



QUEENSLAND URBAN UTILITIES LUGGAGE POINT SEWAGE TREATMENT PLANT PACKAGE 11 (PKE11) WORKS

Limitorque Model MXa-10 Actuator Maintenance Manual



AQUATEC MAXCON

Aquatec Maxcon Document Number: 8894 Final 0 (Actuator)

1. Maintenance Manual

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1 INTRODUCTION

The one (1) final settling tank (FST) 9 return activated sludge (RAS) valve actuator at Luggage Point Sewage Treatment Plant (STP) has been replaced with the following upgrade;

- The installation of one (1) Limitorque model MXa-10 (DN600 RAS butterfly valve) electric actuator – complete with one (1) TMG model AG-W5 (worm-drive) gear box, one (1) (grade-316 stainless steel) flanged riser pipe and one (1) (mechanical) position indicator.

The information contained in this maintenance manual has been extracted from the specific vendor documentation, functional descriptions and/or arrangement and assembly drawings – with the basic structure of the manual being divided into four (4) areas for each system and a particular section for job plans.

The four (4) areas include the following;

- Equipment Listing – Where the major components of the process involved are listed, including the product name, model number, quantity and supplier information – where possible, the maintenance spares and/or lubrication information are supplied.
- Maintenance Schedule – The major maintenance tasks are listed for the major components of the process involved with the supplier/manufacturer recommendations for maintenance intervals – where possible a list of spares are supplied.
- Drawings – A guideline provided to highlight the process isolation required when taking the major components of the process involved off-line for maintenance purposes.
- Job Plans – While these documents do not form part of the maintenance manual – they are located at the end of the section – for clarity. (These “Job Plans” are current at date of issue of this document) Always refer to the electronic version/s prior to accessing critical decisions and/or performing maintenance.

2 0300 PRIMARY TREATMENT

2.1 EQUIPMENT LISTING

2.1.1 LUGGAGE POINT STP PACKAGE 11 UPGRADE

The one (1) final settling tank (FST) 9 return activated sludge (RAS) valve actuator at Luggage Point Sewage Treatment Plant (STP) has been replaced with the following upgrade;

- The installation of one (1) Limitorque model MXa-10 (DN600 RAS butterfly valve) electric actuator – complete with one (1) TMG model AG-W5 (worm-drive) gear box, one (1) (grade-316 stainless steel) flanged riser pipe and one (1) (mechanical) position indicator.

The Limitorque model MXa-10 (DN600 RAS butterfly valve) electric actuator is supported via the (grade-316 stainless steel) flanged riser pipe – extending through the (existing) grid-flooring.

The (mechanical) position-indicator is visible from outside of pit and driven via the arrow indication (On the top side of the TMG model AG-W5 [worm-drive] gear box).



Limitorque Model MXa-10 (Electric) Actuator

The TMG model AG-W5 (worm-drive) gear box is secured to the (existing) DN600 Keystone (Waval) butterfly valve.



TMG Model AG-W5 (Worm-Drive) Gear Box

2.2 EQUIPMENT INFORMATION

2.2.1 LIMITORQUE MODEL MXA (MULTI-TURN) ELECTRIC ACTUATOR



Make/Description: Limitorque (Multi-Turn) Electric Actuator
Model: MXa
Supplier: Fluid Control Sales and Installations Pty Ltd
Unit 3, 160 Fison Avenue West
EAGLE FARM QLD 4009

Phone: (07) 3268 6866
Fax: (07) 3268 5466

<http://fluidcontrol.com.au/>

2.2.2 LIMITORQUE MODEL MXA (MULTI-TURN) ELECTRIC ACTUATOR

	Daily	Weekly	Monthly	3 Monthly	6 Monthly	Yearly	2 Yearly	3 Yearly	5 Yearly	
Description										Lubricant/Comments
LIMITORQUE MODEL MXa ELECTRIC ACTUATOR										
Check for any "abnormal" noises and vibrations	x									Rectify immediately
Check the actuator for oil leakage		x								Rectify immediately
Ensure the actuator assembly is clean of any/all matter										Rectify immediately
Thoroughly clean the actuator valve stem				x						
Lubricate the valve stem				x						Shell Alvania EP 2 Grease
Lubricate the lower thrust bearing				x						Shell Alvania EP 0 Grease
Check the actuator oil level every 50 operating hours										Rectify immediately
Change the actuator oil every 100 operating hours										Mobil SHC 632 Oil
Change the ball bearings every 450 operating hours										
Change the oil seals every 450 operating hours										
Change the o-rings every 450 operating hours										
Change the quad-rings every 450 operating hours										
Check integrity of all protective coatings						x				Repair where necessary
Inspect the actuator motor and cable/s for wear						x				Repair and/or replace
Inspect the actuator motor and cable/s for damage						x				Repair and/or replace
Ensure the actuator fasteners are secure						x				Secure where necessary

2.3 MAINTENANCE PROCEDURES

2.3.1 GENERAL

Danger: **Moving Parts**
 Potential Slip Hazard

2.3.2 LIMITORQUE MODEL MXA ELECTRIC ACTUATOR – PRIOR TO START-UP

Prior to the commencement of any operations; the following items need to be checked:

- Ensure any/all construction debris is removed,
- Ensure the one (1) Limitorque model MXa-10 (butterfly valve) electric actuator baseplate is secured to the foundation,
- Ensure any/all rotating parts turn freely by hand,
- Ensure the one (1) Limitorque model MXa-10 (butterfly valve) electric actuator is checked for correct rotation,
- Ensure any/all shaft supports are secure,
- Ensure power supply is available to the one (1) Limitorque model MXa-10 (butterfly valve) electric actuator.

2.3.3 LIMITORQUE MODEL MXA ELECTRIC ACTUATOR – PRE/POST-START CHECKS

2.3.3.1 PRE-START CHECKS

- Ensure power supply is available.
- Ensure no alarms are "active".
- Ensure the one (1) Limitorque model MXa-10 (butterfly valve) electric actuator is adequately lubricated.

2.3.3.2 POST-START CHECKS

- Visually and audibly check the one (1) Limitorque model MXa-10 (butterfly valve) electric actuator for any abnormal sound and/or vibration – rectify immediately.

2.3.4 LIMITORQUE MODEL MXA ELECTRIC ACTUATOR – SAFETY ASPECTS

2.3.4.1 GENERAL

Always wear protective clothing when operating and/or undertaking any maintenance on the one (1) Limitorque model MXa-10 (butterfly valve) electric actuator and/or associated components.

Always ensure power is isolated to the one (1) Limitorque model MXa-10 (butterfly valve) electric actuator when undertaking any maintenance on the equipment.

2.3.4.2 LIMITORQUE MODEL MXA ELECTRIC ACTUATOR

The one (1) Limitorque model MXa-10 (butterfly valve) electric actuator requires established safety guidelines for both operation and maintenance.

These procedures do not address all safety concerns associated with operating the (multi-turn) electric actuator and do not replace a properly designed and implemented facility safety program.

It is the responsibility of the user to establish appropriate safety and health practices and ensure their implementation.

Any/all operations and maintenance staff should be familiar with any/all hazards associated with the equipment.

2.3.4.3 EQUIPMENT WARRANTY

The equipment warranty can be voided due to inappropriate operation including – but not limited to – the following;

- Not conducting routine maintenance on any/all (supplied) equipment.

2.3.4.4 SAFETY PRECAUTIONS

The following safety pre-cautions should be observed during plant operation;

- “Do not” operate any/all rotating equipment without the protective guards in place.
- “Do not” attempt to dismantle any pipework and/or fittings prior to relieving the system pressure to any/all pipework.

Warning: Any/All electrical work must be carried out by a qualified electrician.

2.3.4.5 SAFETY PROCEDURES

Established facility safety procedures should be followed during maintenance;

- Any/all local isolators and/or motors should be properly locked and/or tagged out according to plant safety procedures. A facility policy should be in place and followed to prevent unauthorised maintenance on any/all equipment.

Warning: Eye protection should be worn at all times when operating, or adjusting any/all equipment on the Limitorque model MXa electric actuator and/or associated components, whilst the system is operational and/or stationary.

2.4 DRAWING LISTING

A blue rectangular box with the word "NOTE" in white capital letters, centered between two horizontal blue lines.

NOTE

**REFER TO THE QUEENSLAND URBAN UTILITIES TAG OUT/LOCK OUT GUIDE
FOR CORRECT TAG OUT/LOCK OUT PROCEDURES**

2. Vendor Documentation



USER INSTRUCTIONS

Limitorque MX Electronic Actuator

FCD LMENIM2306-04 - 2/11

*Installation
Operation
Maintenance*





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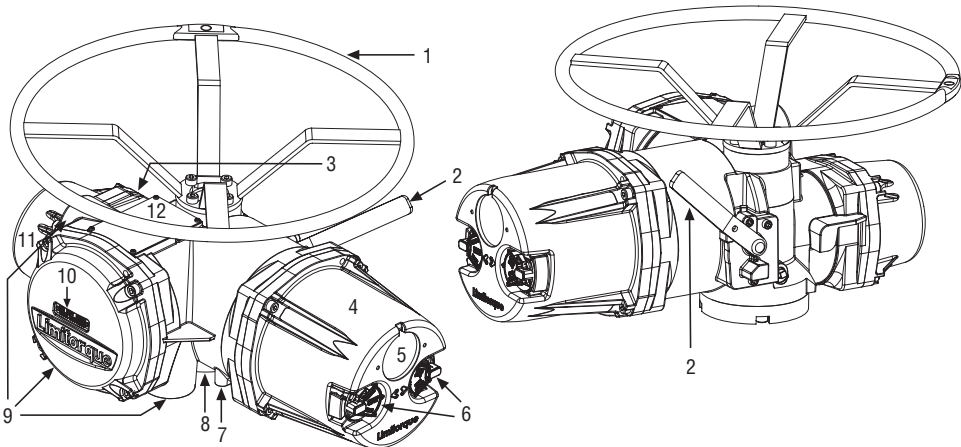
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Figure 1.1 – MX-05 Actuator



Piece	Description
1	Handwheel
2	Declutch Lever (MX-05)
3	Oil Fill
4	Controls Cover
5	LCD
6	Control Knob
7	Ground Lug
8	Thrust/Torque Base
9	Conduit Entry
10	Terminal Compartment
11	Motor
12	Nameplate

1

Important Notes

- Please read this manual in its entirety before attempting to install or operate your MX actuator. A full understanding of the installation and operation options will assist you in installing the actuator in the most effective manner. Limitorque has designed the MX actuator for long life even in the harshest environments. Flexible control and protection options are provided to ensure the actuator meets your requirements.
- All actuator enclosures are sealed by O-rings, and cable entries are supplied with threaded plugs to protect the terminal compartment until the unit is wired. If the actuator cannot be installed immediately, it is recommended that it be stored in a clean, dry place, preferably in an area that is not subject to large fluctuations in temperature.
- Disconnect all incoming power before opening any cover on the actuator. The user/operator must ensure that safe working practices are employed at all times and are in accordance with local or national standards that are enforced at the particular site.
- To install and commission the actuator, only the terminal compartment cover needs to be removed. See Figure 1.1, Item 10. Settings for commissioning the actuator are done externally; therefore, no other covers need to be removed. The actuator was assembled in ideal dry conditions and the total sealing of the enclosure protects all electrical components against deterioration.



NOTE: Removal of any cover, other than the terminal compartment cover, will invalidate the unit warranty. Exposure of actuator components to an environment that results in deterioration of internal components will also invalidate the unit's warranty.

- During final field installation, ensure that all cable entries are correctly sealed in accordance with National Standards or Regulatory Authorities. All temporary transit plugs must be removed and any unused cable entries closed in an approved manner. See Section 3.3.3, Sealing Cable/Conduit Entries.

2

Quick Start

Quick Start provides step-by-step instructions for commissioning each MX actuator. This information is also available in Bulletin LMENIM2310, Quick Start-Up Instructions. These instructions are for the following:

- Position limits calibration – can be performed one of two ways:
 1. Electrical operation: See Section 2.1.2, Electrical Operation Feature.
 2. Handwheel operation: See Section 2.1.3, Handwheel Operation Feature.
- DDC operation: See Section 2.2, DDC Option.
- FF operation: See Section 4.10, FF Option.
- PB operation: See Section 4.11, PB Option.
- DeviceNet operation: See Section 4.12, DN Option.

When these Quick Start instructions are complete, the position limits will be set and the actuator will be ready for normal operation.

NOTE: The actuator has been configured with all customer-specified parameters and no further calibration should be necessary. If full valve data was not provided when ordering, or if changes are needed for parameters, see Sections 3.5 and 6, Commissioning the Actuator and Customizing the Actuator.

2.1 Calibrate – Position Limits

1. Install the MX actuator on the valve.
2. Refer to the nameplate for the correct main power supply voltage. Switch on the main power to the unit.
3. Turn the red knob to the STOP position. The “SET CLOSE POSITION LIMIT” message will be displayed. When the red knob is in “LOCAL” or “REMOTE,” the liquid crystal display (LCD) screen will read “SET POSITION LIMITS.”
4. Calibrate end position limits one of two ways:
 - Electrically, using the control panel. See Section 2.1.2, Electrical Operation Feature.
 - Manually, using the handwheel. See Section 2.1.3, Handwheel Operation Feature.

Once the position limits have been set, the screen message will indicate the valve position as a percentage of the valve opening.

While setting limit switches, place the red selector knob in the “LOCAL” position to permit the actuator to run open or closed in push-to-run mode (inching) only.

▲ CAUTION: Extreme care must be taken as the valve approaches its end position.

The unit will not function with the red selector knob in the “REMOTE” position until both limit switches are set.



The existing configuration of the actuator/valve parameters may be viewed by entering the “SETUP” mode.

2.1.1 Entering the Setup Mode

1. Place the red selector knob in the “STOP” position.
2. Within 10 seconds, place the black control knob in the “YES” position, then the “NO” position, then again in the “YES” position (in quick succession—approximately one-two seconds).
3. The message “SETUP?” will appear in the LCD display for 10 seconds. If no setup action is taken within 10 seconds, the unit will reset.
4. Use the black control knob to answer “YES” or “NO” to the questions appearing in the display.

2.1.2 Electrical Operation Feature

This feature allows for quick and simple calibration. To set the position limits electrically, enter the “CHANGE SETTINGS” mode via the “SETUP” mode.

1. Enter the “SETUP” mode as detailed in Section 2.1.1, Entering the Setup Mode.
2. When screen prompt reads “CHANGE SETTINGS,” select “YES.”
3. The screen will display the “CHANGE SETTINGS” mode menu items. Select “NO” until screen displays “CHANGE POSITION SETUP.” User may select to set close limit first or open limit first.
4. Select “YES.” “CLOSE” or “OPEN VALVE - OK?” is displayed.
5. Place the red selector knob in the “LOCAL” position. Move the black knob in the intended direction. The LCD screens are shown in Figure 2.1.
6. When valve has reached desired position, return the red selector switch to “STOP” and complete calibration.

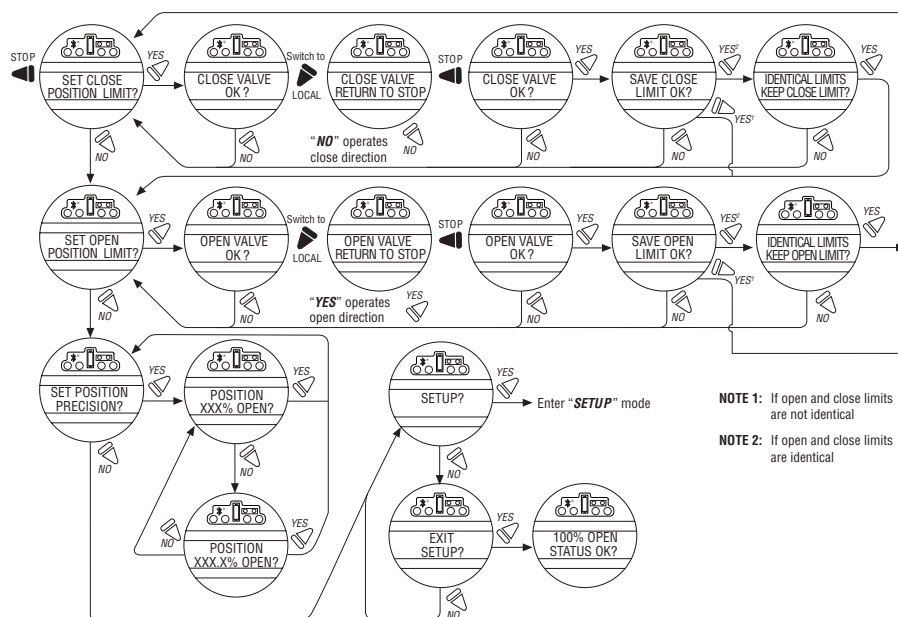
The position settings are now complete. The actuator will now function as ordered, and may be run electrically to inspect for correct operation.

▲ CAUTION: On some valves, position limits could be set adjacent to each other, so be careful that the Close and Open limits are set sufficiently apart to permit operation. If the limits are set adjacent of each other, an error message will be displayed: “KEEP OPEN(CLOSE) LIMIT?”

NO FURTHER MOVEMENT IS PERMITTED UNTIL THE ERROR IS CORRECTED.

Should the User elect to proceed with the setting, an error will be displayed on the screen after re-booting stating “IDENTICAL LIMITS”. THE ACTUATOR WILL NOT MOVE UNTIL THE ERROR IS CORRECTED.

Figure 2.1 – Electrical operation



2.1.3 Handwheel Operation Feature

To set the position limits manually, enter the “CHANGE SETTINGS” mode via the “SETUP” mode.

1. Enter the “SETUP” mode as detailed in Section 2.1.1, Entering the Setup Mode.
2. When LCD reads “CHANGE SETTINGS?”, select “YES.”
3. The LCD will display the “CHANGE SETTINGS” mode menu items. Select “NO” until screen displays “CHANGE POSITION SETUP?”
4. Select “YES.” See Figure 2.2. Manually set position limits:
 - a. Close position limit
 1. “SET CLOSE POSITION LIMIT?” is displayed.
 2. Select “YES.” “CLOSE VALVE - OK?” is displayed.
 3. Depress the declutch lever, and at the same time slowly rotate the handwheel until the clutch is fully engaged. Release the lever; the clutch will be retained in the handwheel mode by spring-loaded latches.
 4. Ensure the valve is fully closed, then move the valve in the open direction for one handwheel turn to allow for coasting of the motor.
 5. When the valve is in the desired position, select “YES” again. The LCD will read “SAVE CLOSE LIMIT OK?”
 6. Select “YES” if the valve’s close limit position is correct. The close position limit is set.
 - b. Open position limit
 1. “SET OPEN POSITION LIMIT?” is displayed.
 2. Select “YES.” “OPEN VALVE - OK?” is displayed.



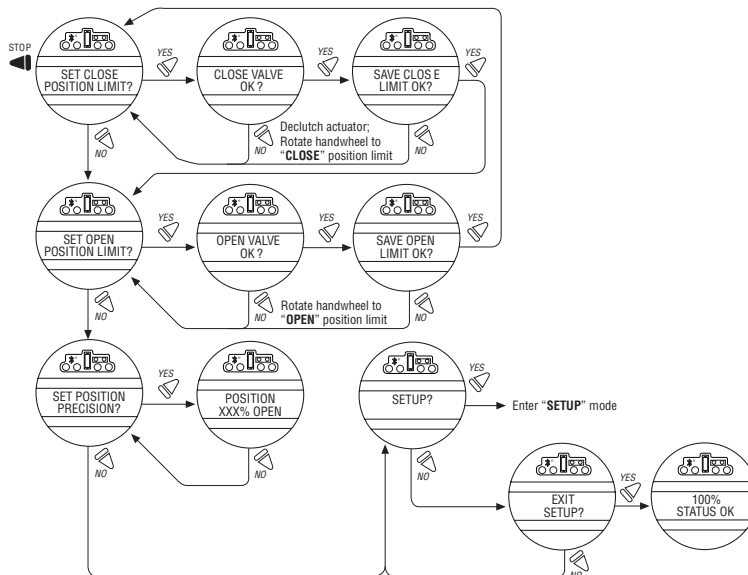
3. Depress the declutch lever, and at the same time slowly rotate the handwheel until the clutch is fully engaged. Release the lever; the clutch will be retained in the handwheel mode by spring-loaded latches.
4. Ensure the valve is fully open, then move the valve in the close direction for one handwheel turn to allow for coasting of the motor.
5. When the valve is in the desired position, select “YES” again. The LCD will read “SAVE OPEN LIMIT OK?”
6. Select “YES” if the valve’s open position limit is correct. The open position limit is set.
7. Move the valve in the close direction. The open lamp should extinguish within one turn of the handwheel.
8. Move the valve back in the open direction and check that the open lamp illuminates just before the full open position is reached (approximately ½ to 1 turn).
9. If the calibration requires adjustment, select “NO” at the “SET CLOSE POSITION LIMIT?” prompt and repeat the “SET OPEN POSITION LIMIT?” routine.
10. Select “NO” to exit “POSITION SETUP?” or “YES” to return to “SET CLOSE POSITION LIMIT?”

▲ CAUTION: On some valves, position limits could be set adjacent to each other, so be careful that the Close and Open limits are set sufficiently apart to permit operation. If the limits are set adjacent to each other, an error message will be displayed: “KEEP OPEN(CLOSE) LIMIT?”

NO FURTHER MOVEMENT IS PERMITTED UNTIL THE ERROR IS CORRECTED.

Should the User elect to proceed with the setting, an error will be displayed on the screen after re-booting stating “IDENTICAL LIMITS”. THE ACTUATOR WILL NOT MOVE UNTIL THE ERROR IS CORRECTED.

Figure 2.2 – Handwheel operation





2.2 DDC/Modbus Option

The following instructions assume that all DDC option parameters are set with the exception of the address.

1. After setting position limits, remain in the “SETUP” mode. If not in the “SETUP” mode, enter the “SETUP” mode as detailed in Section 2.1.1, Entering the Setup Mode.
2. When LCD reads “CHANGE SETTINGS?”, select “YES.”
3. The LCD will display the “CHANGE SETTINGS” mode menu items. Select “NO” until screen displays “CHANGE DDC?” Select “YES.” LCD will display DDC menu items.
4. Select “YES” for each menu item until “DDC ADDRESS OK?” appears. Select “NO.”
5. Enter an address from one to 250 by toggling “NO” until the correct address is displayed. User may select to hold the knob in the “NO” direction and the number will automatically increment by one until the preferred address is reached.

▲ CAUTION: The network address must be entered in accordance with the user address assignment sheet. This assignment sheet should correspond to the contract specifications. The same address must not be used anywhere else in the same network.

The DDC address does not have to be set to exit the setup.

2.3 Check the Settings

1. Operate the valve to the fully “CLOSE” position. Verify that the “CLOSE” (default GREEN) LED illuminates just as the travel limit is reached, and the valve position is displayed as “0% OPEN.”
2. Operate the valve to the fully “OPEN” position. Verify that the “OPEN” (default RED) LED illuminates just as the travel limit is reached, and the valve position is displayed as “100% OPEN.”

3

Installation and Operation

3.1 Preparing the Stem Nut

The MX has two (2) basic base designs:

- Torque-only base, designated by a “B” prefix
- Thrust-only base, designated by an “A” prefix

3.1.1 Type “B” Bases: Torque-only Applications

Standard B4/B4E Base

The standard MX actuator base is the B4 torque-only. It includes a mounting plate and steel torque nut, which may be machined to fit a valve or gearbox. A B4E torque nut can be provided and may be installed to allow for extended stem acceptance.

NOTE: Some MX actuators are supplied with single piece drive sleeves that have been bored and keyed. These are typically mounted directly to gearboxes. The MX actuator maybe mounted in any position as long as the hardwheel is accessible.

Figure 3.1 – B4 base

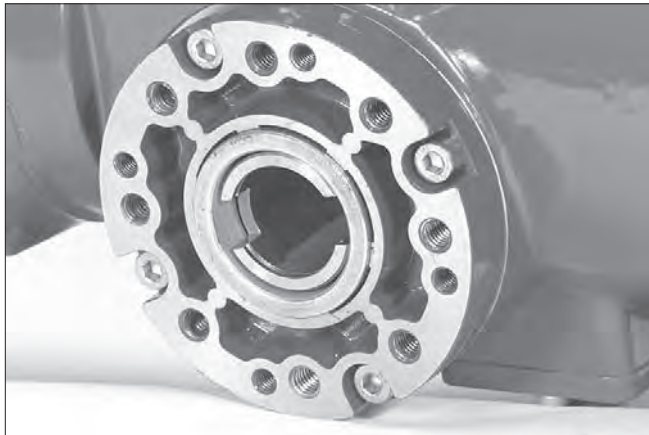


Figure 3.2 – B4E base

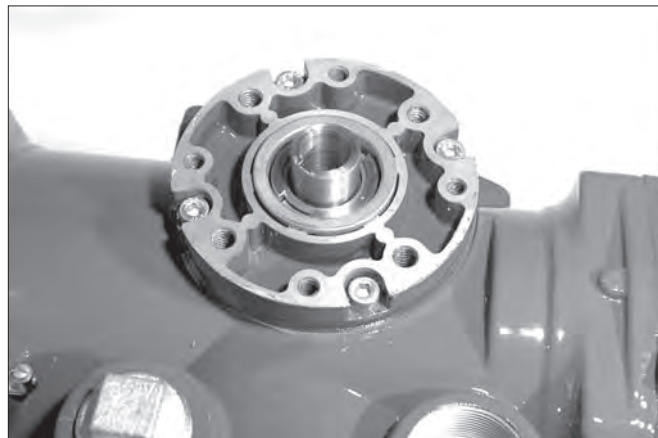
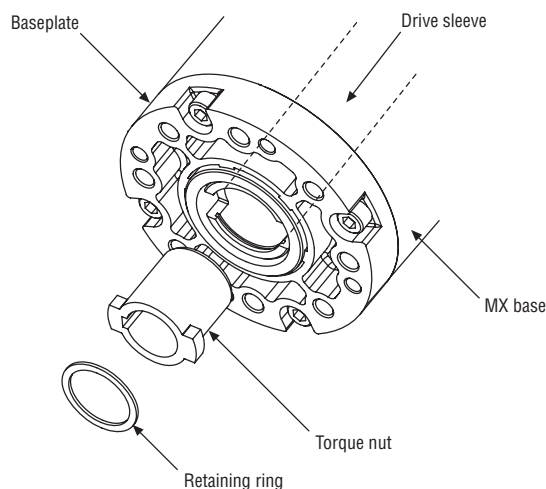


Figure 3.3 – Exploded view of B4/B4E base (MX-05 shown)



Disassembly

1. Remove the retaining ring (B4 base) or spiral-wound ring (B4E base) that retains the torque nut in the drive sleeve.
2. Remove the torque nut. If the torque nut is difficult to remove, insert a suitable device into the drive sleeve through bore and gently tap it loose from the handwheel end.
3. Machine the torque nut to suit the valve stem or gearbox input shaft (see LMENSS2326, MX Performance and Dimensions for maximum stem capacity). Ensure sufficient clearance for a smooth, sliding fit.

Reassembly

1. Clean the torque nut thoroughly and lightly grease.
2. Replace the torque nut in the drive sleeve. Ensure the torque nut meshes with the drive lugs.
3. Refit the retaining ring (B4 base) or spiral-wound ring (B4E base).

Optional B1 Base (not available for MX-85, MX-140 and MX-150)

An optional torque base assembly may be added to allow for a greater stem acceptance. This base is supplied with a fixed bore and key as defined by ISO 5210.



Disassembly

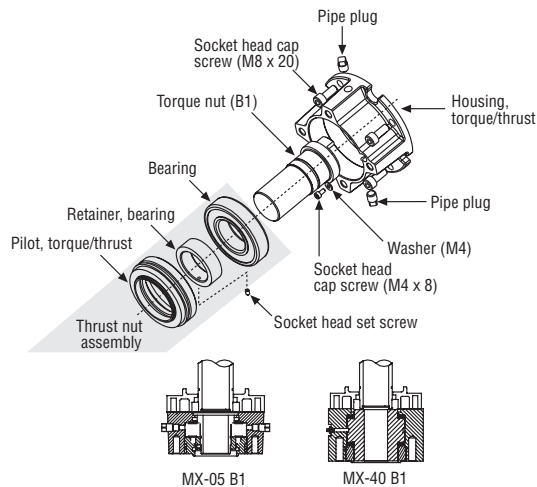
No disassembly is required since the torque nut has been machined to an international standard. Clean the bore and lightly grease.

Figure 3.4 – B1 base



NOTE: Fill base with a Lithium based EP0 grease.

Figure 3.5 – Exploded view of B1 base



3.1.2 Type “A” Bases: Thrust-only Applications

Standard A1/A1E Base

The standard MX actuator thrust base is the A1, and may be bolted directly to the actuator. The thrust base contains a bronze alloy thrust nut that may be machined to suit the valve stem.

An A1E (extended) thrust nut can be provided and may be installed to reach shorter stems.

Figure 3.6 – A1 base



Disassembly – Units MX-05/10/20/40

Refer to Figure 3.7.

Disassembly of the main housing from the base may be recommended to allow the base to remain on the valve if the actuator must be removed for service.



Pilot removal

MX-10/20: Remove the screw and washer holding the valve pilot to the thrust base and remove pilot.

MX-40: Turn counterclockwise (CCW) and remove.

Thrust bearing and nut removal

1. Remove the first set of thrust washers and bearing.
2. Remove stem nut.

NOTE: The thrust washers, bearing, and thrust nut may be removed at the same time. The second set of thrust washers and bearing does not have to be removed.

