baseplate (#11-1) is tightened with the following torque values on mounting screws (#11-5):

MX-05 and -10 = 12 ft-lb (16 N m)

MX-20 and -40 = 24 ft-lb (32 N m)

MX-85, -140, and -150 = 90 ft-lb (114 N m)

Lightly lubricate the outside of the drive sleeve, the quad ring or seal (#11-3), and O-ring (#11-4) before remounting baseplate.



STEP 4

NOTE: (MX-20 only) Match outer bosses of baseplate with outer bosses of actuator housing before mounting baseplate assembly.

NOTE: (MX-85, -140, and -150) Match mounting holes in baseplate to housing taps. Baseplate and housing has one hole/tap that is not equally spaced.

Carefully push the baseplate assembly onto the end of the drive sleeve, ensuring that the quad ring or seal (#11-3) is not damaged. Align the mounting holes and secure the baseplate with the screws (#11-5).

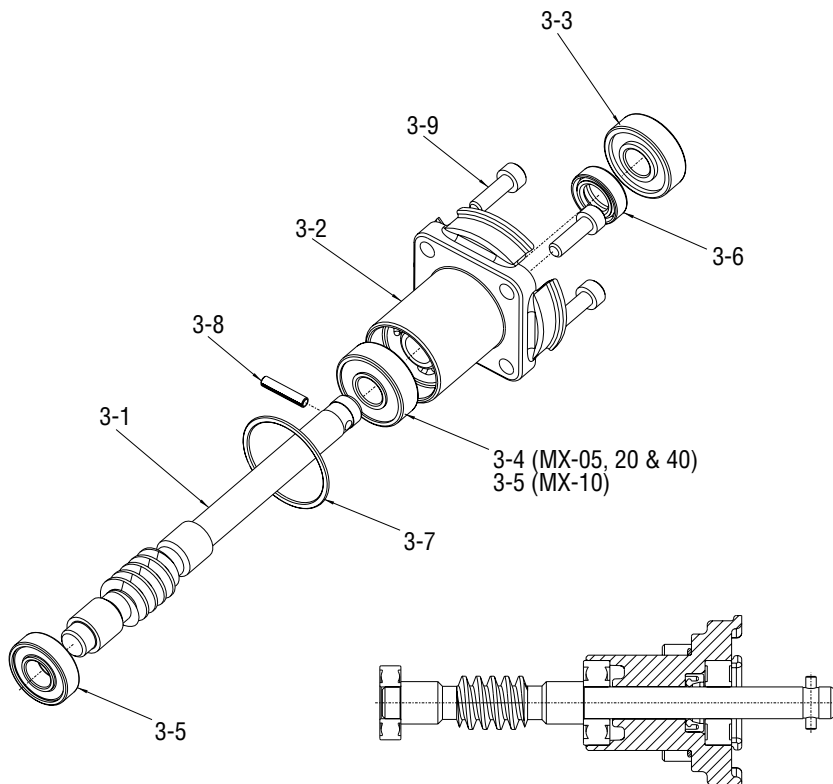


4.10 Worm Shaft

Table 4.17 – Worm Shaft Parts List

Part Number	Description	Quantity	
		MX-05, -10, -20 and -40	MX-85, -140, and -150
3-1	Worm	1	1
3-2	Worm shaft cap	1	1
3-3	Ball bearing	1	1
3-4	Ball bearing	1	2
3-5	Ball bearing	1	N/A
3-6	Oil seal	1	1
3-7	O-ring	1	1
3-8	Pin	1	2
3-9	Socket head cap screw	4	4

Figure 4.18 – Worm Shaft (MX-05, -10, -20, and -40)



4.10.1 Removal

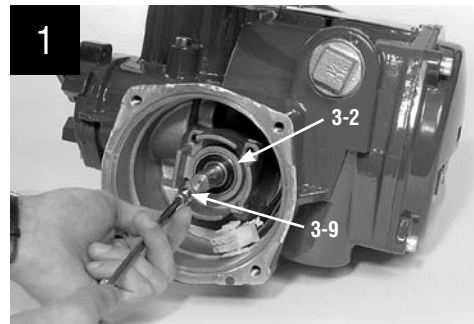
First Remove

1. Remove actuator from mounting adapter.
2. Drain oil.
3. Remove motor (subassembly #4). (See Section 4.1.1.)

STEP 1

⚠ WARNING: Potential to operate while dangerous mechanical parts are exposed during subassembly removal. To prevent injury, turn off all power sources to actuator before removing worm shaft assembly. Power sources may include main power or control power.

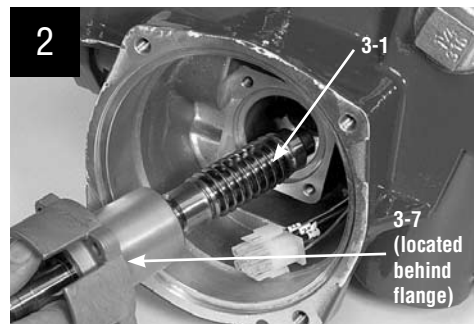
Remove the four screws (#3-9) that secure the worm shaft cap (#3-2) to the actuator housing.



STEP 2

NOTE: The inboard bearing (#3-5 for MX-05, -20, -85, -140, and -150), at the end of the worm shaft (#3-1) should remain in the actuator housing. If it falls out while removing the worm shaft assembly, ensure it is replaced during remounting process.

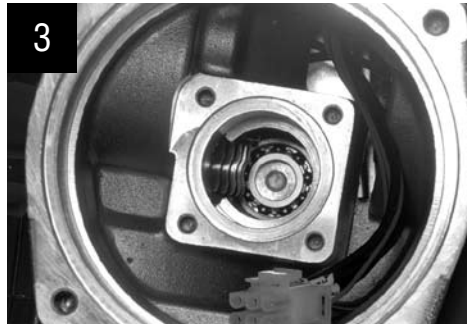
Withdraw the complete worm shaft assembly from the actuator housing, turning/rotating it if necessary to free the worm from the worm gear. Note the O-ring (#3-7) that is on the worm shaft assembly. Replace at remounting.



4.10.2 Remounting

STEP 3

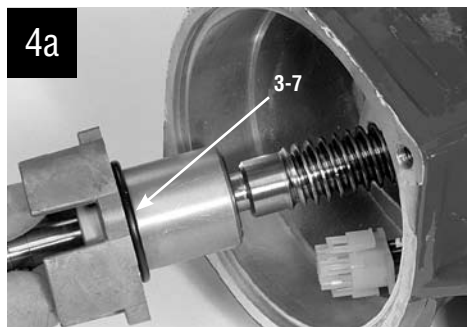
Check that the bearing (#3-5) is seated firmly in the actuator housing.



STEP 4

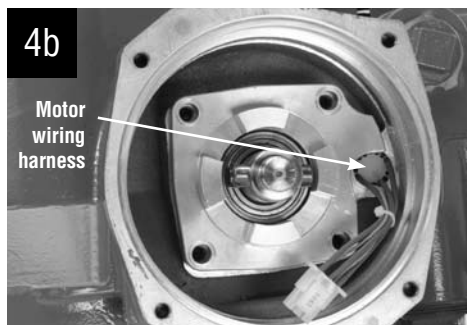
NOTE: Lightly lubricate the O-ring (#3-7) before remounting worm shaft (subassembly #3).

Lightly lubricate the O-ring (#3-7) on the worm shaft (subassembly #3). Push the complete worm shaft assembly into the actuator housing until the worm contacts the worm gear. Turn the worm so it engages the worm gear and continue rotating until the end of the worm shaft is isolated in the inboard bearing (#3-4).



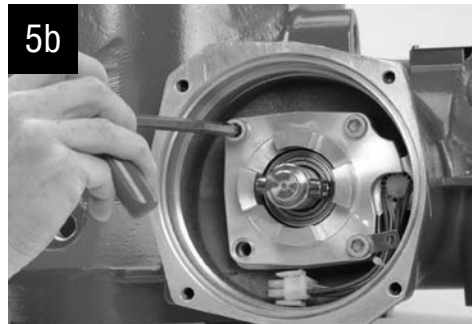
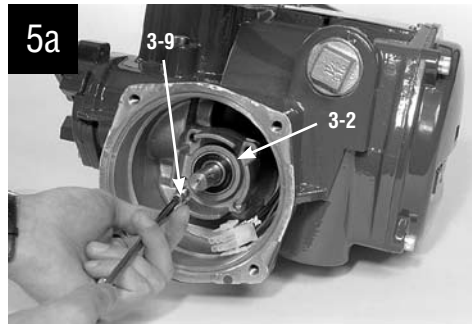
MX-85, -140, AND -150 ONLY

Be sure the motor wiring harness is pushed in, then rotate worm shaft cap (#3-2) around so that tab is holding wiring harness in place. See Section 5.11 for motor wiring harness installation.



STEP 5

Using a hex key, fit the four M6, M8, or M10 screws (#3-9) into the worm shaft cap (#3-2) mounting holes and tighten.

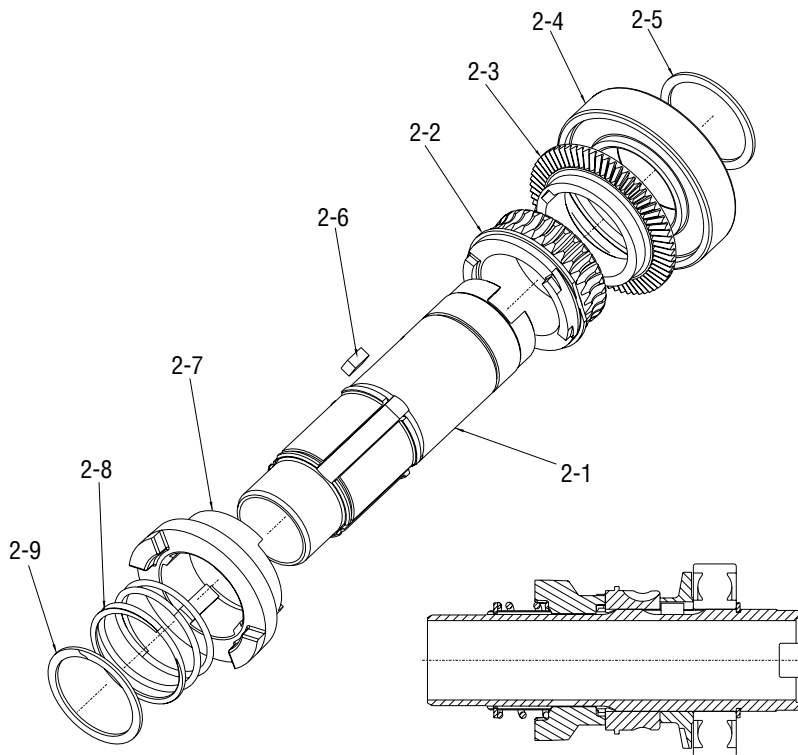


4.11 Drive Sleeve (MX-05 and -10)

Table 4.18 – Drive Sleeve Parts List (MX-05 and -10)

Part Number	Description	Qty.
2-1	Drive sleeve	1
2-2	Worm gear	1
2-3	Encoder drive gear	1
2-4	Ball bearing	1
2-5	Retaining ring	1
2-6	Drive sleeve key	1
2-7	Clutch	1
2-8	Clutch spring	1
2-9	Retaining ring	1

Figure 4.19 – Drive Sleeve (MX-05 and -10)



4.11.1 Removal

First Remove

1. Remove actuator from mounting adapter.
2. Drain oil.
3. Remove thrust base (subassembly #10) - if fitted.
4. Remove motor (subassembly #4). (See Section 4.1.1.)
5. Remove worm shaft (subassembly #3). (See Section 4.10.1.)
6. Remove base plate (subassembly #11). (See Section 4.9.1.)

STEP 1

⚠ WARNING: Potential to operate while dangerous mechanical parts are exposed during subassembly removal. To prevent injury, turn off all power sources to actuator before removing drive sleeve assembly. Power sources may include main power or control power.

Once all other subassemblies are removed, pull out the drive sleeve assembly (#2) until the lower bearing (#2-4) is released from the actuator housing. Remove drive sleeve assembly from actuator.

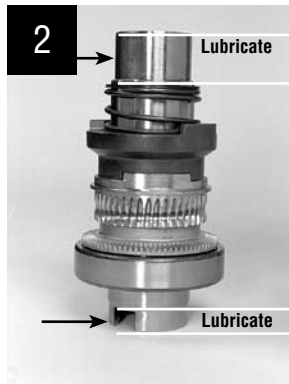


4.11.2 Remounting

STEP 2

▲ CAUTION: The drive sleeve surface serves as an oil-sealing surface. Use caution not to scratch the drive sleeve while completing removal and remounting.

Lightly lubricate the top and bottom of the drive sleeve assembly as shown.



STEP 3

Insert the drive sleeve assembly into the actuator housing base until the lower bearing (#2-4) is fully engaged in the housing (seated on actuator shoulder). If the bearing is a tight fit, gently tap the bottom of drive sleeve (#2-1) with a mallet to properly seat.



STEP 4

Remount all removed subassemblies according to their remounting instructions in the following order:

1. Base plate (subassembly #11). (See Section 4.9.2.)
2. Worm shaft (subassembly #3). (See Section 4.10.2.)
3. Motor (subassembly #4). (See Section 4.1.2.)
4. Thrust base (subassembly #10) - if fitted. (See Section 4.7.2.)

4.12 Drive Sleeve (MX-20, -40, -85, -140, and -150)

Table 4.19 – Drive Sleeve Parts List (MX-20, -40, -85, -140, and -150)

Part Number	Description	Quantity		
		MX-20 and -40	MX-85, -140, and -150	MX-85, -140, and -150 10:1 and 13:1 Ratio
2-1	Drive sleeve	1	1	1
2-2	Worm gear	1	1	1
2-3	Encoder drive gear	1	1	1
2-4	Ball bearing	1	1	1
2-5	Retaining ring	1	N/A	N/A
2-6	Drive sleeve key	1	1	1
2-7	Spacer	N/A	N/A	3
2-8	Ball bearing	N/A	N/A	2
2-9	Retaining Ring	N/A	N/A	1

Figure 4.20 – MX-20 and -40 Drive Sleeve

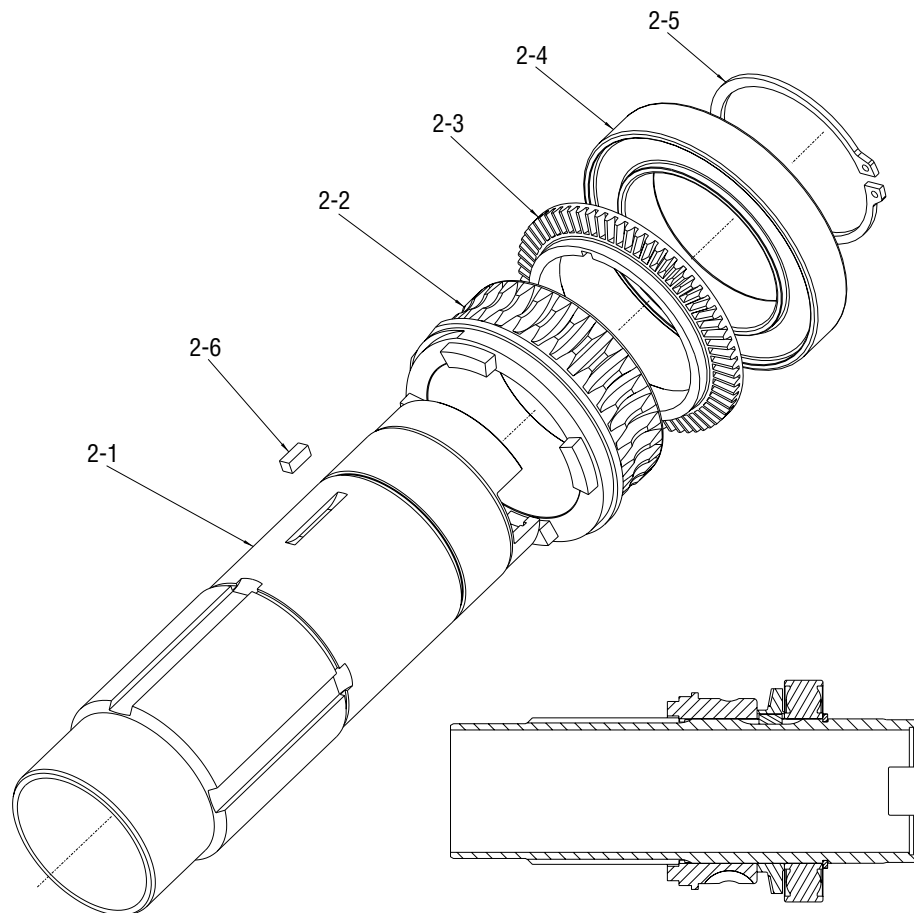
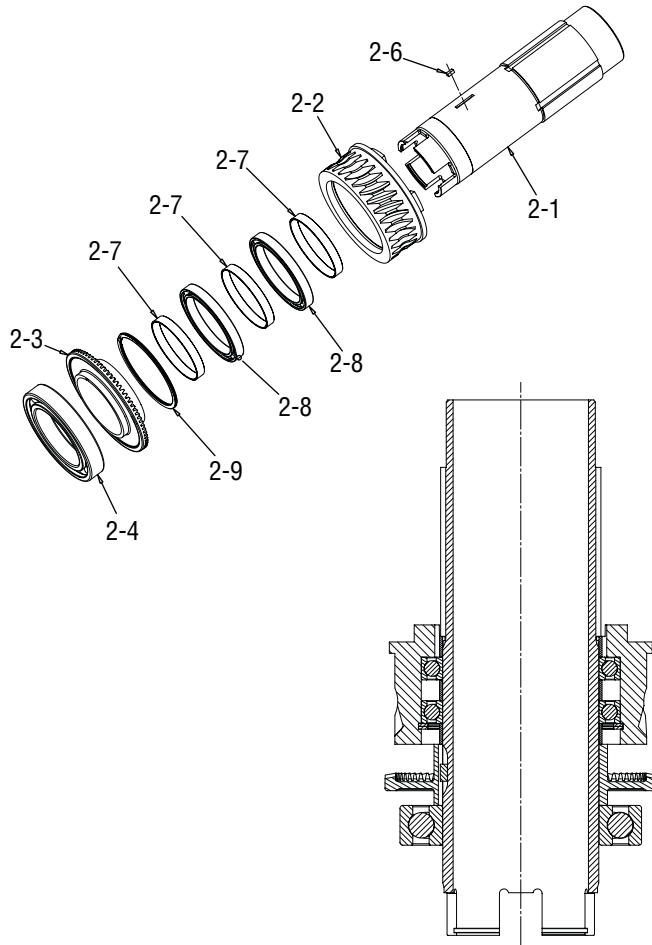


Figure 4.21 – MX-85, -140, and -150 10:1 and 13:1 ratios



4.12.1 Removal

First Remove

1. Remove actuator from mounting adapter.
2. Drain oil.
3. Remove thrust base (subassembly #10) - if fitted. (See Section 4.8.1.)
4. Remove motor (subassembly #4). (See Section 4.1.1.)
5. Remove worm shaft (subassembly #3). (See Section 4.10.1.)
6. Remove top-mounted handwheel (#1-8) or side-mounted handwheel (subassembly #16). (See Section 4.3.1 or 4.4.2.)
7. Remove handwheel adapter (subassembly #12). (See Section 4.14.1.)
8. Remove clutch and clutch ring (subassembly #16). (See Section 4.15.1.)
9. Remove handwheel declutch (subassembly #5). (See Section 4.2.1.)
10. Remove base plate (subassembly #11). (See Section 4.9.1 or Section 4.12.1 for MX-85, -140, and -150)

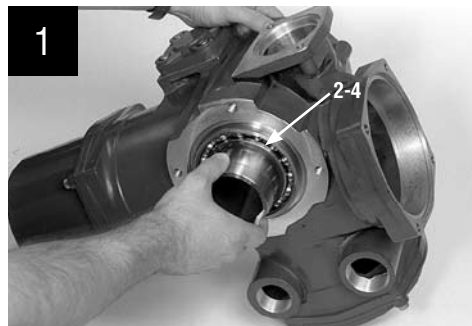
⚠ WARNING: (MX-85, -140, and -150) The drive sleeve assembly may slip and fall out of housing when removing baseplate assembly. Hold the drive sleeve assembly in from opposite end when removing baseplate assembly. See optional drive sleeve and baseplate removal Section 4.12.3 and 4.12.4.

STEP 1

⚠ WARNING: Potential to operate while dangerous mechanical parts are exposed during subassembly removal. To prevent injury, turn off all power sources to actuator before removing drive sleeve assembly. Power sources may include main power or control power.

Once all other subassemblies are removed, pull out the drive sleeve assembly (#2) until the lower bearing (#2-4) is released from the actuator housing. Remove drive sleeve assembly from actuator.

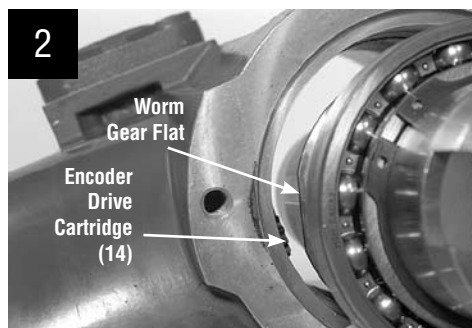
MX-85, -140, and -150: Optional drive sleeve and baseplate removal instructions.



STEP 2 (VIEWED FROM BASEPLATE SIDE OF ACTUATOR)

⚠ CAUTION: (MX-20 and -40) The drive sleeve surface serves as an oil sealing surface. Use caution not to scratch the drive sleeve while completing removal and remounting.

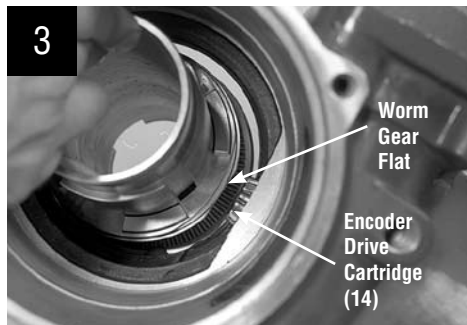
TIP: To avoid interference between drive sleeve assembly and encoder drive cartridge (subassembly #14), turn flat on worm gear to be parallel and on same side as encoder bevel gear.



STEP 3 (VIEWED FROM TOP-MOUNTED HANDWHEEL SIDE OF ACTUATOR)

▲ CAUTION: (MX-20 and -40 only) When removing or remounting drive sleeve assembly, take precaution not to bump drive sleeve assembly against encoder drive cartridge (subassembly #14).

TIP: Worm gear flat turned parallel with encoder drive cartridge (subassembly #14) to permit drive sleeve assembly removal.