3. Machine the thrust nut to suit the valve stem. Ensure sufficient clearance to avoid unnecessary wear and heating during operation.

Reassembly – Units MX-05/10/20/40

Refer to Figure 3.7.

1. Clean the thrust nut, washers, and bearing(s) thoroughly.
2. Slide second set of thrust washers and bearing in place if removed.

NOTE: Order of assembling thrust washers and bearing must be as follows: washer, thrust bearing, washer.

Pilot installation

MX-05/10/20: Slide pilot into thrust base assembly and secure with washer and screw. Tighten fully.

MX-40: Place pilot into thrust base and turn clockwise (CW) until pilot is tight.

NOTE: Fill base with Nebula EP 0, Conoco Conolith EP 00, Mobil SHC 632, Dynalife-L-EP0, Triton ELL, or Lithium based EP0 grease.

Disassembly – Units MX-85

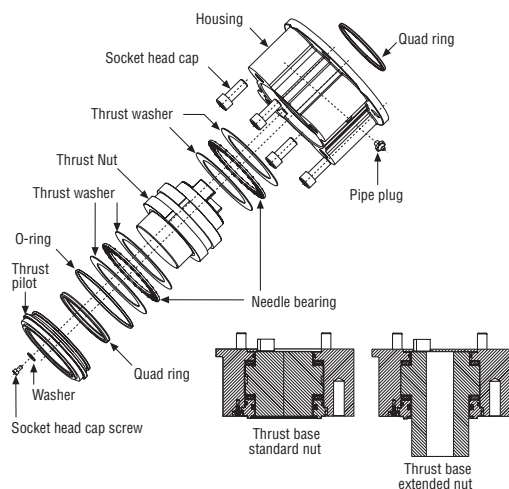
Refer to Figure 3.8.

Disassembly of the main housing from the base may be recommended to allow the base to remain on the valve if the actuator must be removed for service.

Thrust base mounting plate removal

Remove the six socket head cap screws holding the valve mounting plate to the thrust base housing and remove mounting plate.

Figure 3.7 – Exploded view of A1/A1E base (MX-05/10/20/40 only)




Thrust bearing and nut removal

1. Remove the first set of thrust washers and bearing.
2. Remove stem nut.

NOTE: The thrust washers, bearing, and stem nut may be removed at the same time. The second set of thrust washers and bearing does not have to be removed.

3. Machine the stem nut to suit the valve stem. Ensure sufficient clearance to avoid unnecessary wear and heating during operation.

Reassembly – Units MX-85

Refer to Figure 3.8.

1. Clean the stem nut, washers, and bearing(s) thoroughly.
2. Slide second set of thrust washers and bearing in place if removed.
3. Install stem nut. Lubricate thoroughly.
4. Install first set of thrust washers and bearing.

NOTE: Order of assembling thrust washers and bearing must be as follows: washer, thrust bearing, washer.

NOTE: Fill base with Nebula EP 0, Conoco Conolith EP 00, Dynalife-L-EP0, Mobil SHC 632, Triton ELL, or Lithium based EP0 grease.

Thrust baseplate installation

Mount baseplate to thrust base housing and install the six socket head cap screws to the proper torque per Table 3.1.

Table 3.1 - Hardware and torque for thrust base mounting

Screw Size	Torque	
	ft-lb	N m
M8 or 5/16 in. (8 mm)	12-14	16-19
M10 or 3/8 in. (9 mm)	25-30	33-40
M12 or 1/2 in. (13 mm)	40-50	53-67
M16 or 5/8 in. (16 mm)	90-100	122-135
M20 or 3/4 in. (19 mm)	180-200	244-271

NOTE: Screw mounting torque for mounting thrust base to main housing or thrust baseplate to thrust base housing.

Limitorque MX Electronic Actuator FCD LMENIM2306-04 – 2/11

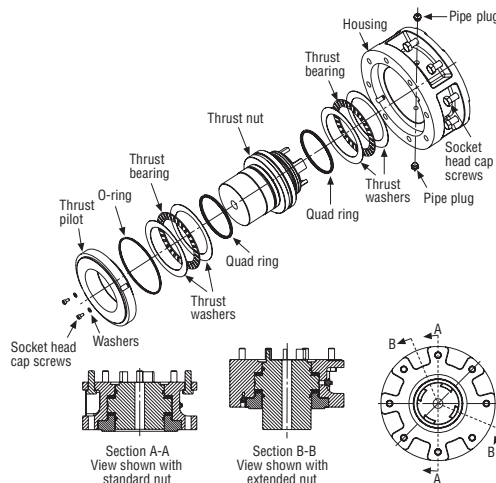
Pilot installation

Slide pilot into thrust base assembly and secure with the two washers and screws. Tighten fully.

3.1.3 Type “BL” Drive: Splined Drive Application

Steel alloy splined nuts are provided to a standard involute spline category for rising and rotating stem valves per customer requirements. Disassembly and reassembly is the same as the B4 base and the torque nut. See Section 3.1.1, Type “B” Bases: Torque-only Applications.

Figure 3.9 – Exploded view of thrust base (MX-140/MX-150 only)



3.2 Mechanical Installation onto Valve or Gearbox

NOTE: Refer to MX Maintenance and Spare Parts bulletin (LMENIM2314) for more detailed instructions.

Before installing the actuator onto a valve or gearbox, check the following to ease installation:

- Verify that mounting flange is suited dimensionally to mate with the actuator base. Ensure that it is perpendicular to the valve stem or gearbox input shaft.
- Ensure the stem nut mates with the valve stem or input shaft. For screwed nuts, it is advisable to run the stem nut down the entire length of the stem to check for tightness. Keyed or splined shafts should exhibit a smooth, sliding fit with the key installed.
- Ensure there is adequate engagement of the stem nut with the valve stem or input shaft when mounted. Generally, the minimum length of engagement is 1.5 times the diameter of the stem.
- Verify that mounting studs or bolts are the correct length to suit the thickness of the mounting plate.
- Verify hardware specifications for English style:
- Socket head cap screw per ASTM A 574 and ANSI 18.3.
- Hex head cap screw per SAE J429 Grade 5.
- Verify hardware specifications for metric style: hex and socket head cap screws per Property Class 12.9.
- Clean and lubricate the valve stem or input shaft.
- Ensure adequate lifting facilities and slings are available at the installation site.

NOTE: Do not use the handwheel to lift the actuator.



3.2.1 Mounting (Type “B” Bases): Torque-only

Refer to Figures 3.1 - 3.5.

1. Ensure torque nut is secured inside actuator drive sleeve with retaining ring.
2. Lower actuator onto the valve or gearbox stem. Align the stem nut key and keyway with valve or gearbox stem key seat.
3. Verify that the actuator and valve mounting adapter flanges mate correctly.
4. Secure the actuator to the valve mounting adapter with mounting bolts.

3.2.2 Removal (Type “B” Bases): Torque-only

Refer to Figures 3.1 – 3.5.

1. Remove the bolts that secure the actuator to the valve mounting adapter. If type B1 base is used in addition to the standard type B4 baseplate, you may leave the B1 base attached to the actuator and remove as a unit.
2. Lift the actuator from the actuator mounting adapter.

3.2.3 Mounting (Type “A” Bases): Thrust-only

Refer to Figures 3.6 – 3.9.

1. The following are two options for mounting the type A base actuator:
 - a. If the type A thrust base was removed from the valve mounting adapter, replace the thrust base onto the valve mounting adapter. Ensure the thrust base stem nut has the lugs positioned upward to engage with the drive sleeve slots when the actuator is reinstalled. Rotate the bronze nut while holding the base steady.

or

 - b. If the thrust base is installed on the valve mounting adapter, proceed to step two.
2. Lower the actuator along the threaded valve stem and onto the valve mounting plate. Ensure the thrust base stem nut lugs properly engage and align with the drive sleeve slots.
3. Install the bolts to secure the actuator to the thrust base assembly.

3.2.4 Removal (Type “A” Bases): Thrust-only

1. Remove the bolts that secure the actuator to the thrust base assembly.
2. Remove the type A thrust base by removing the bolts that secure the actuator to the valve mounting adapter.

or

Leave the type A thrust base mounted to the valve mounting adapter until ready to remount the actuator. The thrust base will maintain valve position provided that the valve stem threads are locking.

3. Lift the complete actuator from the thrust base.



3.3 Electrical Connections

Verify that the supply voltage details on the nameplate are correct for this installation. Setup is non-intrusive; therefore, remove only the terminal cover to make electrical connections and to commission the actuator.

⚠ WARNING: The removal of any other covers without Limitorque's approval will void the warranty. Limitorque will not accept responsibility for any damage or deterioration that may occur as a result of cover removal.

3.3.1 Removing Terminal Cover

Remove the terminal cover as follows:

1. Remove the four cover screws using a 6 mm hexagonal wrench.
2. Remove the cover. XP units have long-spigoted covers and two tapped holes 180° apart. If the XP cover is difficult to remove, fit two of the cover screws into the tapped holes in the cover flange and jack out the cover. Take care to turn the screws by equal increments. Do not lever the cover off with a screwdriver, or similar object, since this may damage the flamepath on an explosionproof unit or the O-ring seal and seating face.

3.3.2 Terminal Compartment Documents

The OEM and user installation kits, wiring diagram, and test report are contained in the terminal compartment or with the actuator. Do not place them in the terminal compartment when the electrical connections have been completed.

NOTE: This instruction does not apply to valve manufacturers or similar installers of the actuator onto a valve prior to shipping to site. It is important that these items are available at the final destination site.

3.3.3 Sealing Cable/Conduit Entries

The sealing of cables and conduit entries should be done in accordance with National Standards or the Regulatory Authorities that have certified the actuators. This is particularly true for units that are certified for use in hazardous areas where the method of sealing must be to an approved standard and cable glands, reducers, plugs, and adapters must be approved and separately certified. All conduit entries should be sealed against the climatic conditions prevailing on-site, especially if temporary submersion is possible. All unused conduit entries should be sealed with threaded metal plugs. Plastic plugs are installed by Limitorque for shipping only and must not be used as permanent seals.

3.3.4 Recommended Terminal Connections

Power Terminals

Ring tongue connectors used on the power terminals should comply with the dimensions shown in Figure 3.10. For Additional information, consult terminal manufacturer.

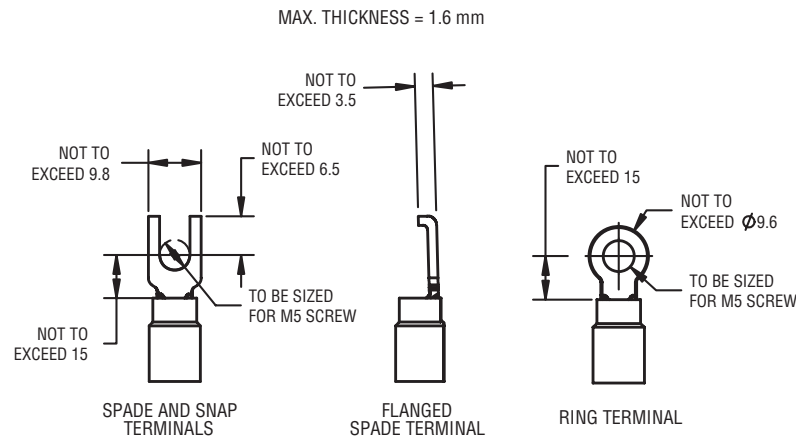
Figure 3.11 details the allowable voltage and current parameters for the terminal block power terminals. Preload the M5 screws to 1.6-3.2 N m (1.2-2.33 ft-lb).

Control Terminals

Ring tongue connectors used on the control terminals should comply with the dimensions shown in Figure 3.12. For additional information, consult terminal manufacturer. Preload the M3 screws to 0.33-0.66 N m (0.25-0.50 ft-lb).

NOTE: Alternative manufacturers may be substituted only if dimensions are in accordance with Figure 3.12.

NOTE: The use of spade terminals is not recommended for secure electrical connections.

Figure 3.10 – Power terminal connector size limitations

Figure 3.11 – Terminal block rating; power terminals

Description	L1	L2	L3
STD Rating	30 AMP	20 AMP	15 AMP
	8 Awg/10 mm ²	10 Awg/6 mm ²	14 Awg/2.5 mm ²
	600 VAC	RMS	150 VDC
Increased Safety Rating	27 AMP	18 AMP	13.5 AMP
	8 Awg/10 mm ²	10 Awg/6 mm ²	14 Awg/2.5 mm ²
	500 VAC	RMS	150 VDC

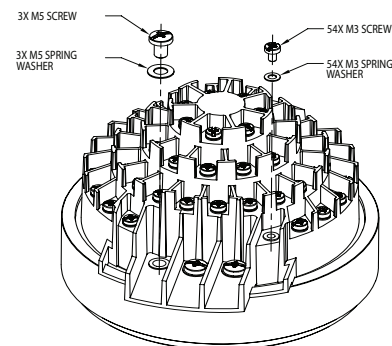
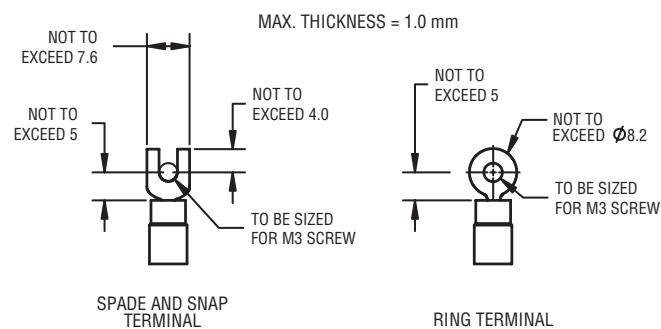
Figure 3.12 – Control terminal connector size limitations


FIGURE 3.13
THE USE OF THE SPRING WASHERS ARE REQUIRED ON INCREASED SAFETY APPLICATIONS.

NOTE: Limitorque recommends the use of the following connector for optimum results: Thomas and Betts #RZ22-6.

NOTE: Alternative manufacturers may be substituted only if the dimensions are in accordance with Figure 3.12.

Table 3.2 lists the maximum allowable voltage and current parameters for the terminal block control terminals.



Table 3.2 – Terminal block rating; control terminals

Low Voltage Row	STD Rating	Increased Safety Rating
1 points 1-16, 50 Volt	0.5 AMP AC RMS	0.45 AMP AC RMS
2 points 17-35, 125 Volt	0.5 AMP AC RMS	0.45 AMP AC RMS
3 and 4 points 36-54, 250 Volt	5 AMP AC RMS	4.5 AMP AC RMS

3.3.5 Termination of Cables

All terminations should be made with insulated ring terminals using the appropriate crimping tool. See Figures 3.10 and 3.11 for power terminal connection recommendations. See Figure 3.12 and Table 3.2 and 3.3 for control terminal connection recommendations.

3.3.6 Cable Connections

See Figure 3.14 for connection information.

1. Connect the main power supply cables, including the earth/ground wire using the M5 screws provided.
2. Attach the earth/ground wire to the separate screw on the inside of the terminal compartment.
3. Use the M3 screws installed in the terminal block to connect the control cables in accordance with the wiring diagram and the project specification.
4. Ensure that all connections are tight, including any spare termination screws that have not been used.

NOTE: A “Customer Connection(s) Diagram” sticker is attached to the interior of the terminal compartment cover. This may be removed and user termination numbers inscribed adjacent to Limitorque’s terminal block numbers for field connection reference. The diagram may also be used to assist in locating the terminal block positions. Service and factory contacts are contained on the sticker.

Certification is based on the use of appropriately rated wire for the application. Installation shall be in accordance with the current issue of the applicable national and or local electric code or regulations.

Table 3.3 – Required ratings for external wires

Up to	Use wire rated at least
40°C Ambient	75°C
55°C Ambient	90°C
60°C and 65°C Ambient ¹	105°C

Note 1: Refer to unit nameplate.

3.3.7 Network Installations

The Limitorque MX offers a number of network options: DDC-Modbus, Foundation Fieldbus H1, Profibus DP_V1, Profibus PA, and DeviceNet.

Ensure that the network cable type is Belden 3074F, Belden 3105, Belden 9841 or another cable that is within 5% of the following specifications.

- Nominal impedance: 120 ohms @ 1 MHz
- Line to shield capacitance: 23.0 pF/ft (75.5 pF/m)
- Line to line capacitance: 12.8 pF/ft (42.0 pF/m)

Using other cables may result in decrease of internodal distance and/or an increase in communication error.



Particular care should be taken when terminating twisted-pair shielded cables in a control network. Avoid nicks, cuts, or abrasions in the insulation of data communication cables, since this may result in inadvertent ground connection. Also, excess cable should be cut, not coiled or looped, to prevent noise induction into the network.

Figure 3.13 – View of terminal block

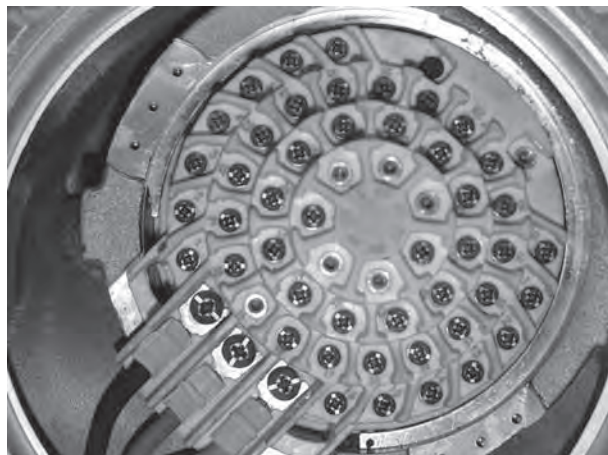
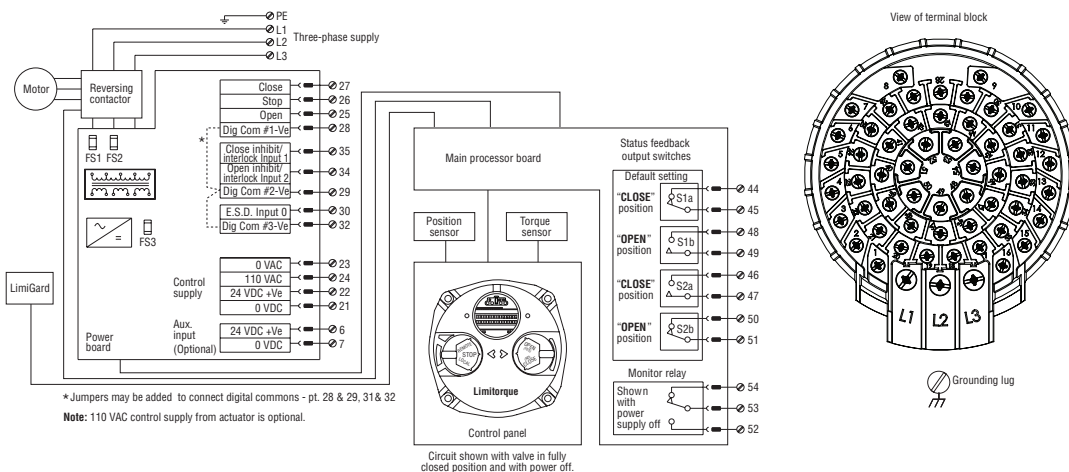


Figure 3.14 – Standard wiring diagram

NOTE: Most current wiring diagram is shipped within the terminal compartment of the MX.



Cable Preparation

Prepare the network cable for connection to the MX actuator terminal block as illustrated in Figures 3.15 through 3.18.

▲ CAUTION: Strip stranded conductors carefully; do not damage the strands. This will weaken the conductor. Do not nick conductors when stripping away the insulation. Nicking stresses the conductor and can cause the conductor to break. This type of damage may not be apparent and failure can occur later without warning.

1. Remove 2 to 3 in. (5 to 8 cm) of the outer plastic jacket as shown in Figure 3.15. Do not cut or nick the drain wire or the insulated conductors.

Figure 3.15 – Removing outer plastic jacket



2. Separate the cable parts. Unbraid the braided shield and peel back the foil shield to the same point where the outer jacket was removed as shown in Figure 3.16.
3. Cut away the braided shield and the foil shield. Strip the insulation from the conductors approximately ½ inch (1 cm) as shown in Figure 3.17.
4. Apply heat shrink tubing to insulate the drain wire and to provide stress relief to the cable.
5. Install ring tongue connectors as shown in Figure 3.18.

▲ CAUTION: Do not melt the insulation.

6. Connect the network cables to the MX actuator terminal block per Table 3.4 and appropriate wiring diagram. Table 3.3 details a connection for the loop topology.

Figure 3.16 – Separating cable parts

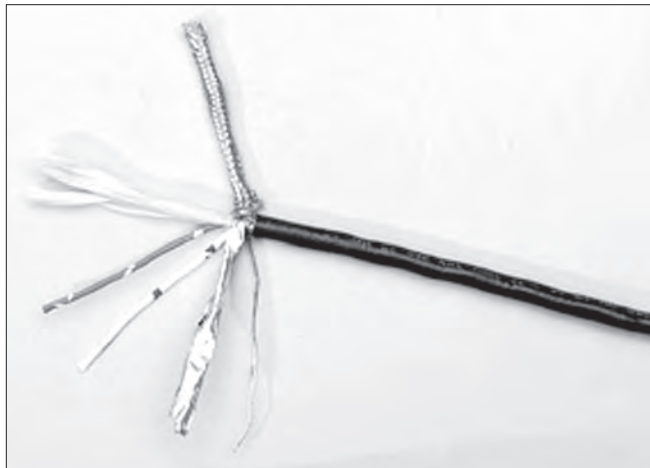


Figure 3.17 – Stripping conductors and applying heat shrink tubing



Figure 3.18 – Ring tongue connectors



Table 3.4 – Loop topology connections

Terminal Block Number	DDC
4	DATA-A1* (-)
5	DATA-A1 (+)
14	DATA-A2* (-)
13	DATA-A2 (+)
3	Surge Protection

In terms of voltage, DATA is negative with respect to DATA*.

NOTE: Surge protection must be grounded to be effective.

NOTE: Ground each segment of the cabling at only one point to prevent ground loops, which can affect system performance. Verify the actuator is properly grounded.

Limitorque defines an effective local earth ground as the M3 taps on the housing next to the terminal block. See figure 3.21.

NOTE: Safety ground may not be disturbed.

NOTE: Shielding is not sufficient to prevent induction of stray voltages onto signal leads from the power lines.

A network wiring diagram for a loop is shown in Figure 3.20.



After installation is complete and prior to operation, inspect the network cable and its connection to each field unit for the following:

There should not be:

- Nicks in the insulation—this can cause a short to the grounded shield.
- Cut strands in a stranded conductor—this can cause a poor connection and eventually an open circuit.
- Cable armor shorted to the cable shield/drain wire—this may not be at ground potential and could be subject to lightning surges.
- Shield/drain wire grounded at more than one end of each cable segment (the section between each adjacent actuator on the loop). This will avoid ground loop problems.
- Ground/earth connection except at true ground potential and effective at all times.

3.3.8 Foundation Fieldbus Installation

Ensure that the Foundation Fieldbus cable type is Belden 3076F, or another cable that is within 5% of the following specifications.

- Characteristic impedance: 100 ohms @ 31.25 kHz
- Resistance, each wire: 7.32 ohms/1000 ft
- Attenuation: 0.914 dB/1000 ft @ 39 kHz
- Capacitive Unbalance: 3.6 pF/ft

Using other cables may result in decrease of internodal distance and/or an increase in communication error.

Particular care should be taken when terminating twisted-pair shielded cables in a FF control network. Avoid nicks, cuts, or abrasions in the insulation of data communication cables, since this may result in inadvertent ground connection. Also, excess cable should be cut, not coiled or looped, to prevent noise induction into the network.

Cable Preparation

Prepare the network cable for connection to the MX actuator terminal block as follows in Figure 3.15 through 3.18. Table 3.5 details connections for Foundation Fieldbus.

Table 3.5 – Foundation Fieldbus connections

Terminal Block Number	FF Function
4	DATA (-)
5	DATA (+)

The shield must be connected to ground or earth at only one place. The cable shield is generally grounded at the power conditioner.

Reference the Fieldbus Foundation Application Guide 31.25 kbit/s Wiring and Installation guide for more information on network wiring.

- ⚠ CAUTION:** Strip stranded conductors carefully; do not damage the strands. This will weaken the conductor. Do not nick conductors when stripping away the insulation. Nicking stresses the conductor and can cause the conductor to break. This type of damage may not be apparent and failure can occur later without warning.



3.3.9 Network Wiring – Profibus DP/PA Installation

Profibus DP is based on RS 485 communication. The standard EN 50170 specifies the cable for use with Profibus DP.

The following specifications need to be fulfilled by the Profibus cable:

Table 3.6 – Profibus cable specifications

Parameter	Type – Profibus DP
Impedance	135 to 165 ohm/3 to 20 MHz
Capacity	< 30 pF/m
Resistance	< 110 ohm/km
Wire gauge	> 0.64 mm
Conductor area	> 0.34 mm ²

The Profibus DP cable is a shielded twisted pair cable.

In general, there are two different types of cables available. The most commonly used cable has solid wire for the Profibus line. When there is a need for more flexibility (bending) and higher environmental resistance, a cable with stranded wire for the Profibus line and special jackets shall be used. Limitorque recommends the use of:

- Belden 3079A Specifications, 22 AWG, shielded, solid two conductor

Key Specifications

- Capacitance/ft = 8.5 pF
- Nominal Impedance (ohms) – 150.0

Network Wiring - Profibus PA

Please refer to IEC 61158 & ANSI/ISA S.50.02 Part 2-1992 for network wiring guidelines. Refer to Table 3.5 for connections.

3.3.10 Network Wiring – DeviceNet

DeviceNet is a CAN-based protocol that uses five wires including a shield. Two of the conductors are used for 24 VDC power and up to 8 amps (4 amps for NEC Class 2) may be passed along the hi-way from a suitable power source. Two conductors are used for the CAN bus signals, CAN_H and CAN_L, which are usually smaller in diameter. Flowserve recommends Belden 3082A cable for connecting to a DeviceNet network. The specifications for this cable are preferred.

Table 3.7 – DeviceNet cable specifications

Belden Part No.	AWG (Stranding) dia. Inches Nom. DCR	Insulation material (color code)	Nominal O.D.	Nom Impedance (ohms)	Nominal Capacitance	Test Frequency (MHz)	Maximum Attenuation dB/100ft
3082A	2 – 15 AWG (19 x 28) 3.6 ohm/1000 ft 11.8 ohm/km	Power pair (Black/Red)	12.2 mm	120	12.0 pF/ft	0.125 0.5 1	0.13 0.25 1.36
	2 – 18 AWG (19 x 30) 6.9 ohm/1000 ft 22.7 ohm/km	Data pair (Blue/White)					
3084A	2 – 22 AWG (19 x 34) 17.5 ohm/1000 ft 57.4 ohm/km	Power pair (Black/Red)	7.2 mm	120	12.0 pF/ft	0.125 0.5 1	0.29 0.50 1.70
	2 – 18 AWG (19 x 36) 28.0 ohm/1000 ft 91.9 ohm/km	Data pair (Blue/White)					



Please refer to Table 3.4 for connections.

3.3.11 Replacing Terminal Cover

Verify that the O-ring seal and spigot joint are clean and in good condition. Lightly coat these items with mineral-based lubricant before replacing the terminal cover and four retaining screws.

3.3.12 External Earth/Ground Connections

In order to help meet the local electric codes of the installation, one external connection point is provided on the main gear housing for the attachment of earth/ground cables. See Figure 3.21. This is in addition to the ground connection inside the terminal compartment.

3.4 Terminal Block Shield Installation

STEP 1

Remove terminal block cover.

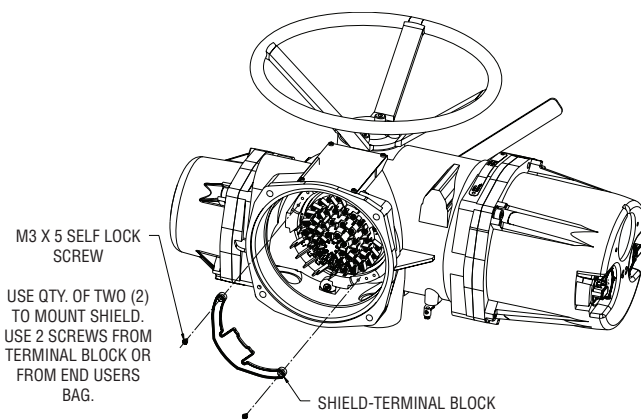
STEP 2

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

STEP 3

Remount terminal block cover.

Figure 3.19 – Terminal Block Shield



3.5 Commissioning the Actuator

Before attempting to commission the actuator, verify that the actuator is installed correctly on the valve and main power is “ON.”

After making the initial electrical connections detailed in Section 3.3, Electrical Connections, the MX actuator may be commissioned without removing any covers. No special tools are required. Configuration is accomplished through the use of the LCD and the control knobs mounted on the control panel.

For positioning the actuator:

1. Place the red knob in the “LOCAL” position.
2. Move the black knob to the “OPEN” or “CLOSE” position.

**For configuring the actuator:**

1. Place the red knob in the “STOP” position.
2. Move the black knob to the “YES” or “NO” position and release to answer questions appearing on the LCD display.

The OPEN and CLOSE position limits must be set after the actuator has been mounted on the valve. See Section 3.5.4, Setting Position Limits. All other actuator parameters are factory-set either in accordance with a Limitorque standard set of default values (see Section 3.5.1, Default Configuration Set) or the requirements specified with the purchase order. Reconfirm these preconfigured settings prior to placing the actuator into service since the requirements of the application may have changed after the manufacture of the actuator. See Section 3.5.2, View the Existing Settings.

3.5.1 Default Configuration Set

Unless otherwise specified, actuators are shipped with the following configuration:

- When Open stopped by position limit; Open seating (position)
- When Close stopped by position limit; Close seating (position)
- Maintained local control; Mode (maintained)
- Clockwise to close; Close direction (CW)
- ESD – User configurable inputs; default is “OFF”
- Inhibits on; Inhibit status (Default = OFF)
- Remote control – three-wire maintained
- Password – 100

*Figure 3.20 – User network connection for loop topology/
Typical for all two-wire network protocols*

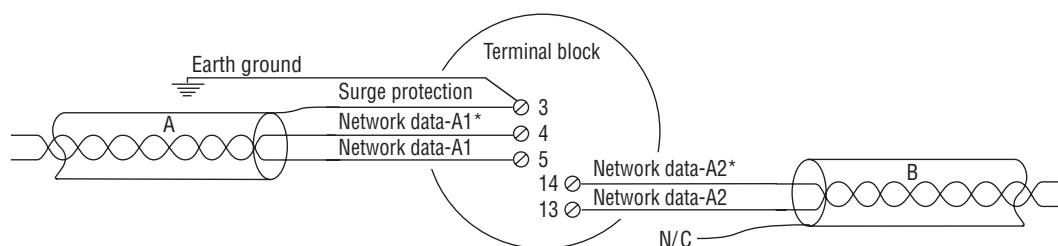


Figure 3.21– External earth/ground connection – housing

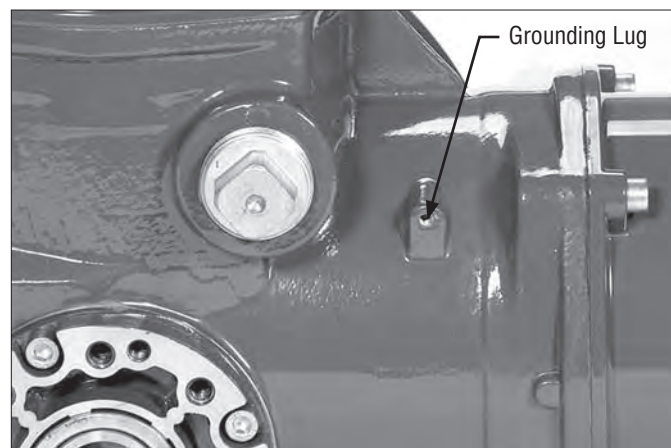




Table 3.8 – Default configurations

Modutronic Option Proportional band – 15% Deadband – 2% Polarity – 20 mA = Open Action on loss of signal = Close	Modbus RTU protocol 9600 baud Analog scale = 0-100 Proportional band – 15% Deadband – 2% Offset – 0 mA
FF Option and PB Option Analog scale = 0-100 Proportional band – 15% Deadband – 2%	

If the default configuration is acceptable, no further configuring is necessary. If any default setting needs to be changed, see Section 4, Customizing the Actuator.

3.5.2 View the Existing Settings

All the existing setup data may be viewed on the LCD display by following a simple step-by-step dialog that may be selected in the following languages: English (default), Spanish, French, German, Italian, Portuguese, Russian, Malay, Mandarin, and Katakana.

1. Enter the “SETUP” mode as detailed in Section 2.1.1, Entering the Setup Mode.
2. Select the dialog language. Toggle “NO” to scan the language options. Select “YES” when the desired language appears on the LCD.
3. Scan menu selections on LCD and select “YES” when “VIEW SETTINGS” appears.
4. Scan through the series of displays and answer “YES” or “NO” at the appropriate prompts. Each display shows the state or value of the existing settings. See Figure 3.22.

NOTE: The “VIEW SETTINGS?” mode can be accessed without entering a password, but no changes to the settings can be made in this mode.

3.5.3 Entering the Setup Mode

To customize the actuator, view settings, or view diagnostics, the user must enter the “SETUP” mode. A three-digit password is required to customize the actuator. All actuators are supplied with the same default password (100). See Sections 4.2 and 4.3, Password Entry and New Password for entering and changing password. Main power must be applied to execute the setup procedure. It is recommended that the actuator be mounted to the valve before commissioning the actuator.

Enter the “SETUP” mode as follows:

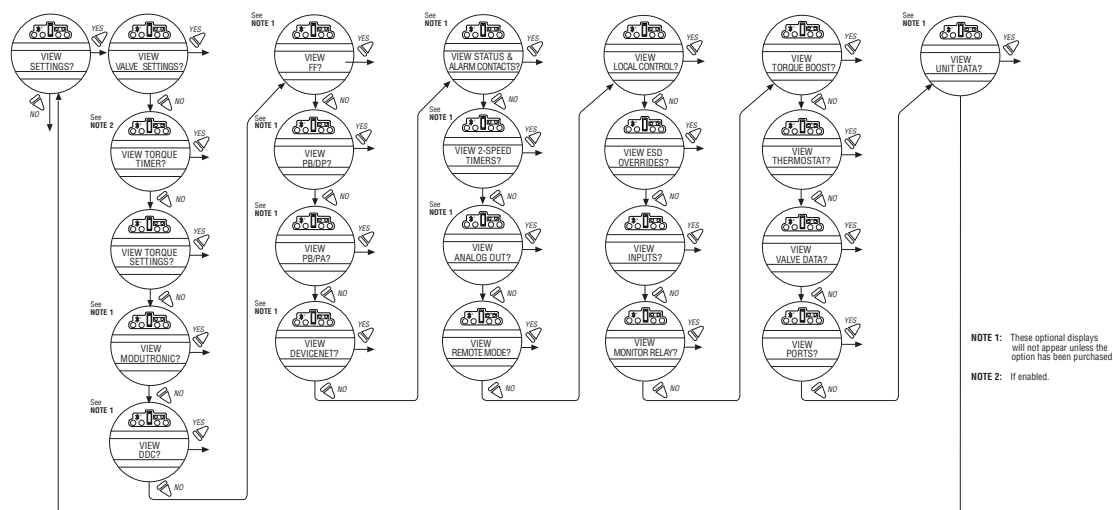
1. Place the red knob in the “STOP” position.
2. Within 10 seconds, place the black control knob in the “YES” position, then the “NO” position, then again in the “YES” position (in quick succession—approximately one-two seconds).
3. The LCD will display “SETUP?” for 10 seconds. If no action is taken within the 10 seconds, the unit will return to “STATUS OK.”
4. Using the black knob, answer “YES” or “NO” to the questions appearing on the LCD display.

NOTE: While in the “SETUP” mode, if there is a lapse of 15 minutes from last action, the unit will return to the “SETUP?” display. Any changes that have been made will be stored.

- When configuration is complete, answer “YES” to “EXIT SETUP?” or move the red knob from “STOP” to “LOCAL” or “REMOTE.”

After exiting the “SETUP” mode, all settings will automatically be saved to a non-volatile memory and retained, even when power is removed from the actuator. However, if power is removed from the unit while the unit is in “SETUP” mode, customization changes will be lost.

Figure 3.22 – View settings



3.5.4 Setting Position Limits

This section will advise how to configure end-of-travel limits.

The actuator’s position limits may be set by manual operation or electrical operation.

⚠ WARNING: If the actuator will not move after setting the limits, the limits have been set incorrectly.

Set Close Position Limit (Handwheel Operation)

- Enter the “SETUP” mode as detailed in Section 2.1.1, Entering the Setup Mode.
- Enter “POSITION SETUP?” routine.
- From the “SET CLOSE POSITION LIMIT?” display, select “YES.” “CLOSE VALVE OK?” will be displayed on the LCD.
- Engage manual override as detailed in Section 3.6.1, Manual Operation.
- Ensure that the valve is fully closed.
- Move the valve in the open direction for one handwheel turn to allow for coasting of the motor.
- When the valve is positioned correctly, select “YES” again. The LCD will display “SAVE CLOSE LIMIT OK?”
- Select “YES.”

The close position limit is now calibrated. Check the position limit setting as follows:

- Move the valve in the open direction. The close lamp should extinguish with approximately one turn of the handwheel.



2. Move the valve back in the close direction and check that the close lamp illuminates just before the full close position is reached (approximately ½ to 1 turn).
3. Select “YES” at the “SET OPEN POSITION LIMIT?” prompt.
4. Set Position Precision? The MX permits position to be reported to the User in either default mode of XXX% OPEN, or single precision mode of XXX.X% OPEN. This may be preferred in Modulating or other positioning applications such as network move-to, analog fail move-to, communication loss move-to, or ESD move-to.

If the calibration requires adjustment:

1. Select “NO” at the “SET OPEN POSITION LIMIT?” prompt.
2. Repeat the “SET CLOSE POSITION LIMIT?” routine.

NOTE: The green LED is the default setting for indicating the (CLOSE) position.

Set Open Position Limit (Handwheel Operation)

1. From the “SET OPEN POSITION LIMIT?” display, select “YES.” “OPEN VALVE OK?” will be displayed on the LCD.
2. Engage manual override as detailed in Section 3.6.1, Manual Operation.
3. Ensure that the valve is fully open.
4. Move the valve in the close direction for one handwheel turn to allow for coasting of the motor.
5. When the valve is positioned correctly, select “YES” again. The LCD will display “SAVE OPEN LIMIT OK?”
6. Select “YES.”

The open position limit is now calibrated. Check the open position limit setting as follows:

1. Move the valve in the close direction. The open lamp should extinguish with approximately one turn of the handwheel.
2. Move the valve back in the open direction and check that the open lamp illuminates just before the full close position is reached (approximately ½ to 1 turn).
3. Select “YES” at the “SET OPEN POSITION LIMIT?” prompt or “NO” to exit “POSITION SETUP?” dialog.

If the calibration requires adjustment:

1. Select “NO” at the “SELECT CLOSE POSITION LIMIT?” prompt.
2. Repeat the “SELECT OPEN POSITION LIMIT?” routine.

NOTE: The red LED is the default setting for indicating the (CLOSE) position.

Set Close or Open Position Limit (Electrical Operation)

1. Enter the “SETUP” mode detailed in Section 2.1.1, Entering the Setup Mode.
2. Enter “POSITION SETUP?” routine.
3. During “CLOSE VALVE - OK?” or “OPEN VALVE - OK?,” move the red knob to “LOCAL” and use the “OPEN” and “CLOSE” switch.

Unit will only operate locally and only in the push-to-run configuration (Inching mode). This does not exit the startup routine—moving red selector knob back to “STOP” returns the user to the same message. This permits the valve to be placed at its travel limits and avoids the necessity to use the handwheel. The unit will run while the black knob is engaged with no stop limit when in this mode. Any previously set travel limits will be ignored.

-
- Figure 1: Sequence of operations for setting limits.**
- The diagram illustrates the sequence of operations for setting limits, divided into three main sections: Close Limits, Open Limits, and Position Precision.
- Close Limits Section:**
- STOP** (Speaker icon)
 - SET CLOSE POSITION LIMIT?** (Speaker icon)
 - YES** (Speaker icon) → **CLOSE VALVE OK?** (Speaker icon)
 - NO** (Speaker icon) → **Switch to LOCAL** (Speaker icon)
 - CLOSE VALVE RETURN TO STOP** (Speaker icon)
 - STOP** (Speaker icon)
 - CLOSE VALVE OK?** (Speaker icon)
 - YES** (Speaker icon) → **SAVE CLOSE LIMIT OK?** (Speaker icon)
 - NO** (Speaker icon) → **Switch to LOCAL** (Speaker icon)
 - SAVE CLOSE LIMIT OK?** (Speaker icon)
 - YES** (Speaker icon) → **IDENTICAL LIMITS KEEP CLOSE LIMIT?** (Speaker icon)
 - NO** (Speaker icon) → **Switch to LOCAL** (Speaker icon)
 - IDENTICAL LIMITS KEEP CLOSE LIMIT?** (Speaker icon)
 - YES** (Speaker icon) → **Switch to LOCAL** (Speaker icon)
- Open Limits Section:**
- SET OPEN POSITION LIMIT?** (Speaker icon)
 - YES** (Speaker icon) → **OPEN VALVE OK?** (Speaker icon)
 - NO** (Speaker icon) → **Switch to LOCAL** (Speaker icon)
 - OPEN VALVE RETURN TO STOP** (Speaker icon)
 - STOP** (Speaker icon)
 - OPEN VALVE OK?** (Speaker icon)
 - YES** (Speaker icon) → **SAVE OPEN LIMIT OK?** (Speaker icon)
 - NO** (Speaker icon) → **Switch to LOCAL** (Speaker icon)
 - SAVE OPEN LIMIT OK?** (Speaker icon)
 - YES** (Speaker icon) → **IDENTICAL LIMITS KEEP OPEN LIMIT?** (Speaker icon)
 - NO** (Speaker icon) → **Switch to LOCAL** (Speaker icon)
 - IDENTICAL LIMITS KEEP OPEN LIMIT?** (Speaker icon)
 - YES** (Speaker icon) → **Switch to LOCAL** (Speaker icon)
- Position Precision Section:**
- SET POSITION PRECISION?** (Speaker icon)
 - YES** (Speaker icon) → **POSITION XXX.X% OPEN?** (Speaker icon)
 - NO** (Speaker icon) → **Switch to LOCAL** (Speaker icon)
 - POSITION XXX.X% OPEN?** (Speaker icon)
 - YES** (Speaker icon) → **POSITION XXX.X% OPEN?** (Speaker icon)
 - NO** (Speaker icon) → **Switch to LOCAL** (Speaker icon)
 - EXIT SETUP?** (Speaker icon)
 - YES** (Speaker icon) → **100% OPEN STATUS OK?** (Speaker icon)
 - NO** (Speaker icon) → **Switch to LOCAL** (Speaker icon)
- Notes:**
- NOTE 1:** If open and close limits are not identical
 - NOTE 2:** If open and close limits are identical

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Moving the red knob from “STOP” to “LOCAL” or “REMOTE” automatically saves to non-volatile memory all the changes that have been made.

3.6 Operating the MX Actuator

3.6.1 Manual Operation

Operate the actuator with the handwheel as follows:

1. Depress the declutch lever and, at the same time, slowly rotate the handwheel until the clutch is fully engaged.
2. Release the lever and it will return to its original position. The clutch will be retained in the handwheel mode by spring-loaded latches.

Manual operation is now possible and the actuator can only be returned to motor operation by energizing the motor. Energizing the motor will trip the spring-loaded latch and allow the clutch to disengage from the handwheel and re-engage with the gear drive. To prevent unauthorized manual operation of the actuator, the declutch lever may be padlocked in “MOTOR” mode. A ½ inch size padlock is recommended.

3.6.2 Electrical Operation

Before applying power to the actuator, check that the supply voltage details on the nameplate are correct for this installation. An incorrect supply connected to the actuator terminals could cause fuses to blow or cause permanent damage to the electrical components in the unit. Phase rotation need not be checked since all units are supplied with an Autophase Correction feature. Apply power to the actuator but do not operate the actuator without first checking that it has been set up and configured correctly for its intended application.

Figure 3.24 – Declutch lever shows direction of engagement (MX-05 shown)



3.6.3 Local Control

Once the position limits have been set (see Section 3.5.4, Setting Position Limits) and the default mode is the maintained mode, the actuator can be controlled locally from the control panel.

1. Place the red selector knob in the “LOCAL” position.
2. Select “OPEN” or “CLOSE” via the black control knob.

If maintained control has been selected, the actuator will continue to run when this control knob is released. The actuator may be stopped at any time by placing the red selector knob in the “STOP” position, or the direction may be reversed or stopped using the black control knob.

If non-maintained control mode (inching) has been selected, the actuator can be inched to any intermediate position by holding the black control knob in the desired position, “OPEN” or “CLOSE,” for as long as necessary. The actuator will stop when the knob is released.



3.6.4 Remote Control

Once the position limits have been set, and “REMOTE” mode is enabled:

1. Place the red selector knob in “REMOTE” to permit command control by a remote device. Local “OPEN/CLOSE” mode will be prevented.
2. Rotating the red selector knob to the “STOP” position will automatically stop the actuator regardless of the remote control signal unless ESD override has been selected. See Section 4.18, ESD (Emergency Shutdown) Overrides.

The red selector knob may be locked in or out of any of its three positions, “LOCAL/STOP/REMOTE,” using a padlock. A ¼ inch padlock is recommended.

The LCD displays status and valve position. In normal operation mode, the top line displays “XXX % OPEN,” while the bottom line displays “STATUS OK.” Refer to Section 4.13, Status and Alarm Contacts for a list of “ALARM” or “STATUS MESSAGES.” Table 3.9 details the LED indicators’ default settings.

3.6.5 Local Indication

Figure 3.25 – Control panel

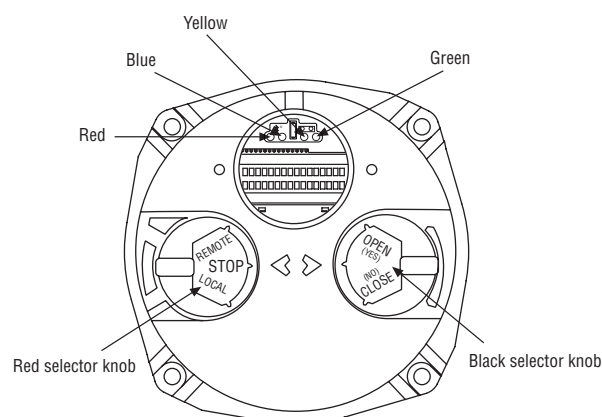


Table 3.9 – LED Indicators – default settings

LED Indicator			Operation Description
Yellow	Red	Green	
OFF	ON	OFF	Valve is fully open (Red knob in “REMOTE”)
OFF	OFF	ON	Valve is fully close (Red knob in “REMOTE”)
OFF	OFF	Blinking	Valve is closing (Red knob in “REMOTE”)
OFF	Blinking	OFF	Valve is opening (Red knob in “REMOTE”)
ON	OFF	OFF	Actuator in “REMOTE” and stopped in mid-travel
Blinking	OFF	OFF	Monitor relay alarm or actuator (red knob) in “LOCAL” or “STOP”

Red and green LED indicators can be reversed. See Section 4.17, Local Control.

NOTE: The blue LED indicator is supplied to indicate optional Bluetooth availability in the MX. This LED will light when the Bluetooth feature is recognized by an external Bluetooth enabled device.



4 Customizing the Actuator

The actuator settings can be customized; i.e., the default settings can be changed and the purchased options can be configured.

Language selection can also be customized. At the “SETUP IN ENGLISH?” prompt, select “NO” to move between the following languages: English, Spanish, German, French, Italian, Portuguese, Russian, Malay, Mandarin, and Katakana.

4.1 Changing the Existing Settings

1. Verify main power is ON.
2. Enter the “SETUP” mode as detailed in Section 2.1.1, Entering the Setup Mode.
3. Answer “YES” to “Change Settings.”
4. Enter password if required. See Section 4.2, Password Entry. To change any of the existing settings or to set the end-of-travel limits for the Open and Close positions of the valve, it may be necessary to enter a password.
5. Answer “YES” or “NO” to each of the following groups of setup data. A “YES” allows the selected setup data group menu to be displayed. A “NO” moves the user to the next setup data group. For details of each data group, see Sections 4.2 – 4.27, Password Entry through Change Port.
 - Valve setup
 - Torque Timer
 - Torque setup
 - Position setup
 - Modutronic
 - DDC (distributed digital control)
 - FF (Foundation Fieldbus control)
 - PB (Profibus Control)
 - DN (DeviceNet Control)
 - Status and alarm contacts
 - Two-speed timer
 - Analog Output
 - Remote mode
 - Local control
 - ESD Overrides (emergency shutdown)
 - Inputs
 - Monitor Relay
 - Diagnostic reset
 - TAG Number
 - LCD contrast



- Password
 - Torque Boost
 - Motor thermostat
 - Valve Data
 - Port
 - Restricted Setup (consult factory)
- Make changes in each setup group as desired. Each display shows the state or value of the existing settings. See Figure 4.3.
 - When configuration is complete, answer “YES” to “EXIT SETUP?” Alternatively, the “SETUP” mode may be terminated at any time by moving the red selector knob from “STOP” to “LOCAL” or “REMOTE.” All the changes made so far will automatically be saved.

NOTE: Once you exit this mode and enter either the “VIEW SETTINGS?” mode or “VIEW DIAGNOSTICS?” mode, the password will need to be entered again to gain access to the “CHANGE SETTINGS?” mode in order to make further changes.

Figure 4.1 – Entering the setup mode

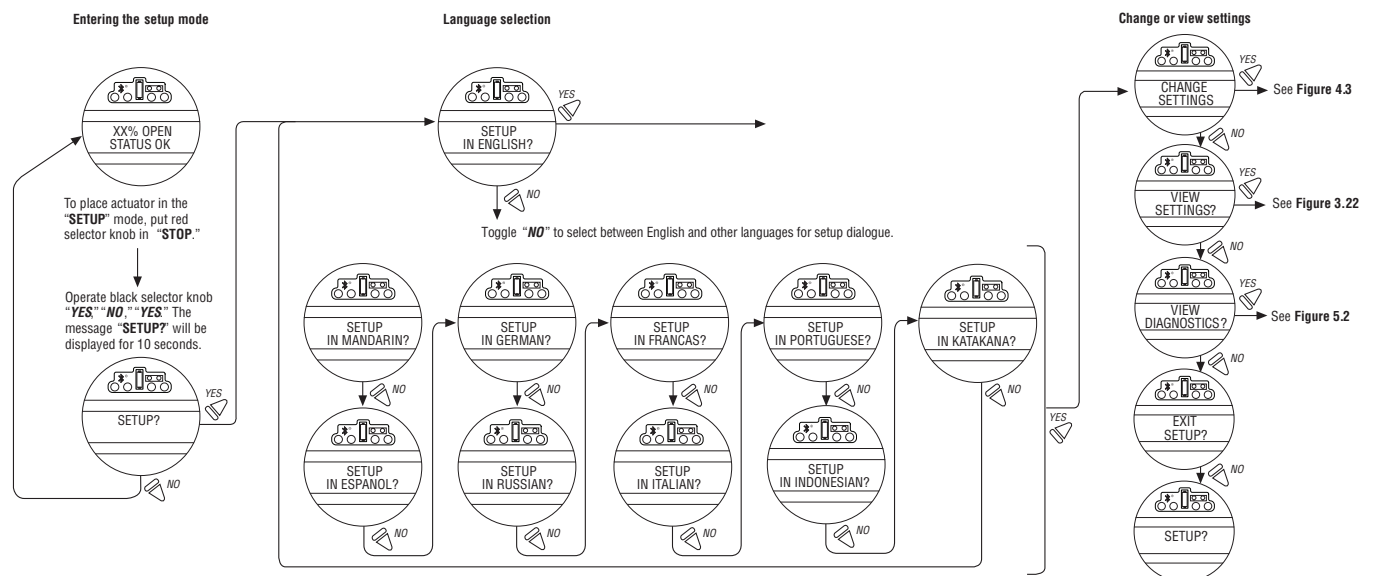




Figure 4.2 – Main menu selections

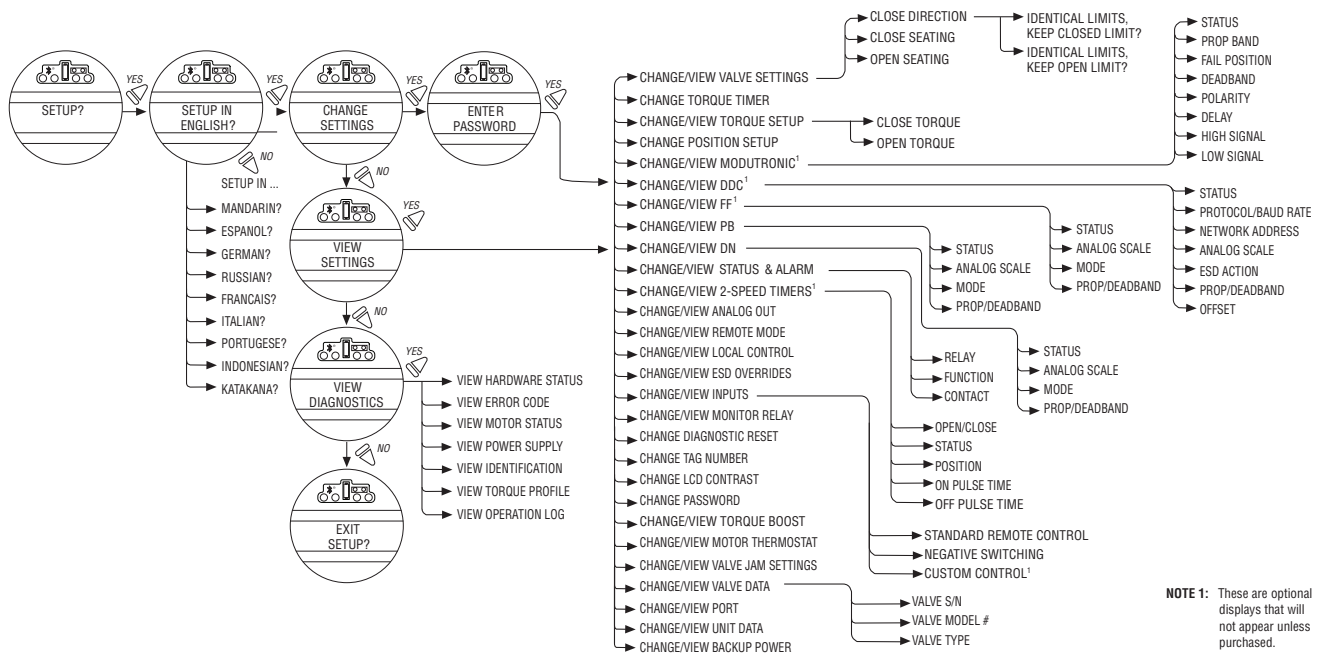
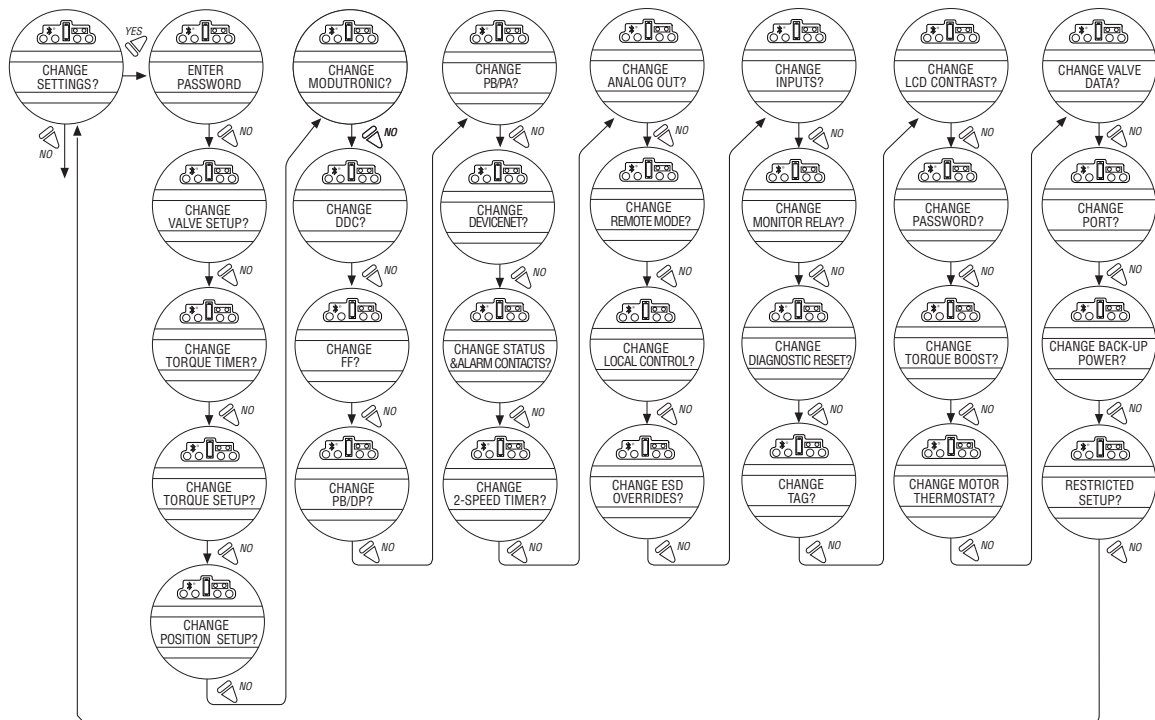


Figure 4.3 – Changing settings





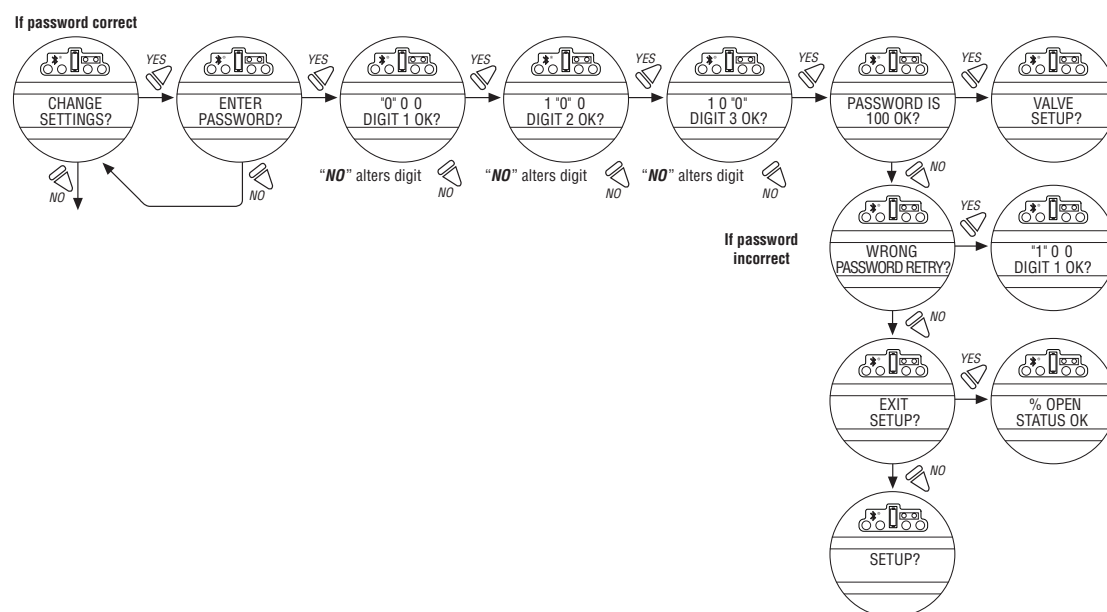
4.2 Password Entry

Default = 100

Unauthorized entry to the “CHANGE SETTINGS?” mode is prevented by a password protection feature. If password protection is not required, the password may be set to “000.” The user will not be prompted to enter a password when the password is set to “000.”