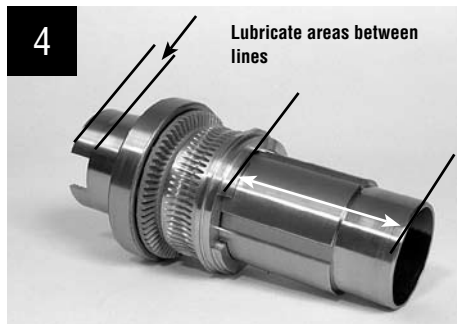


4.12.2 Remounting

STEP 4

NOTE: Before remounting drive sleeve assembly, ensure that bearing (#3-5) is in place in the actuator housing. (Refer to motor subassembly #3 Step 1 for details.)

Lightly lubricate the top and bottom of the drive sleeve assembly as shown.

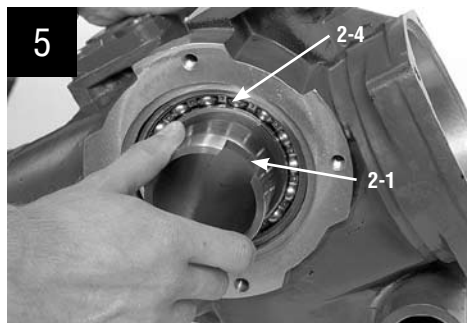


STEP 5

▲ CAUTION: (MX-20 and -40 only) When removing or remounting drive sleeve assembly, take precaution not to bump drive sleeve assembly against encoder drive cartridge (subassembly #14).

Push the drive sleeve assembly into the base of the actuator housing until the lower bearing (#2-4) is fully engaged in the housing up to the shoulder. If the bearing is a tight fit, gently tap the bottom of the drive sleeve (#2-1) with a mallet to properly seat.

MX-85, -140, and -150: See Section 4.12.4 for optional remounting of drive sleeve and baseplate.



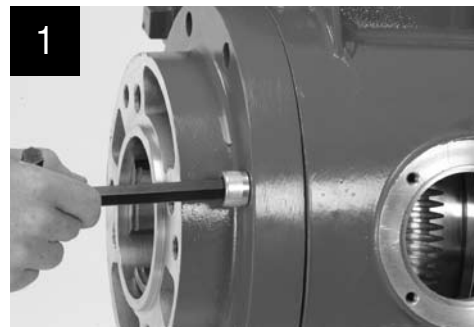
4.12.3 MX-85, -140, and -150 Optional Drive Sleeve and Baseplate Removal

First Remove

1. Remove actuator from mounting adapter.
2. Drain oil.
3. Remove thrust base (subassembly #10) - if fitted. (See Section 4.8.1.)
4. Remove motor (subassembly #4). (See Section 4.1.1.)
5. Remove worm shaft (subassembly #3). (See Section 4.10.1.)
6. Remove top-mounted handwheel (#1-8) or side-mounted handwheel (subassembly #16). (See Section 4.3.1 or 4.4.2.)
7. Remove handwheel adapter (subassembly #12). (See Section 4.14.1.)
8. Remove clutch and clutch ring (subassembly #16). (See Section 4.15.1.)
9. Remove handwheel declutch (subassembly #5). (See Section 4.2.1.)

STEP 1

Lay actuator on its side with the drive sleeve horizontal. Using a hex key, remove seven of the baseplate screws (#11-5).



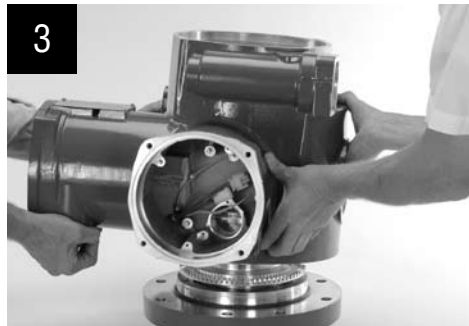
STEP 2

Lay actuator on a table or suitable structure with one of the screws (#11-5) hanging over the edge. Remove screw. If needed, rotate actuator around and remove all other screws.



STEP 3

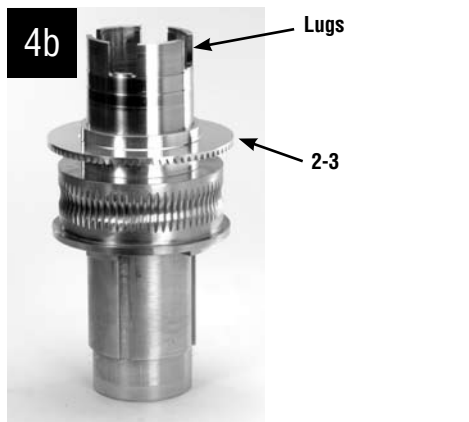
With help, lift housing straight up and off baseplate and drive sleeve assemblies.



STEP 4

Using the encoder gear (#2-3), lift drive sleeve assembly out of the baseplate assembly. Turn the drive sleeve assembly over (lugs of drive sleeve up) and set down on table.

NOTE: The drive sleeve assembly is not held together and will fall apart if set down on a lug end of drive sleeve.



4.12.4 MX-85, -140, and -150 Optional Drive Sleeve and Baseplate Remounting

STEP 1

Assemble drive sleeve assembly with drive sleeve lying on opposite end of lugs. Place worm gear (#2-2), key (#2-6) and encoder drive gear (#2-3) onto the drive sleeve (#2-1). Place the ball bearing (#2-4) into the baseplate assembly. See picture 4b in Section 4.12.3.

Lightly lubricate the bottom of the drive sleeve (#2-1) and the baseplate seal (#11-3).

Lift the drive sleeve assembly up, and holding the encoder drive gear (#2-2), turn the drive sleeve over and place into the baseplate assembly. See picture 4a in Section 4.12.3.

STEP 2

With help, lift housing and place over the drive sleeve and baseplate assemblies. Match up the mounting holes in the baseplate and housing. With the actuator sitting on the baseplate, slide the unit over to the edge and mount one or two of the baseplate screws (#11-5). Turn unit over on its side with the drive sleeve horizontal and secure the baseplate with the rest of the mounting screws.

NOTE: The drive sleeve is held in from the top by the handwheel worm gear. Without the handwheel worm gear, the drive sleeve may slip out of position. Push the drive sleeve back into position from the handwheel worm gear end. See pictures 3, 2, and 1, in that order, from Section 4.12.1.

STEP 3

Remount all removed subassemblies according to their remounting instructions in the following order:

1. Base plate (subassembly #11). (See Section 4.9.2.)
2. Worm shaft (subassembly #3). (See Section 4.10.2.)
3. Handwheel declutch (subassembly #5). (See Section 4.2.2.)
4. Clutch and clutch ring (subassembly #16). (See Section 4.15.2.)
5. Handwheel adapter (subassembly #12). (See Section 4.14.2.)
6. Top-mounted handwheel (subassembly #1-8) or side-mounted handwheel (subassembly #13). (See Section 4.3.2 or 4.4.3.)
7. Motor (subassembly #4). (See Section 4.1.2.)
8. Thrust base (subassembly #10) - if fitted. (See Section 4.8.2.)

4.13 Handwheel Adapter (MX-05)

Table 4.20 – Handwheel Adapter Parts List (MX-05)

Part Number	Description	Qty.
12-1	Handwheel adapter	1
12-2	Needle bearing	1
12-3	Quad ring	1
12-4	O-ring	1

Figure 4.22 – Handwheel Adapter (MX-05)

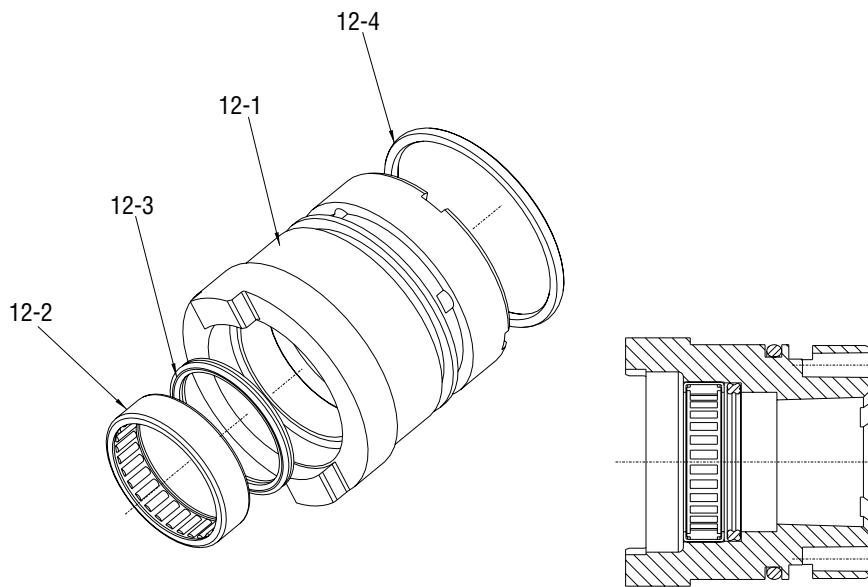
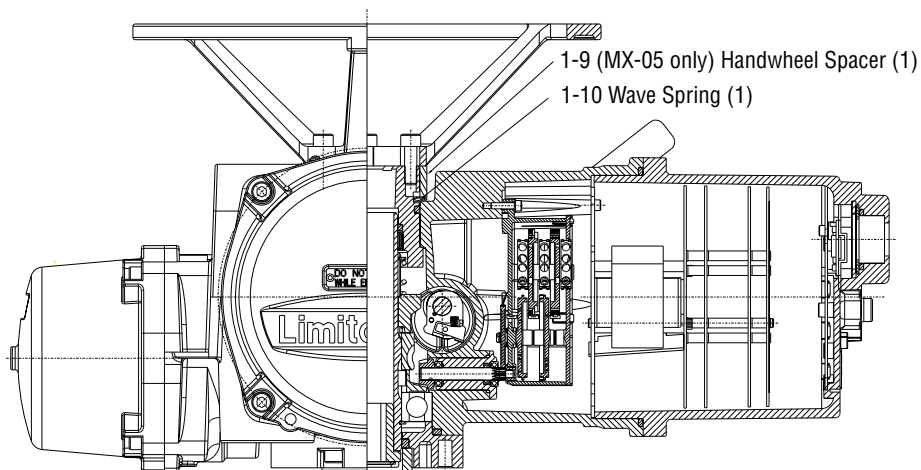


Figure 4.23 – Handwheel (MX-05)



4.13.1 Removal

First Remove

1. Remove actuator from mounting adapter.
2. Drain oil.
3. Remove top-mounted handwheel (#1-8). (See Section 4.3.1.)
4. Remove motor (subassembly #4). (See Section 4.1.1.)
5. Remove worm shaft (subassembly #3). (See Section 4.10.1.)
6. Remove base plate (subassembly #11). (See Section 4.9.1.)
7. Remove drive sleeve (subassembly #2). (See Section 4.11.1.)

STEP 1

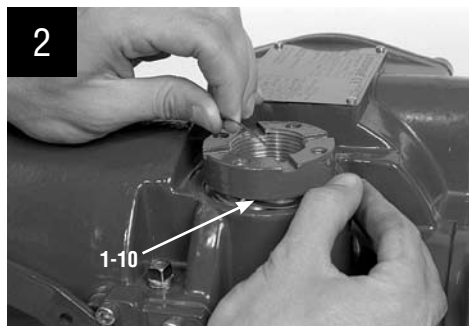
⚠ WARNING: Potential to operate while dangerous mechanical parts are exposed during subassembly removal. To prevent injury, turn off all power sources to actuator before removing handwheel adapter assembly. Power sources may include main power or control power.

Remove handwheel spacer (#1-9).



STEP 2

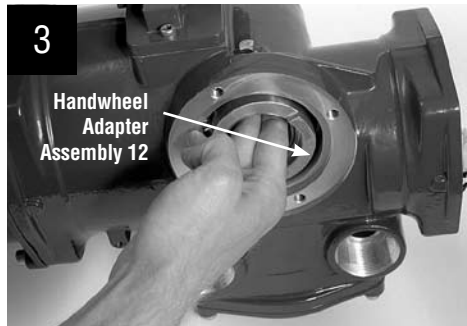
Unwind wave spring (#1-10) and remove.



STEP 3

NOTE: The handwheel adapter for the MX-05 is removed and introduced from the base of the actuator housing.

Push adapter assembly (#12) from the top of the actuator out through the bottom of the actuator housing.



4.13.2 Remounting

STEP 4

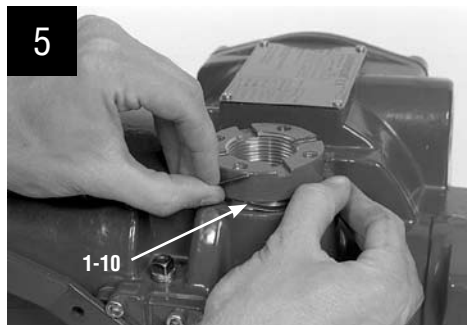
NOTE: Lightly lubricate quad rings/O-rings before remounting subassemblies.

With handwheel screw taps facing toward the nameplate side of the actuator, slide handwheel adapter assembly (#12) into the actuator housing's drive sleeve bore. Use hammer handle or similar device to push handwheel adapter assembly against shoulder inside actuator housing.



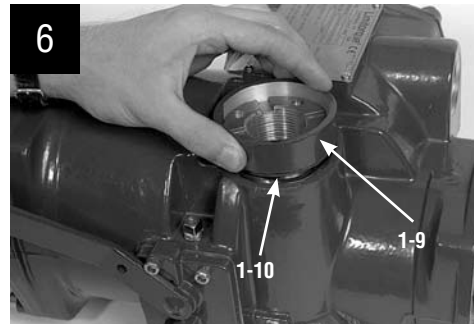
STEP 5

Once handwheel adapter assembly is installed in actuator housing, wind wave spring (#1-10) into groove on the handwheel adapter.



STEP 6

Slide handwheel spacer (#1-9) over handwheel adapter assembly, ensuring wave spring (#1-10) is seated in groove of the handwheel spacer.

**STEP 7**

Remount all removed subassemblies according to the remounting instructions in the following order:

1. Drive sleeve (subassembly #2). (See Section 4.11.2.)
2. Base plate (subassembly. #11). (See Section 4.9.2.)
3. Worm shaft (subassembly. #3). (See Section 4.10.2.)
4. Motor (subassembly #4). (See Section 4.1.2.)
5. Top-mounted handwheel (#1-8). (See Section 4.3.2.)

NOTE: After completing handwheel assembly procedure, turn handwheel enough to ensure wave spring is not pinched between actuator housing and handwheel spacer. If it is pinched, remove handwheel (#1-8) and handwheel spacer (#1-9) to reseal the wave spring (#1-10) into the groove on the handwheel spacer. Install handwheel.

6. Add oil.

4.14 Handwheel Adapter (MX-10, -20 and -40)/ Handwheel Worm Gear (MX-10, -20, -40, -85, -140, and -150)

Table 4.21 – Handwheel Adapter Assembly Parts List

Part Number	Description	Qty.
12-1	Handwheel adapter	1
12-2	Ball bearing	1
12-3	Quad ring	1
12-4	O-ring	1

Figure 4.24 – Handwheel Adapter Assembly

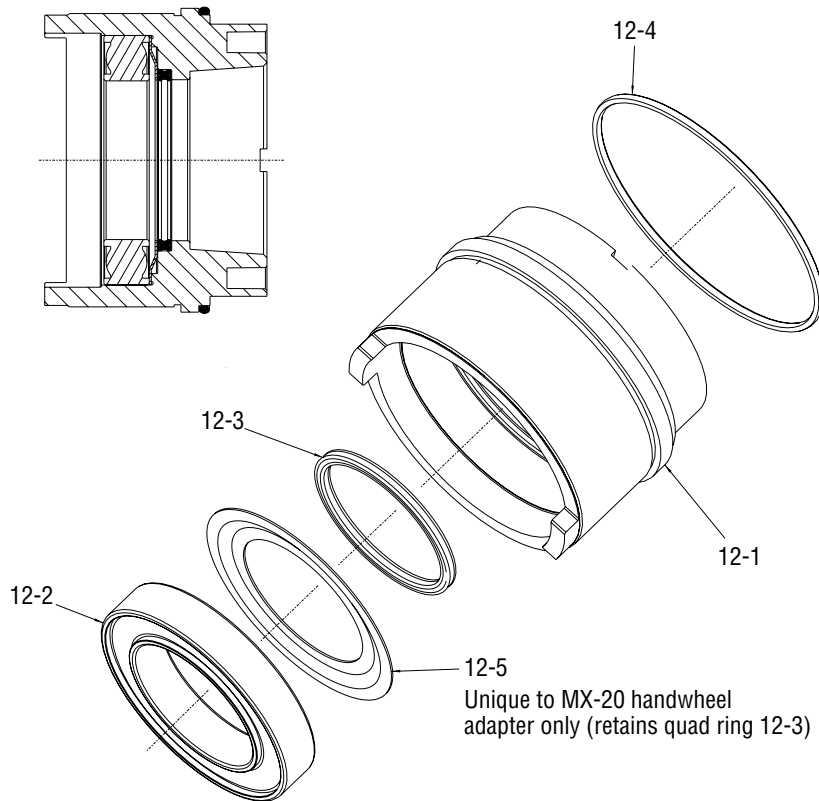
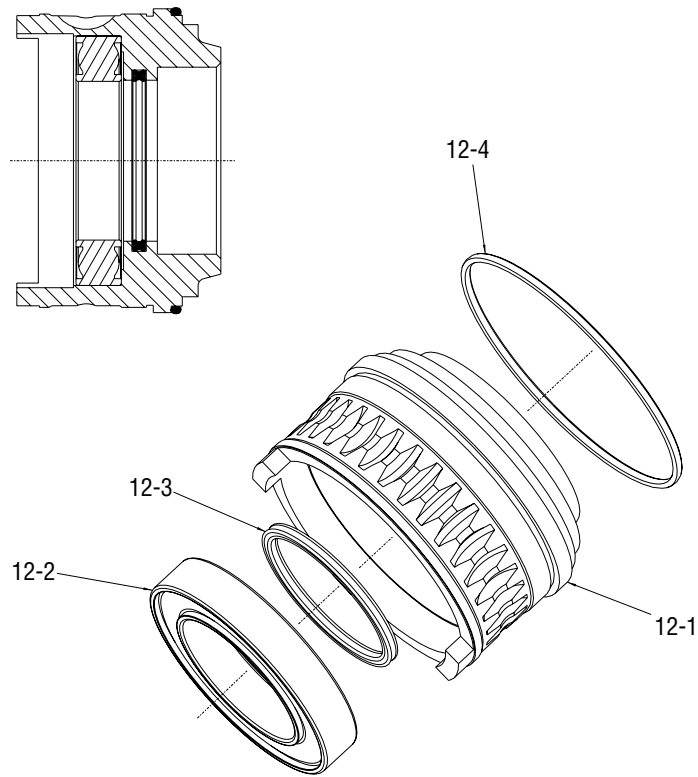


Table 4.22 – Handwheel Worm Gear Assembly Parts List

Part Number	Description	Qty.
12-1	Handwheel worm gear	1
12-2	Ball bearing	1
12-3	Quad ring	1
12-4	O-ring	1
12-5	Handwheel adapter	1

Figure 4.25 – Handwheel Worm Gear Assembly



4.14.1 Removal

First Remove

1. Top-mounted handwheel (#1-8) or side-mounted handwheel (subassembly #13). (See Section 4.3.1 or 4.4.2.)

NOTE: Before removing handwheel and handwheel adapter assembly, turn handwheel approximately 45° to permit declutch lever to fully engage therefore making handwheel assembly easy to remove.

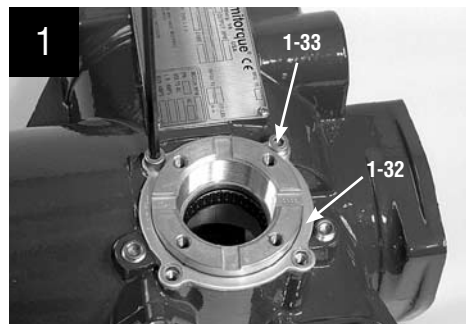
The handwheel adapter assembly and the handwheel worm gear assembly procedures are interchangeable. The parts within the assembly are the same with exception to the handwheel adapter (#12-1) and the handwheel worm gear adapter (#12-1). The handwheel adapter assembly is used when the handwheel is top-mounted. The handwheel worm gear assembly is used when the handwheel is side-mounted.



STEP 1

⚠ WARNING: Potential to operate while dangerous mechanical parts are exposed during subassembly removal. To prevent injury, turn off all power sources to actuator before removing handwheel adapter assembly. Power sources may include main power or control power.

Remove the four screws (#1-33) from the retainer plate (#1-32).

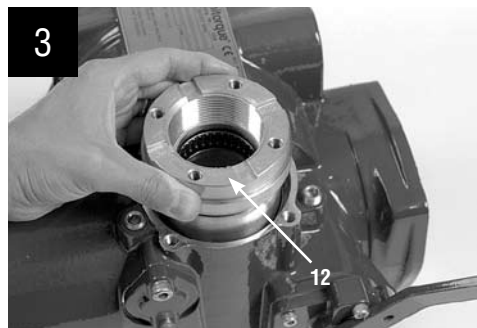


STEP 2

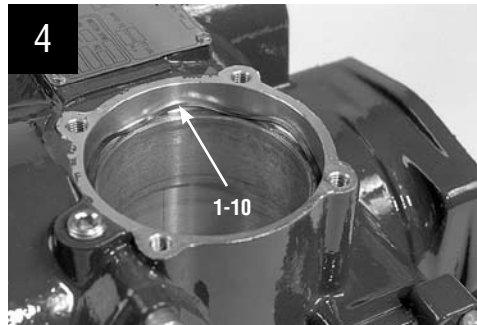
Lift off the retainer plate (#1-32).

**STEP 3**

Pull the handwheel adapter assembly (#12) out of the actuator housing.

**STEP 4 (MX-10 ONLY)**

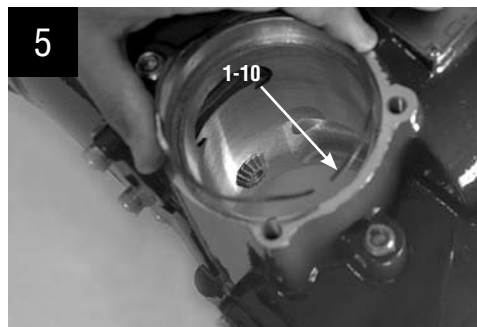
Lift out wave spring (#1-10) from the actuator housing.



4.14.2 Remounting

STEP 5 (MX-10 ONLY)

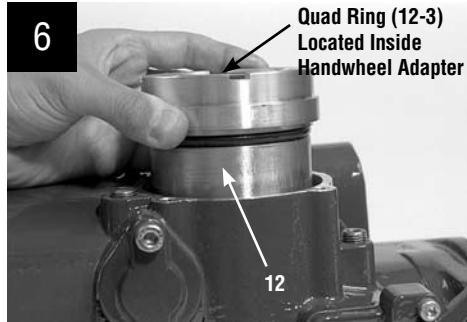
Insert the wave spring (#1-10) onto the shoulder of the actuator housing.



STEP 6

NOTE: Lightly lubricate quad rings/O-rings before remounting subassemblies.