1. Enter the password digit by digit. The password is a three-digit number, ranging from 000-999. The factory default is 100.
2. If the wrong password is entered, re-enter the correct one. After three attempts to enter the correct password, a recovery screen will appear. The screen will display a serial number that can be used for password recovery. A password recovery service is available. Contact Limitorque service coordinator at (434) 528-4400.

Figure 4.4 – Password entry



4.3 New Password

The password may be changed from the default of 100 to a customer-selected value as indicated in Figure 4.5.

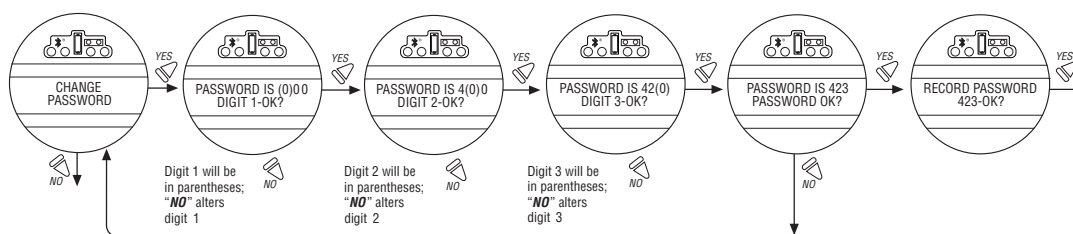
The new password becomes effective as soon as the operator answers “YES” to the “RECORD PASSWORD?” display.

NOTE: Take care to record the new password in a secure location to ensure its retrieval in the future, yet prevent unauthorized access to the actuator “SETUP” routine.

If password protection is not required, the password may be set to “000.” The user will not be prompted to enter a password when the password is set to “000.”



Figure 4.5 – New password



4.4 Valve Setup

Valve setup enables the actuator to be changed to suit the type of valve that it is mounted on.

4.4.1 Close Direction

Default = CW to Close

The majority of valves require clockwise (CW) rotation of the actuator drive sleeve when viewed from above the actuator.

1. Engage manual override and check whether the valve closes with CW or CCW rotation of the handwheel.
2. Select "NO" until the required direction is displayed, then "YES."

NOTE: If in doubt as to valve seating, consult the valve manufacturer.

NOTE: For torque seated valves, ensure that the "POSITION" limit is not set at "TORQUE" seat. It is recommended that the "POSITION" limit be set approximately one handwheel turn (360°) in the opposite direction from the "TORQUE" seat.

4.4.2 Close Seating

Default = Position Seating

1. Configure the actuator to close on "TORQUE" limit for seating valve types such as wedge gate and globe.
2. Select "POSITION" limit for valve types such as ball, butterfly, plug, sluice gate, parallel slide, knife gate, and through conduit.
3. Select "NO" until the required seating is displayed.
4. Select "YES."

4.4.3 Open Seating

Default = Position Seating

The majority of valves, regardless of their construction, seat on position limit in the open direction. Some valves are "back-seating" and require torque limit in the open direction.

1. Select "NO" until the required seating is displayed.
2. Select "YES" to return to the "VALVE SETUP?" display.



4.5 Torque Switch Timer

Torque switch timer permits a user to select a time for the torque switch to time out once the actuator determines that it has reached its torque seat. The torque switch timer can be adjusted from zero (0) seconds to a maximum of ten (10) seconds. The default is five (5) seconds.

NOTE: It should be noted that the purpose of this feature is to ensure that the torque sensing has shut off the motor after a brief period of time. It is an additional safety feature to prevent the actuator from reaching a stall torque.

If operating in torque seating for either open or close torque seating, a backup timer can be used to halt the actuator to protect the valve in case the actuator does not torque out after it has passed the expected limit.

1. From "VALVE SETUP?" select "NO" to enter "CHANGE TORQUE TIMER" routine. This option will only appear if either the open or close valve setting is set to torque seating.
2. Select "YES" to change setting. If "NO" is selected, the "POSITION SETUP?" routine will be entered.

4.5.1 Status

Default = ON

1. Select "NO" to change torque timer status to "OFF". If "OFF" is selected you will not advance to timer selection for that direction.

4.5.2 Torque Timer

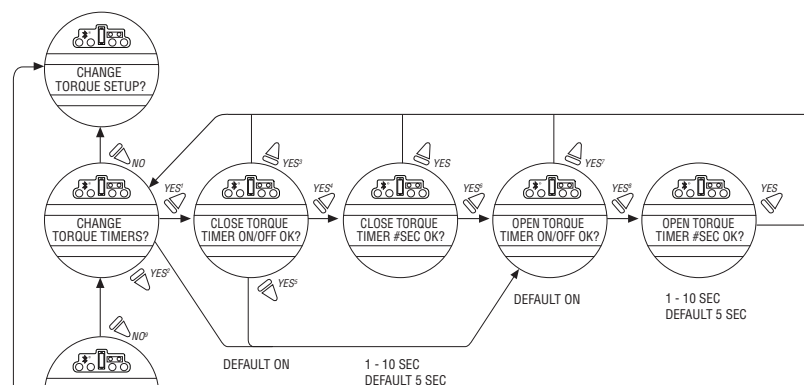
The timer value is how long in seconds that the unit will run once it has passed the expected position limit.

Default = 5 seconds

1. Select "NO" to increase the timer value. The timer is configurable from 1-10 seconds. The counter will wrap around to 1 second when you attempt to increase after 10 seconds.

NOTE: If the unit is only setup for open torque seating, then only the open torque timer will be available to change. This is the same with close torque seating and the close torque timer. If both open and close torque seating are selected then you will be prompted to change close torque timer first, followed by open torque timer.

Figure 4.6 – Torque Switch Timer



Note 1: YES & CLOSE Torque Seated
 Note 2: YES & OPEN Torque Seated CLOSE Position Seated
 Note 3: YES & TIMER OFF
 Note 4: YES & TIMER ON
 Note 5: YES & TIMER OFF & OPEN Torque Seated

Note 6: YES & OPEN Torque Seated
 Note 7: YES & TIMER OFF
 Note 8: YES & TIMER ON
 Note 9: NO & Open or Close Torque Seated
 Note 10: NO & OPEN/CLOSE Position Seated



4.6 Torque Setup

The output torque can be changed between 40% and 100% of the rated torque as follows:

1. From “VALVE SETUP?” or “CHANGE TORQUE TIMER?” (if enabled) select “NO” to enter the “TORQUE SETUP?” routine.
2. Select “YES” to change the settings.

If “NO” is selected, the “POSITION SETUP?” routine will be entered.

4.6.1 Close Torque Valve or Open Torque Valve

The output torque from the actuator to close or open the valve may be configured between 40% and 100% of the rated torque (as stated on the actuator nameplate), in 1% increments (unless limited by the factory).

To Increase the % of Torque Required:

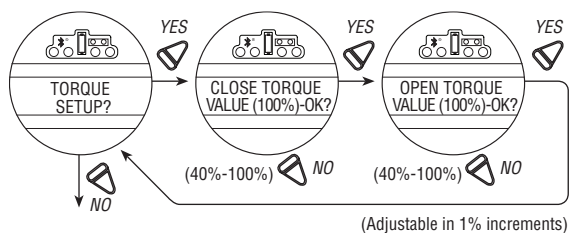
1. Select “NO” until the desired % is indicated.
2. Select “YES” to save the required torque.

Should the user select a maximum torque setting less than 100% due to valve or gearbox limitations, this selection can be password protected.

Figure 4.7 – MX Nameplate

FLOWSERVE Limitorque Actuation Systems
 Lynchburg, VA, USA
 APPROVED
 CE
 MX- [] OUTPUT RPM []
 ORDER No. []
 TAG No. []
 S/N []
 ENCLOSURE TYPE:
 3,4,4X,6,IP68
 ACTUATOR MAY HAVE MULTIPLE
 POWER SOURCES
 DO NOT OPEN ENCLOSURE
 WHILE UNIT IS ENERGIZED
 INSTALL PER MANUAL LMENIM306
 RATED TQ [] FT-LBS
 [] N·m
 -30°C ≤ T ≤ 60°C
 MOTOR RPM []
 PH. [] HZ. []
 VOLTS AC []
 L.R. AMPS []
 RUN AMPS []
 DUTY []

Figure 4.8 – Torque setup





4.7 Position Setup

Change Settings Menu. After successfully entering the password, answer “NO” to the Change Settings menu prompts until you reach the prompt “CHANGE POSITION SETUP?” Answer “YES.”

4.7.1 Set Position Limits for Electrical Operation

1. Set closed valve position. At the “CLOSE VALVE–OK?” prompt, move the red control knob to “LOCAL.” Hold the black control knob in the “CLOSE” position until the valve has reached the desired position. Move the red control knob to “STOP.”
2. Set the open valve position. At the “OPEN VALVE–OK?” prompt, move the red control knob to “LOCAL.” Hold the black control knob in the “OPEN” position until the valve has reached the desired position. Move the red control knob to “STOP.”
3. Inspect for correct operation. If the position limits are set adjacent to each other then an error message will be displayed: “KEEP OPEN (CLOSE) LIMIT?” The position calibration is now complete. The actuator will function as ordered. Inspect for correct operation by running actuator electrically.

NOTE: For torque seated valves, ensure that the Position limit is not set at torque seat. It is recommended that the Position limit be set approximately one handwheel turn (360°) in the opposite direction from the torque seat.

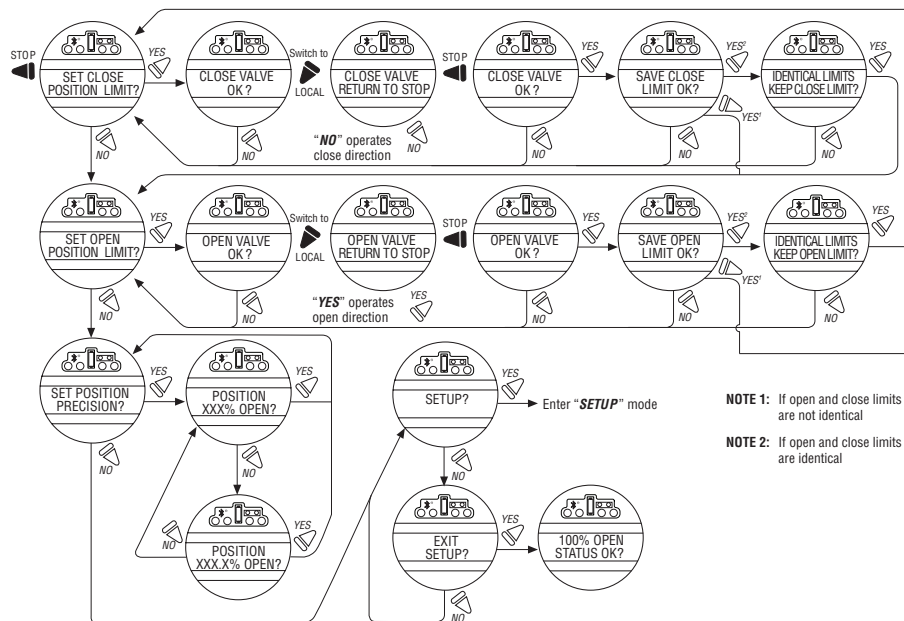
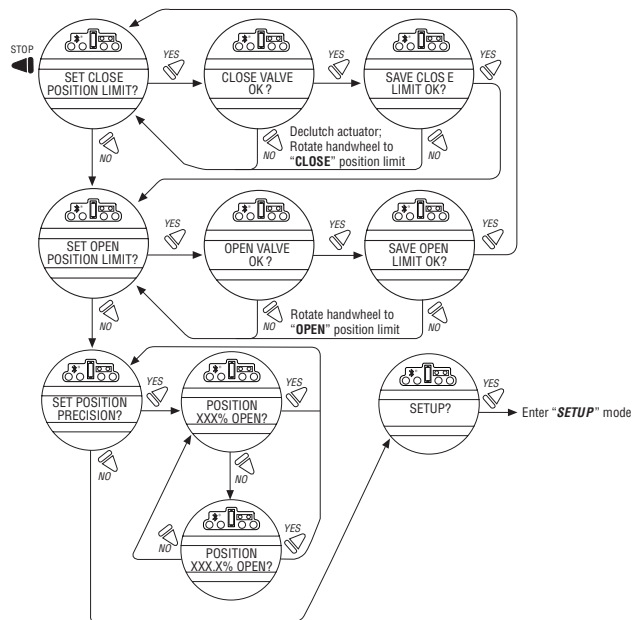
▲ CAUTION: On some valves, position limits could be set adjacent to each other, so be careful that the Close and Open limits are set sufficiently apart to permit operation. If the limits are set adjacent of each other, an error message will be displayed: “KEEP OPEN(CLOSE) LIMIT?”

NO FURTHER MOVEMENT IS PERMITTED UNTIL THE ERROR IS CORRECTED.

Should the User elect to proceed with the setting, an error will be displayed on the screen after re-booting stating “IDENTICAL LIMITS”. THE ACTUATOR WILL NOT MOVE UNTIL THE ERROR IS CORRECTED.

4.7.2 Set Position Limits for Manual Operation

1. Set close position. At “SET CLOSE POSITION LIMIT?” answer “YES.” At “CLOSE VALVE-OK?” depress declutch lever and slowly rotate handwheel until clutch is fully engaged. Release declutch lever; the clutch will stay in hand-wheel mode. If the valve is fully closed, move the handwheel one turn in the open direction to allow for coasting of the motor. When valve is in the desired location, select “YES.” At “SAVE CLOSE LIMIT-OK?” select “YES” to set the close position or “NO” to adjust the setting.
2. Set open position. At “SET OPEN POSITION LIMIT?” select “YES” to get “OPEN VALVE-OK?.” Engage the clutch (see step 1). Valve should be fully opened. Move the handwheel one turn toward the closed position to allow for coasting of the motor. When valve is in the desired location, select “YES” again to set the open position or “NO” to adjust the setting.
3. Checking the settings. Turn the handwheel and verify that the open and close LED’s function correctly (see Checking the Settings). If adjustments are necessary, select “NO” to return to “CHANGE POSITION SETUP?” and repeat from step 1.


Figure 4.9 – Electrical operation

Figure 4.10 – Handwheel operation




4.8 Modutronic Option

The Modutronic option enables the actuator to be controlled via a milliamp input signal.

- If the Modutronic option has been purchased, it is automatically calibrated when position limits are set. No further adjustments are required, unless the defaults do not suit the application.
- If the Modutronic option has not been purchased, the screens for changing Modutronic will not be available. To add the Modutronic option, please consult Limitorque service at (434) 528-4400.

4.8.1 Status

Default = OFF

1. Select “NO” to change Modutronic status to “ON.” If “OFF” is selected, no further menus will be displayed.

4.8.2 Proportional Band

Proportional band is the range of errors between position and demand signal that will produce reduced speed (pulsing).

Default = 15%

To change from the default, select “NO” until the required value is displayed. The value is adjustable between 1% and 100%, in 1% increments.

4.8.3 Fail Position

Fail position enables the customer to change the response of the actuator on loss of the milliamp signal.

Default = “CLOSE” Position

Fail position takes effect when the signal level falls below 2 mA or above 20.5 mA.

To Change the Default Position:

Select “NO” to choose whether the valve moves to “CLOSE” or

“OPEN” position, or “STOP” (stops) in its present position at the time of signal failure.

4.8.4 Deadband

Default = 2%

The deadband should be wide enough to prevent “hunting” of the actuator but as low as possible to give adequate response to changes in the error signal.

To Change from the Default:

Select “NO” to adjust the value between 1% and 50%, in 1% increments to suit the application, or 0.1% to 50.0% if the position precision is set to XXX.X%.

4.8.5 Polarity (20 mA)

Polarity allows the user to change the valve position corresponding to the maximum milliamp value.

Default Setting is: 20 mA = Full Open

Select “NO” to select the required position of the valve that is to correspond to the maximum signal level of 20 mA.

Choose between: 20 mA = Full Close or Full Open.

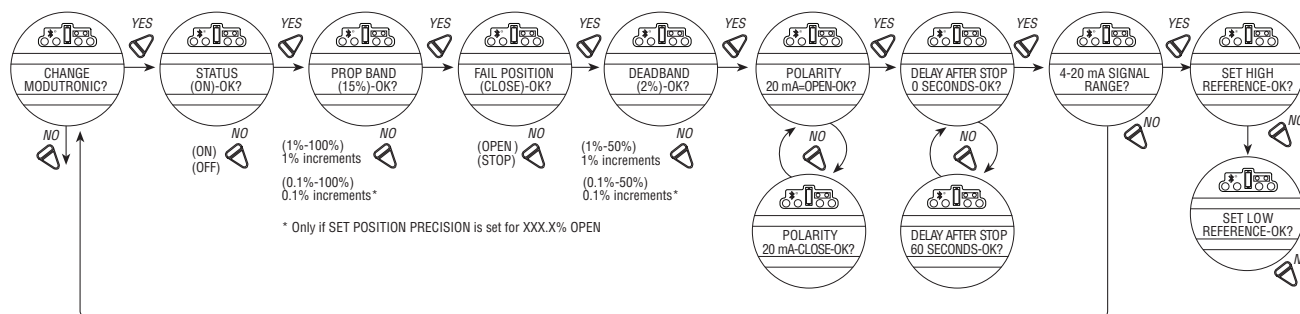


4.8.6 Delay After Stop

Default setting = 0 seconds

To change from the default setting, select “NO” to adjust the length of delay time after the actuator stops modulating. The delay after stop is adjustable from 0-60 seconds.

Figure 4.11 – Modutronic option



4.8.7 4-20 mA Signal Range

Signal range allows the user to change the signal range from the default range.

Default Setting is for High Reference = 20 mA (High Reference can also be scaled to some older 10-50mA instrumentation systems. A 166.66 Ohm resistor should be placed across the milliamp inputs when scaled from 10-50 mA.)

Default Setting for Low Reference = 4 mA

To change signal range (i.e. 4 mA-12 mA or 12 mA-20 mA or others) answer “YES.” Proceed from “SET HIGH REFERENCE” to “SET HIGH REFERENCE - OK?” A “YES” answer will require the use of a calibrator. If no, change to the signal range is required, answer “NO” and return to “CHANGE MODUTRONIC?” dialog.

4.8.8 Set High Reference

Default = 20 mA

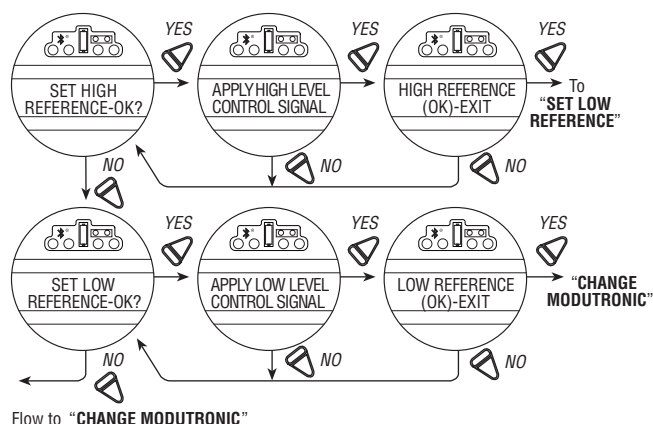
1. Select “NO” to accept pre-existing setting (no change).
2. Select “YES” to enter the display “APPLY HIGH LEVEL CONTROL SIGNAL.”
3. Apply this signal to terminal 19 and 20 indicated on the wiring diagram.
4. Select “YES” again to record this signal as the high reference. See Figure 4.10.

4.8.9 Set Low Reference

Default = 4 mA

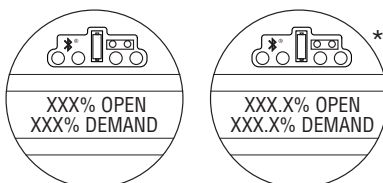
1. Select “NO” to move from “SET HIGH REFERENCE” to “SET LOW REFERENCE.”
2. Select “YES” to enter the display “APPLY LOW LEVEL CONTROL SIGNAL.”
3. Using a calibrator, apply the low signal, and select “YES” to record this signal as the low reference.

Figure 4.12 – Modutronic signals



4.8.10 Modutronic LCD Display

When the Modutronic option has been purchased, is set to "ON," and the red selector switch is in "REMOTE," the normal LCD display will read:



* If SET POSITION PRECISION is set to XXX.X% OPEN

XXX% Demand is the percentage value of the milliamp input signal.

4.9 DDC/Modbus Option

DDC option enables the actuator to be controlled by an RS-485 serial communication signal. If the DDC option has been purchased, it is automatically enabled. The customer must set the DDC address.

NOTE: If the DDC option has not been purchased, the screens for changing DDC will not be available. To add the DDC option, please consult Limitorque service at (434) 528-4400.

The MX is equipped with the ability to either hardwire to digital inputs for control, set-up for analog control (Modutronic), or control via network protocols. In order to utilize this feature, then select "Multi-control mode" operation located in Section 4.16, Remote Mode. This is the default setting for remote control. There are three modes of remote control when remote mode is configured for multi control: digital control, analog control, and network control. Digital and network control operation is based on the last command received. Analog operation is initiated by either toggling user input 2 (configure for CSE input) or breaking and reapplying the analog control.

4.9.1 Status

Default = ON

DDC Status enables user to change from the default condition to turn on and off the digital control capability of the actuator.

To Change from the Default Setting:

Select "NO" to switch DDC to "OFF." If "OFF" is selected, no further menus will be displayed.



4.9.2 Network Address

Default = 1

Network address allows user to assign a unique network address to an actuator.

1. The network address must be entered in accordance with the Instrument Data Sheet, and care must be taken to ensure that the same address is not used anywhere else in the same network.
2. Select “NO” for small incremental changes or hold it continuously in that position for larger changes until the required value is displayed. The address may be set at any value between 001 and 250.

4.9.3 Protocol

Default = Modbus RTU 9600 Baud

Protocol changes the communication language/speed from the default to match the application.

To Change from the Default Language:

Select “NO” to choose between MODBUS, ASCII, or RTU, and the baud rate depending on the design of the DDC system. Refer to the contract documentation.

4.9.4 Analog Scale

Default = 0-100

Analog scale allows the user to change the scaling of the analog input from the default.

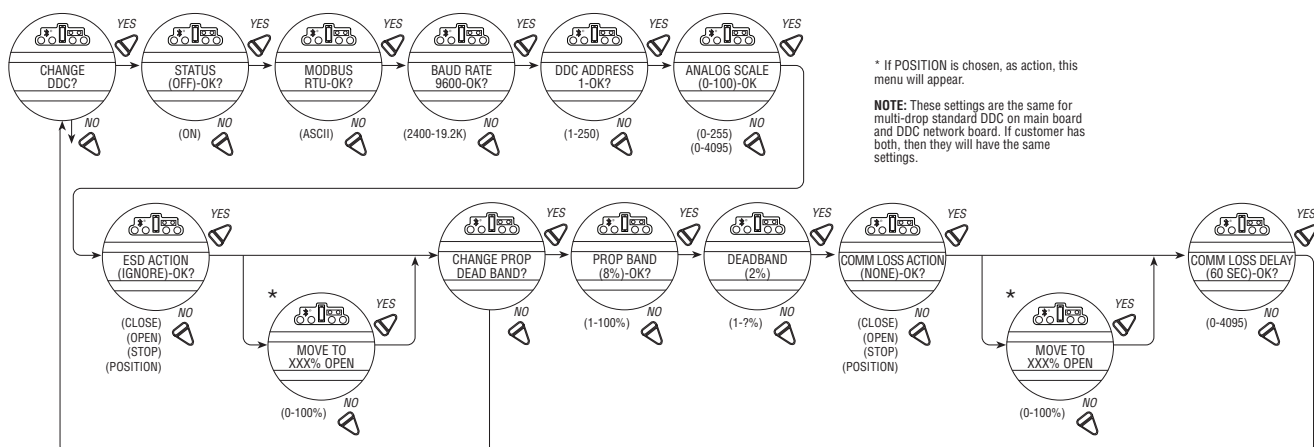
To Change from the Default Range:

Select “NO” until the required scale is displayed. 0-255 and 0-4095 counts are available.

4.9.5 ESD Action

A network ESD function can be enabled after the ESD configuration has been established for the unit. This network ESD can be selected to either ignore the command; Close, Open, Stop, or Position the actuator.

Figure 4.13 – DDC





4.9.6 Proportional Band

Proportional band is the range of errors between position and demand signal that will produce reduced speed (pulsing).

Default = 15%

To change from the default, select “NO” until the required value is displayed. The value is adjustable between 1% and 100%, in 1% increments.

4.9.7 Deadband

Default = 2%

The deadband should be wide enough to prevent “hunting” of the actuator but as low as possible to give adequate response to changes in the error signal.

To Change from the Default Range:

Select “NO” to adjust the value between 0.5% and 50%, in 0.5% increments to suit the application.

4.9.8 Offset

Default = 4 mA/20 mA

No options are available. Select “YES.”

0-10 VDC is available on all units shipped after 6/01/03.

4.9.9 Move To

If positioning is selected as an action, then the Move To dialog will appear. Position is configurable from 0-100%.

4.9.10 Comm Loss Delay

Default = 60 sec.

The User may select the amount of time delay before communication loss is flagged to the network. This selection is configurable from 120 seconds.

4.9.11 Comm Loss Action

Default = None

The User may select what action the actuator should take when network communication is interrupted. This action is configurable as Close, Open, Stop, Position.

4.10 FF Option

FF option enables the actuator to be controlled by a Foundation Fieldbus communications signal. If the option has been purchased, it is automatically enabled. A Fieldbus System configuration tool must be used by the customer to set the FF address.

NOTE: If the FF option has not been purchased, the screens for changing FF will not be available. To add the FF option, please consult Limitorque service at (434) 528-4400.

The MX is equipped with the ability to either hardwire to digital inputs for control, set-up for analog control (Modutronic), or control via network protocols. In order to utilize this feature, then select “Multi-control mode” operation located in Section 4.16, Remote Mode. This is the default setting for remote control. There are three modes of remote control when remote mode is configured for multi control: digital control, analog control, and network control. Digital and network control operation is based on the last command received. Analog operation is initiated by either toggling user input 2 (configure for CSE input) or breaking and reapplying the analog control.



4.10.1 Status

Default = ON

FF Status enables user to change from the default condition to turn on and off the digital control capability of the actuator.

4.10.2 Terminate Bus

Should a user select to make this unique actuator the termination point for the network, select "YES." If not, then "NO." Default is "NO."

4.10.3 Analog Scale

Default = 0-100

Analog scale allows the user to change the scaling of the analog input from the default.

To Change from the Default Range:

Select "NO" until the required scale is displayed. 0-255 and 0-4095 counts are available.

4.10.4 ESD Action

A network ESD function can be enabled after the ESD configuration has been established for the unit. This network ESD can be selected to either ignore the command; Close, Open, Stop, or Position the actuator.

4.10.5 OPEN/CLOSE Mode

Default = YES

To select operation as typically "OPEN" or "CLOSE," select "YES." To select operation as position mode, select "NO."

4.10.6 Proportional Band

Proportional band is the range of errors between position and demand signal that will product reduced speed (pulsing).

Default = 15%

To change from default, select "NO" until the required value is displayed. The value is adjustable between 1% and 100%, in 1% increments.

4.10.7 Deadband

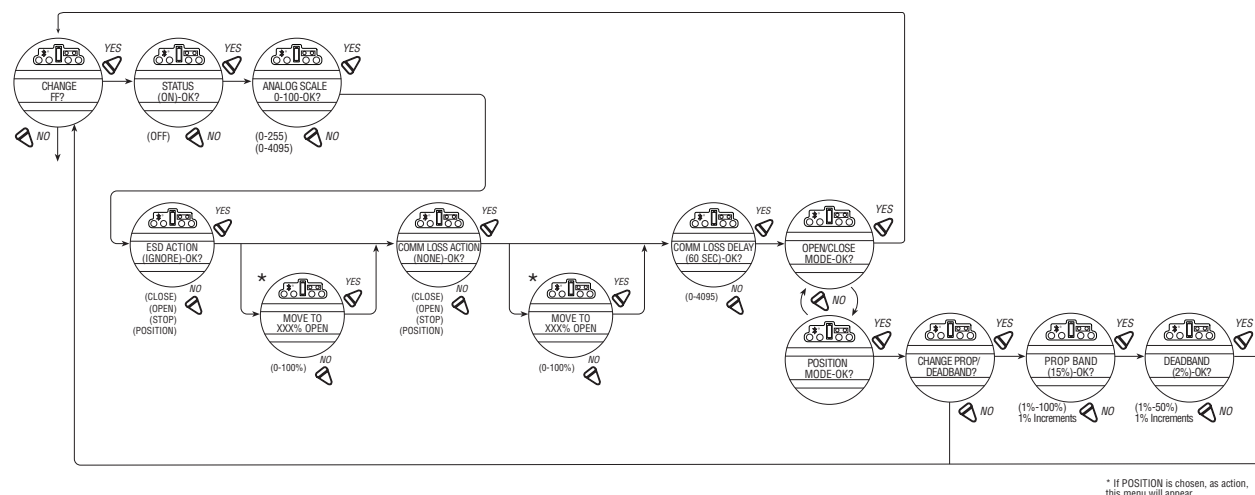
Default = 2%

The deadband should be wide enough to prevent "hunting" of the actuator but as low as possible to give adequate response to changes in the error signal.

To change from default, select "NO" to adjust the value between 1% and 50%, in 1% increments to suit the application.



Figure 4.14 – FF



4.10.8 Comm Loss Delay

Default = 60 sec.

The User may select the amount of time delay before communication loss is flagged to the network. This selection is configurable from 120 seconds.

4.10.9 Comm Loss Action

Default = None

The User may select what action the actuator should take when network communication is interrupted. This action is configurable as Close, Open, Stop, Position.

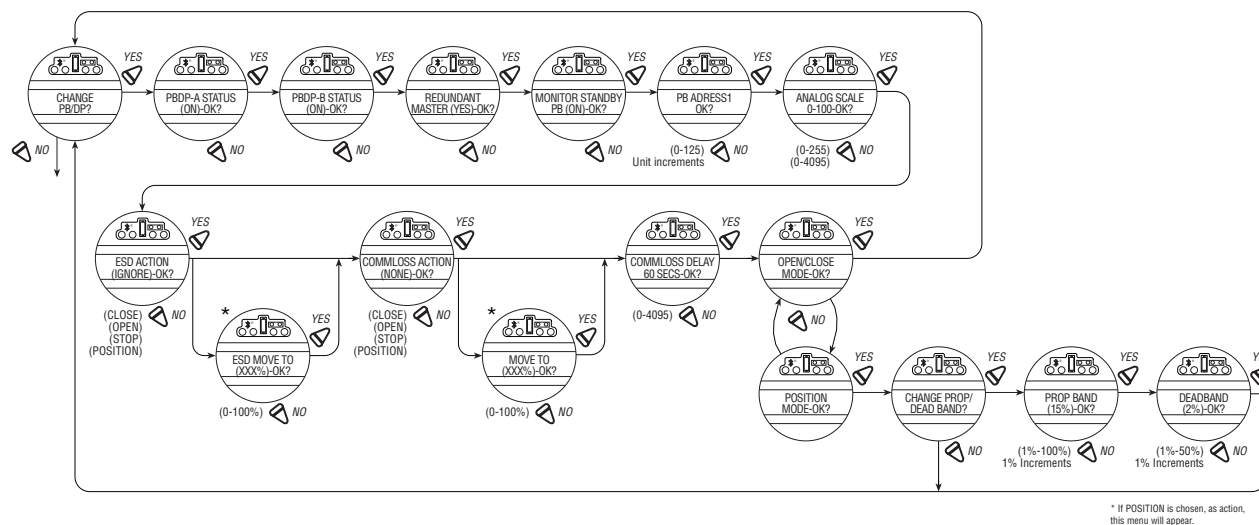
4.11 PB Option

PB option enables the actuator to be controlled by a Profibus communications signal. If the option has been purchased, it is automatically enabled. A Fieldbus System configuration tool must be used by the customer to set the PB address.

NOTE: If the PB option has not been purchased, the screens for changing PB will not be available. To add the PB option, please consult Limitorque service at (434) 528-4400.

MX Multi-control Mode Operation - The MX is equipped with the ability to either hardwire to digital inputs for control, set-up for analog control (Modutronic), or control via network protocols. In order to utilize this feature, then select “Multi-control mode” operation located in Section 4.16, Remote Mode. This is the default setting for remote control. There are three modes of remote control when remote mode is configured for multi control: digital control, analog control, and network control. Digital and network control operation is based on the last command received. Analog operation is initiated by either toggling user input 2 (configure for CSE input) or breaking and reapplying the analog control.

Figure 4.15 – Profibus DP



4.11.1 Status

Default = ON

PB Status enables user to change from the default condition to turn on and off the digital control capability of the actuator.

4.11.2 PB DP Operation

Figure 4.15 illustrates the setup sequence for the MX/QX PB DP field unit. For proper operation, either Position Mode or Open/Close Mode must be selected.

Follow these steps to enter and configure the setup mode:

1. Proceed through the Setup to the CHANGE PBDP? display.
2. Select YES to proceed to the PBDP-A STATUS (ON)-OK? display. PBDP-A Status enables the user to change from the default condition to turn on and off the digital control capability of the actuator.
3. Select YES to proceed to the PBDP-B STATUS (ON)-OK? display. PBDP-B Status enables the user to change from the default condition to turn on and off the redundant digital control capability of the actuator, if installed.
4. Select YES to proceed to the REDUNDANT MASTER (YES)-OK? display. Selecting REDUNDANT MASTER will allow for System Redundancy with two independent connections to Profibus masters. REDUNDANT MASTER must be set to NO for Flying Redundancy (single Profibus master connection).
5. If YES is selected, MONITOR STANDBY PB (ON)-OK? is displayed.
6. To allow the standby Profibus master to monitor the health of the actuator's standby PB DP board, select YES.
7. The unit will display PB ADDRESS 1-OK? If OK, select YES. If NO, select different address (1-125).
8. Select YES to proceed to the ANALOG SCALE display.
9. From ANALOG SCALE, if the default value of 0-100 is OK, select YES. If not, select NO.
10. If YES is selected, ESD ACTION (IGNORE) – OK? is displayed.
11. For ignoring ESD ACTION, select YES. For setting ESD ACTION, select NO. If POSITION is chosen as action, ESD MOVE TO (XXX%)-OK? is displayed. Select NO to set desired position.



12. If YES is selected, COMM LOSS ACTION (NONE) – OK? is displayed.
13. For no COMM LOSS ACTION, select YES. For setting COMM LOSS ACTION, select NO. If POSITION is chosen, as action, COMM LOSS MOVE TO (XXX%)-OK? is displayed. Select NO to set desired position.
14. If YES is selected, COMM LOSS DELAY (60 SEC) – OK? is displayed.
15. For a 60-second delay, select YES. Otherwise, select NO until the required value is displayed.
16. If YES is selected, OPEN/CLOSE MODE-OK? is displayed.
17. For OPEN/CLOSE MODE, select YES. For POSITION MODE, select NO. In position mode, the host device can set the valve position to any desired value; in OPEN/CLOSE MODE the host can only fully open or fully close the valve. The user must locally configure one of these two modes.
18. Proceed to configure the proportional band and deadband as discussed in the next sections.

4.11.3 Comm Loss Delay

Default = 60 sec.

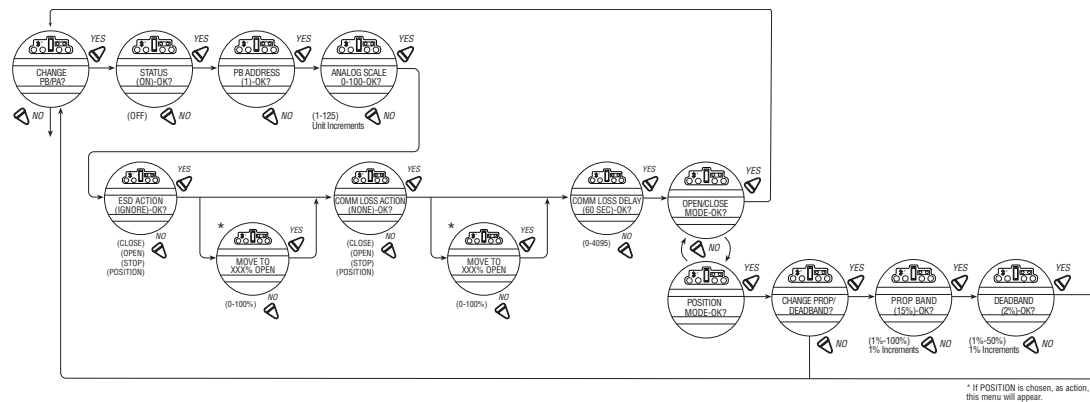
The User may select the amount of time delay before communication loss is flagged to the network. This selection is configurable from 120 seconds.

4.11.4 Comm Loss Action

Default = None

The User may select what action the actuator should take when network communication is interrupted. This action is configurable as Close, Open, Stop, Position.

Figure 4.16 – Profibus PA





4.12 DN Option

DN option enables the actuator to be controlled by a DeviceNet communications signal. If the option has been purchased, it is automatically enabled. A DeviceNet System configuration tool must be used by the customer to set the DN address.

NOTE: If the DN option has not been purchased, the screens for changing DN will not be available. To add the DN option, please consult Limitorque service at (434) 528-4400.

The MX is equipped with the ability to either hardwire to digital inputs for control, set-up for analog control (Modutronic), or control via network protocols. In order to utilize this feature, then select “Multi-control mode” operation located in Section 4.16, Remote Mode. This is the default setting for remote control. There are three modes of remote control when remote mode is configured for multi control: digital control, analog control, and network control. Digital and network control operation is based on the last command received. Analog operation is initiated by either toggling user input 2 (configure for CSE input) or breaking and reapplying the analog control.

4.12.1 Status

Default = ON

DN Status enables user to change from the default condition to turn on and off the digital control capability of the actuator.

4.12.2 Baud Rate

Default = 125K Baud

Baud rate changes the communication speed from the default to match the application.

To Change from the Default Speed:

Select “NO” to choose between 125k, 250k, 500k baud rate depending on the design of the DN system. Refer to the contract documentation.

4.12.3 Network Address

Default = 1

Network address allows user to assign a unique network address to an actuator.

1. The network address must be entered in accordance with the Instrument Data Sheet, and care must be taken to ensure that the same address is not used anywhere else in the same network.
2. Select “NO” for small incremental changes or hold it continuously in that position for larger changes until the required value is displayed. The address may be set at any value between 001 and 63.

4.12.4 Analog Scale

Default = 0-100

Analog scale allows the user to change the scaling of the analog input from the default.

To Change from the Default Range:

Select “NO” until the required scale is displayed. 0-255 and 0-4095 counts are available.

4.12.5 ESD Action

A network ESD function can be enabled after the ESD configuration has been established for the unit. This network ESD can be selected to either “IGNORE” the network command; or Close, Open, Stop, Position the actuator.



4.12.6 Proportional Band

Proportional band is the range of errors between position and demand signal that will produce reduced speed (pulsing).

Default = 15%

To change from the default, select “NO” until the required value is displayed. The value is adjustable between 1% and 100%, in 1% increments.

4.12.7 Deadband

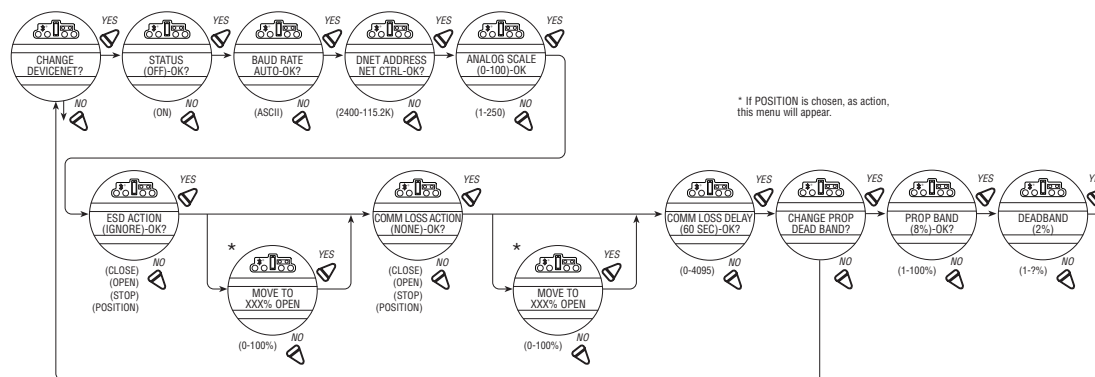
Default = 2%

The deadband should be wide enough to prevent “hunting” of the actuator but as low as possible to give adequate response to changes in the error signal.

To Change from the Default Range:

Select “NO” to adjust the value between 1% and 50%, in 1% increments to suit the application.

Figure 4.17 – DN Option



4.12.8 Comm Loss Delay

Default = 60 sec.

The User may select the amount of time delay before communication loss is flagged to the network. This selection is configurable from 120 seconds.

4.12.9 Comm Loss Action

Default = None

The User may select what action the actuator should take when network communication is interrupted. This action is configurable as Close, Open, Stop, Position.

4.13 Status and Alarm Contacts

The status and alarm contacts permit wiring to existing contacts for visibility of operation or fault conditions. (See wiring diagram for contact ratings.)

The status contacts (S) and optional alarm contacts (R) may be configured to have any one of the following functions:



- “CLOSING” – valve closing
- “OPENING” – valve opening
- “STOPPED” – valve stopped in mid-travel
- “VALVE MOVING” – either direction
- “LOCAL SELECTED” – red selector knob in “LOCAL”
- “MOTOR OVERTEMP” – thermistor range exceeded
- “OVERTORQUE” – torque exceeded in mid-travel
- “MANUAL OVERRIDE” – actuator moved by handwheel
- “VALVE JAMMED” – valve can’t move
- “CLOSE TORQUE SW” – torque switch trip at “CLOSED”
- “OPEN TORQUE SW” – torque switch trip at “OPEN”
- “LOCAL STOP/OFF” – red selector knob at “STOP”
- “LOST PHASE” – one or more of three phases lost
- “ESD SIGNAL” – signal active
- “CLOSE INHIBIT” – close inhibit signal active
- “OPEN INHIBIT” – open inhibit signal active
- “ANALOG IP LOST” – 4-20 mA not present
- “REMOTE SELECTED” – red selector in “REMOTE”
- “LIMIGARD ACTIVE” – (future—LimiGard™ functionality is not affected)
- “HARDWARE FAILURE” – indication
- “NETWORK CONTROLLED” – permits relay control via DDC, FF, or other network driver
- “CLOSE” – valve closed “(0% OPEN)”
- “OPEN” – valve open “(100% OPEN)”
- “MID-TRAVEL” – valve position, 1-99% open
- “CSE CONTROL” – CSE station in LOCAL or STOP and controls actuator

4.13.1 Status and Alarm Contact Default Settings

All actuators are supplied with the following status or alarm (optional) contact default factory settings:

Status Contacts

S1a – Normally closed contact at valve fully Close

S1b – Normally closed contact at valve fully Open

S2a – Normally open contact at valve fully Close

S2b – Normally open contact at valve fully Open

Alarm Contacts (Optional/requires I/O board)

R1 – Normally closed contact at valve fully Close R5 – Motor Overtemp

R2 – Normally closed contact at valve fully Open R6 – Remote Selected

R3 – Normally open contact at valve fully Close R7 – Overtorque

R4 – Normally open contact at valve fully Open R8 – Analog I/P (Input)

To change any of the default settings:

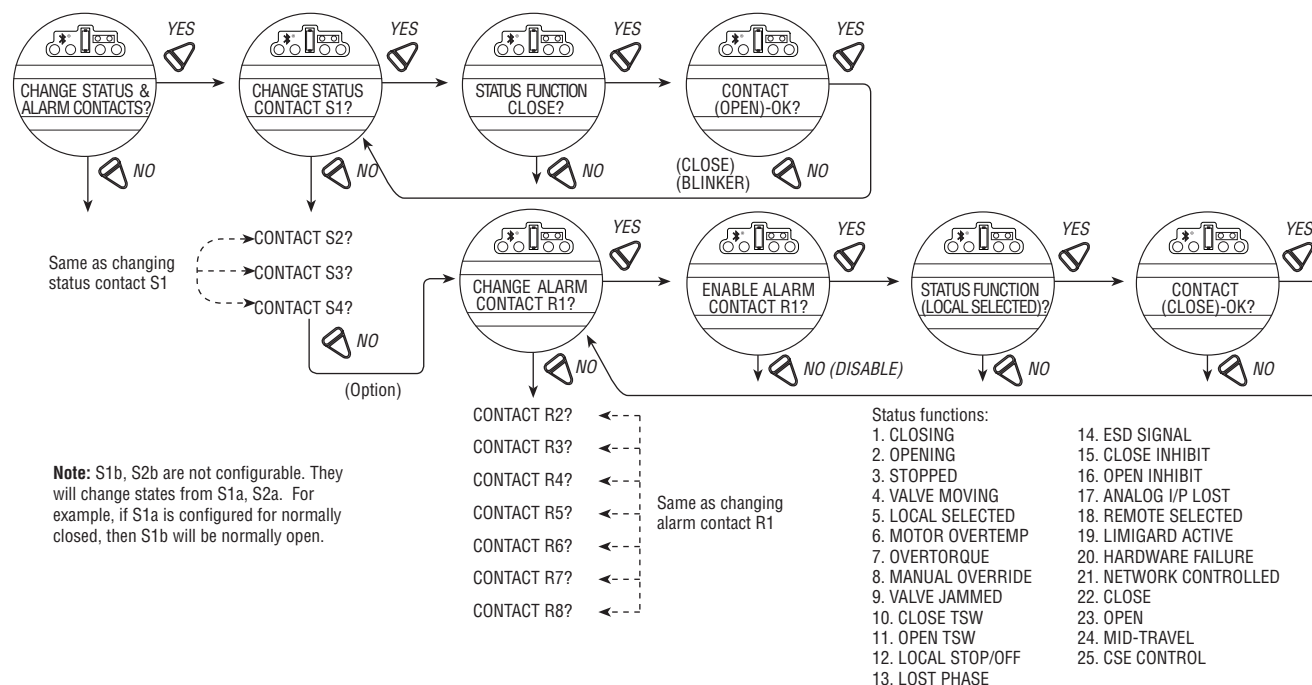
Select “CHANGE STATUS & ALARM CONTACTS?” from the “SETUP” routine.

Select “YES” to enter the “SETUP” routine for each individual contact. Select “NO” until the particular contact is referenced in the display, then “YES” to make the changes.

4.13.2 Status Function

Toggle “NO” through the range of functions, as listed, until the desired feature is displayed.

Figure 4.18 – Status and alarm contacts (Shown with optional boards added)



4.13.3 Contact

This mode allows the user to select the state of the contact when the function is active. Select “NO” to choose whether the contact is required to be normally closed, normally open, or blinker when the function is active. When “Blinker” has been selected, the contact will switch automatically between open and close (1 second open/1 second close).

4.13.4 Valve Position

This display will appear only if the function “MID-TRAVEL POSITION” has been selected. Toggle “NO” until the display indicates the required value of percentage “OPEN” at which the contact should trip. If the contact has been selected as normally closed, then it will close when the trip point has been reached, with the actuator moving in the open direction.

NOTE: Status contacts (S) and optional alarm (R) contacts are latching type and will remain in their last set position in the event of a main power supply failure.

4.14 Two-speed Timer (Optional)

The optional two-speed timer extends the operating time of the actuator, in the closing and/or the opening direction, by pulsing the motor ON and OFF. Pulsing may be applied to full valve travel or only a part of it. The ON and OFF pulse times are adjustable.

1. Select “CHANGE 2-SPEED TIMERS?”
2. Select “YES” to enter the “CHANGE OPEN TIMER?” routine.
3. If slow opening is required, select “YES;” otherwise select “NO” to move into the “CHANGE CLOSE TIMER?” routine.



4.14.1 Status

Select “NO” to switch the timer ON or OFF. If OFF, no further menus will be displayed.

4.14.2 Start Position

If the Close or Open timer has been switched ON, pulsing will start when the set point is reached in the selected direction and the actuator will continue pulsing until the valve reaches the desired “STOP” position.

Select “NO” until the display indicates the required value of percentage OPEN at which the pulsing should start. Adjustable in 1% increments as listed:

Closing = 0% to 99%. Opening = 1% to 100%.

4.14.3 Stop Position

If the Close or Open timer has been switched ON, pulsing will commence as the valve moves out of its close position and the actuator will continue pulsing until stopped at the set point.

Select “NO” until the display indicates the required value of percentage open at which the pulsing should stop. Adjustable in 1% increments as listed:

Closing = 0% to 99%. Opening = 1% to 100%.

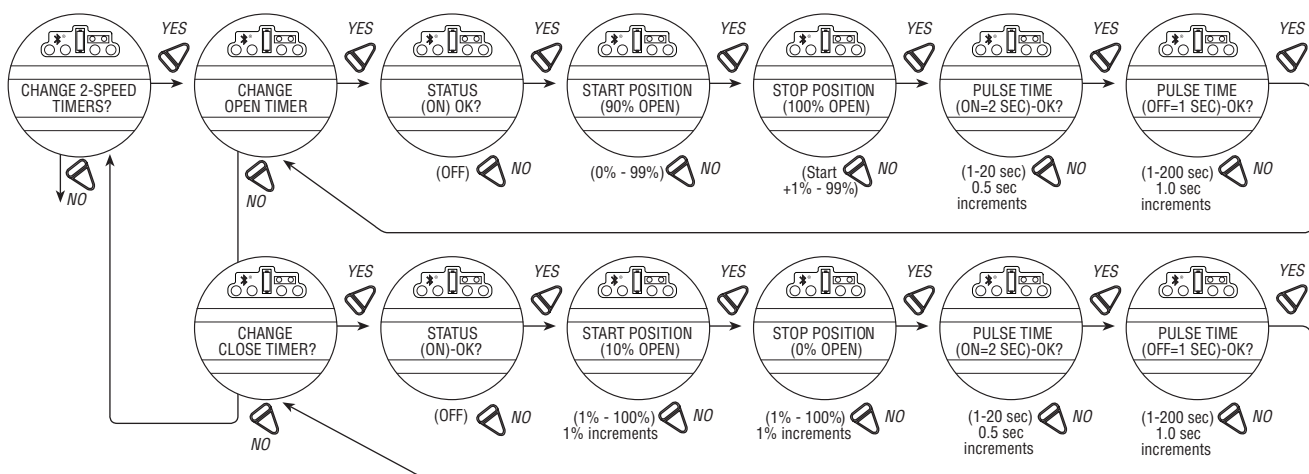
4.14.4 Pulse Time – ON

This mode allows user to change the ON pulse time from the default setting.

Default Setting = 2.0 Second

Select “NO” until the required length of ON pulse is displayed. Adjustable between 1 and 20 seconds, in 0.5 second increments.

Figure 4.19 – Two-speed timers



4.14.5 Pulse Time – OFF

This mode allows user to change the OFF pulse time from the default setting.

Default Setting = 1 Second

Select “NO” until the required length of OFF pulse is displayed. Adjustable between 1 and 200 seconds, in 1.0 second increments.

4.15 Analog Output

The MX offers an optional, configurable analog output feedback signal. The User may select between APT (Analog Position Transmitter) or ATT (Analog Torque Transmitter) functionality. Each selection is defined below.

Figure 4.20 – Change Analog Out

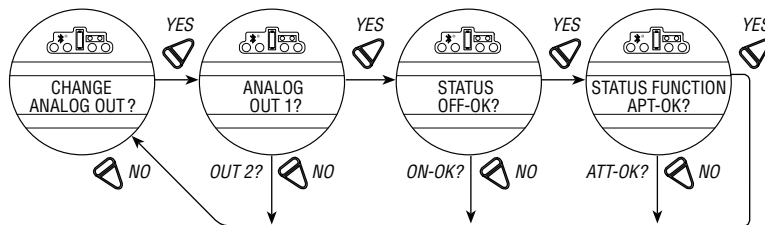
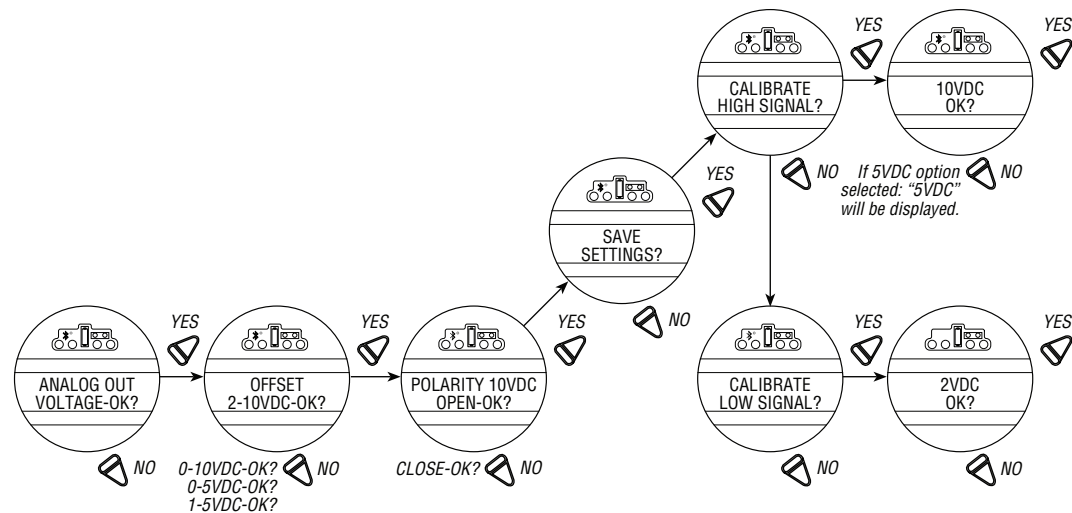


Figure 4.21 – Change Analog Out Voltage – APT



Limitorque MX Electronic Actuator FCD LMENIM2306-04 – 2/11

Figure 4.22 – Change Analog Out Current – APT

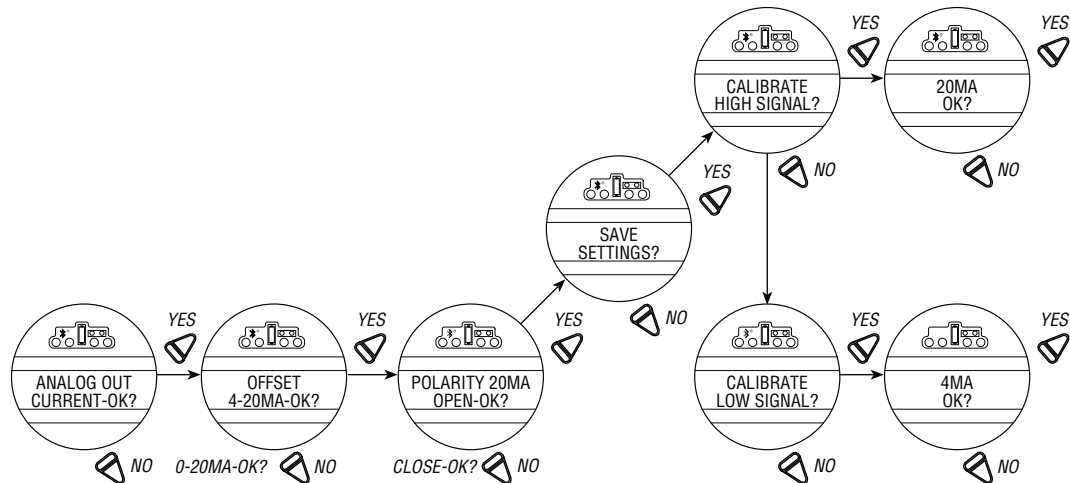


Figure 4.23 – Change Analog Out Voltage – ATT

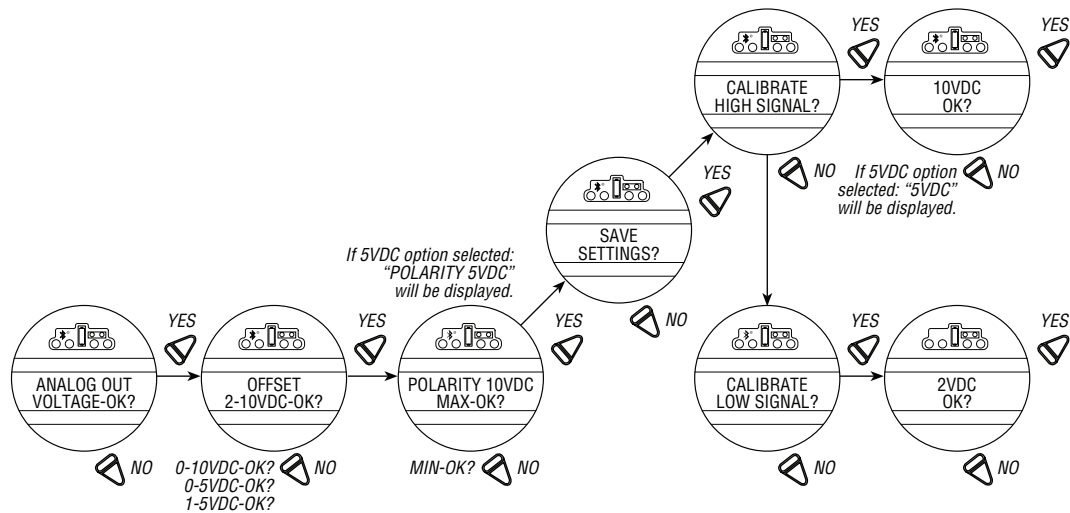
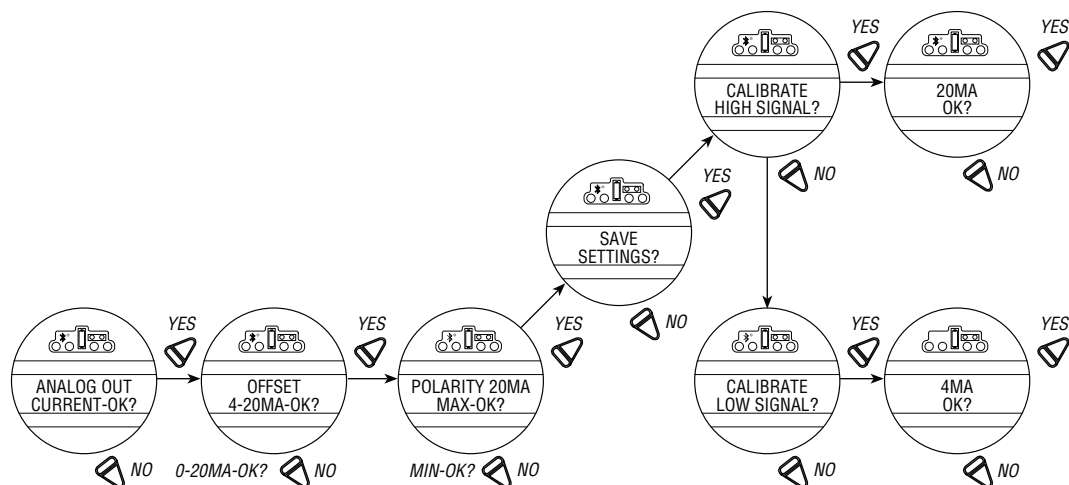


Figure 4.24 – Change Analog Out Current – ATT



4.15.1 APT Polarity Option

The APT option provides a 4-20 mA feedback signal proportional to valve position. APT is connected at terminals 17 and 18 for 4-20 mA output. Consult actuator wiring diagram for details.