Fit the handwheel adapter assembly (#12) into the top of the actuator housing. Slowly rotate the assembly as it approaches its lower position in the actuator; this will allow the quad ring (#12-3) to ease over the end of the drive sleeve avoiding damage to the quad ring.

**STEP 7 (MX-20 AND -40 ONLY)**

Place the O-ring (#12-4) around handwheel adapter, pressing the O-ring into the slot between the handwheel adapter assembly (#12) and the actuator housing (approximately every 15° to 30°) until the O-ring seats into slot.

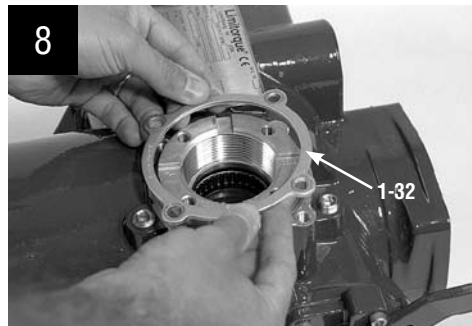


STEP 8

NOTE: Retainer plate (#1-32) may sit slightly above actuator housing until screws are retightened.

⚠ WARNING: The MX-10 through -150 require precaution to prevent damage to the declutch latch. This applies while installing the handwheel adapter/gear assembly (#1-35), retainer plate (#1-32) and screws (#1-33). If the unit is in the clutched position (handwheel operation) during assembly, a lug-to-lug condition can result between the clutch and the handwheel adapter/gear. In this situation the latch will be compressed and damaged when the plate screws are tightened.

Assure the clutch lugs are fully engaged to the bronze gear lugs before installing the handwheel adapter/gear assembly. The latch must be rotated down and not holding the clutch off the bronze worm gear. When installing the handwheel adapter/gear, ensure these lugs fall between the clutch lugs. This position will allow the handwheel adapter/gear lugs to be fully engaged to the clutch lugs. The final step is to install the retaining plate and socket head cap screws.



Place the retainer plate (#1-32) on the top of the actuator housing. Align the mounting taps, and secure with screws (#1-33).

STEP 9 (MX-10, -20 AND -40)

Install handwheel (#1-8) onto handwheel adapter assembly (#12), align the handwheel with screw holes and tighten the four socket head cap screws (#1-11).

or

Install side-mounted handwheel (subassembly #13) according to remounting instructions detailed in Section 4.4.3.



4.15 Clutch and Clutch Ring Components (MX-20, -40, -85, -140, and -150)

Table 4.23 – Clutch and Clutch Ring Components Parts List

Part Number	Description	Qty.
1-38	Clutch	1
1-37	Clutch ring	1
1-39	Clutch spring	1
1-40	Spring spacer	1

Figure 4.26 – MX-20 and -40 Clutch and Ring Components

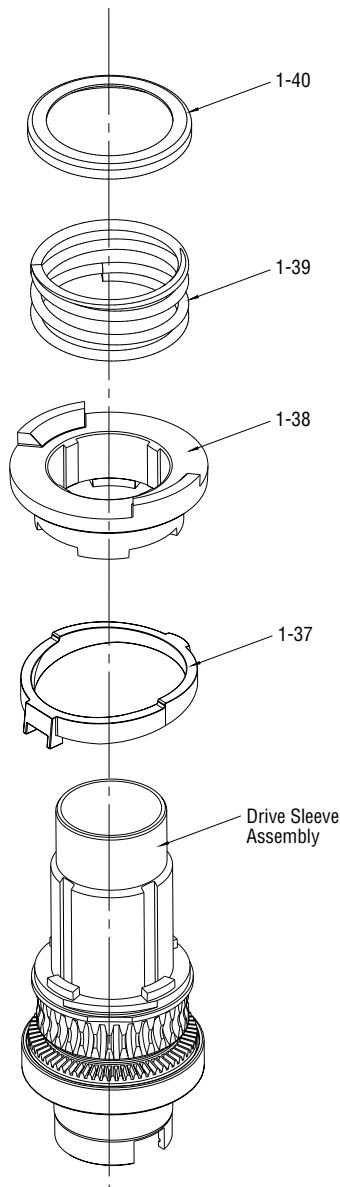
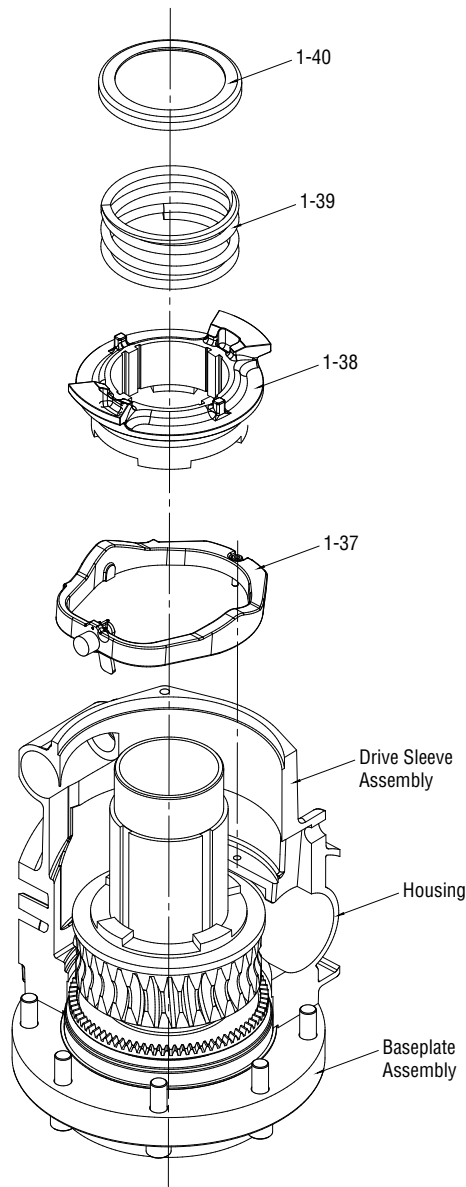


Figure 4.27 – MX-85, -140, and -150 Clutch and Ring Components



4.15.1 Removal

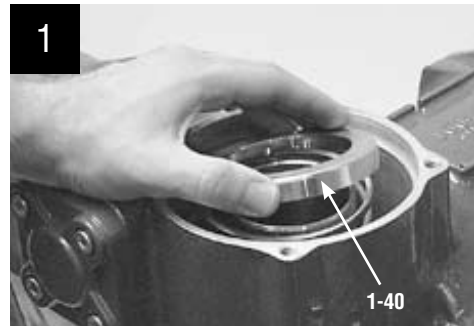
First Remove

1. Drain oil.
2. Remove top-mounted handwheel (#1-8) or side-mounted handwheel (subassembly #13). (See Section 4.3.1, Section 4.4.2, or Section 4.5.2.)
3. Remove handwheel adapter (subassembly #12). (See Section 4.14.1.)

STEP 1

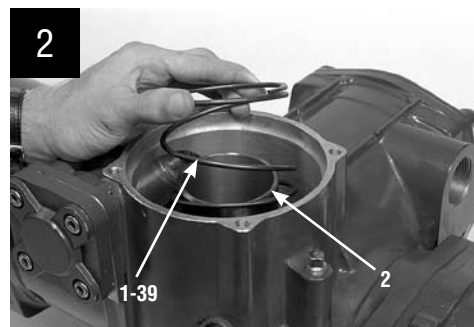
⚠ WARNING: Potential to operate while dangerous mechanical parts are exposed during subassembly removal. To prevent injury, turn off all power sources to actuator before removing clutch and clutch ring components. Power sources may include main power or control power.

Remove spring spacer (#1-40).



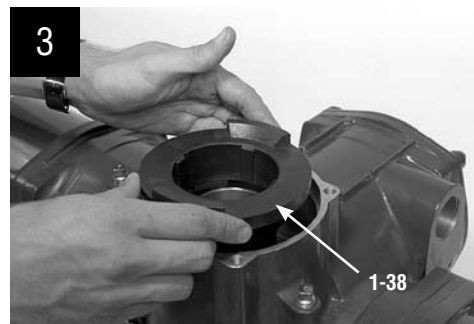
STEP 2

Remove clutch spring (#1-39) that is positioned over the drive sleeve assembly (#2).



STEP 3

Remove clutch (#1-38).



STEP 4

Remove clutch ring (#1-37).

MX-85, -140, and -150 (removing clutch ring assembly):

While pulling up on clutch ring end with socket head cap screw (#15-9), rotate latch 90° and slide clutch ring over drive sleeve and out of housing.



4.15.2 Remounting

⚠ WARNING: Potential to operate while dangerous mechanical parts are exposed during subassembly removal. To prevent injury, turn off all power sources to actuator before removing clutch and clutch ring components. Power sources may include main power or control power.

STEP 5A (MX-20 AND -40 ONLY)

Remounting clutch ring

Fit the clutch ring (#1-37) over the drive sleeve with the tangs (forked protrusion) facing down. Seat tangs over declutch cam (see pictures 5a and 5a1 at right). See warning note in Section 4.14.2, Step 8.

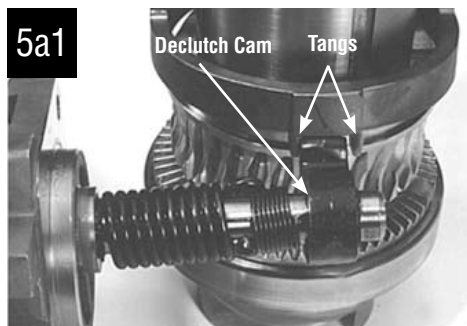
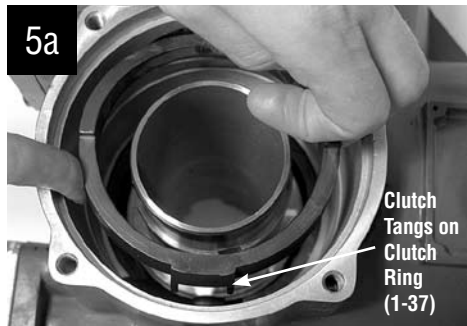
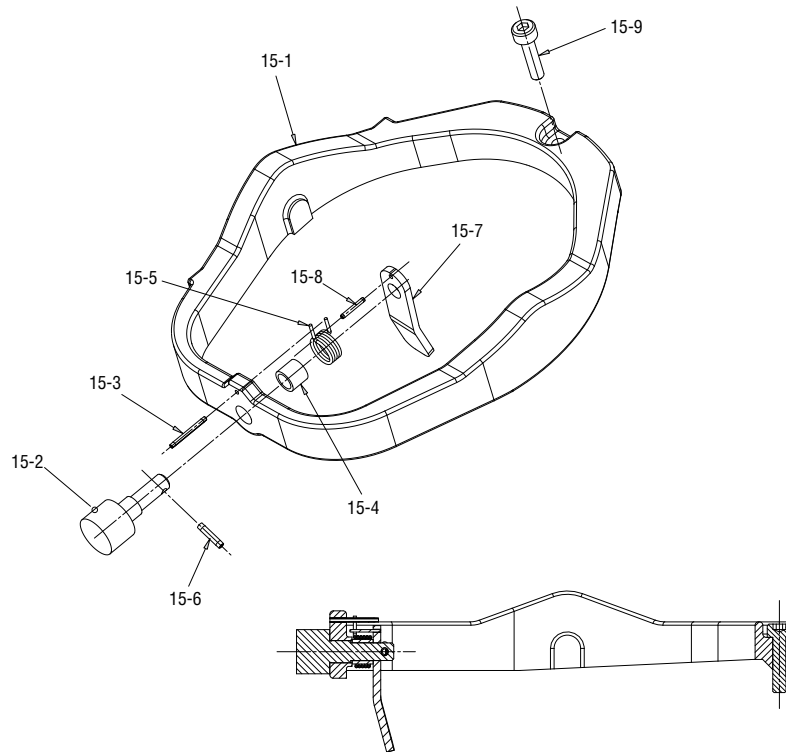


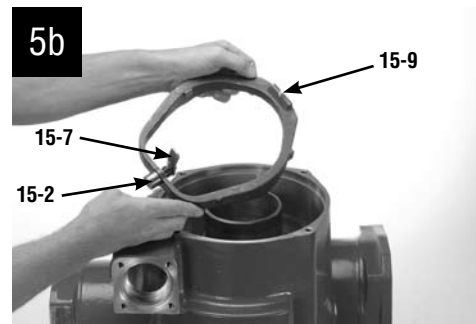
Table 4.24 – Clutch Ring Assembly Parts List

Part Number	Description	Qty.
15-1	Clutch ring	1
15-2	Roller	1
15-3	Roll pin	1
15-4	Spacer	1
15-5	Latch spring	1
15-6	Roll pin	1
15-7	Latch	1
15-8	Roll pin	1
15-9	Socket head cap screw	1

Figure 4.28 – MX-85, -140, and -150 Clutch Ring



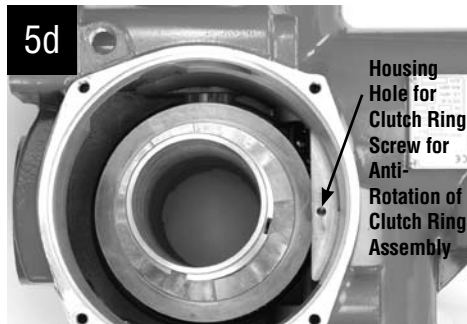
STEP 5B (MX-85, -140, AND -150 ONLY)



**STEP 5B, C, D (MX-85, -140, AND -150)
CONTINUED**

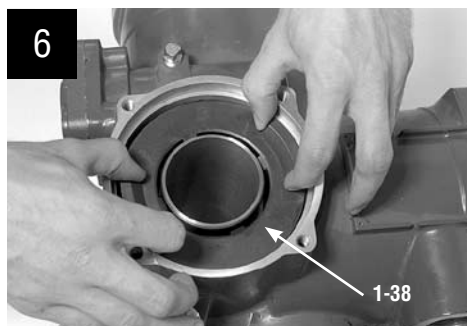
Fit the clutch ring (#1-37) over the drive sleeve. With the roller (#15-2) down and holding the latch (#15-7) 90° from free position. See picture 5c.

NOTE: The clutch ring socket head cap screw (#15-9) must fit into hole in housing to keep ring from rotating. See picture 5d. See warning Note in Section 4.14.2, Step 8.



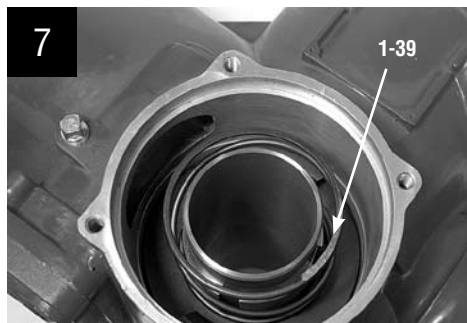
STEP 6

Slide clutch (#1-38) over drive sleeve assembly.



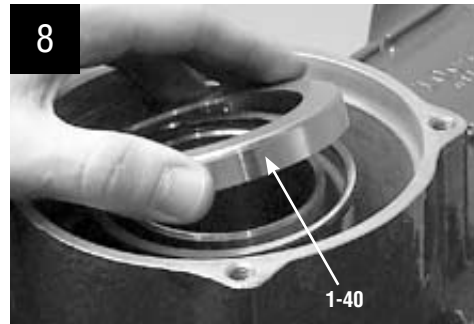
STEP 7

Slide spring (#1-39) over drive sleeve assembly.



STEP 8

Slide spring spacer (#1-40) over drive sleeve assembly.

**STEP 9**

Remount removed subassemblies according to their remounting instructions in the following order:

1. Handwheel adapter assembly (subassembly #12). See Section 4.14.2.
2. Top-mounted handwheel (#1-8) or side-mounted handwheel (subassembly #13). See Section 4.3.2 or Section 4.4.3 (MX-20), or Section 4.5.3 (MX-40).

5

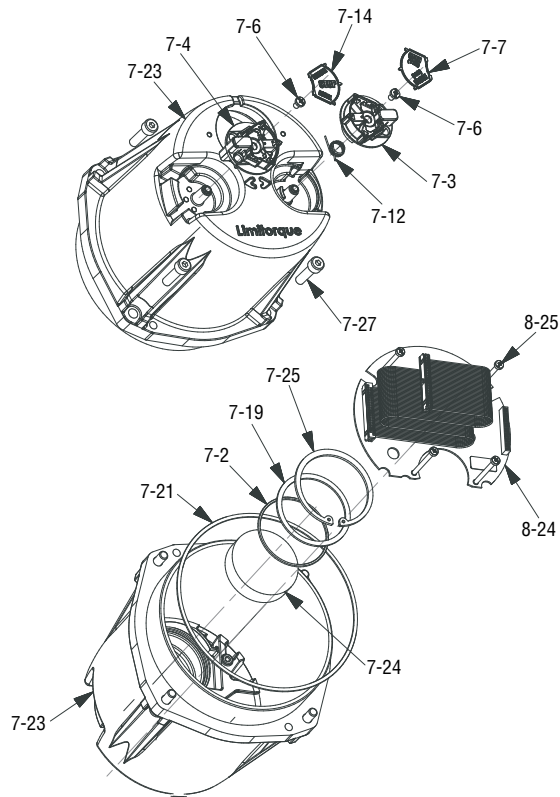
Electronic Assemblies

5.1 Control Panel (CP)

Table 5.1 – Control Panel Parts List

Part Number	Description	Qty.
7-2	O-ring	1
7-3	Black knob	1
7-4	Red knob	1
7-5	Brass pin (not shown)	2
7-6	Self-tapping screw	2
7-7	Black knob cap	1
7-9	Extension spring	1
7-10	Ball (not shown)	1
7-12	Torsion spring	1
7-14	Red knob cap	1
7-19	O-ring retainer	1
7-21	O-ring	1
7-23	Controls cover	1
7-24	Window	1
7-25	Snap ring	1
7-27	Socket head cap screw	4
8-24	PC board	1
8-25	Pan head machine screw (M4x6)	4

Figure 5.1 – Control Panel

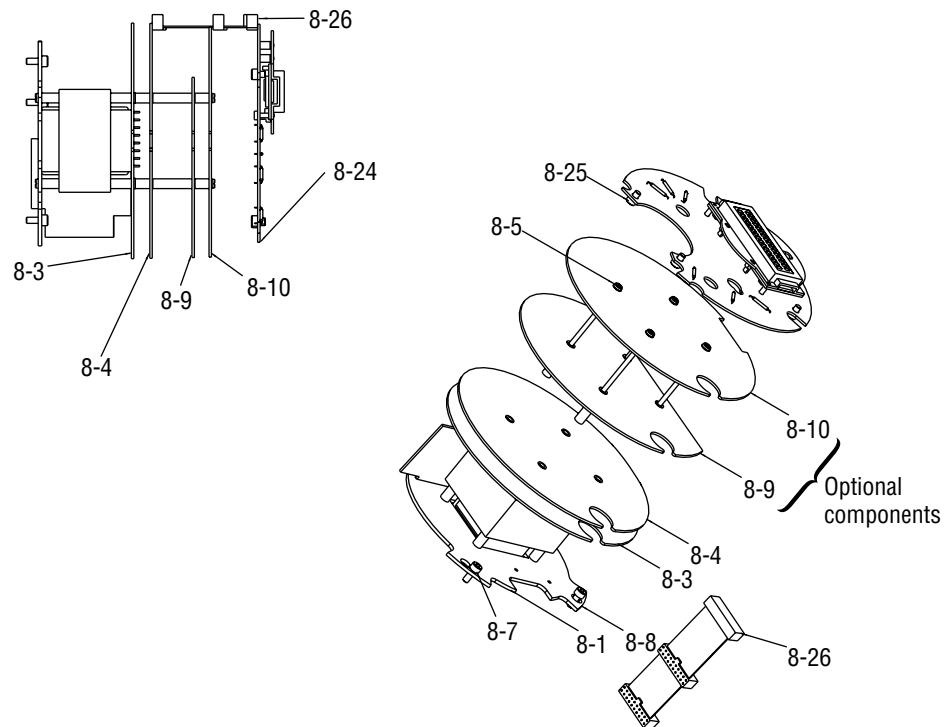


5.2 Control Module (Units Supplied Before September 2003)

Table 5.2 – Control Module Parts List

Part Number	Description	Qty.
8-1	Controls chassis plate	1
8-3	Power board	1
8-4	Main processor board	1
8-5	Phillips pan head mach	4
8-7	Socket head cap screw (M4x10)	3
8-8	Chassis assembly	1
8-9	DDC board (network board) - optional	1
8-10	PC board, (I/O board) - optional	1
8-24	PC board, local control station	1
8-25	Socket head cap screw (M4x6)	4
8-26	Ribbon cable assembly	1

Figure 5.2 – Control Module



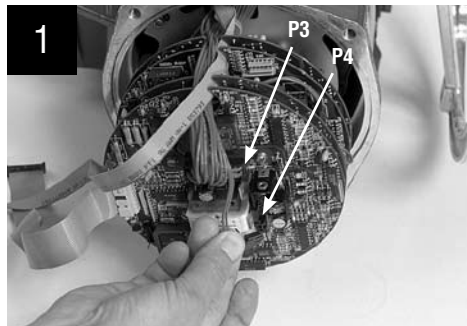
5.2.1 Removal

STEP 1

⚠ WARNING: Hazardous Voltage! Turn off all power sources to actuator before removing control module assembly. Power sources may include main power or control power.

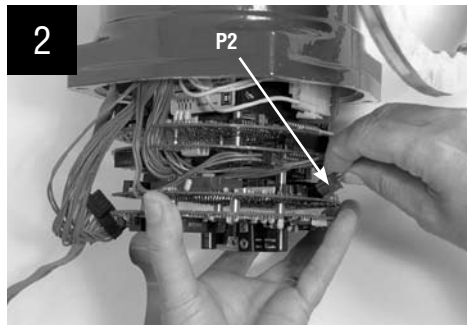
⚠ CAUTION: Potential to cause electrostatic damage to electronic components. Before handling electronic components, ensure that you are discharged of static electricity by briefly touching a grounded metal object.

If the I/O option board is installed, disconnect wire harness plug P3 and P4.



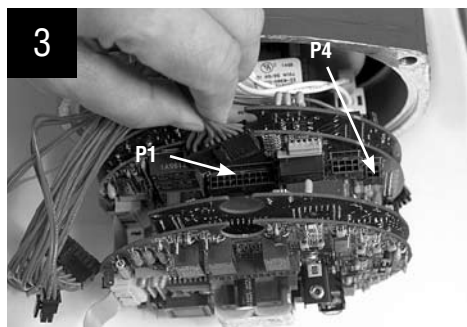
STEP 2

If DDC board is installed, disconnect wire harness plug P2.



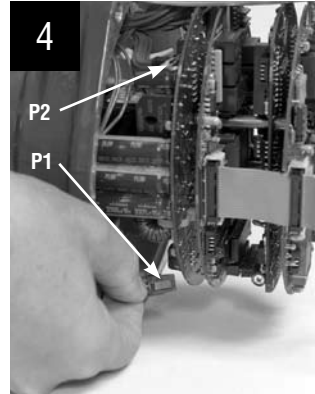
STEP 3

Disconnect wire harness plug P1 and P4 from the main processor board.