NOTE: If the second analog out option is turned ON but this option was not purchased, the display will show a hardware fault. An optional I/O board is required for this option. To purchase, please contact Limitorque service coordinator at (434) 528-4400.

During position limit calibration (see Section 3.5.4, Setting Position Limits) the APT is automatically calibrated to default settings: Default = 20 mA OPEN, 4 mA CLOSE.

To Customize the Settings:

1. Select "CHANGE APT?" from the "SETUP" routine. Select "YES."
2. Select "NO" to select the status if OFF. If ON, select "YES" to enter the "Status Function APT?" display. Select "NO" to select ATT display.
3. Select "NO" to select 4 ma/0 VDC2. Select "YES" to enter the "POLARITY" display.
4. Select "NO" to choose between:

20 mA = OPEN

or

20 mA = CLOSE

OR
5. Select "NO" to recalibrate new value (low end 3.4-4.5 mA; high end 19.5-21 mA) as shown on meter. New value will not be shown on display.

4.15.2 ATT Polarity Option

The ATT option provides a 4-20 mA signal proportional to actuator output torque and is for reference only. The signal range is from approximately 40% of rated torque to approximately 100% rated torque. This option is connected at terminals 17 and 18 for 4-20 mA output. Consult the actuator wiring diagram for details.

NOTE: If the second analog out option is turned ON but this option was not purchased, the display will show a hardware fault. An optional I/O board is required for this option. To purchase, please contact Limitorque service coordinator at (434) 528-4400.

To Customize the Settings:

1. Select "CHANGE ATT?" from the "SETUP" routine, then "YES" to select ATT status as "ON" or "OFF."
2. Select "NO" to select the status if OFF. If ON, select "YES" to enter the "Status Function?" display. Select "NO" to select ATT display.
3. Select "NO" to select 4 ma/0 VDC2. Select "YES" to enter the "POLARITY" display.
4. Select "NO" to choose between:

20 mA = OPEN

or

20 mA = CLOSE

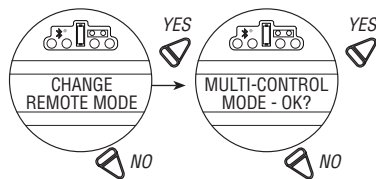
OR
5. Select "NO" to recalibrate new value (low end 3.4-4.5 mA; high end 19.5-21 mA) as shown on meter. New value will not be shown on display.

4.16 Remote Mode

Remote mode permits a User to select from multiple remote control permissions, or isolate remote control to a single control selection:

- Multi Control mode (default): There are three modes of remote control for the MX actuator allowed when the remote mode is configured for multi-control: digital control, analog control, and network control. Digital and network control operation is based on the last command received. Analog control operation is initiated by either toggling user input 2 (configured for CSE input) or breaking and reapplying the analog signal.
- Digital Control Only: the unit will operate only upon the last digital input command received.
- Network Control Only: the unit will operate only upon the last network command received.
- Analog Control only: the unit will operate only upon the last analog input command received.

Figure 4.25 – Remote Mode





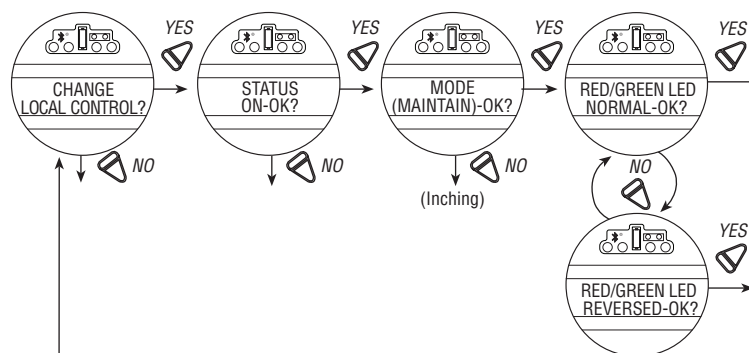
4.17 Local Control

“LOCAL CONTROL” mode changes how the local control switches and display are used from the default settings.

Default = On & Maintain Mode

NOTE: User may select to disable the LOCAL CONTROL, which prohibits the cycling of the MX from OPEN to CLOSE or REVERSE. The LOCAL-STOP-REMOTE knob still functions, which permits the user to re-enter set-up and turn the LOCAL CONTROL back to “ON.”

Figure 4.26 – Local control



- Maintain mode: the unit will operate continually in either direction when the black knob is actuated and released, until the position of the black knob is changed or the red knob is changed from “LOCAL” to either “STOP” or “REMOTE.”
- Inching mode: the unit will operate only when the black knob is held in the open or close position. If the black knob is released, the unit will stop.

To Customize the Settings:

1. Select “CHANGE LOCAL CONTROL?” from the “SETUP” routine.
2. Select “YES” to enter the mode display.
3. Select “NO” to change from Maintain to Inching control.

4.17.1 LED Customization

This selection allows the customer to reverse the colors of the LED in open and close mode from the default setting.

Default = Red-Open/Green-Close

1. After mode selection, select “YES” to change the colors of the LEDs.
2. Select “NO” to change from the default to Red-Close/Green-Open.

4.18 ESD (Emergency Shutdown) Overrides

An external contact may be used to place the actuator in emergency shutdown mode. An ESD contact may be connected to the actuator to override existing command signals and send the valve to a predetermined position.

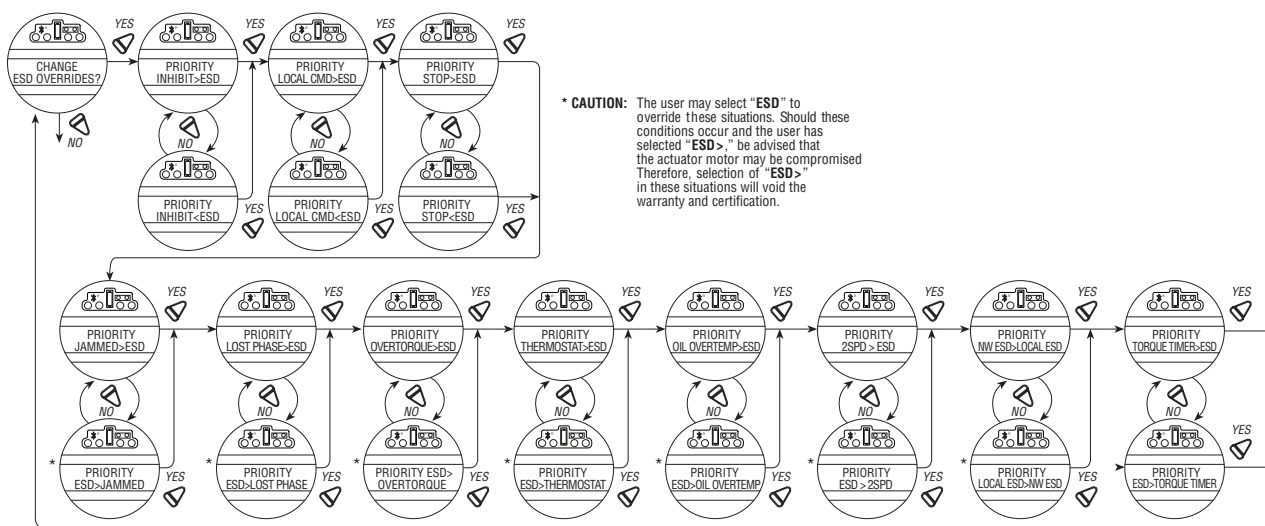
The ESD Action and Signal presence is selected in Section 4.19, Inputs. The default ESD input = Input 0., pt. 30 on wiring diagram.



4.18.1 ESD Override

It may be desirable that ESD override other events. These events are selectable. The “>” symbol after ESD indicates that ESD will override that particular event. Sections 4.19 - 4.25, Inputs through Motor Thermostat list the choices.

Figure 4.27 – ESD Overrides



4.18.2 Inhibit

Default = INHIBIT>ESD

To Customize the Settings:

Select “NO” to choose:

- “ESD>INHIBIT” – ESD overrides active inhibit signal
- “INHIBIT>ESD” – Active inhibit signal will override ESD

NOTE: Removing the wires to these terminals can disable active inhibits.

4.18.3 Local Command

Default = LOCAL>ESD

To Customize the Settings:

Select “NO” to choose:

- “ESD>LOCAL” – ESD overrides local command to operate actuator
- “LOCAL>ESD” – Local command to operate actuator overrides ESD



4.18.4 Stop

Default = STOP>ESD

To Customize the Settings:

Select “NO” to choose:

- “ESD>STOP” – ESD overrides stop command
- “STOP>ESD” – Stop command overrides ESD

4.18.5 Jammed Valve*

Default = JAMMED VALVE>ESD

To Customize the Settings:

Select “NO” to choose:

- “ESD>JAMMED VALVE” – ESD overrides jammed valve indication
- “JAMMED VALVE>ESD” – Jammed valve indication overrides ESD (default)

* See CAUTION on Figure 4.24.

4.18.6 Lost Phase*

Default = LOST PHASE>ESD

To Customize the Settings:

Select “NO” to choose:

- “ESD>LOST PHASE” – ESD overrides lost phase indication
- “LOST PHASE>ESD” – Lost phase indication overrides ESD

* See CAUTION on Figure 4.24.

4.18.7 Overtorque*

Default = OVERTORQUE>ESD

To Customize the Settings:

Select “NO” to choose:

- “ESD>OVERTORQUE” – ESD overrides overtorque situation
- “OVERTORQUE>ESD” – Overtorque situation overrides ESD

* See CAUTION on Figure 4.24.

4.18.8 Motor Thermostat

Default = THERMOSTAT>ESD

To Customize the Settings:

Select “NO” to choose:

- “ESD>THERMOSTAT” – ESD overrides Motor Thermostat tripped
- “THERMOSTAT>ESD” – Motor Thermostat tripped overrides ESD

NOTE: Disabling the motor thermostat voids all third party certifications including Factory Mutual, CSA, ANZex, IECEx and ATEX. Disabling the motor thermostat removes protection from overheating the motor and may cause unsafe conditions.



4.18.9 Oil Over Temperature

Default = OIL OVERTEMP>ESD

To Customize the Settings:

Select “NO” to choose:

- “ESD>OIL OVERTEMP” – ESD overrides high oil temperature
- “OIL OVERTEMP>ESD” – High oil temperature overrides ESD

4.18.10 Two-Speed Timer

Default = 2SPD > ESD

To Customize the Settings:

Select “NO” to choose:

- “ESD > 2SPD” - ESD overrides 2 speed timer
- “2SPD > ESD” - 2 speed timer overrides ESD

4.18.11 Network ESD

Default = LOCAL ESD > NW ESD

To Customize the Settings:

Select “NO” to choose:

- “NW ESD > LOCAL ESD” - Network ESD overrides Local ESD
- “LOCAL ESD > NW ESD” - Local ESD overrides Network ESD

4.18.12 Torque Switch Timer

Default = TORQUE TIMER>ESD

To Customize the Settings:

Select “NO” to choose:

- “ESD>TORQUE TIMER” - ESD overrides torque switch timer
- “TORQUE TIMER>ESD” - Torque switch timer overrides ESD

4.19 Inputs

The User can select up to 3 Inputs (0, 1, 2) and configure them to perform these functions:

- ESD
- Inhibits
- User defined
- CSE

NOTE: Input 0 Default: The default for input 0 will be ESD, signal present, disabled, and ignore.

Input 1 Default: The default for input 1 will be open inhibit, signal present, and disabled.

Input 2: The default for input 2 will be close inhibit, signal present, and disabled.

The inputs will be the same as in previous versions of software. If a firmware upgrade is done from a previous version that did not have configurable inputs, to the later version that does, then the users settings will remain the same.



4.19.3 Custom Input Mode #1 – Momentary ESD/PSESD (Optional)

Custom software is available for the MX that permits the User to establish certain performance characteristics for partial stroke (PS) testing and momentary contact closure ESD.

Note: These three inputs are normally configurable. However, when this custom mode is enabled, they are set to the predefined configuration and cannot be changed by the customer.

Input 0 (normal default – ESD) terminal 30:

- Set as disabled, user input function, signal present

Input 1 (normal default – Open Inhibit) terminal 34:

- Set as enabled, partial stroke enable function, signal present = active

Input 2 (normal default – Close Inhibit) terminal 35:

- Set as enabled, partial stroke enable function, signal absent = active

The partial stroke enable signals are setup as redundant signals for safety. There are two signal inputs, and BOTH must be in the active state. If the partial stroke enable inputs are in the active state, and an input is detected (>800 ms) on the momentary ESD/PSESD input, then a partial stroke ESD test will be run. If the partial stroke enable inputs are not active or in a fault state, and an input is detected on the momentary ESD/PSESD input, then the ESD will be latched in and the actuator will perform ESD until the ESD Release is given.

NOTE: These three inputs are the normal open-close-stop inputs. When this custom mode is enabled, they are set to the predefined configuration and cannot be changed by the customer. The only change the customer can make is to set the momentary ESD action (if action is position – then also the target value for the ESD) and the partial stroke target value.

Input 3 (normal default – stop) terminal 26:

- Set as enabled, ESD release function, signal absent = active

Input 4 (normal default – open) terminal 25:

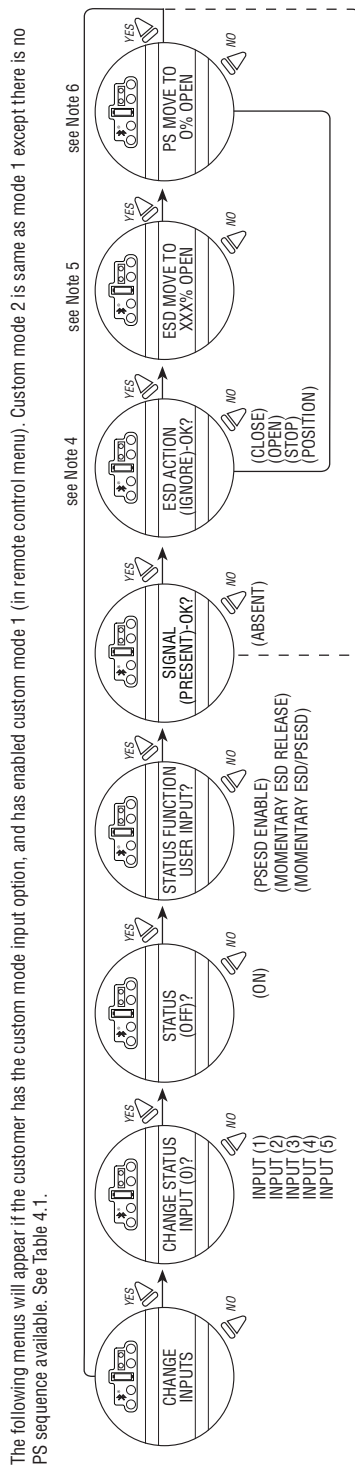
- Set as enabled, ESD Release function, signal present = active

Input 5 (normal default – close) terminal 27:

- Set as enabled, momentary ESD/PSESD function, signal present > 800 ms = active, ESD action = Close, partial stroke target position = 0% open

The ESD release signals are setup as redundant signals for safety. There are two signal inputs, and BOTH must be in the active state. If there is an active ESD and both ESD release inputs are in the active state, the ESD will be unlatched and the unit will return to normal operation. If the ESD release inputs are in a fault state, an active ESD will NOT be released. The ESD release inputs will have no effect on a partial stroke ESD test. The momentary ESD/PSESD input will be ignored if there is a signal present for less than 100 ms, and is guaranteed to latch in the ESD/PSESD if the signal is present for greater than 800 ms. Once the ESD is latched in, the unit will perform the ESD action. In this case the ESD will move the unit to the close limit and remain in ESD mode until the ESD release indication is given using the ESD release inputs.

Figure 4.29 – Custom Input Modes



The user will only be able to change the ESD ACTION (and ESD MOVE TO target if ESD action is position, and the PS MOVE TO settings when in this special custom mode 1. Following are the preconfigured settings for each input.

Note 5: The "ESD MOVE TO" menu only appears if position is chosen as action.

Note 6: "PS MOVE TO" menu only appears if the status function of the input is "MOMENTARY ESD/PSESD".

The user will only be able to change the ESD ACTION (and ESD MOVE TO target if ESD action is position, and the PS MOVE TO settings when in this special custom mode 1. Following are the preconfigured settings for each input.

INPUT 0: ON, ESD Time Delay Relay, signal present, ESD action closed.

INPUT 1: ON, User Input, signal present

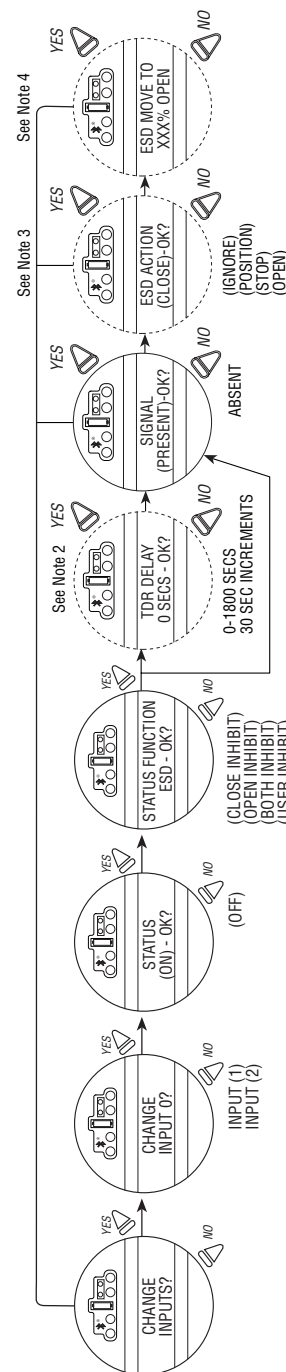
INPUT 2: ON, User Input, signal present

INPUT 3: ON, Stop

INPUT 4: ON, Open

INPUT 5: ON, Close

The following menus will appear if the customer has the custom mode input option, and has enabled custom mode 3 (in remote control menu).



INPUT 0: ON, ESD Time Delay Relay, signal present, ESD action closed.

INPUT 1: ON, User Input, signal present

INPUT 2: ON, User Input, signal present

INPUT 3: ON, Stop

INPUT 4: ON, Open

INPUT 5: ON, Close

Note 1: ESD is hard coded for INPUT 0. You can only configure INPUTS 1 and 2 for the other options.

Note 2: TDR DELAY will only show for INPUT 0. All other inputs this is skipped.

Note 3: ESD ACTION menu will only appear if the STATUS FUNCTION for inputs is ESD otherwise the SIGNAL PRESET menu will return to the CHANGE INPUTS menu.

Note 4: The ESD MOVE TO menu only appears if position is chosen as action.



4.19.4 Custom Input Mode #2 – Momentary ESD/CSE (Optional)

Custom software is available for the MX that permits the user to establish certain performance characteristics momentary contact closure ESD and 4-wire remote control.

NOTE: These three inputs are normally configurable, however, when this custom mode is enabled, they are set to the predefined configuration and cannot be changed by the customer.

Input 0 (normal default – ESD) terminal 30:

Set as remote stop

Input 1 (normal default – Open Inhibit) terminal 34:

Set as remote close

Input 2 (normal default – Close Inhibit) terminal 35:

Set as remote open

NOTE: These three inputs are the normal open-close-stop inputs. When this custom mode is enabled, they are set to the predefined configuration and cannot be changed by the customer. The only change the customer can make is to set the momentary ESD action (if action is position – then also the target value for the ESD).

Input 3 (normal default – Stop) terminal 26:

Set as enabled, ESD release function, signal absent = active

Input 4 (normal default – Open) terminal 25:

Set as enabled, ESD Release function, signal present = active

Input 5 (normal default – Close) terminal 27:

Set as enabled, momentary ESD function, signal present > 800 ms = active, ESD action = Close.

The ESD release signals are setup as redundant signals for safety. There are two signal inputs, and BOTH must be in the active state. If there is an active ESD and both ESD release inputs are in the active state, the ESD will be unlatched and the unit will return to normal operation. If the ESD release inputs are in a fault state, an active ESD will NOT be released. The ESD release inputs will have no effect on a partial stroke ESD test. The momentary ESD input will be ignored if there is a present for less than 100 ms, and is guaranteed to latch in the ESD if the signal is present for greater than 800 ms. Once the ESD is latched in, the unit will perform the ESD action. In this case the ESD will move the unit to the close limit and remain in ESD mode until the ESD release indication is given using the ESD release inputs.

4.19.5 Custom Input Mode #3 – ESD Time Delay Relay

Custom software is available for the MX that permits the User to establish certain performance characteristics for ESD.

NOTE: These three inputs are normally all configurable. However, when this custom mode is enabled, the customer still retains the ability to change inputs 1 and 2 to their choosing, but Input 0 will always remain ESD. The timer is default 0-30 min (30 sec increment with default 0 sec).

Input 0 (normal default – ESD) terminal 30:

Set as enabled, ESD, 0 sec Delay(default), Signal present = active, ESD action Close

Input 1 (normal default – Open Inhibit) terminal 34:

Set as enabled, User Input, Signal present = active

Input 2 (normal default – Close Inhibit) terminal 35:

Set as enabled, User Input, Signal present = active



The ESD Time Delay Relay input (input 0) functions like any normal ESD input signal. Only if a time has been entered into the Delay Timer value then the unit will not act on that ESD for that delayed amount of time. If the ESD signal is removed, then the timer is canceled and will start fresh with the next assertion. You cannot change that Input 0 is ESD, but it can be enabled/disabled, set to signal present/absent, or you can change the ESD action.

NOTE: These three inputs are kept as open-stop-close inputs. When the custom mode is enabled, the wire mode is preset to 4-wire control and cannot be altered.

Input 3 (normal default – Stop) terminal 26

Input 4 (normal default – Open) terminal 25

Input 5 (normal default – Close) terminal 27

Table 4.1 – Digital Input Terminals

Standard Control													
Mode		Input 0		Input 1		Input 2		Input 3		Input 4		Input 5	
2-wire		configurable		configurable		configurable		not used		open		not used	
3-wire inch		configurable		configurable		configurable		not used		open		close	
3-wire maint		configurable		configurable		configurable		not used		open		close	
4-wire		configurable		configurable		configurable		stop		open		close	
User Input		configurable		configurable		configurable		user input		user input		user input	
Terminal connections													
Input 0		Input 1		Input 2		Input 3		Input 4		Input 5			
+VDC	-VDC	+VDC	-VDC	+VDC	-VDC	+VDC	-VDC	+VDC	-VDC	+VDC	-VDC		
30	32 or 33	34	29 or 31	35	29 or 31	26	28	25	28	27	28		
Jumpers can be used to connect the digital commons as need. 28 to 29, 31 to 32, 33 to VDC source common.													
Negative Switching (Positive Earth)													
Mode		Input 0		Input 1		Input 2		Input 3		Input 4		Input 5	
2-wire		configurable		open		not used		configurable		not used		not used	
3-wire inch		close		open		not used		configurable		not used		not used	
3-wire maint		close		open		not used		configurable		not used		not used	
4-wire		close		open		not used		stop		not used		not used	
User Input		configurable		configurable		not used		configurable		not used		not used	
Terminal connections													
Input 0		Input 1		Input 2		Input 3		Input 4		Input 5			
+VDC	-VDC	+VDC	-VDC	+VDC	-VDC	+VDC	-VDC	+VDC	-VDC	+VDC	-VDC		
30	32	34	29	N/A	N/A	26	28	N/A	N/A	N/A	N/A		
Custom Modes													
Mode		Input 0		Input 1		Input 2		Input 3		Input 4		Input 5	
1		not used		PS Enable 1		PS Enable 2		ESD Release 2		ESD Release 1		MO ESD/PSESD	
2		stop		close		open		ESD Release 2		ESD Release 1		MO ESD	
3		ESD TDR		configurable		configurable		stop		open		close	
(MO - momentary signal)													
Terminal connections													
Input 0		Input 1		Input 2		Input 3		Input 4		Input 5			
+VDC	-VDC	+VDC	-VDC	+VDC	-VDC	+VDC	-VDC	+VDC	-VDC	+VDC	-VDC		
30	32 or 33	34	29 or 31	35	29 or 31	26	28	25	28	27	28		
Jumpers can be used to connect the digital commons as need. 28 to 29, 31 to 32, 33 to VDC source common.													

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4.20 Monitor Relay

The monitor relay indicates the actuator is available for remote operation. The monitor relay will de-energize on loss of power or if any of the following functions become active:

Normal operation

Each selection is User configurable. Select “Enabled” to turn the feature on, and “Disabled” to turn the feature off.

- “LOCAL STOP/OFF” – Red selector knob in “STOP/OFF”
- “LOCAL SELECTED” – Red selector knob in “LOCAL”
- “TORQUE TIMER” - if enabled

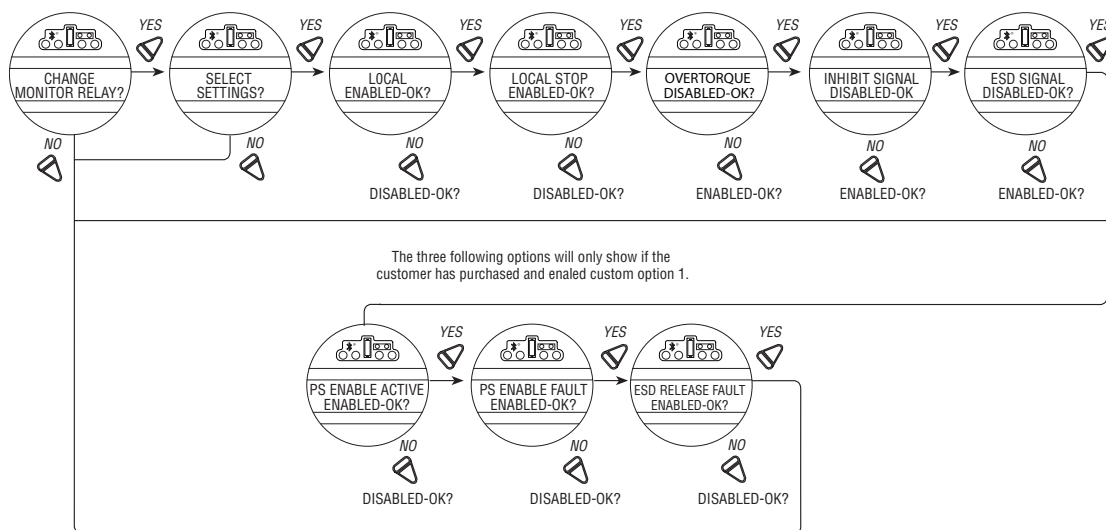
Fault indication

Each selection is User configurable. Select “Enabled” to turn the feature on, and “Disabled” to turn the feature off.

- “LOST PHASE” – Single phasing
- “VALVE JAMMED” – Valve cannot move when energized to pull out of valve seat
- “MOTOR OVERTEMP” – Thermistor range exceeded

The yellow LED will blink when monitor relay is de-energized.

Figure 4.30 – Monitor relay



These functions are monitored continuously and may not be changed, but an additional three functions may be configured individually during setup.

1. Select “CHANGE MONITOR RELAY?” from the “SETUP” routine.
2. Select “YES” to enter the “SELECT SETTINGS?” display. Select “YES” to access each of the following three functions:
 - “OVERTORQUE” – Torque range exceeded in mid-travel, thermistor temperature exceeded, or malfunction in thermistor
 - “INHIBIT SIGNAL” – Inhibit “ON” and active
 - “ESD SIGNAL” – ESD “ON” and active

3. Select “NO” to:

- “ENABLED” – will trip monitor relay or
- “DISABLED” – will not trip monitor relay.