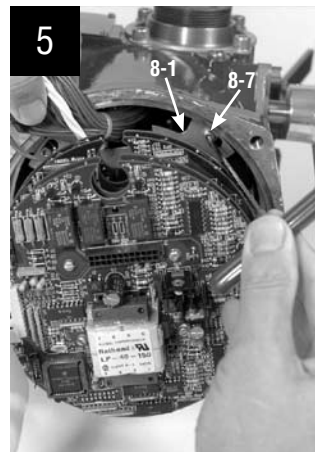


STEP 4

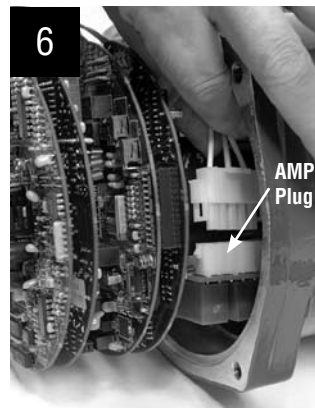
Disconnect wire harness plugs P1 and P2 from the main power board.

**STEP 5**

Using a 3 mm hex key, loosen the three M4 mounting plate screws (#8-7) located at the back of the controls compartment. Slightly rotate the complete control module assembly in a counterclockwise (CCW) direction, until the keyhole slots in the baseplate (#8-1) allow the heads of the screws to pass through.

**STEP 6**

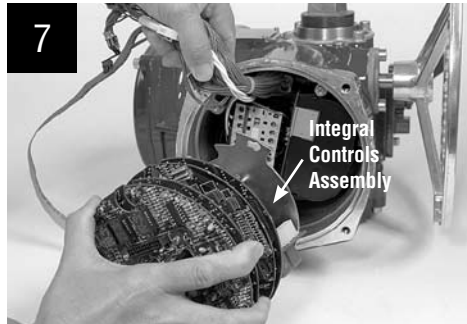
Disconnect the AMP® power connector from the fuse section of the main power board.



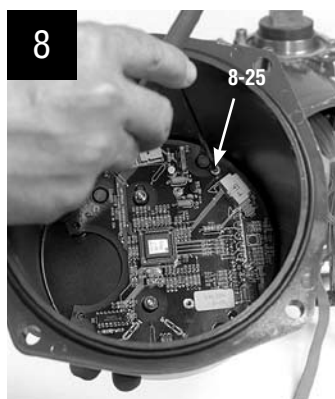
STEP 7

Remove the control module assembly from actuator housing (leave 20-pin ribbon cable connected to control module boards). Take control module assembly to work area to perform maintenance as required.

If control module assembly return is required for repair/replacement, remove the CP board from inside the CP cover as follows:

**STEP 8**

Using a 3 mm hex key, remove the four M4 screws (#8-25) that retain the CP board inside the CP cover.

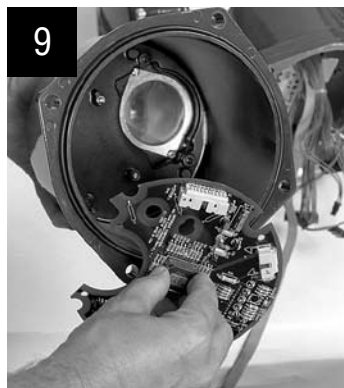
**STEP 9**

Lift the CP board out of the CP cover.

(See Section 5.2.3 for fuse replacement.)

(See Section 5.2.4 for control module return options.)

(See Section 5.2.5 for EPROM care and replacement.)



5.2.2 Remounting

If the standard board set was separated from the DDC and/or I/O option boards, reassemble boards back together as a complete unit before remounting the control module back into the actuator.

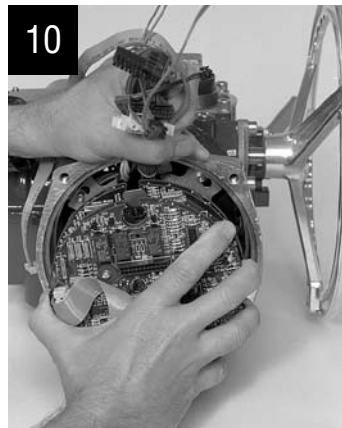
STEP 10

⚠ WARNING: Hazardous Voltage! Turn off all power sources to actuator before remounting ACP assembly. Power sources may include main power or control power.

⚠ CAUTION: Ensure the voltage jumper on power board (see Figure 5.3) is located in the proper slot for the nameplate and motor voltage!

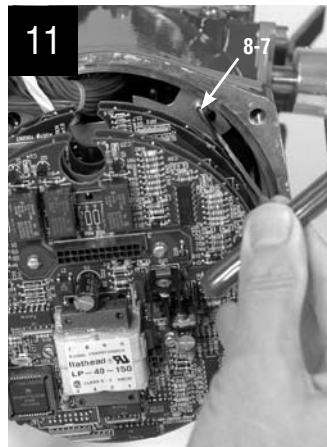
⚠ CAUTION: Potential to cause electrostatic damage to electronic components. Before handling electronic components, ensure that you are discharged of static electricity by briefly touching a grounded metal object.

Position the control module subassembly over the three mounting screw heads (#8-7). Rotate the subassembly in clockwise (CW) direction until all three screws are seated in the keyhole slots. (The keyhole slots in the mounting plate [#8-1] are spaced in such a way that the control module assembly will mount in only one position).



STEP 11

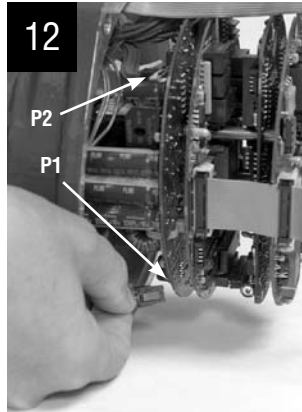
Tighten the three screws (#8-7) with a 3 mm hex key.



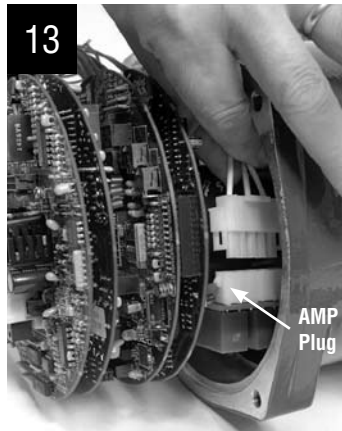
STEP 12

NOTE: Ensure wiring harness bundle routes through the semicircular slots on the printed circuit boards.

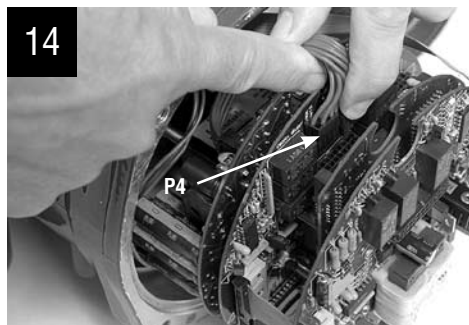
Connect the 6-pin Molex® wire harness to plug P1 and 14-pin Molex® harness to plug P2 on main power board.

**STEP 13**

Connect the AMP® power connector to the fuse section on the main power board.

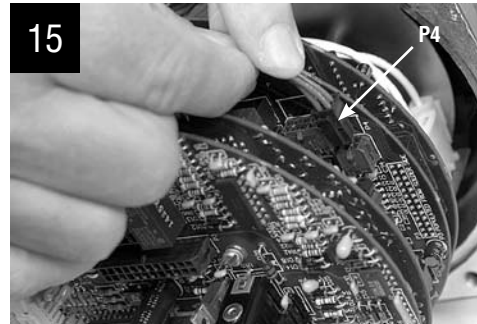
**STEP 14**

Connect the 20-pin Molex® harness to plug P1 on the main processor board.

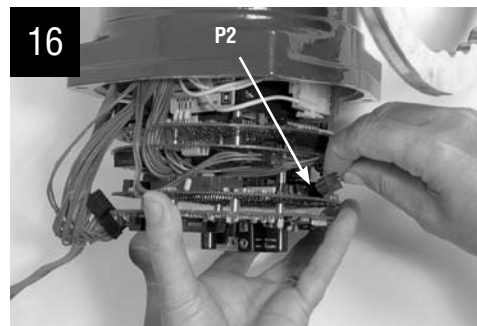


STEP 15

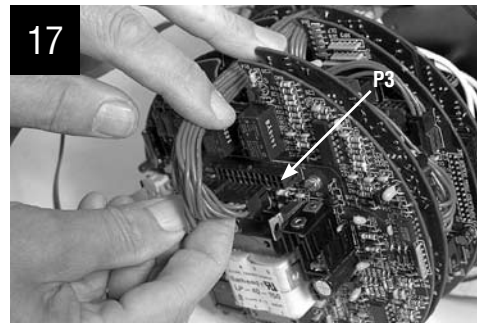
Connect the 4-pin Molex® harness to plug P4 on the main processor board.

**STEP 16**

If DDC board is installed, connect 10-pin Molex® harness to plug P2 on DDC board (network processor board).

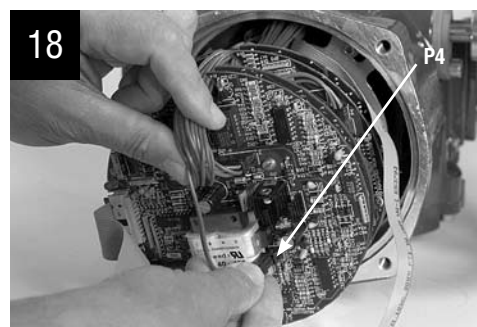
**STEP 17**

If I/O option board is installed, connect 24-pin Molex® harness to plug P3 ...

**STEP 18**

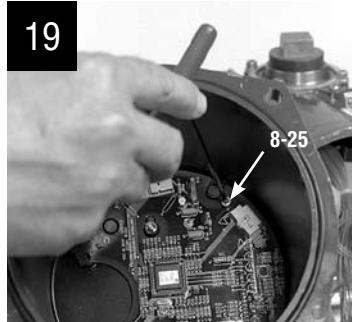
... and connect 2-pin Molex® harness to plug P4 on I/O option board.

If control module assembly return was required for repair/replacement, remount the CP board back inside the CP cover as follows:



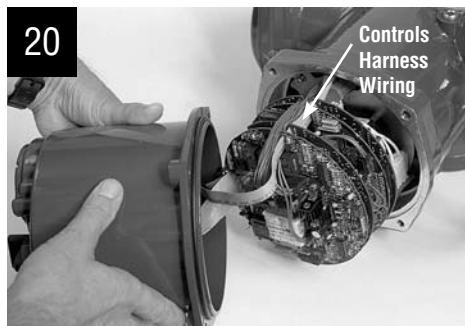
STEP 19

Using a 3 mm hex key, install the four M4 screws (#8-25) to retain the CP board inside the CP cover.



STEP 20

Ensure control harness wiring bundle is routed through the control module mounting plate notch and along electronic board semicircular slot. This will help prevent pinching the wiring when the CP cover is installed.



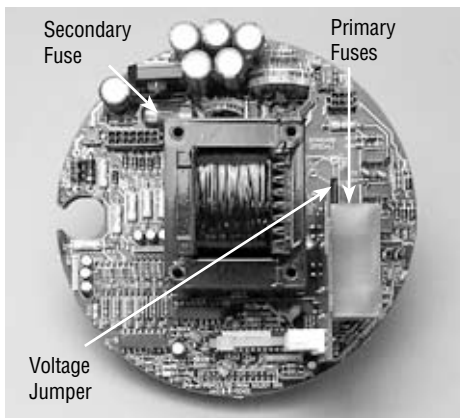
STEP 21

Reference CP (subassembly #7) to reconnect plugs and install the CP cover.

5.2.3 Fuse Replacement

NOTE: If fuses need to be replaced, they can be found on the power board (#8-3). There are two primary fuses (1 A, 600 V) on the part of the power board that is perpendicular to the main processor board. There is also one secondary fuse (0.1 A, 250 V) on the part of the power board that is parallel to the main processor board. Remove plastic covers to replace the fuses. Removal of the steel chassis assembly (#8-8) may be necessary to access the secondary fuse. The view to the right shows the control module with the chassis assembly removed.

Figure 5.3 – Location of Fuses and Voltage Jumper



5.2.4 Control Module Return Options

Please contact factory for return options.

5.2.5 EPROM Care and Replacement

There are four EPROMs in the through hole fabricated MX Control Module. These are located on the LCS board, on the main processor board, on the Power Board, and on the DDC option board. Under normal circumstances, these EPROMs should not require replacement. Kits including the EPROMs for the DDC, Main, and LCD board are available for unit upgrades.

NOTE: DDC firmware and Mainboard firmware must be the same revision level.

The location of the LCS EPROM is shown in Figure 5.4.

Figure 5.4 – LCS Board

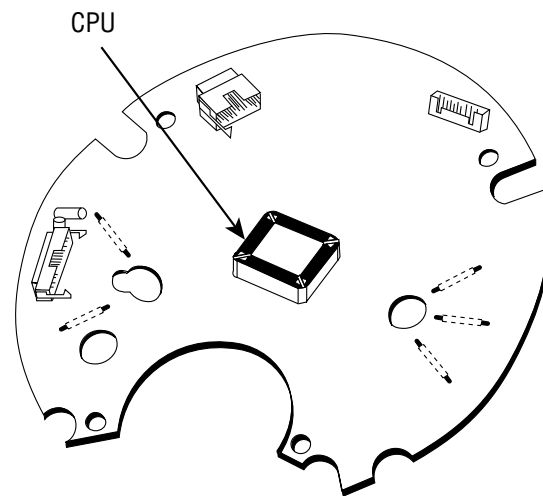
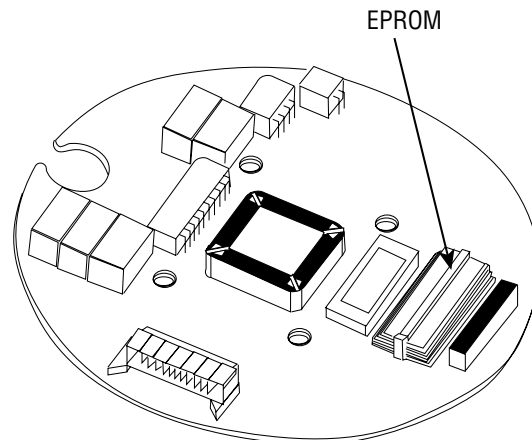


Figure 5.5 shows the location of the Main CPU Board EPROMs.

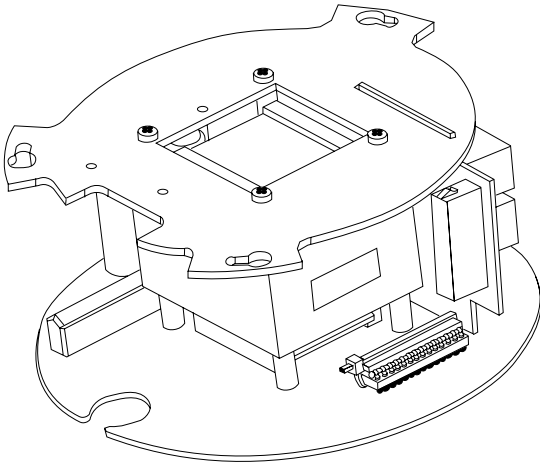
Figure 5.5 – Main CPU Board



NOTE: Remove and replace tie wrap.

Figure 5.6 shows the location of the EPROM on the Power Board.

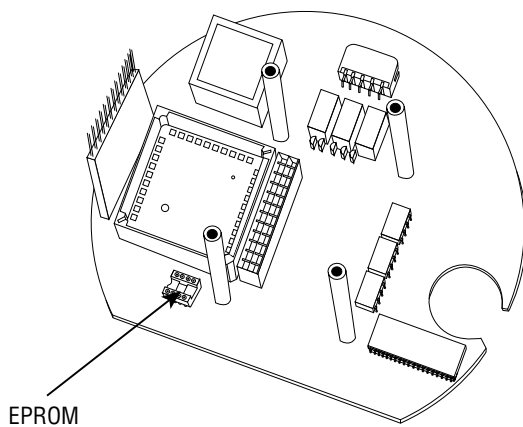
Figure 5.6 – Power Board



NOTE: Power board EPROM is not included in replacement kit. This EPROM should not be replaced in the field.

Figure 5.7 shows the location of the DDC EPROM on the DDC Option Board.

Figure 5.7 – DDC Board



5.2.5.1 EPROM Storage and Handling

MX through hole control modules contain EPROMs that are fragile and static-sensitive integrated circuits. Care should be taken in the storage and handling of the EPROMs.

Do not ship or store EPROMs near strong electrostatic, electromagnetic, magnetic or radioactive fields.

Do not remove labels from EPROMs.

Store EPROMs in static-free containers with care to prevent breakage from shock or damage to pins.

Always use an ESD (ElectroStatic Discharge) wristwrap and proper grounding techniques when removing or installing EPROMs. Flowserve Limitorque provides a kit which contains an ESD wristwrap with proper grounding instructions; P/N 102424. Please contact Flowserve Limitorque service at (434) 528-4400 for purchase.

5.2.5.2 EPROM Removal

It is recommended that an IC (Integrated Circuit) insertion/extraction tool be used to remove EPROMs from the socket. Flowserve Limitorque provides a kit which contains an EPROM removal tool; P/N 102424.

5.2.5.3 EPROM Installation

It is recommended that an IC insertion/extraction tool be used to hold the EPROM for installation. Flowserve Limitorque provides a kit which contains an EPROM removal tool; P/N 102424. To insert a replacement EPROM, use the following procedure:

The notch at one end of the EPROM must be lined up with the notch at one end of the socket. If the EPROM notch is not matched to the socket notch, the EPROM will be damaged when the unit is powered. Gently place the pins of one side of the EPROM into the socket holes in the correct side of the socket.

Roll the EPROM over until the pins on the other side are each lined up with the socket holes. You may have to use slight pressure to line up the pins. When you are sure all pins are in line with the socket holes, firmly push down on top of the EPROM until the pins are well seated in the socket.

NOTE: A problem that can frequently occur when inserting ICs into sockets is if one or more pins are misaligned, missing the intended socket hole. In this case, the affected pins do not make contact. The problem is difficult to see because the pins can appear to be in the socket hole. After installing the EPROM or other IC, always examine both rows of pins very carefully to ensure that the pins are aligned correctly with the IC.

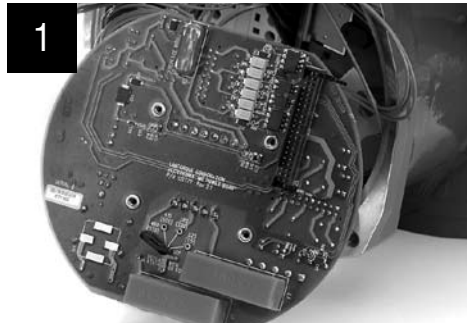
5.3 Installation and Removal of SMT Controls (most units supplied after September 2003 and before September 2007)

5.3.1 Installation

STEP 1

▲ CAUTION: Ensure the voltage jumper on power board is located in the proper slot for the nameplate and motor voltage! Follow the template provided on the Mylar protection barrier for proper voltage jumper location.

▲ CAUTION: Potential to cause electrostatic damage to electronic components. Before handling electronic components, ensure that you are discharged of static electricity by briefly touching a grounded metal object. Flowserve recommends the use of a wrist strap grounded to an appropriate ground.



STEP 2

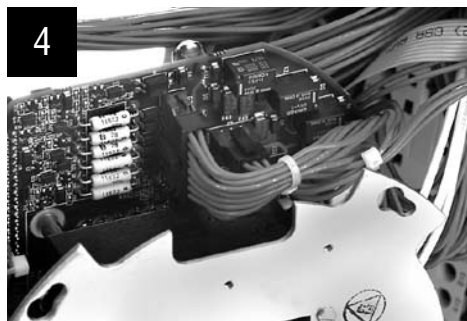
Attach the SMT terminal block conversion wiring harness (P/N 64-825-0010-4) to the existing through hole wiring harness. Connect each through hole Molex connector to its corresponding SMT Molex connector.

STEP 3

Install a tie wrap on the mated 20-pin Molex connector pair so that they cannot be separated.

STEP 4

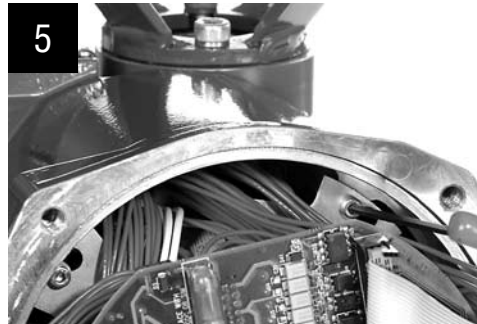
Connect the 6-pin Molex wire harness to plug P2 and 16-pin Molex harness to plug P3, and the 20-pin Molex wire harness to plug P4 on power board.



STEP 5

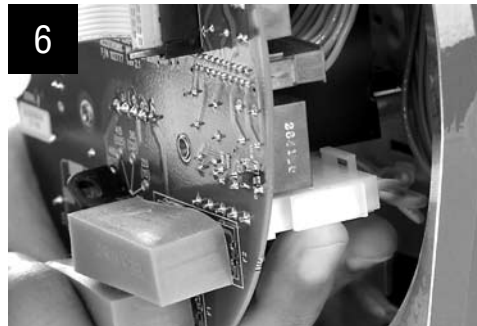
Position the power assembly over the three mounting screw heads (#1-45). Rotate the subassembly in the clockwise (CW) direction until all three screws are seated in the key slots. (The keyhole slots in the mounting plate (#8-1) are spaced in such a way that the control module assembly will mount in only one position).

Tighten the three screws (#1-45) with a 3 mm hex key.



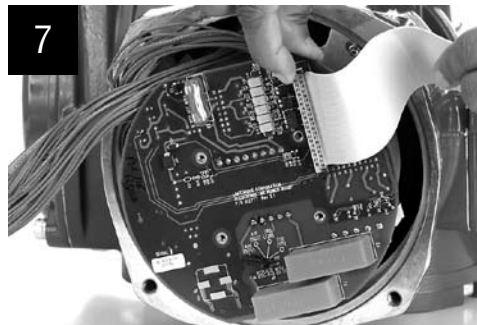
STEP 6

Connect the AMP power connector to the fuse section on the power board (P1).



STEP 7

Connect the 10-pin encoder ribbon cable to plug P3 on the Main/LCS processor board. Align the polarization plug with the slot in the center of connector J1.

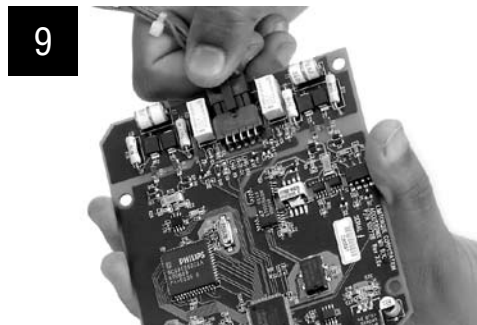


STEP 8

Connect the 4-pin Molex harness to plug P4 on the Main/LCS processor board.

STEP 9

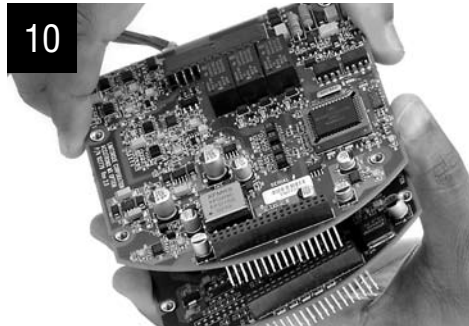
If DDC, FOUNDATION Fieldbus H1 or PROFIBUS DP/PA board is installed, stack the network board onto the Main/LCS board (or I/O option board) assuring proper mating of the board-to-board connector P1. Connect 10-pin Molex harness to plug P2 on these boards (network processor board).



STEP 10

If I/O option board is installed, stack the I/O option board onto the Main/LCS board assuring proper mating of the board-to-board connector P2. Connect 24-pin Molex harness to plug P1 on I/O option board.

NOTE: If network or I/O option boards are installed, they may be stacked on the Main/LCS board in any order.



STEP 11

Before mounting the LCS/Main processor board into the Control Panel (CP), replace the knobs per instructions #102254 (supplied with the knob conversion kit).

NOTE: Applies only to version 1 of CP (V1 = triangle-shaped knobs)

Mount the LCS/Main processor board inside the CP cover as follows:

STEP 12

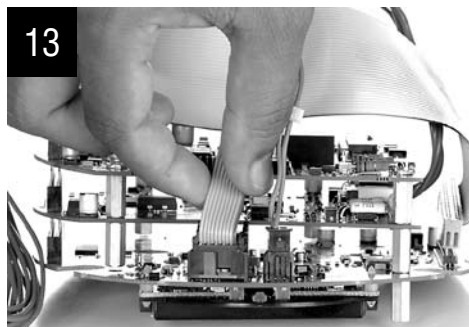
Using a screwdriver, install the four M4 screws (#7-44) to retain the LCS/Main board inside the CP cover. Select the screws based upon the number of option boards in the actuator; M4 X 6 mm for standard set, M4 X 25 mm for one option board, and M4 X 45 mm for two option boards.

Ensure the O-ring (#7-21) is intact on the CP spigot/pilot. Hold the CP in front of the control module assembly and connect the 40-pin ribbon connector plug to connector J1 on the power board. This ribbon cable is to always remain connected to the LCS/Main board. Align the polarization tab of the ribbon connector with the slot in J1.

STEP 13

▲ CAUTION: Potential to pinch cables. When remounting CP cover, take special care not to pinch the ribbon cables.

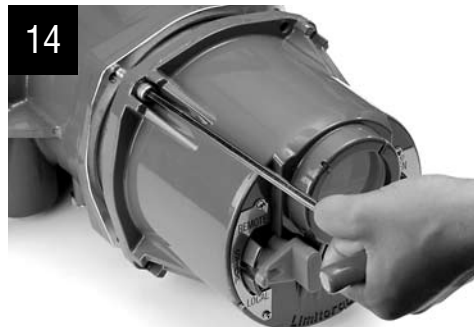
Dress the cables as shown, being careful to position wires so that they pass perpendicularly over the housing flange.



STEP 14

NOTE: The face of the CP may be installed in any one of four 90° incremental positions. When changing CP position, avoid over-twisting the ribbon cable.

Rotate the CP until the display orientation of the front face is correct for normal viewing, and then slide the CP assembly into the actuator housing.



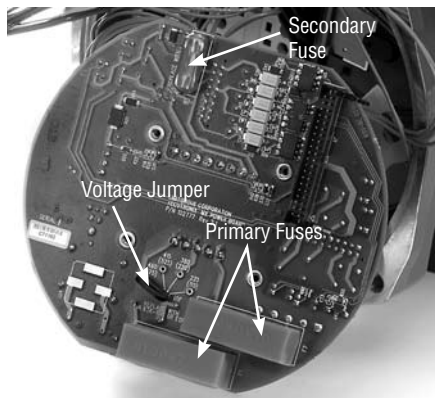
5.3.2 Removal

For removal, follow installation instructions in reverse.

5.3.3 Fuse Replacement

The view below shows the control module with the chassis assembly removed.

Figure 5.8 – Location of Fuses and Voltage Jumper



Primary Fuse

Remove plastic covers, fuse, and replace with 1 A, 600 V fuse.

Secondary Fuse

Remove plastic cover, fuse, and replace with a 0.1 A, 250 V fuse.

Voltage jumper selection

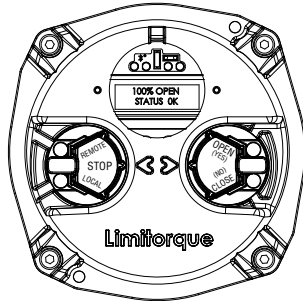
Remove and replace in proper slots according to nameplate voltage.

5.3.4 Control Module Return Options

Please contact factory for return instructions.

5.4 Mounting of SMT Controls with 54-point terminal block and four LED configuration (some units supplied from December 2006 with majority after September 2007)

Figure 5.9 – SMT Controls with four LEDs



5.4.1 Installation

STEP 1

▲ CAUTION: Ensure the voltage jumper on power board (see Figure 5.3) is located in the proper slot for the nameplate and motor voltage! Follow the template provided on the Mylar protection barrier for proper voltage jumper location.

Table 5.3 - Voltage Jumper Positions

Supply Power	Jumper Position		
	(106V/115V/200V/212V) Transformer	[226V/366V/392V/450V] Transformer	[212V/505V/530V/572V] Transformer
110Vac 50/60Hz	(106)	n/a	n/a
115Vac 60Hz	(115)	n/a	n/a
120Vac 60Hz	(115)	n/a	n/a
208Vac 60Hz	(200)	n/a	n/a
220Vac 60Hz	n/a	(226)	n/a
230Vac 50/60Hz	n/a	[226]	n/a
240Vac 60Hz	n/a	[226]	n/a
380Vac 50/60Hz	n/a	[366]	n/a
400Vac 50Hz	n/a	[392]	n/a
415Vac 50Hz	n/a	[392]	n/a
440Vac 50/60Hz	n/a	[450]	n/a
460Vac 60Hz	n/a	[450]	n/a
480Vac 60Hz	n/a	[450]	n/a
525Vac 50/60Hz	n/a	n/a	[505]
550Vac 60Hz	n/a	n/a	[530]
575Vac 60Hz	n/a	n/a	[572]
600Vac 60Hz	n/a	n/a	[572]

NOTE: Brackets indicate setting for transformer in use. See marking on Power Assembly's shield to determine the installed transformer and use the primary taps voltage in the corresponding brackets to determine jumper position. "()" indicates primary voltages for the (106V/115V/200V/212V) transformer, "[|]" for the [226V/366V/392V/450V] transformer, and "[]" for the [212V/505V/530V/572V].

▲ CAUTION: Potential to cause electrostatic damage to electronic components. Before handling electronic components, ensure that you are discharged of static electricity by briefly touching a grounded metal object. Flowserve recommends the use of a wrist strap grounded to an appropriate ground.

STEP 2 – LCS/MAIN BOARD

Assemble the LCS/Main board into the actuator control cover using four (4) M4x8 screws.

STEP 3

Connect the yellow 12-pin wire cable harness from the 54-point terminal block to the J5 header.

STEP 4

Connect the two-wire blue cable harness from the 54-point terminal block to header J3.

STEP 5

Connect the grey keyed ribbon cable harness from the 54-point terminal block to header J4.

STEP 6

Connect the blue keyed 18-pin/wire cable harness from the 54-point terminal block to header J8.

STEP 7 – POWER BOARD

Install the three (3) standoffs (#1-55) into the housing mounting.

STEP 8

Install the power board complete with the electromechanical starter using the M4 power board mounting screws. Position power assembly over the three mounting screw heads (#1-45). Rotate the subassembly in clockwise (CW) direction until all three screws are seated in the key slots.

NOTE: The keyhole slots in the mounting plate (#8-1) are spaced in such a way that the control module assembly will mount in only one position.

Tighten the three screws (#1-45) with a 3 mm hex key.

STEP 9

Plug the 3-pin Molex harness (L1-L3) to plug into motor reverser. Plug the two (2) two-wire and thermistor cable (T1-3) to the motor leads.

5.4.2 Removal

For removal, follow installation instructions in reverse.

5.5 Mounting of Standard and Optional Controls with 54-point terminal block and four LED configuration

5.5.1 Installation

NOTES: RESTRICTIONS ON OPTION BOARD COMBINATIONS: Only one of the following can be on any unit: Modbus - DDC, Profibus PA, Profibus DP, FOUNDATION Fieldbus, DeviceNet.

A shield must be installed on the last board fitting between the last option board and the power board. See Figure 5.10 for illustration.

A maximum of four option boards can be used per unit, barring other restrictions. A four option board stack requires four (4) M4x70 pan head screws.

A maximum of three option boards can be used with SSMR due to size constraints. A three option board stack requires (4) M4x55 pan head screws.

A maximum of two option boards can be used with the 19 amp contactor, due to size constraints. A two option board stack requires (4) M4x40 pan head screws.

A single option board stack requires four (4) M4x25 pan head screws.

STEP 1 – STANDARD 2A, (4) “OS” CONTACTS (LCS/MAIN BOARD)

Connect to the control cover using (4) M4x8 pan head screws.

From the terminal block, connect 12-pin plug (Cable J1) to socket J5 on the main board.

STEP 2 – OPTION “OA”, 4-5A “R” CONTACTS AND (1) 5A MR (MONITOR RELAY); DIGITAL OUTPUT BOARD CONNECTION

Connect to the control cover using four (4) M4x25 pan head screws.

Ensure that jumper on the DO board is located in the 1-2 position. Connect 12-to-22 pin adapter to Cable J1 (12-pin plug). Connect to the 22-pin socket J3 on DigOut board

NOTES: This will disable the digital relays on the main board. A keycode must be entered to restore them. Please contact factory at 434-528-4400 for the keycode.

A shield is required to be installed between the digital output board and any adjacent boards.

STEP 3 - OPTION “OB”, 4-5A “R” CONTACTS AND (1) 2A MR (MONITOR RELAY); DIGITAL OUTPUT BOARD CONNECTION AND 2 – 2A “S” CONTACTS

Connect to the control cover using four (4) M4x25 pan head screws.

Ensure that the jumper is located in the 3-4 position. Connect Cable J1 (12-pin) to socket J5 (12-pin) on the main board. Connect cable J5 (22-pin) to socket J3 on DigOut board.

STEP 4 - OPTION “OC”, 8-5A “R” CONTACTS AND (1) 5A MR (MONITOR RELAY); 2 DIGITAL OUTPUT BOARDS CONNECTION

Connect to the control cover using four (4) M4x40 pan head screws.

Ensure that the jumper on DigOut board 1 is in the 1-2 position and the jumper on DigOut board 2 is in the 3-4 position. Connect the 12-22 pin adapter to Cable J1 (12-pin), then connect it to socket J3 (22-pin) of board 1. Connect cable J5 to socket J3 of board 2.

STEP 5 – ANALOG OPTION BOARD CONNECTION

Connect to the control cover using four (4) M4x25 pan head screws if one analog board is installed. Connect to the control cover using four (4) M4x40 pan head screws if two analog boards are installed.

Ensure that jumpers 1 and 2 are in the same position. If there is only one board, both should be in the 1-2 position (Board 1). If there are two boards, the second board should have the jumpers in 2-3 position. Connect J8 (3-pin) cable to J3 of board 1. Connect J3 (4-pin) cable to J1 of board 2.

STEP 6 – MODBUS – DDC NETWORK BOARD CONNECTION

Connect to the control cover using four (4) M4x25 pan head screws if one DDC board is installed. Ensure that Jumpers 1 and 2 are both in the “A” position. Connect the J7 6-pin cable from the terminal block to socket J2.

STEP 7 – PROFIBUS-DP NETWORK BOARD CONNECTION

Connect to the control cover using four (4) M4x25 pan head screws if one Profibus-DP board is installed. Ensure that both jumpers are in the “A” position. Connect the J7 6-pin cable from the terminal block to socket J8.

STEP 8 – PROFIBUS-PA NETWORK BOARD CONNECTION

Connect to the control cover using four (4) M4x25 pan head screws if one Profibus-PA board is installed. Ensure that both jumpers are in the “A” position. Connect the J7 6-pin cable from the terminal block to socket J8.

STEP 9 – FOUNDATION FIELDBUS NETWORK BOARD CONNECTION

Connect to the control cover using four (4) M4x25 pan head screws if one FOUNDATION Fieldbus board is installed. Ensure that both jumpers are in the “A” position. Connect the J7 6-pin cable from the terminal block to socket J8.

STEP 10 - DEVICENET NETWORK BOARD CONNECTION

Connect to the control cover using four (4) M4x25 pan head screws if one DeviceNet board is installed. Ensure that both jumpers are in the “A” position. Connect the 6-pin cable from the terminal block to socket J8. Set aside yellow ground wire to be fastened to top of option board stack per Figure 5.10. Above the shield, the wire must make contact with the screw.

STEP 11 – ALIGNMENT OF OPTION BOARDS INTO LCS/MAIN BOARD

Line up screw sockets and stack the boards so that J7 (option board pins and sockets) fits in with the main board or any boards that are installed previously. Place shield so sockets match up with cuts in shield. If DeviceNet board (61-825-0058-4) is used, position grounding wire on top of shield before fastening screws. Fasten four screws, then align in cover and install to main housing. Please refer to Table 5.4 for the connector numbers.

Table 5.4 - Control Board Connectors

Control Board	Connector Number
DeviceNet	X1
Foundation Fieldbus	X1
Profibus PA	X1
PBDP	X1
Digital Out	J2
Modbus/DDC	X1
Analog	J2

Figure 5.10 – Option Board Assembly

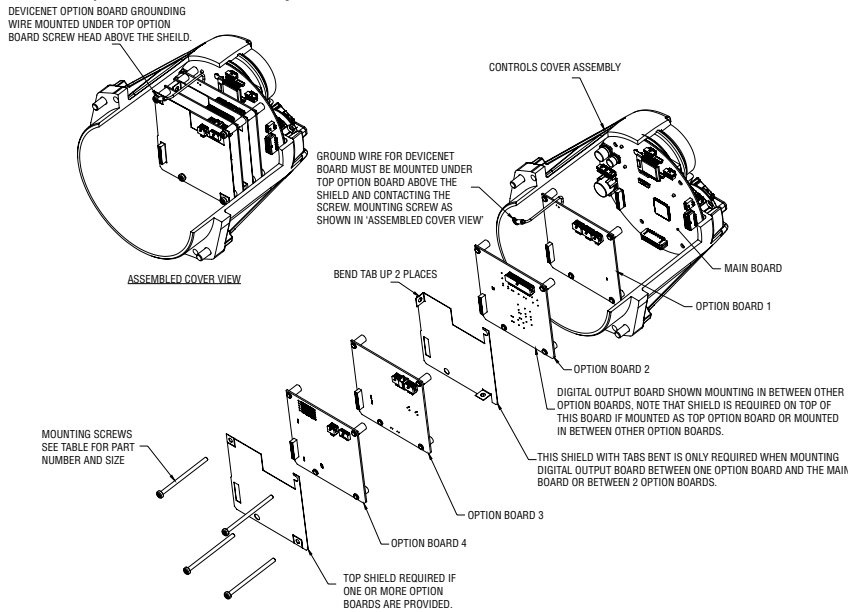


Table 5.5 - Screw Part Numbers

BOARD DESCRIPTION	SCREW PART NUMBER	DESCRIPTION	QTY.
MAIN WITH NO OPTION BOARDS	64-818-0001-35	M4X8	4
MAIN WITH 1 OPTION BOARD	64-818-0001-32	M4X25	4
MAIN WITH 2 OPTION BOARDS	64-818-0001-36	M4X40	4
MAIN WITH 3 OPTION BOARDS	64-818-0004-3	M4X55	4
MAIN WITH 4 OPTION BOARDS	64-818-0005-3	M4X70	4

▲ CAUTION: Potential to pinch cables. When remounting ACP cover, take special care not to pinch ribbon cables.

Dress the cables being careful to position wires so that they pass perpendicularly over the housing flange.

NOTE: The face of the ACP may be installed in any one of four 90° incremental positions. When changing ACP position, avoid over-twisting the ribbon cable(s).

Rotate the ACP until the display orientation of the front face is correct for normal viewing, and then slide the ACP assembly into the actuator housing.

5.5.2 Removal

For removal, follow installation instructions in reverse.

5.6 Adding Electronic Options to Your MX Actuator (Most Supplied After September 2007)

Listed below are the options available for the MX.

1. Modutronic option; does not require any hardware; however, a “keycode” from the factory is required.
2. Two-speed timer; does not require any hardware, however a “keycode” from the factory is required.
3. APT option; Analog Position Transmitter, non-contacting 4-20 mA position transmitter requiring the addition of an analog I/O (input/output) option board.
4. ATT option; Analog Torque Transmitter, non-contacting 4-20 mA torque transmitter requiring the addition of an analog I/O (input/output) option board.
5. R option; Alarm Relays, four latching relays requiring the addition of a digital output board. Latching relays do not change state when power is removed from the actuator, e.g. if the relay is CLOSED and power is removed, the relay will remain CLOSED.
6. DDC option; network communication field board that is required for two-wire twisted pair, MODBUS communication.
7. FF option; network communications board required for FOUNDATION Fieldbus communication.
8. PB options network communications board required for either Profibus DP or PA communication.
9. DeviceNet; network communication board required for DeviceNet communication.

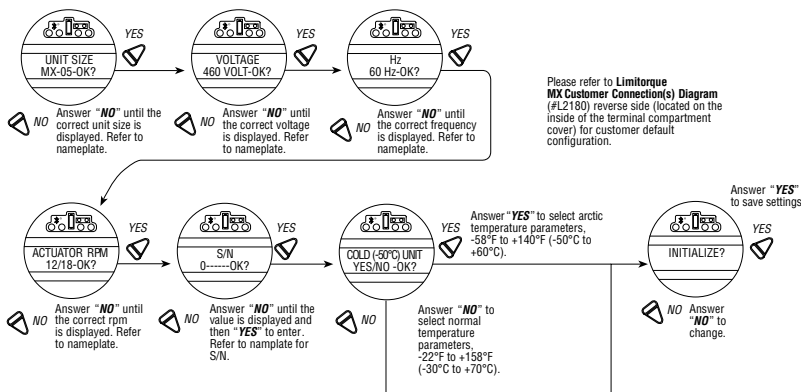
The procedure for adding electronic options to your MX actuator is as follows:

- For adding the Modutronic and two-speed timer options, the actuator QA Stamp ID must be supplied in order to acquire the necessary keycode.
- Each MX actuator is supplied a unique “QA Stamp ID”. This number is assigned during the end-of-line test sequence for each unit.
- This serial number is located on the second screen after the “Restricted Settings” screen. It is an eight-digit number after the letters “S/N”. Please refer to the IOM manual, LMENIM2306, supplied with your actuator for the Menu sequence. User must supply this number. Example: 12345678
- Also record the Order Number and Serial Number of the actuator. These numbers can be found on the unit nameplate.
- Once you have acquired the QA Stamp, O/N and S/N, please contact your assigned Service Coordinators for the keycodes required to turn on the desired options at (434) 528-4400.
- The “keycode” is then entered into the desired option menu found in “Restricted Settings” using the black knob on the ACP. A “NO” answer will change the value form 0-9 and A-E. A “YES” answer will truncate to the next space.

- After enabling the Modutronic option, if digital inputs are used for control, remote control may be set to user inputs.
- For adding the APT, ATT, and R options, the analog output board(s) and/or the digital output board(s) will be required. When these board(s) are installed into the actuator, it will already have the option(s) enabled. The unit will recognize the board and turn on the required software menu feature. Please refer to the IOM manual, LMENIM2306, supplied with your actuator for the Menu sequence. The user will need to enable the menu options. Please contact your assigned Service Coordinators for purchase of these desired options at (434) 528-4400.
- For adding the DDC, FF, DN or PROFIBUS option, the DDC, FF, DeviceNet or PB option board is required. When these boards are received and installed into the actuator, it will recognize the board and turn on the required software menu feature. Please refer to the IOM manual, LMENIM2306, supplied with your actuator for the Menu sequence. The user will need to enable the menu options. Please contact your assigned Service Coordinators for purchase of the network options at (434) 528-4400.

5.7 Restoring Power to Actuator with New Control Module

Figure 5.11 – Restoring Power to Actuator with New Control Module

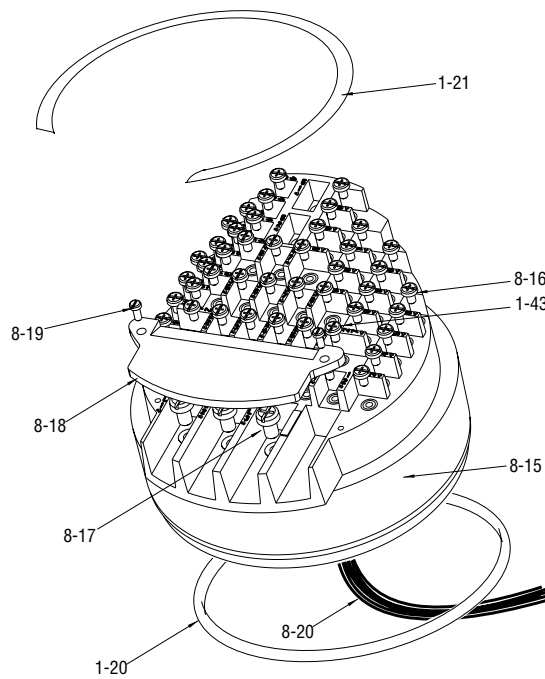


5.8 Terminal Block (prior to March 2007)

Table 5.5 – Terminal Block Parts List

Part Number	Description	Qty.
1-20	O-ring	1
1-21	Retaining ring	1
1-43	Pan head (M3x4) plastic screw	2
8-15	Terminal block	1
8-16	Self-lock combo head screw (M3x5)	48
8-17	Self-lock combo head screw (M5x8)	3
8-18	Cover plate	1
8-19	Pan head self-tapping screw	2
8-20	Control wiring harness	1

Figure 5.12 – Terminal Block



5.8.1 Removal

▲ CAUTION: Potential to cause electrostatic damage to electronic components. Before handling electronic components, ensure that you are discharged of static electricity by briefly touching a grounded metal object.