4.21 Diagnostic Reset

For diagnostic purposes the following parameters are recorded at certain points in the valve travel on every opening and closing stroke:

- Proportional measurements of torque
- Drive sleeve turns
- Contactor operations
- Maximum and minimum voltage
- Motor run time
- Stroke time

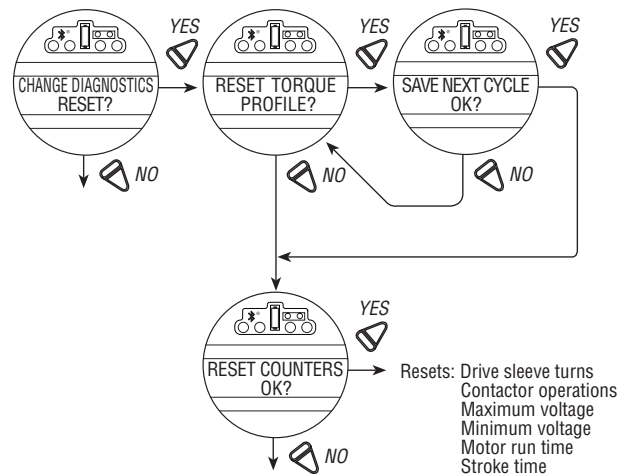
To enable the new values to be compared with previous measurements, it is essential to record reference values. Limitorque recommends this be done after the valve has been installed, commissioned, and is operating under normal process conditions, and after a plant shutdown or actuator/valve overhaul. The user may select to reset the torque profile at any time.

1. Select “RESET TORQUE PROFILE?” from the “RESET DIAGNOSTICS” routine.
2. Select “YES” to enter the “SAVE NEXT CYCLE?” display.
3. Select “NO” to switch the reset ON or OFF.

After the next complete cycling of the valve, in both the open and close directions, this reset will automatically be switched OFF.

4. Select “RESET COUNTERS” to reset all the listed parameters to “0.”

Figure 4.31 – Diagnostic reset



4.22 TAG Number

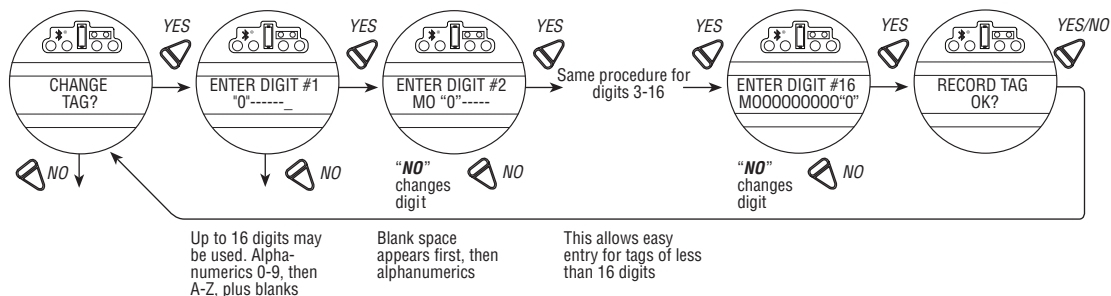
Defaults to blanks.

To Customize the Setting:

1. Select “CHANGE TAG?” from the “SETUP” routine.
2. Select “YES” to enter the “ENTER DIGIT” displays.
3. Select “NO” to choose the required number or letter for each digit of the valve tag number, up to a maximum number of 16 digits.

The alphanumeric display scrolls from a symbol set, numerals and then A-Z in the following order: ! “ # \$ % @ ‘ () * + , - . / 0-9 ; < = > ? A-Z. There is one blank at each end to enable a tag number with less than 16 digits to be entered clearly. To highlight the digit being entered, a dot appears over the space and the letter above the space disappears.

Figure 4.32 – TAG number

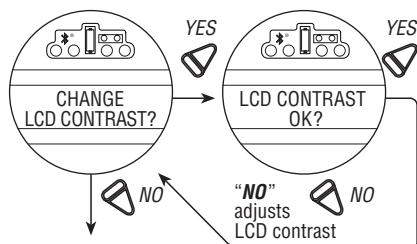


4.23 LCD Contrast

Permits adjustment of the viewing contrast of the LCD.

1. Select “YES” to enter the “LCD CONTRAST” display.
2. Select “NO” to adjust contrast to desired level.

Figure 4.33 – LCD contrast

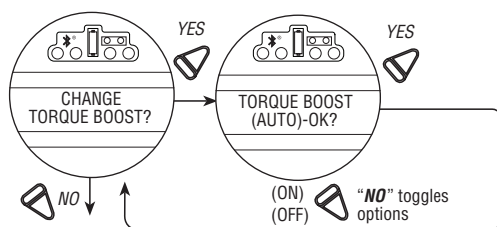


4.24 Torque Boost

Default = “AUTO”

Torque boost increases the capacity to move valves under conditions of low temperature or extreme valve stiffness. In the default setting, the MX will permit more output torque up to the unit's maximum torque rating when the temperature falls below 32°F (0°C). When configured as ON, torque boost will be present under all conditions regardless of temperature, and when OFF, torque boost will not be present.

Figure 4.34 – Torque boost



4.25 Motor Thermostat

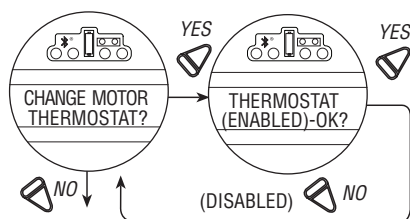
The thermostat setting may be customized:

1. Select “CHANGE MOTOR THERMOSTAT?” from the “SETUP” routine.
2. Select “YES” to enter the “MOTOR THERMOSTAT” display.
3. Select “NO” to choose between “ENABLED” and “DISABLED.”

In the “DISABLED” mode, the motor thermostat is bypassed and detection of an overheated motor does not prevent operation of the actuator. This feature is user-selected when required by the application and may be desirable during critical service.

NOTE: If the motor thermostat is disabled, third party certification including Factory Mutual, CSA, ANeZ, ATEX, and warranty, will be voided.

Figure 4.35 – Motor thermostat



4.26 Change Valve Data

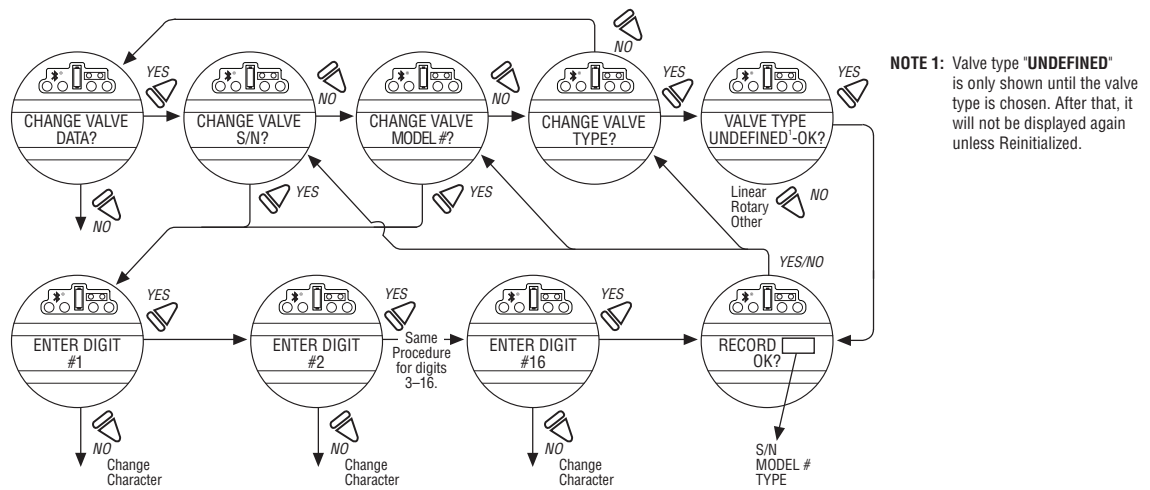
“Change Valve Data” allows the user to identify the type of valve the MX actuator is mounted to.

- Select “YES” to “Change Valve S/N?” Then select “YES” to “ENTER DIGIT” displays.
- Select “NO” to choose the required number or letter for each digit of the valve S/N, up to a maximum of 16 digits.



- Select “YES” when the desired number or letter is displayed. When all digits have been entered select “YES” to “Record S/N OK?”
- Follow same sequence for “CHANGE VALVE MODEL #?”, “CHANGE VALVE TYPE?”
- If “YES” to “CHANGE VALVE TYPE?” then “VALVE TYPE UNDEFINED-OK?” is displayed. “VALVE TYPE UNDEFINED-OK?” is only shown until the valve type is chosen. In the rare event that the user would need to “REINITIALIZE” the MX actuator, the screen will reappear. See Figure 5.1.
- The alphanumeric display scrolls from a symbol set, numerals and then A-Z in the following order: ! “ # \$ % & ‘ () * + , - . / 0-9 : ; < = > @ A-Z. There is one blank at each end to enable a tag number with less than 16 digits to be entered clearly. To highlight the digit being entered, a dot appears over the space and the letter above the space disappears.

Figure 4.36 – Change valve data



Default = Local Port

The flowchart outlines the following steps for Bluetooth configuration:

- CHANGE PORTS?** (Icon: Two ports with arrows)
 - YES:** Proceeds to **DIAGNOSTIC PORT BLUETOOTH-OK?**
 - NO:** Proceeds to **LOCAL PORT (ON)-OK?**
- DIAGNOSTIC PORT BLUETOOTH-OK?** (Icon: Two ports with arrows)
 - YES:** Proceeds to **BLUETOOTH PRESENT-OK?**
 - NO:** Toggles options: **IRDA-OK?** and **NONE-OK?**
- BLUETOOTH PRESENT-OK?** (Icon: Two ports with arrows)
 - YES/NO:** Proceeds to **ADDRESS-OK? 0CW0961586E2**
- ADDRESS-OK? 0CW0961586E2** (Icon: Two ports with arrows)
 - YES/NO:** Proceeds to **FCC IDENTIFICATION POOWML-C40**
- FCC IDENTIFICATION POOWML-C40** (Icon: Two ports with arrows)
 - YES/NO:** Proceeds to **CHANGE BLUETOOTH?**
- CHANGE BLUETOOTH?** (Icon: Two ports with arrows)
 - YES:** Proceeds to **BLUETOOTH NAME USE UNIT S/N-OK?**
 - NO:** Proceeds to **LOCAL PORT (ON)-OK?**
- LOCAL PORT (ON)-OK?** (Icon: Two ports with arrows)
 - Diagnostic use only:** Proceeds to **CHANGE BLUETOOTH?**
- BLUETOOTH NAME USE UNIT S/N-OK?** (Icon: Two ports with arrows)
 - YES:** Proceeds to **SECURITY ENABLED-OK?**
 - USE UNIT TAG-OK? NO:** Proceeds to **CHANGE BLUETOOTH?**
- SECURITY ENABLED-OK?** (Icon: Two ports with arrows)
 - YES:** Proceeds to **CHANGE BLUETOOTH PIN**
 - DISABLED-OK? NO:** Proceeds to **CHANGE BLUETOOTH?**
- CHANGE BLUETOOTH PIN** (Icon: Two ports with arrows)
 - YES:** Proceeds to **DISCOVERY ENABLED-OK?**
 - NO:** Proceeds to **ENTER DIGIT #1 default 123456789**
- ENTER DIGIT #1 default 123456789** (Icon: Two ports with arrows)
 - DISCOVERY ENABLED-OK? NO:** Proceeds to **DISCOVERY ENABLED-OK?**
- DISCOVERY ENABLED-OK?** (Icon: Two ports with arrows)
 - YES:** Proceeds to **DISCOVERY ENABLED-OK?**
 - DISABLED-OK? NO:** Proceeds to **ENTER DIGIT #1 default 123456789**

15 character pin/passkey – no changes the character, yes goes to the next digit.



5 Troubleshooting

WARNING: This actuator is non-intrusive. Do not open the control compartment on the actuator unless absolutely necessary. It was sealed in dry, clean conditions in the factory and entry to this compartment should not be necessary. Unauthorized entry could void the warranty.

If the actuator will not operate, before attempting to troubleshoot, verify the following:

- LCD display reads “XX% OPEN,” “STATUS OK.”
- Red selector switch is not in the STOP position.
- All three phases of the main power supply are present at the actuator terminals.
- The supply voltage is the same as that stated on the actuator nameplate.
- Optional 110 VAC is measured at terminals 23 and 24.
- 24 VDC is measured at terminals 22 (+Ve) and 21.
- If 24 VDC power supply is ON, check that the loading does not exceed 5 W across terminals 21 and 22 (remove wires from 21, 22, 23, and 24).
- LCD and LED display on the control panel are illuminated.

If these checks are satisfactory, then attempt to locate the fault using the “VIEW DIAGNOSTICS” routine. It is also recommended that the actuator settings be verified using “VIEW SETTINGS.”

5.1 View Diagnostics Routine

1. Enter “VIEW DIAGNOSTICS” as detailed in Section 5.3, View Diagnostics.
2. Review the various displays to try to find the reason the actuator will not operate. The displays that may help to isolate the fault are as follows:
 - View Hardware Status
 - View Motor Status
 - View Power Supply

5.2 Troubleshooting Problems/Corrective Action

(Refer to LMENIM2314, MX Maintenance and Spare Parts and the standard wiring diagram in the Section 3.3, Electrical Connections). We recommend that only Limitorque service personnel perform this operation.

1. Switch off the main power supply and 24 VDC supply at terminals 6 and 7 (if used).
2. Remove control compartment cover (ACP) and protect against the ingress of moisture or dust.
3. Remove any wiring that has been connected to terminals 21, 22, 23 and 24.



4. Switch on main power supply.
5. Measure VAC at 23, 24 – should be 110 VAC if actuator is supplied with optional 110 VAC circuit. If no power, check fuses FS1, FS2 (600 VAC, 1 A, fast acting, 10.3 x 38.1 mm tube) and FS3 (250 VAC, 0.1A, time delay, 5 x 20 mm glass tube) and replace if necessary. If replacing fuses does not fix the problem, replace damaged board. Contact Limitorque Service at (434) 528-4400.
6. Measure VDC at 21, 22 – should be 24 VDC, maximum power of 5W. If not, replace damaged board.
7. Replace the control compartment cover (ACP).

5.2.1 Actuator Fails to Operate

Actuator Fails to Operate from LOCAL Controls

1. Place the red selector knob in “LOCAL.”
2. If motor runs but actuator output does not turn, check that declutch lever has returned to motor operation position.
3. Check LCD display for following alarms:
 - If motor runs but no actuator movement is detected, check if the display says “JAMMED VALVE” and free if necessary.
 - Inhibit signal may be present or absent at the terminals. Check for signal and adjust as necessary. “INHIBIT ACTIVE” appears on display.
 - Thermal overload of the motor may have been detected. Check motor for high temperature. Thermal overload is self-resetting when motor cools. “MOTOR OVERTEMP” appears on the display.
4. Check to see if the position limits are set incorrectly on top of one another. See Section 3.5.4, Setting Position Limits.

Actuator Fails to Operate from REMOTE Controls

1. Check that the actuator will operate from “LOCAL.” If not, then carry out the checks described below.
2. Check that the red knob is in “REMOTE.”
3. ESD signal may be present or absent at the terminals. Check for signal and adjust as necessary. (“ESD ACTIVE” at display.) If actuator was previously operated in “LOCAL,” then the fault is probably in the remote control circuit. Check the integrity of the cabling and that the connections to the terminals are in accordance with the wiring diagram. If motor runs in “LOCAL,” but not “REMOTE,” adjust ESD to be greater than local (“ESD>LOCAL”).
4. Confirm correct monitor relay operation. See Table 3.5.

5.2.2 Jammed Valve Detected

1. Check that position limits have been set correctly. If valve is position-seated, the limits should stop the motor just before the end-of-travel. Recalibrate the position limits if necessary. See Section 3.5.4, Setting Position Limits.
2. Check that torque settings are correct for the valve. Recalibrate if necessary. See Section 4.6, Torque Setup.
3. Check the condition of the valve and lubrication of the valve stem and thrust bearings. The valve may have remained in the same position for a long time and become corroded internally or externally. Engage manual override and employ the handwheel drive to unseat the valve.
4. Verify that the actuator will now operate the valve. Open and close the valve a few times to check for correct operation throughout the travel.

NOTE: To free a jammed valve from the “CLOSE” or “OPEN” position, engage manual override and attempt to unseat it using the handwheel drive. If a rising stem valve is jammed in the close position, loosen the fixing bolts that attach the



thrust base to the valve. This will release the compression in the drive components and reduce the effort to unjam the valve. Partly open the valve, then retighten the bolts.

5.2.3 Actuator Operates but Does Not Drive Valve

1. Verify that the declutch lever has returned to motor-operated position.
2. Verify that the stem nut is fitted correctly in the actuator base.
3. Verify that the stem nut has sufficient engagement with the valve stem.
4. Verify that the key is fitted in bore/keyway applications.

5.2.4 Valve Does Not Seat Correctly

1. Verify that position limits are calibrated correctly for the valve travel.
2. Verify that the torque-seating valves have been configured to close on torque, not position.
3. Verify that closing torque value has been set high enough to suit the process conditions.
4. Verify that the valve is not obstructed.

5.2.5 Status Messages

Normal display status is listed in Section 3.6.5, Local Indication. Status or alarm messages are listed below. Once a status or alarm condition occurs, the message will be displayed on the bottom line of the Local Control Station (LCS) screen until the condition is addressed and cleared. If multiple status or alarm conditions are active, the bottom display will cycle through each screen until the condition is addressed and cleared (one message per four seconds).

Status or Alarm Messages (XX = Input # (0, 1, 2))

“---% OPEN, STATUS OK” – Normal display

“---% OPEN, VALVE JAMMED” – Valve cannot start moving

“---% OPEN, LOST PHASE” – One of three phases lost

“---% OPEN, MOTOR OVERTEMP” – Thermistor range exceeded

“---% OPEN, OVERTORQUE” – Torque exceeded in mid-travel

“---% OPEN, HARDWARE FAILURE” – Indication

“---% OPEN, DDC OFF” – DDC enabled, but “OFF”

“---% OPEN, ESD ACTIVE” – ESD signal present

“---% OPEN, INHIBIT ACTIVE” – Inhibit signal present

“---% OPEN, FF OFF” – FF enabled but “OFF”

“---% OPEN, PB OFF” – PB enabled but “OFF”

“---% OPEN, DN OFF” – DN enabled but “OFF”

“---% OPEN, WARMING UP” – Warm up delay active (cold temperature option)

“---% OPEN, NO ANALOG SIGNAL” – 4-20 mA signal absent (Mod enabled, red selector switch in “REMOTE”)

“---% OPEN, DDC COM LOST” – DDC enabled, signal absent

“---% OPEN, THERMISTOR” – There is a failure with the motor thermistor



“---% OPEN, KNOBS” – There is a failure with the local knobs

“---% OPEN, DDC NOT PRESENT” – DDC board expected but not found (missing or not communicating)

“---% OPEN, FF NOT PRESENT” – FF board expected but not found

“---% OPEN, PB DP NOT PRESENT” – Profibus DP board expected but not found

“---% OPEN, PB PA NOT PRESENT” – Profibus PA board expected but not found

“---% OPEN, DN NOT PRESENT” – Device Net board expected but not found

“---% OPEN, ANG1 NOT PRESENT” – Analog 1 board expected but not found

“---% OPEN, ANG2 NOT PRESENT” – Analog 2 board expected but not found

“---% OPEN, CONTACTOR” – Contactor failure

“---% OPEN, ENCODER” – Encoder failure

“---% OPEN, R1R4RM RLY FAILED” – R1-R4 board relay check failed

“---% OPEN, R5R8 RLY FAILED” – R5-R8 board relay check failed

“---% OPEN, DDC FAILED” – Communication with the main board failed, or hardware fault

“---% OPEN, FF FAILED” – Communication with the main board failed, or hardware fault

“---% OPEN, PB DP FAILED” – Communication with the main board failed, or hardware fault

“---% OPEN, PB PA FAILED” – Communication with the main board failed, or hardware fault

“---% OPEN, DN FAILED” – Communication with the main board failed, or hardware fault

“---% OPEN, R1R4RM NOT AVAIL” – R1-R4 board expected but not found

“---% OPEN, R5R8 NOT PRESENT” – R5-R8 board expected but not found

“---% OPEN, ENCODER WARNING” – The encoder has not yet failed, but there was a momentary glitch detected. If the glitch persists, encoder failure will be reported.

“---% OPEN, FF COM Lost” – FF enabled, signal absent

“---% OPEN, PB COM Lost” – PB enabled, signal absent

“---% OPEN, DN COM Lost” – DN enabled, signal absent

---%OPEN, ESD XX ACTIVE – Input # set for ESD, is asserted, and has highest priority

---%OPEN, ESD = XXX.X % = ESD ACTIVE and its action is “move to” ---.% position

---%OPEN, ESD XX INHIBITED – Active ESD XX has been inhibited by an ESD override

---%OPEN, ESD XX CONFLICT – ESD XX is set for ESD, asserted, and is in conflict with the active ESD

---%OPEN, ESD OPEN – active ESD action is OPEN

---%OPEN, ESD CLOSED – active ESD action is CLOSED

---%OPEN, ESD STOP – active ESD action is STOP

---%OPEN, ESD IGNORE – active ESD action is IGNORE



---%OPEN, INHIBIT ACTIVE – INHIBIT signal is asserted

---%OPEN, INHIBIT CONFLICT – Conflict with multiple INHIBITS

---% OPEN, IDENTICAL LIMITS – Position limits identical preventing operation

---% OPEN, TORQUE TIMEOUT – The torque switch timed out after the actuator determined that it has reached its torque seat

“SET LIMITS” – Normal display if red selector knob is in “LOCAL” or “REMOTE” and position limits have not been set

“INITIALIZE” – “INITIALIZE” will be displayed if module has no actuator configuration. No operation will be permitted until initialization has been completed. Refer to “ROM ERROR” for routine on next page. See Figure 5.1.

“ANALOG OUT 1 LOSS” – Analog board output-driver chip is reporting a fault, and cannot be reset; resulting in loss of analog out signal.

“ANALOG OUT 2 LOSS” – Analog board output-driver chip is reporting a fault, and cannot be reset; resulting in loss of analog out signal.

RAM Error

The MX processor continually checks RAM for memory corruption errors. If corruption is detected, the processor will force a reset to clear RAM. The LCD will temporarily display the following prior to this reset:

“XXX% OPEN”

“RAM ERROR”

After the reset, the display will read normally. Any momentary commands (DDC command, momentary pushbutton, etc.) that were not completely executed must be reissued.

ROM Error

The MX processor continually checks EPROM for memory corruption errors. If corruption is detected, operation is disabled. If the selector switch is in “LOCAL” or “REMOTE,” the LCD will display the following:

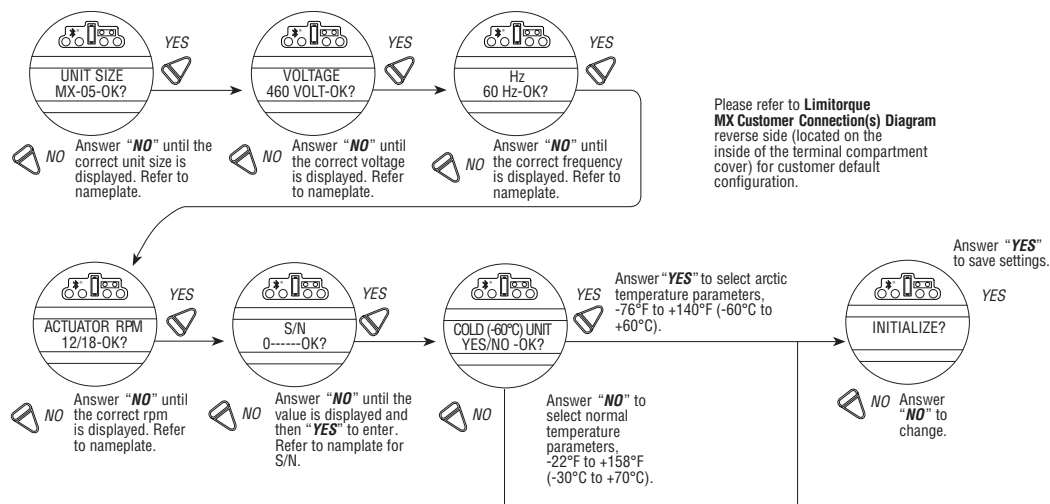
“XXX% OPEN”

“ROM ERROR”

When the selector is placed in “STOP,” the unit will require reinitialization and the LCD will display the following dialog:



Figure 5.1 – Initialize routine



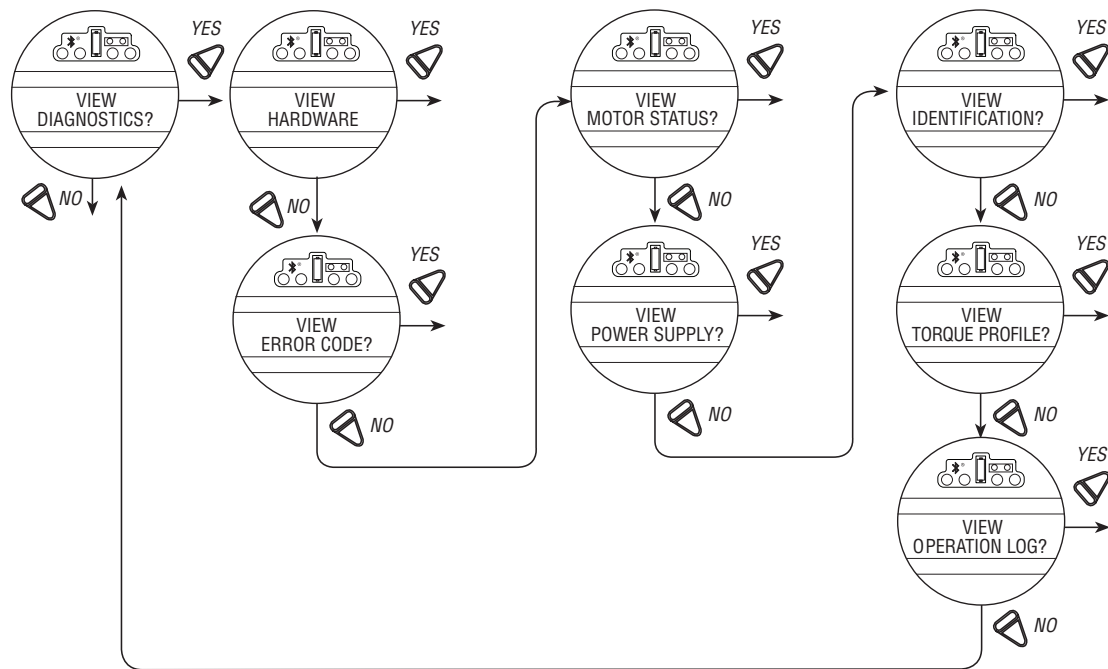
5.3 View Diagnostics

A large amount of historical data is stored in the actuator memory and can be retrieved very easily, without the need for password entry. The data is displayed in dialog format.

1. Enter the "SETUP" mode routine detailed in Section 2.1.1, Entering the Setup Mode.
2. Select "VIEW DIAGNOSTICS?"
3. Select "YES" to access the first display "VIEW HARDWARE?"

NOTE: It is recommended that ALL diagnostics information be recorded prior to contacting an authorized Limitorque service coordinator at (434) 528-4400. This information aids in diagnosing any problem the actuator may experience.

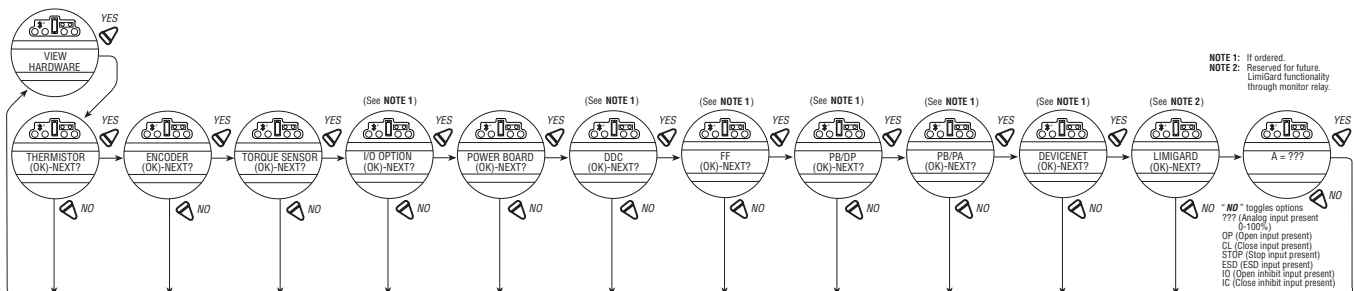
Figure 5.2 – Diagnostic overview



5.4 View Hardware Status

Accessing the “VIEW HARDWARE” routine will enable some of the actuator components to be reviewed for their integrity, as indicated below. These components are continuously being monitored.

Figure 5.3 – View hardware status

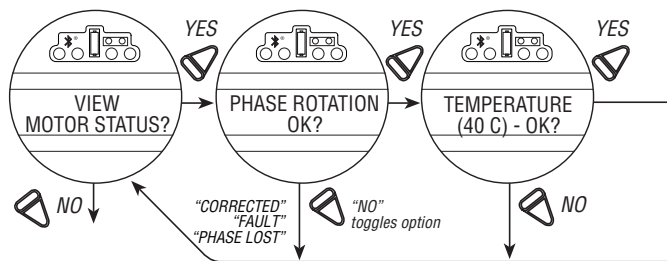


5.5 View Motor Status

Viewing “MOTOR STATUS” will provide information on the following:

- If the three-phase power supply is connected correctly.
- If autophase correction is in operation.
- If there is a fault or loss of a phase.
- Temperature of the windings in the motor.