First Remove

1. Control panel (subassembly #7). (See Section 5.1.)
2. Control module (subassembly #8). (See Section 5.2.1.)

STEP 1

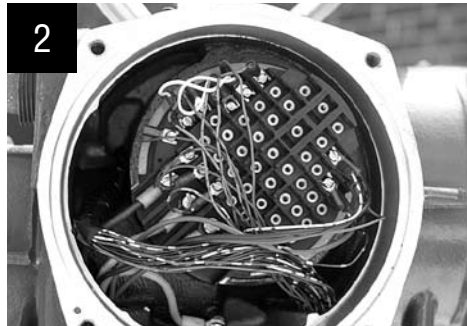
☠ WARNING: Hazardous Voltage! Turn off all power sources to actuator before removing terminal block assembly. Power sources may include main power or control power.

Using an M6 hex key, remove the four M8 screws (#8-14) that mount the terminal compartment cover to the actuator.



STEP 2

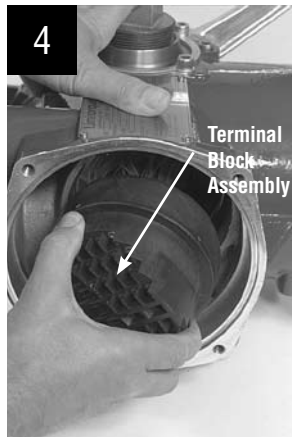
If actuator is already in service, disconnect incoming power leads L1, L2, and L3 (and control wiring from the terminal block if terminal block replacement is required).

**STEP 3**

Using a flat head screwdriver, insert the screwdriver blade underneath the edge of the snap ring (#1-21) and work the blade around the back of the snap ring to remove it from the groove, thus allowing terminal block removal.

**STEP 4**

Remove terminal block assembly.

**STEP 5**

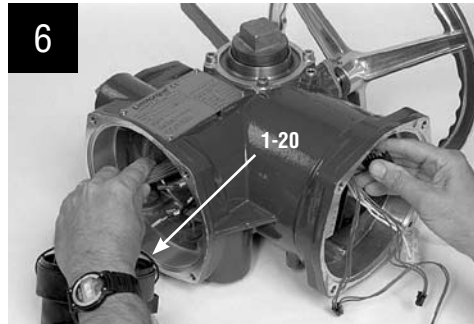
Disconnect leads L1, L2, and L3 from back of terminal block.



STEP 6

Feed the terminal block harness plugs over the contactor assembly (in the control module compartment) while removing the terminal block from the terminal block compartment.

NOTE: An O-ring (#1-20) is included with the terminal block assembly. Ensure you retain or replace the O-ring at remounting.

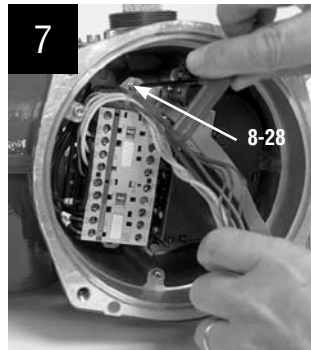


5.8.2 Remounting

STEP 7

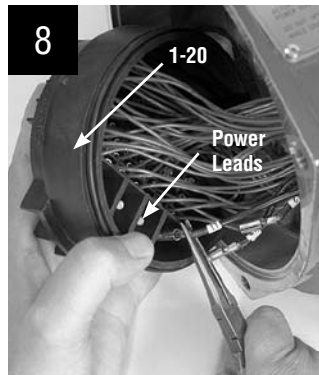
⚠ WARNING: Hazardous Voltage! Turn off all power sources to actuator before remounting terminal block assembly. Power sources may include main power or control power.

If necessary, to allow terminal block wiring bundle to pass across the end of the contactor and into the controls compartment, use a M3 hex key to loosen the two 4 mm contactor screws (#8-28). Pull contactor assembly off the screws and lower assembly to create extra space for the wire harness to pass over the contactor and into the controls compartment.



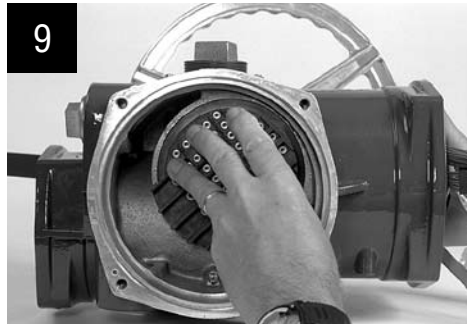
STEP 8

Plug power leads L1, L2, and L3 from contactor assembly into terminal connectors L1, L2, and L3 on back of terminal block. Verify that the O-ring (#1-20) is installed on back of terminal block. Lightly lubricate O-ring before installing the terminal block.



STEP 9

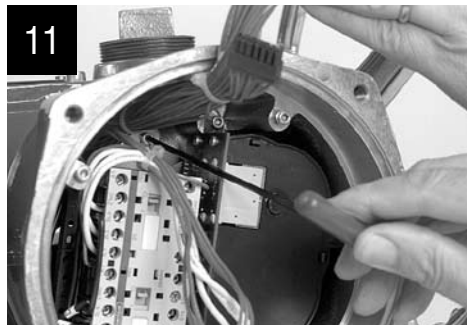
Insert the terminal block into the terminal block mounting cavity.

**STEP 10**

Insert the retaining ring (#1-21) into the retaining ring groove - snap the retaining ring into the groove by working a flat blade screwdriver around the edge of the retaining ring until it seats into the groove.

**STEP 11**

If the contactor assembly was loosened in Step 7, then remount the contactor on screws (#8-28). Retighten with M3 hex key.

**STEP 12 AND 13**

Connect the incoming power leads and the control wiring according to the application wiring diagram if the terminal block has been replaced.

Install the terminal compartment cover and secure with four M8 screws using a 6 mm hex key.

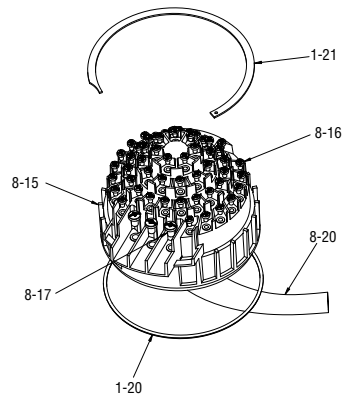


5.9 MX Terminal Block (Supplied With Most Actuators Since March 2007)

Table 5.7 – Terminal Block Parts List

Part Number	Description	Qty.
1-20	O-ring	1
1-21	Retaining ring	1
8-15	Terminal block	1
8-16	Self-lock combo head screw (M3x5)	52
8-17	Self-lock combo head screw (M5x8)	3
8-20	Control wiring harness	1

Figure 5.13 – Terminal Block



5.9.1 Terminal Block Shield Installation

STEP 1

Remove terminal block cover.

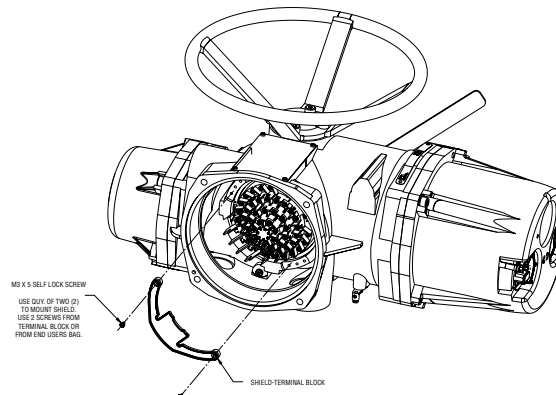
STEP 2

Use Qty of 2 screws from terminal block or from end users bag to attach shield.

STEP 3

Remount terminal block cover/

Figure 5.14 – Terminal Block Shield



5.10 Control Module-Contactor Assembly (Not required for most actuators shipped after September 2007. Please see Section 5.4 for power board installation with contactor.)

Table 5.8 – Control Module-Contactor Assembly Parts List

Part Number	Description	Qty.
8-27	Contactor bracket	1
8-28	Socket head cap screw (M4x8)	1
8-29	Contactor assembly	1

Figure 5.15 – Control Module - Contactor Assembly and Wiring Diagrams

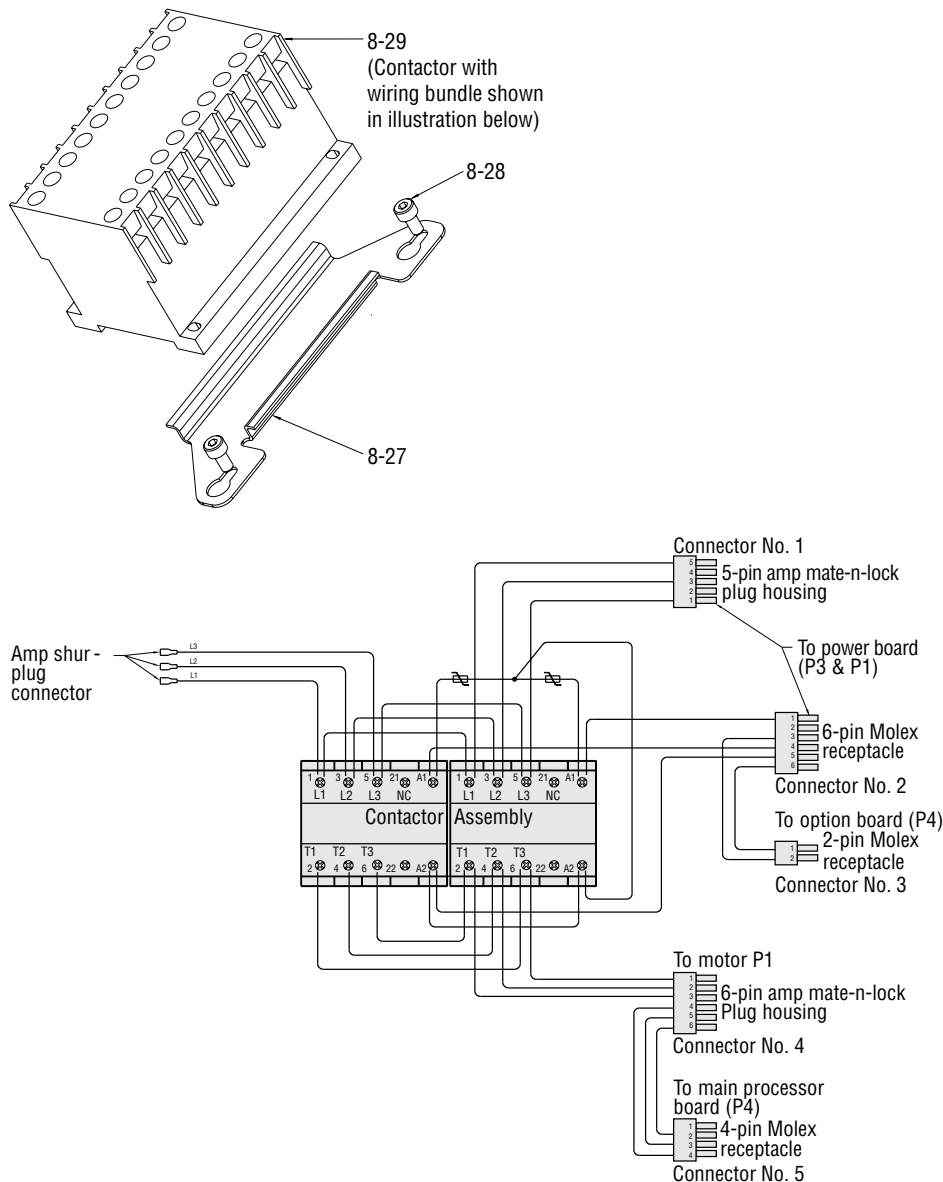
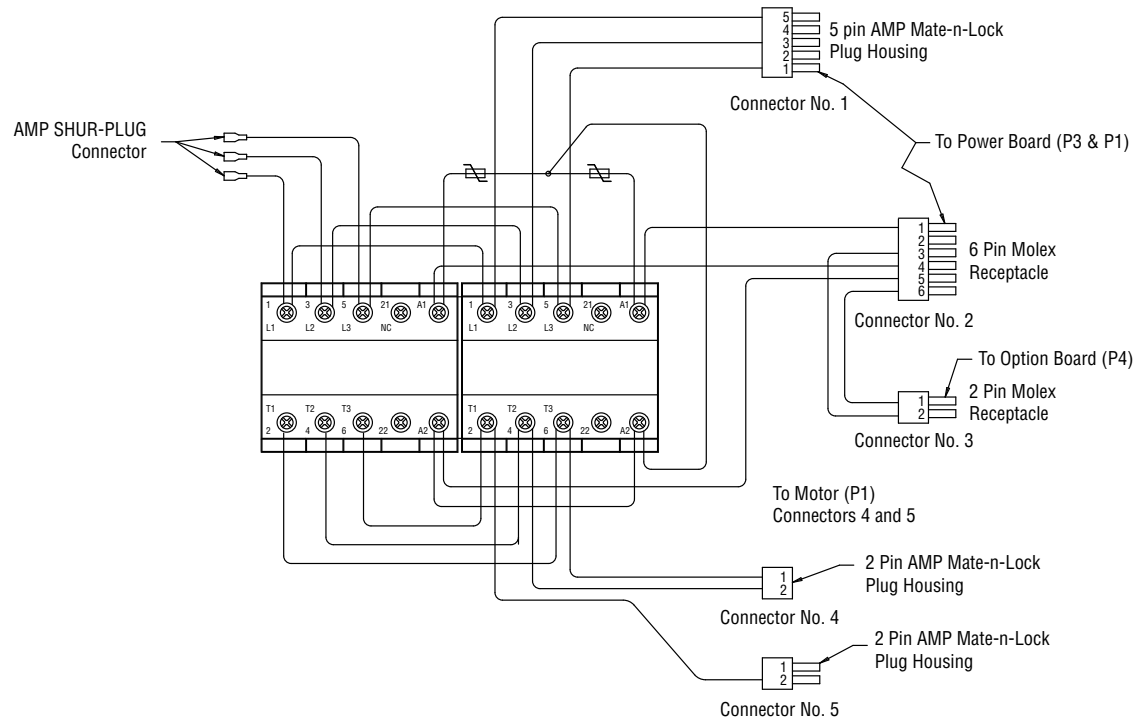


Figure 5.15 – (continued)



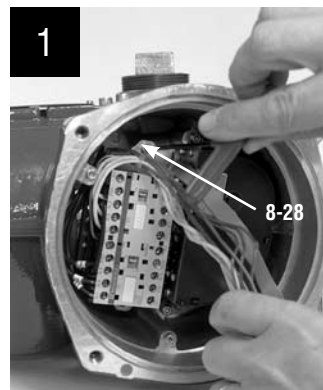
5.10.1 Removal

First Remove

1. Remove motor (subassembly #4). (See Section 4.1.1.)
2. Remove control panel (subassembly #7). (See Section 5.1.)
3. Remove control module (subassembly #8). (See Section 5.2.1.)
4. Remove terminal block (subassembly #15). (See Section 5.8.1.)

STEP 1

Using an M3 hex key, loosen the two 4 mm screws (#8-28) that mount the contactor assembly to the actuator.



STEP 2

Lift contactor assembly until the keyhole slots in the contactor mounting plate allow the heads of the M4 screws to pass through.

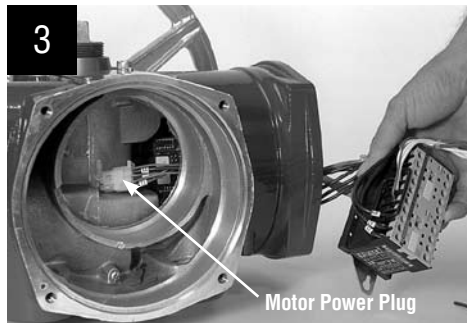
**STEP 3**

Remove the contactor assembly while threading the motor power socket out of the motor compartment.

NOTE: Only the MX-05, -10, -20 and -40 have the long motor power socket lead.

MX-85, -140, AND -150

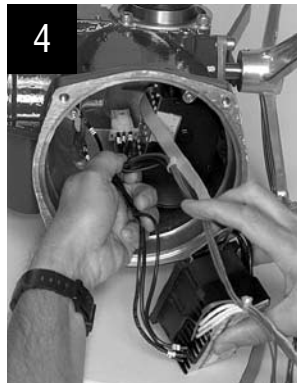
Disconnect connectors 4 and 5 to motor lead harness.



5.10.2 Remounting

STEP 4

Insert contactor assembly into control module cavity.



STEP 5

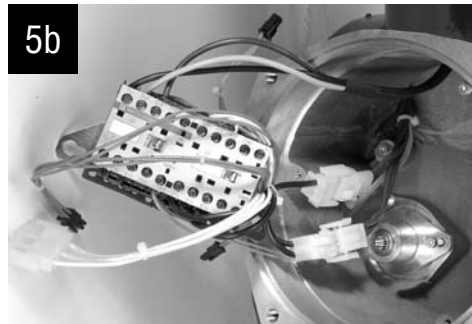
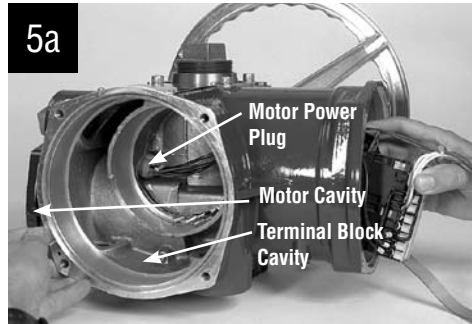
Route leads L1, L2, and L3 (input power) to the terminal block cavity.

MX-05, -10, -20 AND -40 ONLY

Feed the motor power plug through the housing to the motor cavity.

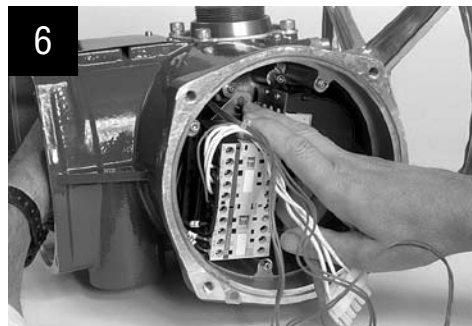
MX-85, -140, AND -150 ONLY

Reconnect connectors 4 and 5 to the motor lead harness.



STEP 6

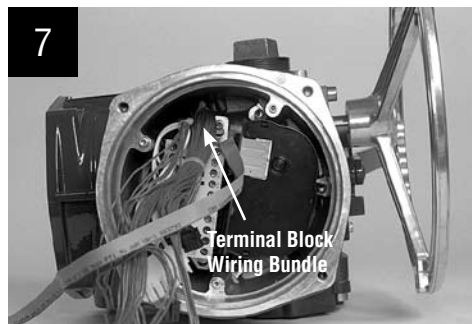
Leave the contactor assembly unmounted in the control module compartment to allow space for the terminal block harness plug bundle to be threaded over the top of the contactor assembly and pulled into the control module cavity.



STEP 7

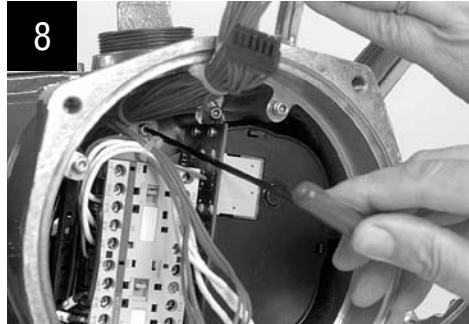
Reference the terminal block assembly procedures to remount the terminal block assembly into actuator. (See Section 5.8.2.)

Before mounting the contactor assembly, ensure the terminal block wiring harness bundle is positioned across the end of the contactor.



STEP 8

Position the contactor assembly so that the keyhole slots in the contactor mounting plate allow the M4 screw heads to pass through; shift the contactor assembly until the screw heads seat in the key slots. Tighten screws using 3 mm hex key to secure assembly.

**STEP 9**

Remount all removed subassemblies according to the remounting instructions in the following order:

1. Terminal block (subassembly #15). (See Section 5.8.2.)
2. Control module (subassembly #8). (See Section 5.2.2.)
3. Control panel (subassembly #7). (See Section 5.1.)
4. Motor (subassembly #4). (See Section 4.1.2.) If the motor voltage has changed, please see Section 5.2.3, Step 10 to ensure the voltage jumper on the power board is located in the proper slot.

5.11 Replacing 19 Amp Reverser on the MX-140 and -150 (Not for most actuators shipped after September 2007)

STEP 1

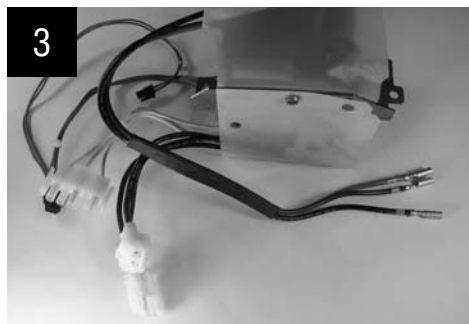
Follow the steps in 5.10.1. Remove control cover and disconnect the encoder and controls package. Remove controls package from MX housing.

STEP 2

Remove terminal cover, retaining ring, terminal block and O-ring to access the back of the terminal block.

STEP 3

Disconnect black, blue and brown wires (L1, L2 and L3) from back of terminal block.

**STEP 4**

Disconnect the lead seal from the reverser by unplugging the 2-pin and single-pin white connectors.

STEP 5

Disconnect and remove the encoder mounting screws and the encoder.

STEP 6

Remove the mounting screws for the reverser package and remove the reverser by moving the reverser towards the space previously occupied by the encoder. Discard the used reverser package.

STEP 7

On the new reverser connect the 2-pin and single-pin white connectors to the lead seal.

STEP 8

Connect the black, blue and brown wires (L1, L2 and L3) to the back of the terminal block.

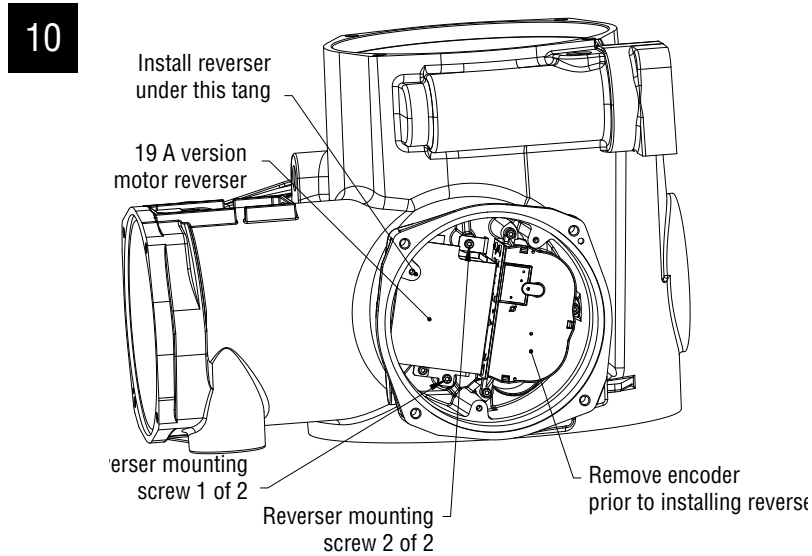
**STEP 9**

Install the terminal block with the O-ring and the retaining ring. Install the terminal cover and screws.

▲ CAUTION: While and after installing, keep wires away from cutout. This cutout allows non-restricting actuation of the reverser plunger.

STEP 10

Place the cutout in the insulator against the housing wall. Place side with the screw securing insulator towards the space for the encoder. The screw is shown in figure 2. Mount the reverser with the insulator on the housing using two screws. See picture 10.



STEP 11

Install the encoder and mount with screws.

STEP 12

Install the controls package and mount with screws.

STEP 13

Connect the white 3-wire power connector from the reverser to the Power board.

STEP 14

Connect the black 6-pin connector from the reverser to the Power board.

STEP 15

Connect the encoder ribbon to the PC board in the control cover.

STEP 16

Reconnect the cables disconnected during step 1.

NOTE: The black 2-pin connector is not used with this reverser.

STEP 17

Install the control cover and the mounting screws.

STEP 18

Complete by following Step 9 in Section 5.10.

5.12 19 Amp Power Assembly for Units Shipped After September 2007

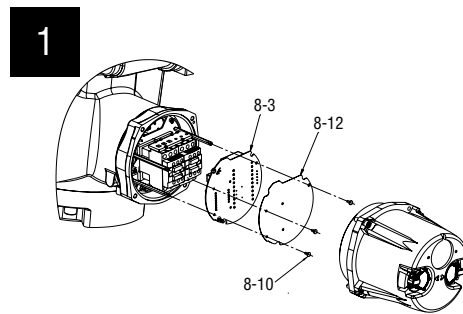
Table 5.9 – 19 Amp Power Assembly

Part Number	Description	Qty.
1-19	Controls Assembly	1
8-3	Power Board	1
8-7	Mounting Plate Screws	3
8-10	Screws	3
8-12	Shield	1

5.12.1 Removal

STEP 1

Remove the ACP controls cover assembly

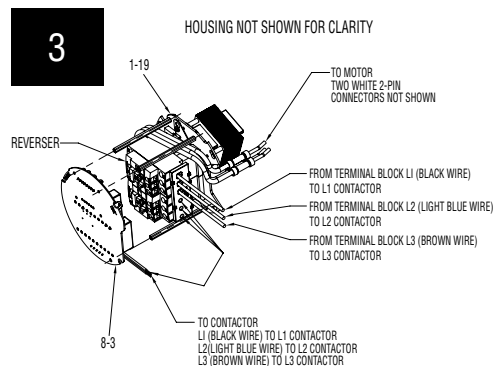


STEP 2

Disconnect all connectors to power board (8-3)
Remove the three screws (8-10) and shield (8-12).

STEP 3

Disconnect the three power board wires from I1, I2 and I3 on reverser as shown by loosening the reverser screws and remove the power board.



STEP 4

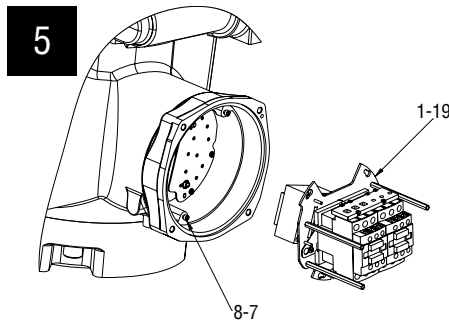
Disconnect the three terminal block wires from I1, I2 and I3 on reverser as shown by loosening the reverser screws.

Remove the 19 amp controls assembly (1-19) by loosening the three M4 mounting plate screws (8-7) and slightly rotating the controls assembly counterclockwise (CCW) direction until the keyhole slots in the baseplate allow the heads of the screws to pass through the baseplate.

Disconnect the two 2-pin white connectors from the lead seal.

STEP 5

Remove the 19 amp controls assembly (1-19) by loosening the three M4 mounting plate screws (8-7) and slightly rotating the controls assembly counterclockwise (CCW) direction until the keyhole slots in the baseplate allow the heads of the screws to pass through the baseplate.



Disconnect the two 2-pin white connectors from the lead seal.

5.12.2 Remounting

Remount 19 amp power assembly by reversing the steps for removal.

5.13 Encoder (Through hole and surface mount technology, most units prior to September 2007)

Table 5.10 – Encoder Parts List

Part Number	Description	Qty.
1-6	Encoder assembly	1
1-36	Socket head cap screw (M4x16)	3
6-11	Input gear, 78-tooth (ID 3 through 8)	1
6-24	Input gear, 69-tooth (ID 1 or 2)	1

Figure 5.16 – Encoder

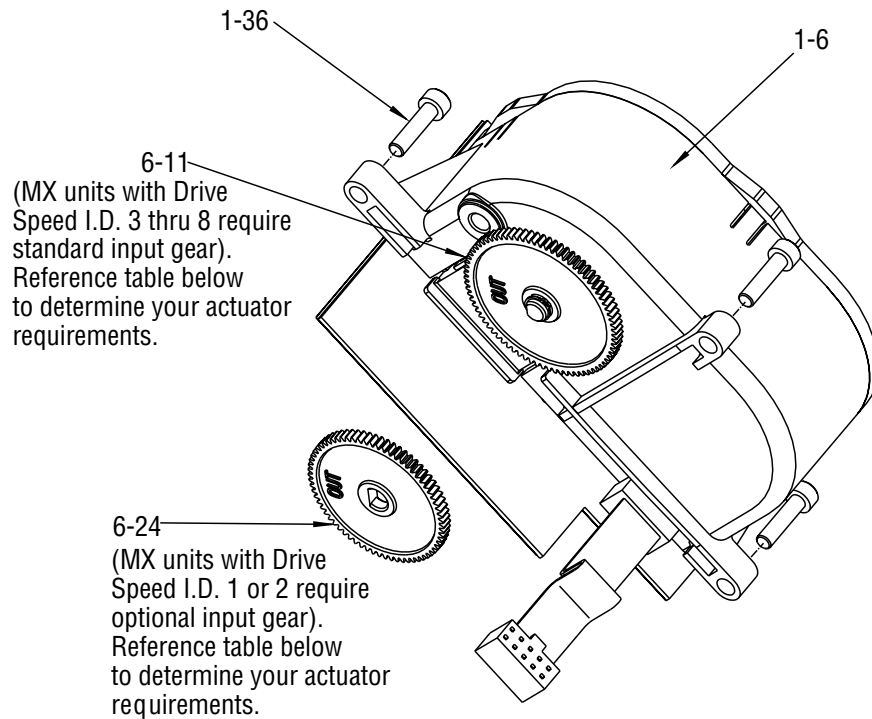


Table 5.11 – Encoder Drive Sleeve Speed (RPM)

Drive Sleeve Speed ID	1	2	3	4	5	6	7	8
50 Hz	15	22	33	43	65	84/110 ¹	127/143 ¹	165 ²
60 Hz	18	26	40	52	77	100/131 ¹	155/170 ¹	200 ²

1: MX-85, -140, and -150 only.

2: N/A MX-85, -140, and -150.

NOTE: MX units with Drive Speed ID 1 or 2 require an optional input gear. Reference the Output RPM block located on the MX nameplate and cross-reference in table above to determine the unit Drive Speed ID.

5.13.1 Removal

NOTE: Before removal you must:

▲ CAUTION: Potential to cause electrostatic damage to electronic components. Before handling electronic components, ensure that you are discharged of static electricity by briefly touching a grounded metal object.

1. Remove the control panel (subassembly #7). (See Section 5.1.)
2. Remove the control module (subassembly #8). (See Section 5.2.1.)

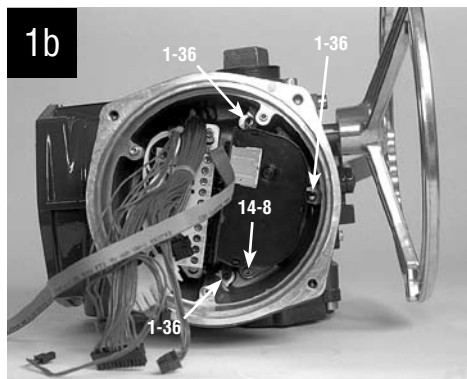
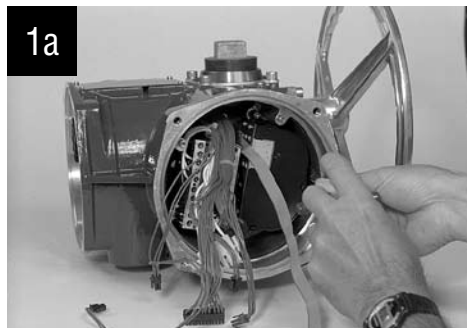
NOTE: The encoder is a sealed assembly of high-precision components and not suitable for repair. Should the encoder fail, it will be necessary to install a factory replacement.

STEP 1

⚠ WARNING: Hazardous Voltage! Turn off all power sources to actuator before removing encoder assembly. Power sources may include main power or control power.

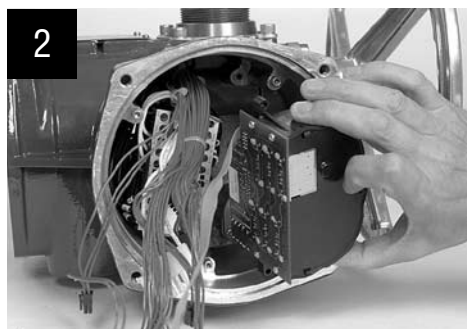
⚠ CAUTION: To avoid accidental oil leakage when removing encoder screws (#1-36), be careful not to remove the encoder cartridge mounting screw (#14-8). The encoder cartridge screw is located near one of the encoder mounting screws. Accidentally removing the encoder cartridge mounting screw could cause oil leakage into the control compartment. (See Picture 1a.)

Remove the encoder by locating and removing the three M4 screws (#1-36) that mount the encoder to the actuator housing. Use a 3 mm hex key to remove the screws. Reference Picture 1b to locate screws (#1-36); note important cautionary statement discussed with Step 1 and 1a).



STEP 2

Pull the complete encoder straight out of the mounting holes to disengage the gear drive from the encoder drive cartridge pinion.

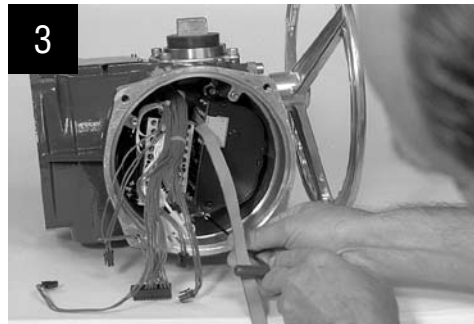


5.13.2 Remounting

STEP 3

⚠ WARNING: Hazardous Voltage! Turn off all power sources to actuator before remounting encoder assembly. Power sources may include main power.

If the actuator uses drive sleeve speed ID 1 or 2, ensure the optional encoder input gear (#6-24) is installed on the encoder. Align the three encoder mounting holes with the matching holes in the actuator housing and push the encoder straight on to the mounting boss, carefully positioning the encoder to ensure correct meshing with the encoder drive cartridge pinion. If needed to align gearing, declutch the actuator and turn handwheel until the encoder gear engages with the drive cartridge pinion). Fit the three M4 screws (#1-36) and tighten using a 3 mm hex key. Do not overtighten.



5.14 Encoder Drive Cartridge (Most units prior to September 2007)

Table 5.12 – Encoder Drive Cartridge Parts List

Part Number	Description	Qty.
14-1	Encoder drive cartridge	1
14-2	Encoder drive shaft	1
14-3	Encoder pinion	1
14-4	Ball bearing	2
14-5	Oil seal	1
14-6	Retaining ring	1
14-7	Roll pin	1
14-8	Socket head cap screw	1
14-9	O-ring	1
6-25	Input gear, 21-tooth	1

Table 5.13 – Encoder Drive Cartridge Drive Sleeve Speed

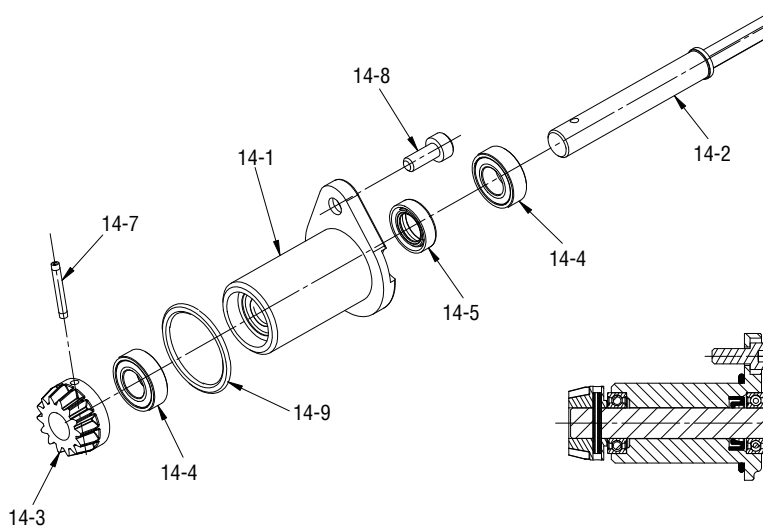
Drive Sleeve Speed I.D.	1	2	3	4	5	6	7	8
50 Hz RPM	15	22	33	43	65	84/110 ¹	127/143 ¹	165 ²
60 Hz RPM	18	26	40	52	77	100/131 ¹	155/170 ¹	200 ²

NOTE: Reference the Output RPM block located on the MX nameplate and cross-reference in table above to determine the unit Drive Speed ID.

NOTE 1: MX-85, -140, and -150 only.

NOTE 2: N/A MX-85, -140, and -150.

Figure 5.17 – Encoder Drive Cartridge



5.14.1 Removal

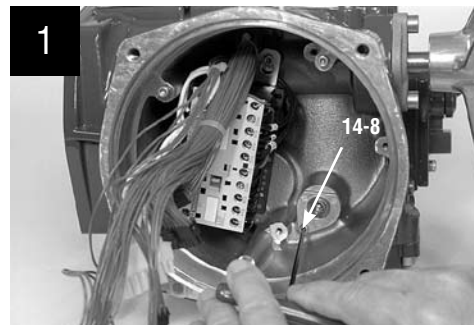
NOTE: Before removal you must:

1. Drain oil.
2. Remove the CP cover (subassembly #7). (See Section 5.1.)
3. Remove the control module (subassembly #8). (See Section 5.2.1.)
4. Remove the encoder (subassembly #6). (See Section 5.13.1.)

STEP 1

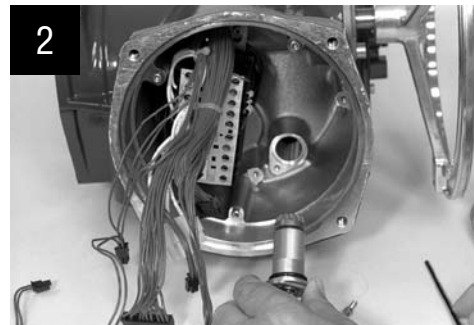
⚠ WARNING: Hazardous Voltage! Turn off all power sources to actuator before removing encoder drive cartridge. Power sources may include main power or control power.

Remove the M4 screw (#14-8) using a 3 mm hex key.



STEP 2

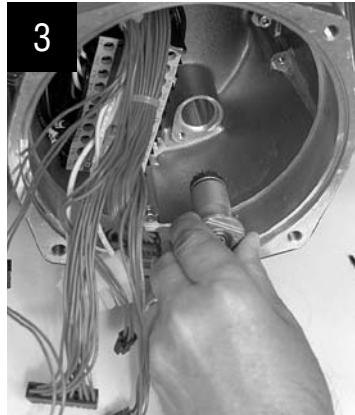
Withdraw the complete encoder drive cartridge from the actuator housing.



5.14.2 Remounting

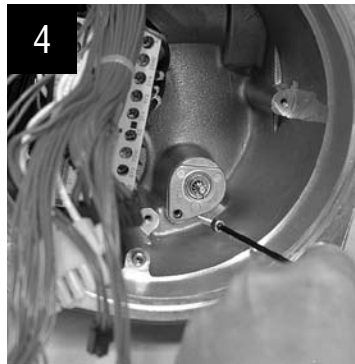
STEP 3

If actuator uses drive sleeve speed ID 1 or 2, ensure the input gear (#6-25) is installed on the encoder. Fit the encoder drive cartridge into the actuator housing.



STEP 4

Using a 3 mm hex key, fit the M4 screw (#14-8) into the actuator housing to secure the encoder cartridge.



5.15 Removal and Replacement of MX Encoder (Supplied With Most Actuators Since September 2007)

Table 5.14 – Encoder Parts List

Part Number	Description	Qty.
1-6	Encoder assembly	1
1-36	Socket head cap screw (M4x10)	3

Figure 5.18 – Encoder

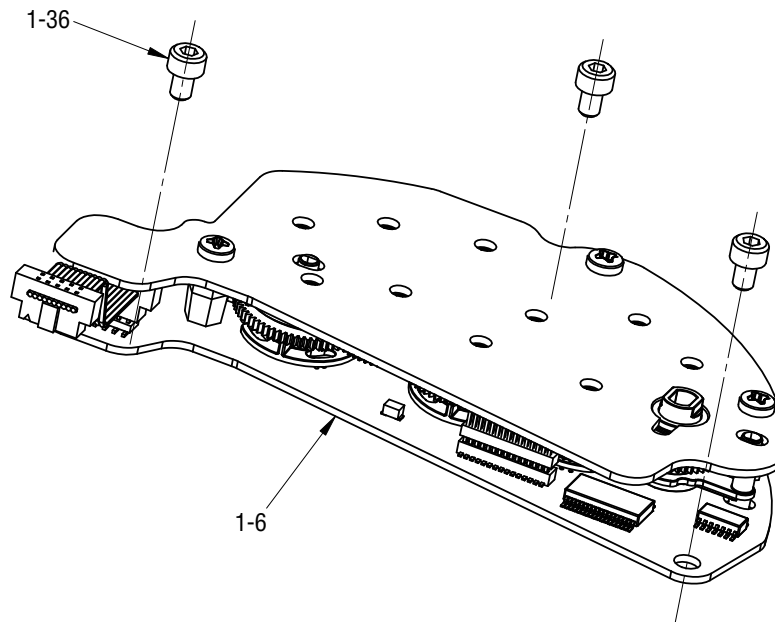


Table 5.15 – Encoder Drive Sleeve Speed (RPM)

Drive Sleeve Speed ID	1	2	3	4	5	6	7	8
50 Hz	15 ²	22	33	43	65	84/110 ¹	127/143 ¹	165 ²
60 Hz	18 ²	26	40	52	77	100/131 ¹	155/170 ¹	200 ²

NOTE 1: MX-85, -140, and the only available speeds for the MX-150.

NOTE 2: N/A MX-85, -140, and -150.

5.15.1 Removal

NOTE: Before removal you must:

▲ CAUTION: Potential to cause electrostatic damage to electronic components. Before handling electronic components, ensure that you are discharged of static electricity by briefly touching a grounded metal object.

1. Remove the control panel (subassembly #7). (See Section 5.1.)
2. Remove the control module (subassembly #8). (See Section 5.2.1.)

NOTE: The encoder is a sealed assembly of high-precision components and not suitable for repair. Should the encoder fail, it will be necessary to install a factory replacement.

STEP 1

⚠ WARNING: Hazardous Voltage! Turn off all power sources to actuator before removing encoder assembly. Power sources may include main power or control power.

▲ CAUTION: To avoid accidental oil leakage when removing encoder screws (#1-36), be careful not to remove the encoder cartridge mounting screw (#14-8). The encoder cartridge screw is located near one of the encoder mounting screws. Accidentally removing the encoder cartridge mounting screw could cause oil leakage into the control compartment.

Remove the encoder by locating and removing the three M4 screws (#1-36) that mount the encoder to the actuator housing. Use a 3 mm hex key to remove the screws.

5.15.2 Remounting

STEP 2

⚠ WARNING: Hazardous Voltage! Turn off all power sources to actuator before remounting encoder assembly. Power sources may include main power.

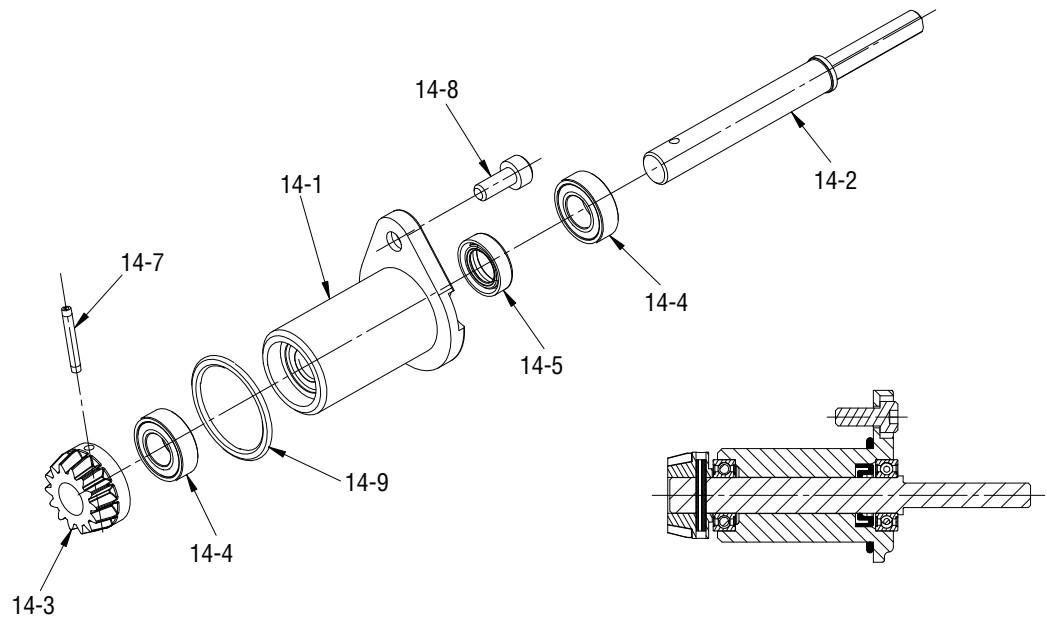
Align the three encoder mounting holes with the matching holes in the actuator housing and push the encoder straight on to the mounting boss, carefully positioning the encoder to ensure correct meshing with the encoder drive cartridge pinion. If needed to align gearing, declutch the actuator and turn handwheel until the encoder gear engages with the drive cartridge pinion). Fit the three M4 screws (#1-36) and tighten using a 3 mm hex key. Do not overtighten.

5.16 Encoder Drive Cartridge (Supplied With Most Actuators Since September 2007)

Table 5.16 – Encoder Drive Cartridge Parts List

Part Number	Description	Qty.
14-1	Encoder drive cartridge	1
14-2	Encoder drive shaft	1
14-3	Encoder pinion	1
14-4	Ball bearing	2
14-5	Oil seal	1
14-7	Roll pin	1
14-8	Socket head cap screw	1
14-9	O-ring	1

Figure 5.19 – Encoder Drive Cartridge



5.16.1 Removal

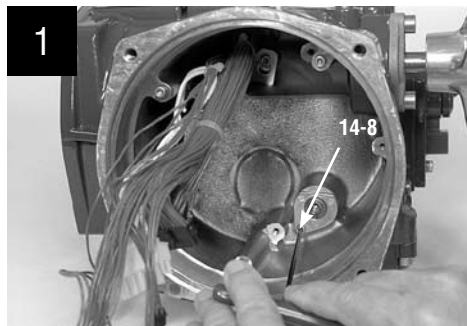
NOTE: Before removal you must:

1. Drain oil.
2. Remove the CP cover (subassembly #7). (See Section 5.1.)
3. Remove the control module (subassembly #8). (See Section 5.2.1.)
4. Remove the encoder (subassembly #6). (See Section 5.15.1.)

STEP 1

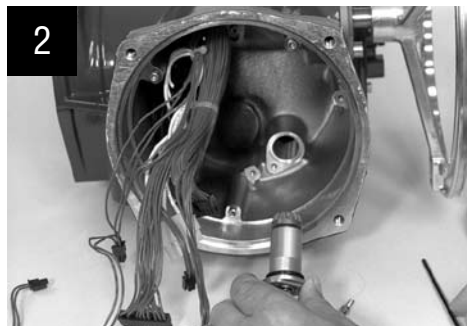
⚠ WARNING: Hazardous Voltage! Turn off all power sources to actuator before removing encoder drive cartridge. Power sources may include main power or control power.

Remove the M4 screw (#14-8) using a 3 mm hex key.



STEP 2

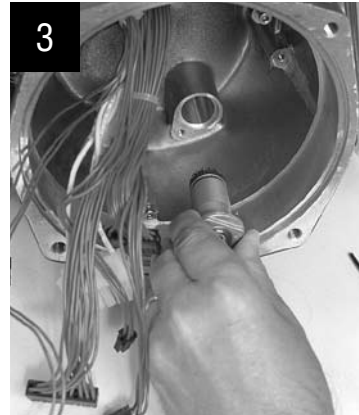
Withdraw the complete encoder drive cartridge from the actuator housing.



5.16.2 Remounting

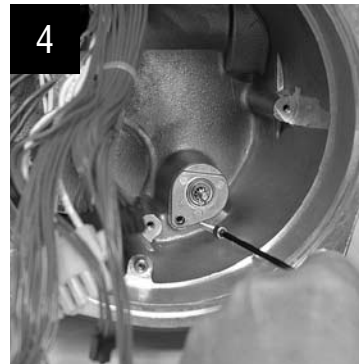
STEP 3

If actuator uses drive sleeve speed ID 1 or 2, ensure the input gear (#6-25) is installed on the encoder. Fit the encoder drive cartridge into the actuator housing.



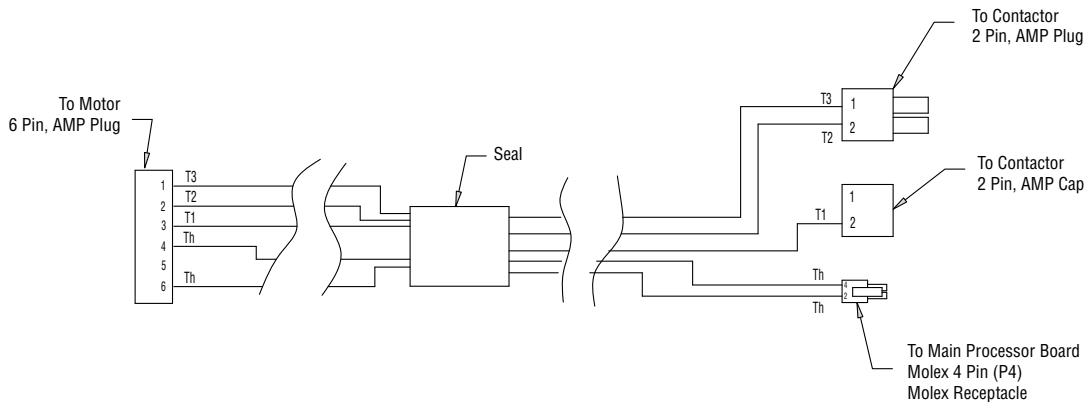
STEP 4

Using a 3 mm hex key, fit the M4 screw (#14-8) into the actuator housing to secure the encoder cartridge.



5.17 Motor Lead Harness (MX-85, -140, and -150)

Figure 5.20 – Motor Lead Assembly



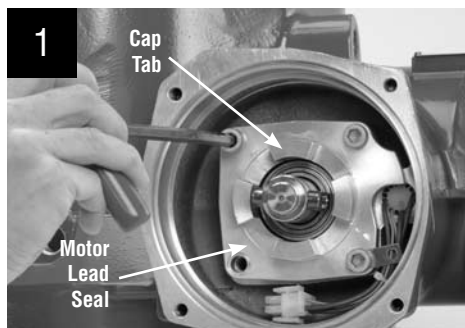
5.17.1 Removal

NOTE: Before removal you must:

1. Remove the motor (subassembly #4). (See Section 4.1.1)
2. Remove the CP (subassembly #7). (See Section 5.1)
3. Remove the control module (subassembly #15). (See Section 5.6.1)
4. Remove the contractor assembly (subassembly #8). (See Section 5.10.1)

STEP 1

If the worm shaft assembly (subassembly #3) is still mounted in the unit, remove the four screws (#3-9) and rotate the cap (CCW) to rotate the cap tab away from the motor lead seal.



STEP 2

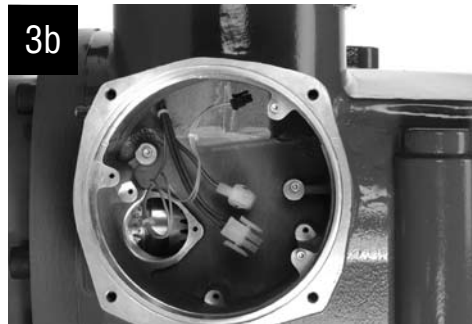
Remove the motor lead harness by threading the harness back through the housing and out the motor end. Work the three connectors out through the hole/slot in the housing one at a time.



5.17.2 Remounting

STEP 3

Work the three connectors through the hole/slot in the housing. (Hole/slot is located in the motor cavity next to the worm shaft bore.) Thread the three connectors through the housing into the controls compartment cavity until the lead seal fits completely into the hole/slot in the housing.



STEP 4

Remount all removed subassemblies according to the remounting instructions in the following order.

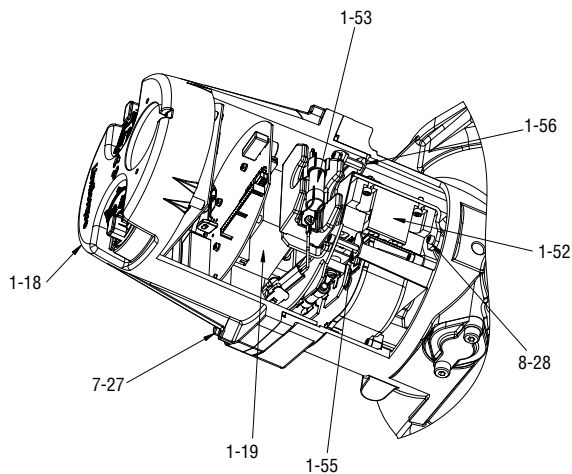
1. Contactor assembly (subassembly #8). (See Section 5.10.1)
2. Control module (subassembly #15). (See Section 5.6.1)
3. Control panel (subassembly #7). (See Section 5.1)
4. Motor (subassembly #4). (See Section 4.1.1)

5.18 Solid State Motor Reverser Upgrade Instructions (Most units prior to September 2007)

Table 5.17 – SSMR Upgrade Kit Parts List

Part Number	Description	Quantity
7	Control panel (CP)	1
7-27	Socket head cap screws (CP)	4
1-52	Solid state reverser assembly	1
1-53	SSMR protection fuse assembly	1
1-54	Motor fuse block assembly	1
1-55	Standoff	3
1-56	Washer	3

Figure 5.21 – Cutaway View of SSMR Controls Area

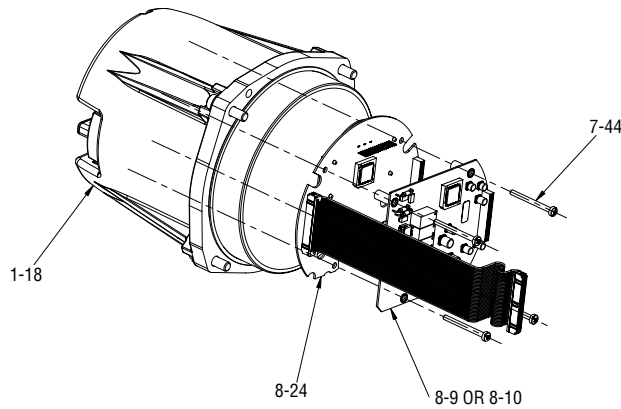


Tools required:

- M3 hex key
- M6 hex key
- Phillips head screwdriver
- Flat head screwdriver

5.18.1 Disassembly Procedure

Figure 5.22 – Disassembly Procedure



STEP 1

Remove contactor. See Section 5.10.1 for removal procedure.

NOTE: Removal of the contactor requires removal of the motor, CP cover, controls, and terminal block. Sections for these procedures are listed under the contactor removal. See Sections 4.1, 5.1, 5.4 and 5.5.

STEP 2

Retain the Main/LCS board, power assembly, mounting screws, and any optional boards removed from the CP cover.

STEP 3

Discard the CP cover assembly and the four M8 mounting screws. A new CP with integral insulator and mounting screws is included in the upgrade kit.

STEP 4

Discard the mechanical contactor assembly, keeping the two M4 mounting screws (8-28) per Figure 5.9.

5.18.2 Assembly Procedure

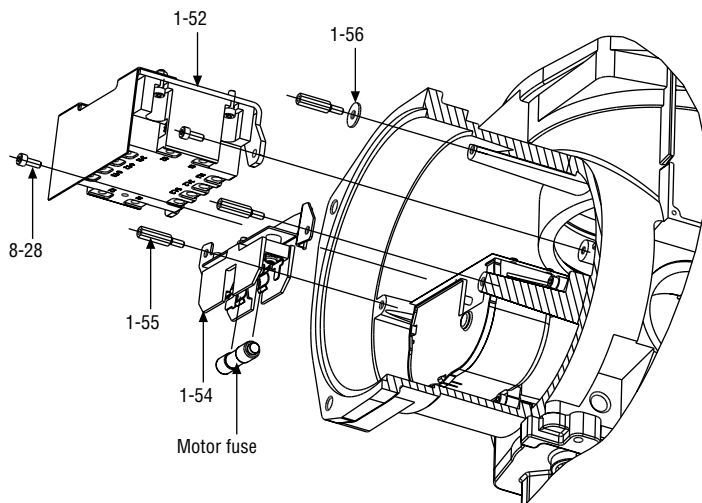
STEP 1

Mount the fuse block assembly (1-54) in the unit housing using two of the three standoffs (1-55). Insert the proper L3 motor fuse into the fuse block (1-54). See Table 5.19 for proper fuse size.

Table 5.18 – SSMR Motor Fuse Table

Nameplate	Limitorque P/N	Ferraz-Shawut
.6 to .89	102478	ATDR 1-6/10
.9 to 1.34	102480	ATDR 2-½
1.35 to 2.25	102482	ATDR 4
2.26 to 3.2	102484	ATDR 6
3.21 to 4	102487	ATDR 9
4.1 to 6	102488	ATDR 12

Figure 5.23 – Solid State Reverser and Fuse Block Assembly Installation



NOTE: The Ferraz-Shawut replacement part numbers for the fuses that are supplied for L3 are listed in the third column in Table 5.19. These fuses can be ordered from Flowserve Limitorque using the part number in the second column.

STEP 2

Place the solid state reverser (1-52) in unit housing. Feed the motor power plug through the housing to the motor cavity. Also route leads L1, L2 and L3 to the terminal block cavity. Connect the (L3) Panduit push-on terminals to each end of the fuse block (1-54). Leave the SSMR reverser assembly unmounted to allow space for routing the terminal block plug bundle. This bundle is to be routed over the top of the reverser assembly.

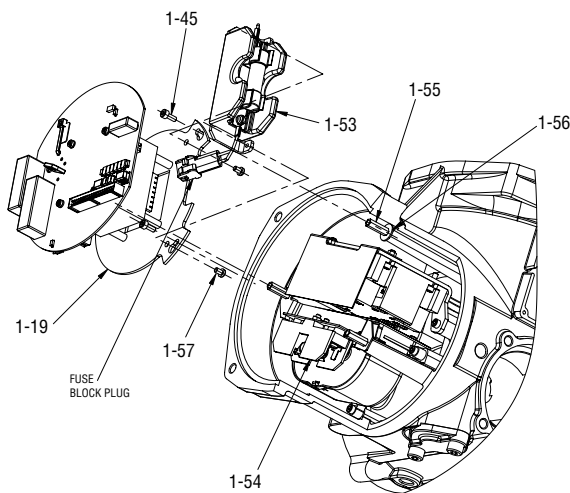
STEP 3

Route the terminal block plug bundle over the top of the reverser assembly and mount the terminal block per Section 5.8.2, Steps 7 through 10.

STEP 4

Mount the solid state reverser assembly (1-52) in the unit housing using the existing M4 contactor mounting screws (8-28).

Figure 5.24 – Control module reinstallation



STEP 5

Mount the washer (1-56) and the third standoff (1-55) in the housing.

STEP 6

Mount the motor per Section 4.1.2.

STEP 7

Mount the Main/LCS, and if applicable, an optional board into CP using M4 Screws (7-44) per Section 5.2.2.

NOTE: Only one optional board may be used with the SSMR, either I/O or Network (but not both) in the same actuator.

STEP 8

Mount the SSMR fuse assembly (1-53) using two pan head machine screws (1-57). See Figure 5.23.

STEP 9

Mount new power assembly (1-19) on top of the three standoffs (1-55) using the existing three M4 power assembly screws (1-45).

▲ CAUTION: Assure the voltage jumper on the power board is located in the proper location per the nameplate and motor voltage! See Figure 5.8 for location of jumper.

STEP 10

Route the two-pin AMP plugs (L1 power connector) over the bottom plate of the control module and connect to the ceramic fuse block plug.

NOTE: 1-53 SSMR protection fuse Limitorque part number 102476, Bussmann part number FWP-30A14F.

STEP 11

Referring to Section 5.2.2, connect all plugs.

STEP 12

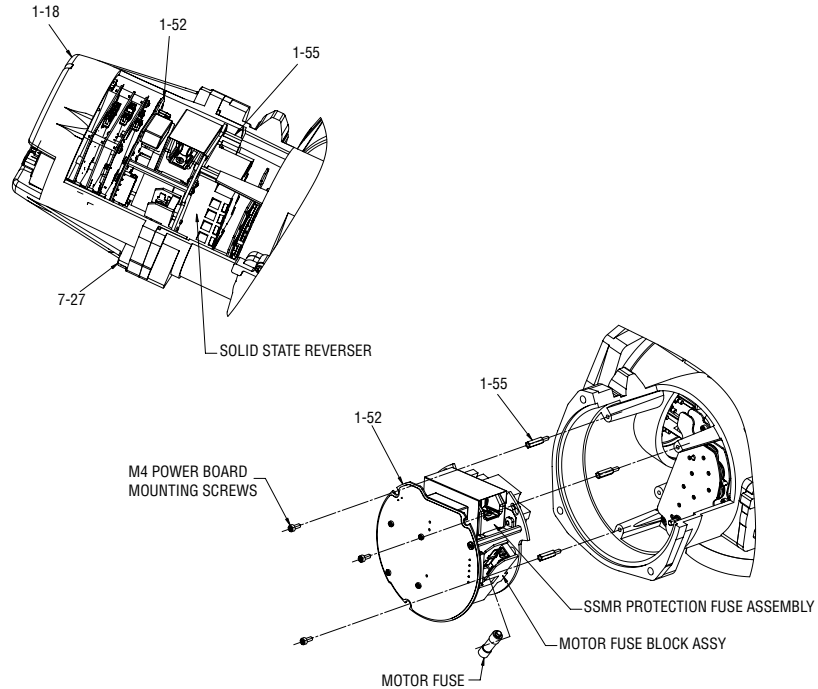
Mount the CP cover assembly per Section 5.1. Applicable wiring diagrams: 1792, 1793, 1794, 1795, 1796, and 1797.

5.19 Mounting of SSMR (Solid State Motor Reverser) in units shipped after February 2008

Table 5.19 - SSMR Parts List

Part Number	Description	Qty.
1-18	Controls cover assembly	1
7-27	Socket head cap screws	4
1-52	Solid state reverser power assembly	1
1-55	Standoff	3

Figure 5.25 – SSMR (Solid State Motor Reverser)



▲ CAUTION: Potential to cause electrostatic damage to electronic components. Before handling electronic components, ensure that you are discharged of static electricity by briefly touching a grounded metal object. Flowserve recommends the use of a wrist strap grounded to an appropriate ground.

STEP 1

Install the three (3) standoffs (#1-55) into the control board housing mounting holes.

STEP 2

Install the power board complete with the SSMR using the M4 power board mounting screws.

STEP 3

Ensure the SSMR fuses are correct per Table 5.19. Part numbers for the SSMR are the same as the Note under Table 5.19. Confirm the motor FLA current from the MX nameplate.

STEP 4

Plug the 3-pin Molex harness (I1-L3) to plug into motor reverser. Plug the three-wire and thermistor cable (T1-T3) to the motor leads.

5.20 Complete Conversion to SMT Controls

NOTE: In addition to the SMT controls, a different terminal block (P/N 26100-006) and contactor assembly (P/N 21600-009 or 26100-010, or 26100-017) are required for a complete conversion to SMT controls.

Follow the steps as listed in Section 5.8.1 for removal of the existing through hole terminal block. To replace with new SMT ready terminal block (P/N 26100-006) follow steps as listed in Section 5.8.2.

Follow steps as listed in Section 5.10 for removal of the existing contactor assembly.

6 Spare and Replacement Parts

6.1 Guidelines for Recommended Spare Parts

Since every Flowserve Limitorque actuator is designed to meet a specific application, the recommended spare parts needed to support the actuator will vary for every project. The following guidelines are provided to assist in determining the specific spare parts requirements for your MX actuators.

6.1.1 Wear Components

The following components will eventually wear under normal use and should therefore be planned as spares. The expected lifetime of these parts will vary from application to application. They are listed in order of most frequent to least frequent replacement. Flowserve recommends stock levels of between 5% and 10% of the total population of each part with a minimum of one of each in order to support the product for life.

1. Stem nut
2. Worm shaft subassembly
3. Drive sleeve subassembly

6.1.2 Bearings, O-rings, and Seals

All bearings should be replaced any time an actuator is refurbished. Therefore, all bearings should be planned for stock for any scheduled refurbishment. In addition, any O-ring or seals should be replaced any time an actuator is disassembled. Complete actuator seal kits are available for the MX-05/10, the MX-20/40 and the MX-85/140/150. Flowserve recommends stock levels for seal kits of 10% of the total population of each actuator model and size. Also, an adequate supply of Flowserve approved oil (Mobil SHC-632) should be maintained in stock to support any necessary maintenance or refurbishment.

6.1.3 Critical Components

The following parts are not subject to wear but are still recommended for stock due to their critical nature. Flowserve recommends stock levels of between 5% and 10% of the total population of each part with a minimum of one of each in order to support the product for life.

1. Motor
2. Encoder
3. Control module

6.2 Recommended Spare Parts for MX Actuators

6.2.1 Commissioning and Startup

No additional spare parts are required. All necessary spares are included in the end-user bag.

6.2.2 Short-Term Duty

This is defined as up to 3000 seats or up to 1 million drive sleeve turns, whichever occurs first. There are no spare parts required for the actuator during short-term duty.

6.2.3 Long-Term Duty

This is defined as service beyond short-term duty but less than 6000 seats and less than 1.5 million drive sleeve turns. The spares suggested for long-term duty are as follows:

- Quad rings at the top and bottom of the drive sleeve
- Drive sleeve assembly, which includes the worm gear
- Wormshaft assembly
- Encoder cartridge assembly
- Motor assembly
- Fuse (Controls, quantity 1)
- Fuses (Power, quantity 2)
- Encoder assembly
- Reversing starter/contactator with harness
- Control module (includes PCB-power, main, CP, and optional DDC and I/O boards)
- Bronze stem nut for thrust base
- Quad rings in thrust base (MX-10, -20, -40, -85, -140, and -150)
- Quad rings in B1 base

NOTE: Oil should be changed every 6000 seats or sooner if the oil has been contaminated with water or other foreign material.

6.2.4 Severe Duty

This is defined as open/close service when run loads exceed 30% of the unit rating. This also includes all modulating applications.

NOTE: Oil should be changed every 3000 seats for open/close service, or sooner if the oil has been contaminated.

The spares suggested for severe duty are identical to the long-term duty spares.

6.3 Other Concerns

There are other unique application requirements that may result in additional parts being added to the list of recommended spares. Some additional issues or requirements that should be considered when determining required spare parts include (but are not limited to):

1. Maintenance program
2. Frequency of operation
3. Modulating duty
4. Frequent operation by handwheel
5. Regular testing
6. Stall/overload condition

Flowserve strongly recommends using OEM parts to support and maintain your MX actuator. Installing parts other than genuine Flowserve Limitorque parts could cause premature failure of your actuator and voids any remaining warranty.

The above guidelines are provided to assist you in determining your unique spare parts needs. Please contact your local Limitorque Sales Office or local Authorized Stocking Distributor for additional help in evaluating your needs.

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7

Regulatory Information

7.1 Declaration of Conformity

Application of Council Directive(s)

89/336/EC; EMC Directive
 89/392/EC; Machinery Directive
 2003/10/EC; Airborne Noise Directive
 94/9/EC; ATEX Directive

Standard(s) to which Conformity is Declared

Machinery; EN 60204-1
 EMC - Emissions; EN 50081-1&2, EN 55011, CFR 47
 Immunity; EN 50082-1&2, IEC 801-3 & IEC 801-6
 ESD; IEC 801-2
 EFT/Bursts; IEC 801-4
 Surge Immunity; IEC 801-5, ANSI/IEEE C62.41
 Mains (power) Harmonics; MIL-STD-462, Method CS01 & CS02
 Airborne Noise; MIL-STD-740-1, Table 1, and EN 60204
 ATEX
 Electrical Apparatus for Potentially Explosive Atmospheres;
 General Requirements EN 50014:1997(A1 and A2)
 Flameproof “d” EN 50018:2000(A1)
 Increased Safety “e” EN 50019: 2000
 Essential Health and Safety Requirements PrEN 13463-5:2003
 Non-Electrical Equipment for Potentially Explosive Atmospheres
 EN 13463-1:2001

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Importer’s Name

Limitorque International

Importer’s Address

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 United Kingdom

Type & Description of Equipment

Valve Actuators

Model Number

MX Series

NOTE: Tested with Limitorque products only and with standards applicable at time of tests.

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) and Standard(s). List as follows:



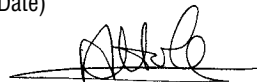
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December 9, 2005
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