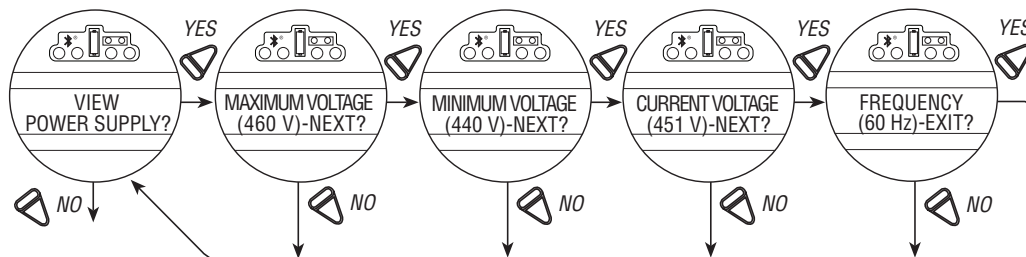
Figure 5.4 – View motor status



5.6 View Power Supply

Viewing “POWER SUPPLY” will provide historical data on the maximum and minimum voltages that have been applied to the actuator, as well as the frequency of the AC supply. These can be reset. See Section 4.21, Diagnostic Reset.

Figure 5.5 – View power supply



NOTE: Motor temperature and voltage updates every 0.5 seconds.

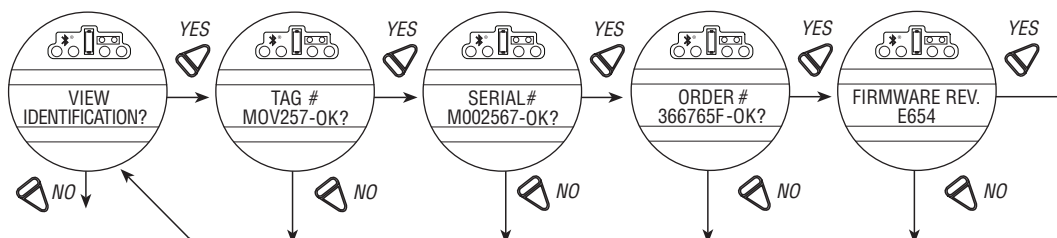


5.7 View Identification

In this dialog, the identity of the actuator may be reviewed. This dialog provides valuable information for the ordering of spare parts or checking the specification of the actuator.

NOTE: The serial number, order number, and software revision number were entered at the time of manufacture and cannot be changed on screen. The software revision number is necessary when option boards are ordered.

Figure 5.6 – View identification



*Network revisions will only be displayed if the optional network board is installed within the MX.

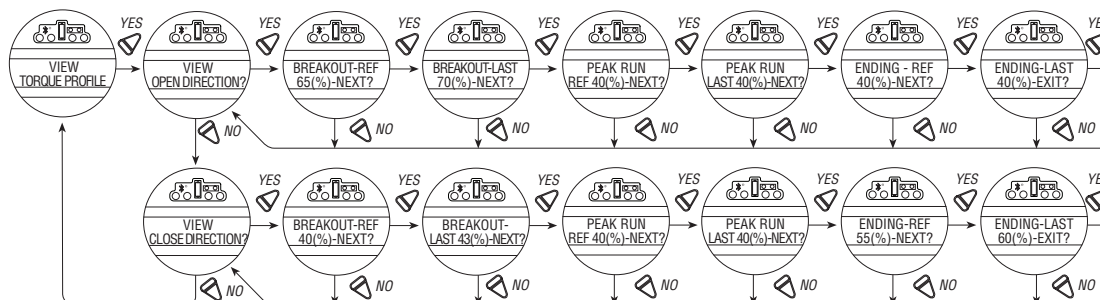
5.8 View Torque Profile

The information contained in the “TORQUE PROFILE” dialog provides indication of the condition of the valve relative to the last time that the “DIAGNOSTIC RESET” reference values were reset. See Section 4.22, TAG Number. It can give an indication of a change in the process conditions, such as an increase in pressure.

Details are given for the REFERENCE and the LAST torque, expressed as a percentage of the rated torque (stated on the nameplate, Figure 4.7) that occurred at BREAKOUT, ENDING, and PEAK RUNNING for both the opening and closing directions. Torque will be expressed proportionally as a reference only from 40% to 100% inclusive. Initial indication may read 0% until torque exceeds 40% minimum.

- “BREAKOUT” – Amount of torque required to unseat the valve.
- “ENDING” – Amount of torque required to seat the valve.
- “PEAK RUNNING” – Maximum torque detected while cycling from BREAKOUT to ENDING. (Maximum mid-travel torque.)

Figure 5.7 – View torque profile



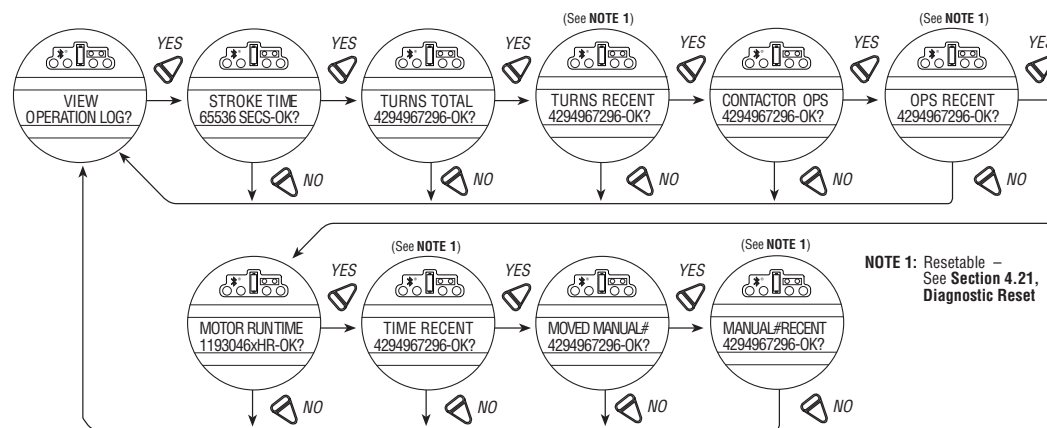
5.9 View Operation Log

The “OPERATION LOG” provides information to assist in the maintenance program for the actuator because it indicates the total number of actuator turns, contactor operations, motor run time, and declutching operations since the actuator was manufactured. These figures may not be reset except in “RESTRICTED SETUP.” Contact factory.

The LCD screen definitions are as follows:

- “STROKE TIME” – Length of time of last actuator operation
- “TURNS TOTAL” – Total number of drive sleeve revolutions
- “TURNS RECENT” – Number of drive sleeve revolutions since last diagnostic reset. See Section 4.21, Diagnostic Reset, for reset diagnostics instructions.
- “CONTACTOR OPS” – Total number of contactor operations
- “OPS RECENT” – Number of contactor operations since last diagnostic reset. See Section 4.21, Diagnostic Reset, for reset diagnostics instructions.
- “MOTOR RUN TIME” – Total motor operational time
- “TIME RECENT” – Motor operational time since last diagnostic reset. See Section 4.21, Diagnostic Reset, for reset diagnostics instructions.
- “MOVED MANUAL #” – Total number of times unit has been operated manually
- “MANUAL # RECENT” – Number of times unit has been operated manually since last diagnostic reset. See Section 4.21, Diagnostic Reset, for reset diagnostics instructions.

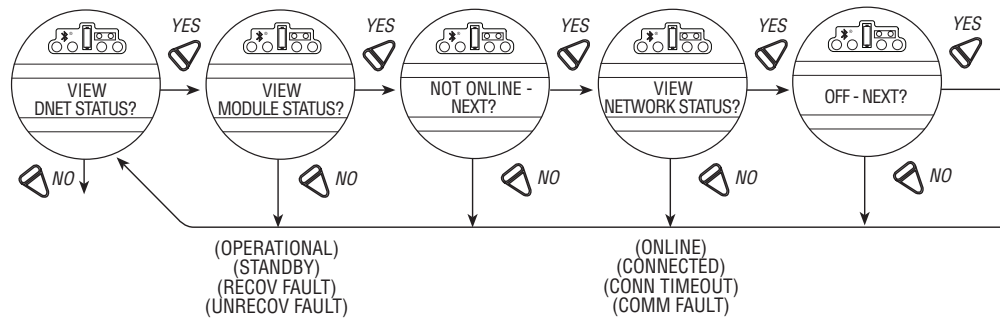
Figure 5.8 – View operation log



5.10 View DNET Status?

This selection permits the User to view pertinent information that summarizes the status of the DeviceNet option board

Figure 5.9 – View DNET status



VIEW MODULE STATUS?

Answer “YES” to determine status of individual DN board within the actuator.

Configuration choices are:

“OFF” = board installed but turned off

“STANDBY” = The device needs commissioning due to configuration missing, incomplete or incorrect.

“RECOVERABLE FAULT” = Conditions that can cause this event are e.g. communication fault, power fault or Limiguard fault of the SMT Main Board. Device may need resetting.

“UNRECOVERABLE FAULT” = Internal Diagnostic Fault detected e.g.

- Receive Queue Overrun
- Transmit Queue Overrun
- CAN Controller Overrun

Device may need replacing.

“SELF TESTING” = The device is in self-test mode.

**VIEW NETWORK STATUS?**

Answer “YES” to determine status of DN network.

“NOT ON LINE” = Device is not on-line.

- The device has not completed the self-test yet.
- The device may not be powered, look at Module Status Display.

“ONLINE” = Device is on-line but has no connections in the established state.

- The device has passed the SELF test, is on-line, but has no established connections to other nodes.
- For a Group 2 Only device it means that this device is not allocated to a master.
- For a UCMM capable device it means that the device has no established connections.

“CONNECTED” = The device is on-line and has connections in the established state.

- For a Group 2 Only device it means that the device is allocated to a Master.
- For a UCMM capable device it means that the device has one or more established connections.

“CONN TIMEOUT” = One or more I/O Connections are in the Timed-Out state.

“COMM FAULT” = Failed communication device. The device has detected an error that has rendered it incapable of communicating on the network (Duplicate MAC ID, or Bus-off).

“ID COM FLT REQ” = A specific Communication Faulted device. The device has detected a Network Access error and is in the Communication Faulted state. The device has subsequently received and accepted an Identify Communication Faulted Request. Long Protocol message.



6

Maintenance

Under normal operating conditions, the MX is a maintenance-free actuator. For ordinary applications, the actuator will require no formal maintenance program. However, if the actuator is used under severe service conditions or operated in a Hazardous Location, the following maintenance procedures are required:

1. Check the oil level every 50 hours of operation at a minimum. Where conditions are severe due to frequent operation or high ambient temperatures, a more regular inspection interval should be maintained.
2. Change the gear oil every 100 hours of operation. See Section 6.1: Lubrication.
3. All ball bearings, oil seals, O-rings and quad-rings are to be replaced after 450 hours of operation. See Bulletin LMENIM2314, MX Maintenance and Spare Parts for disassembly procedures.

Clean and lubricate the valve stem regularly to avoid torque build-up and wear due to silting and corrosion. Infrequent operation can lead to corrosion and contamination of the valve stem thread lubricant. Check any thrust bearings that are fitted to the actuator for proper lubrication at regular intervals. For additional details refer to LMENIM2314, MX Maintenance and Spare Parts.

6.1 Lubrication

MX actuators are oil-filled, as standard, using Mobil SHC 632. Exxon Teresstic SHP 320 may be used as a direct substitute. These products are synthetic machine oils suitable for ambient temperatures of -20°F to 250°F (-30°C to 120°C). For extreme low temperature conditions (< -30°C to -55°C), an alternative lubricant is available—Petro Canada TRAXON Synthetic 75W-90 with TOS. Consult factory for arctic temperature applications.

6.1.1 Oil Capacities

To avoid pressurization of the gearcase, the following recommended oil capacities should not be exceeded:

- | | |
|--------------------------------|-------------------------------|
| • MX-05 – 10 oz. (256 ml) | MX-85 – 192 oz. (5.7 liters) |
| • MX-10 – 21 oz. (.6 liters) | MX-140 – 192 oz. (5.7 liters) |
| • MX-20 – 48 oz. (1.4 liters) | MX-150 – 192 oz. (5.7 liters) |
| • MX-40 – 65 oz. (1.9 liters)) | |

6.1.2 Checking Oil Level

To check the level:

1. Remove the uppermost filler plug on the gearcase.
2. Check that the level of oil is within 1 inch (25 mm) of the hole (when actuator is mounted with base horizontal).



7

Regulatory Information

Application of Council Directive(s)

2004/108/EC; EMC Directive

2006/42/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 Harmonized Standards

prEN 60079-0:200X (IEC 60079-0:2007)

EN 60079-1:2007

EN 60079-7:2007

EN 60529:1991 + A1:2000

EN 13463-1: 2009

EN 13463-5: 2003

Materials of Construction Terminal & Control Covers - Aluminum Alloys 380 or 383

CS Station - Aluminum Alloy 319

Nameplate - Stainless Steel

Housing - 356-T6 Aluminum

Window - Heat tempered Soda Lime Glass

Antenna Cover - Polytetrafluoroethylene


Limitorque MX Electronic Actuator FCD LMENIM2306-04 – 2/11

EMC - Electromagnetic Compatibility (EMC) and Electromagnetic Interference (EMI) standards to which this actuator complies:

Applicable Emissions standards	EN50011:1998	Class A service	
Radiated emissions	EN55011:1998 & FCC Part 15, subpart J	30-130MHz 40dBmV / m 230-1000MHz 47dBmV / m	
Conducted emissions	EN55011:1998 & FCC Part 15, subpart J	0.15 to 0.5MHz 79dBmV (QuasiPeak 66dBmV avg) 0.5 to 30MHz 73dBmV (QuasiPeak 60dBmV avg)	
Applicable immunity standards	IEC EN 61000-6-1:2001		
ESD	IEC61000-4-1:1995	±8kV thru air ±4kV thru contact	
Radiated RF immunity	IEC61000-4-3:1995	80MHz to 2GHz 10Vrms / m	
Fast transients/burst	IEC61000-4-4:1995	EFT AC Power leads: ±2kV Signal leads: ±1kV	
Voltage surges	IEC61000-4-5:2001	AC Power: ±2kV com, ±1kV diff Signal leads: ±0.5V com, ±1kV diff	Perf criterion: B
Conducted RF immunity	IEC61000-4-6:1996	150kHz to 80MHz 10Vrms	Perf criterion: A w/ 80% AM modulation @ 1KHz
Magnetic field immunity	IEC61000-4-8:1993	Power line frequency 30A/m @ 60Hz	Perf criterion: A
Voltage dips and interrupts	IEC6326-1:2005 (IEC61000-4-11:2004)	60Hz 100% dip, 1 cycle duration 40% dip, 10 cycle duration 70% dip, 25 cycle duration 100% interrupt for 5s	Perf criterion: B, C 3 test each @ 10 sec interval 3 test each @ 10 sec interval 3 test each @ 10 sec interval 3 test each @ 10 sec interval



Notified Body

FM Approvals Limited
1 Windsor Dials
Windsor UK
Certification Number
FM09ATEX0058X"

IECEX

IEC 60079-0:2007
IEC 60079-1:2007
IEC 60079-7:2006
IEC 60529:1989 + A1:1999

Manufacturer's Name

Limitorque, a division of Flowserve Corporation

Manufacturer's Address

5114 Woodall Road
Lynchburg, VA 24502

Importer's Name

Limitorque International

Importer's Address

Euro House
Abex Road
Newbury
Berkshire, RG14 5EY
England

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:

A handwritten signature in black ink, appearing to read "Earnest Carey".

(Signature)
Earnest Carey
(Full Name)

Manager, Product Management
(Title)

Flowserve Limitorque
5114 Woodall Rd., Lynchburg VA 24502
(Place)

February 2011
(Date)



7.1 Specific Conditions for Use — Atex/Cenelec/IECEx Applications

1. ISO Class 12.9, M8 / M10 / M16 / M20 socket-head cap screws (Yield Stress 1100 MPa) shall be used to replace the terminal, control, or motor compartment fasteners.
2. K-500 Monel, M8 socket-head cap screws (Yield Stress 700 MPa) shall be permitted as an alternate to the ISO Class 12.9 socket-head cap screws on the terminal or control compartments of Group IIB actuators.
3. K-500 Monel, M8 socket-head cap screws (Yield Stress 700 MPa) shall be permitted as an alternate to the ISO Class 12.9 socket-head cap screws on the motor compartments of Group IIB, MX-05 / 10 / 20 / 40 actuators.
4. Stainless steel, ISO Class 70, M10 socket-head cap screws (Yield Stress 450 MPa) shall be permitted as an alternate to the ISO Class 12.9 socket-head cap screws on MX-85 motor (Frame 56 or Frame 180) compartments.
5. Stainless steel, ISO Class 70, M10 / M16 / M20 socket-head cap screws (Yield Stress 450 MPa) shall be permitted as an alternate to the ISO Class 12.9 socket-head cap screws on MX-140 (Frame 180) or MX-150 motor compartments.
6. Consult the manufacturer if dimensional information on the flameproof joints is necessary.

7.2 Statement of Compliance with Applicable European Directives

We, Flowserve Limitorque, 5114 Woodall Road, Lynchburg, VA, USA 24502, as the manufacturer of the equipment listed below:

MX-05, 10, 20, 40, 85, 140 and 150 electronic valve actuator. The MX is a non-intrusive electronic actuator. It is specifically designed for the purpose of being mounted to multi-turn valves (or other apparatus) in order to move the valve from fully closed to fully open.

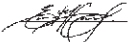
Confirm, in accordance with the requirements of clause 1.2.7 of the Essential Health and Safety Requirements of Community Directive 94/9/EC on equipment and protective systems intended for use in potentially explosive atmospheres that the above equipment has been designed and manufactured to:

- a) Avoid physical injury or other harm which may be caused by direct or indirect contact;
- b) Assure that the surface temperature of accessible parts or radiation which cause a danger, are not produced;
- c) Eliminate non-electric dangers which are revealed by experience;
- d) Assure that foreseeable conditions of overload shall not give rise to dangerous situations.

And where these risks are wholly or partly covered by other Community Directives, the equipment satisfies the requirements of those specific Directives.

And that literature describing the equipment will not contradict the instructions with regard to safety aspects.

Issued on: February 2011

Authorized by: 

Name: Earnest G. Carey, Jr.

Position: Manager Product Management and Marketing







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Limitorque Actuation Systems

Quick Setup for Accutronix MX Actuators

Q-Pulse Id: TMS1578

Active: 23/02/2016



Page 112 of 294

Before You Begin

The MX actuator's 32-character LCD display provides easy-to-read actuator status, diagnostics, and setup information—in the language you choose. Once you have set the actuator's position limits, the unit will be ready for normal operation. The screen message will indicate the valve position as a percentage of the valve opening. Full open is expressed as **100% OPEN** and full close is expressed as **0% OPEN**.

Factory Settings

The MX actuator can be configured with the parameters that you require in the field. The calibration of position limits are addressed in this document. If full valve data was not provided when ordering, or if changes to the default settings are needed, see *Bulletin LMAIM1306, Installation and Operation for MX-05 through MX-140*, for complete instructions.

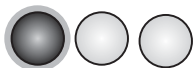


Checking the Open/Closed Settings

- **Valve Closed** As you close the valve using the actuator, make sure that the close light (green) illuminates just as the travel limit is reached. The display should read **0% OPEN**.
- **Valve Open** As you open the valve using the actuator, make sure that the open light (red) illuminates just as the travel limit is reached. The display should read **100% OPEN**.



0% OPEN



100% OPEN

Setting the Password

At the **ENTER PASSWORD?** prompt, use the black knob and toggle to select the correct password. Another option in the Change Settings menu is **CHANGE PASSWORD?** You may disable the actuator's password function by setting the password to **000**. The password function can be re-enabled by resetting the password to any other three-digit code.

100

**FACTORY DEFAULT
PASSWORD**

Setup






1

Connect Power to the Unit.

Refer to the nameplate on the actuator for the correct voltage for the main power supply. Or connect an auxiliary 24 VUC supply to terminal points 37 (-) and 38 (+).

2

Begin Setup.



Move the red selector knob to  **STOP**. Within 10 seconds, toggle the black control knob to the  **YES**,  **NO**, and  **YES** positions. This will trigger the prompt **SETUP?** to appear on the screen. Answer  **YES** within 10 seconds.

Use the black control knob to answer the following prompts:

SETUP?  **YES**

CHANGE SETTINGS? ...  **YES**


ENTER PASSWORD  **YES**

Toggle through numbers using the  **NO** knob and select the correct three-digit password by toggling  **YES**. See “Setting the Password” if you are having trouble.

3

Change Settings Menu.

After successfully entering the password, answer




 **NO** to the Change Settings menu prompts until you reach the prompt **CHANGE**

POSITION SETUP?

Answer  **YES**.

Setup

Set Position Limits for Electrical Operation

4 Set closed valve position. At the **CLOSE VALVE-OK?** prompt, move the red control knob to  **LOCAL**. Hold the black control knob in the  **CLOSE** position until the valve has reached the desired position. Move the red control knob to  **STOP**.

5 Set the open valve position. At the **OPEN VALVE-OK?** prompt, move the red control knob to  **LOCAL**. Hold the black control knob in the  **OPEN** position until the valve has reached the desired position. Move the red control knob to  **STOP**.

6 Inspect for correct operation. The position calibration is now complete. The actuator will function as ordered. Inspect for correct operation by running actuator electrically.

Note: For torque seated valves, ensure that the Position limit is not set at torque seat. It is recommended that the Position limit be set approximately one handwheel turn (360°) in the opposite direction from the torque seat.

Set Position Limits for Manual Operation

- 4 **Set close position.** At **SET CLOSE POSITION LIMIT?** answer **YES**. At **CLOSE VALVE-OK?** depress declutch lever and slowly rotate handwheel until clutch is fully engaged. Release declutch lever; the clutch will stay in handwheel mode. If the valve is fully closed, move the handwheel one turn in the open direction to allow for coasting of the motor. When valve is in the desired location, select **YES**. At **SAVE CLOSE LIMIT-OK?** select **YES** to set the close position or **NO** to adjust the setting.
- 5 **Set open position.** At **SET OPEN POSITION LIMIT?** select **YES** to get **OPEN VALVE-OK?**. Engage the clutch (see step 1). Valve should be fully opened. Move the handwheel one turn toward the closed position to allow for coasting of the motor. When valve is in the desired location, select **YES** again to set the open position or **NO** to adjust the setting.
- 6 **Checking the settings.** Turn the handwheel and verify that the open and close LED's function correctly (see Checking the Settings). If adjustments are necessary, select **NO** to return to **CHANGE POSITION SETUP?** and repeat from step 1.

If your actuator has DDC, Modutronic, or APT options,

continue to the next page for steps 7 and 8.

Set Actuator Options

Distributed Digital Control (DDC)

7 Change DDC menu. At the **CHANGE SETTINGS?** prompt, select **YES** and enter your password. Toggle through the change settings menu items until you reach **CHANGE DDC**. Select **YES**. (If you are already in the Change Settings menu, select **NO** to the prompts until you reach **CHANGE DDC**.)

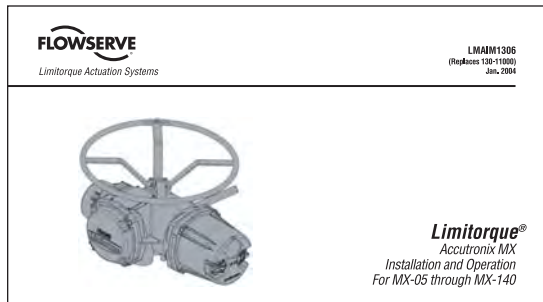
8 Set DDC address. Select **YES** at each prompt in the DDC menu until you reach **DDC ADDRESS OK?** Select **NO**. Change the address by selecting **NO** with the black control knob until the correct number is displayed (**1-250**). Set the address by selecting **YES**.
Caution: The network address of the valve must be entered in accordance with the user address assignment sheet. The address should correspond to the contract specifications and should not be used elsewhere in the same network.

Modutronic & Analog Position Transmitter (APT)

If you have these options, setting the open and close limits will automatically calibrate zero and span of the Modutronic and APT (Analog Position Transmitter) actuators. The 4-20 mA signal will default to 4 mA at close and 20 mA at open. To change from the default setting, see *Bulletin LMAIM1306, Installation and Operation for MX-05 through MX-140*.

For More Information

For in-depth instructions for setup and operation of your MX actuator, see *Bulletin LMAIM1306, Installation and Operation for MX-05 through MX-140*. This document is supplied with each actuator.





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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

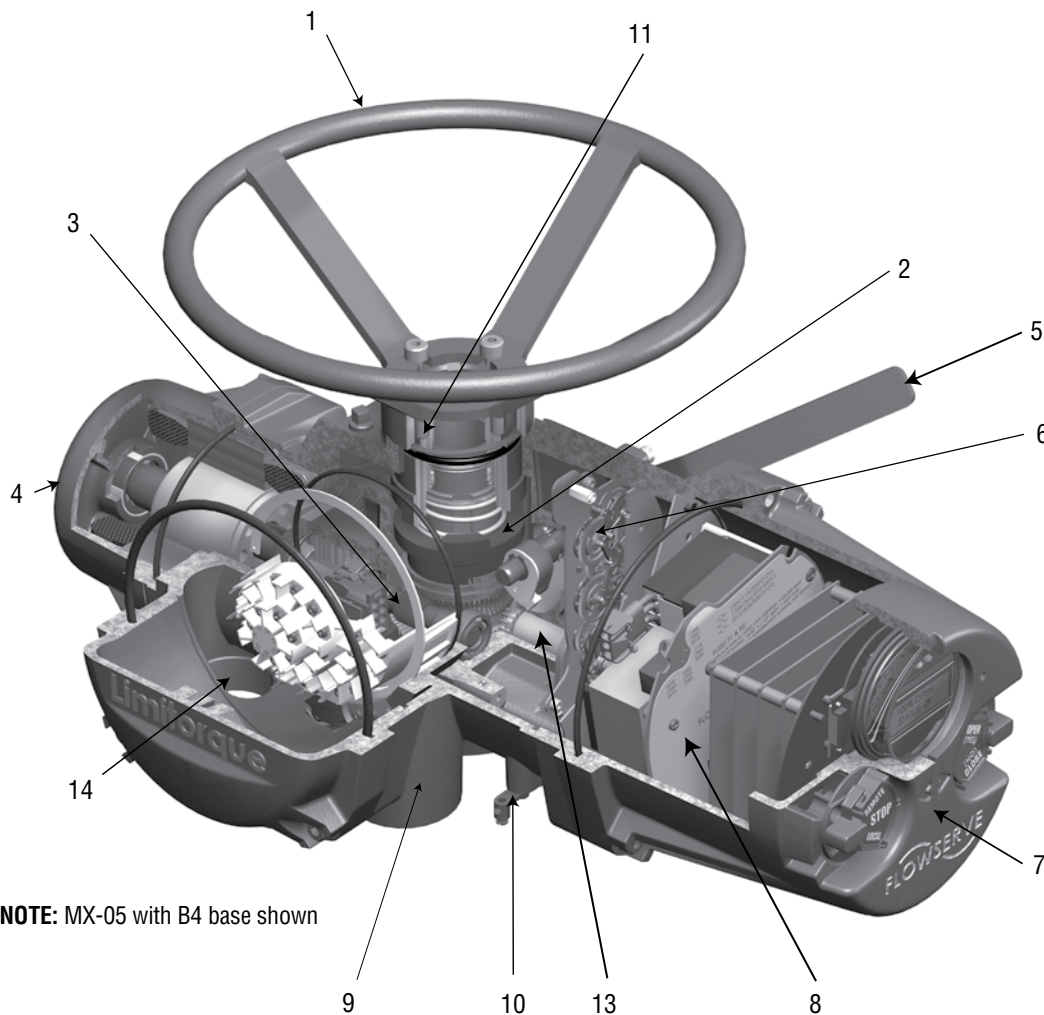
- Protection, Control and Monitoring features of MX Electric Actuators (Bulletin LMENTB2300)
- MX Control, Performance and Value in Multi-turn Electric Valve Actuators (Bulletin LMENBR2302)
- MX Installation Manual (Bulletin LMENIM2306)

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

Flowserve Limitorque Actuation Systems
 APPROVED
 CE
 MX- OUTPUT RPM
 ORDER No. RATED TO FT-LBS
 TAG No. N·m
 S/N -30°C ≤ T AMB ≤ 60°C
 ENCLOSURE TYPE: 3, 4, 4X, 5, IP68
 ACTUATOR MAY HAVE MULTIPLE POWER SOURCES
 DO NOT OPEN ENCLOSURE WHILE UNIT IS ENERGIZED
 INSTALL PER MANUAL LMENIM306
 MOTOR RPM
 P.H. H.Z.
 VOLTS AC
 L.R. AMPS
 RUN AMPS
 DUTY



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

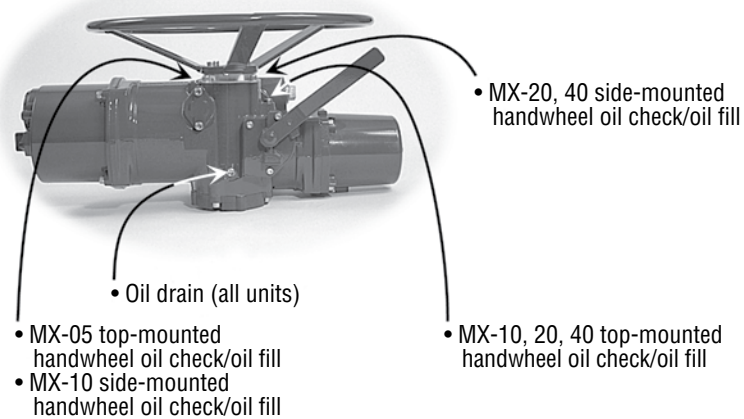
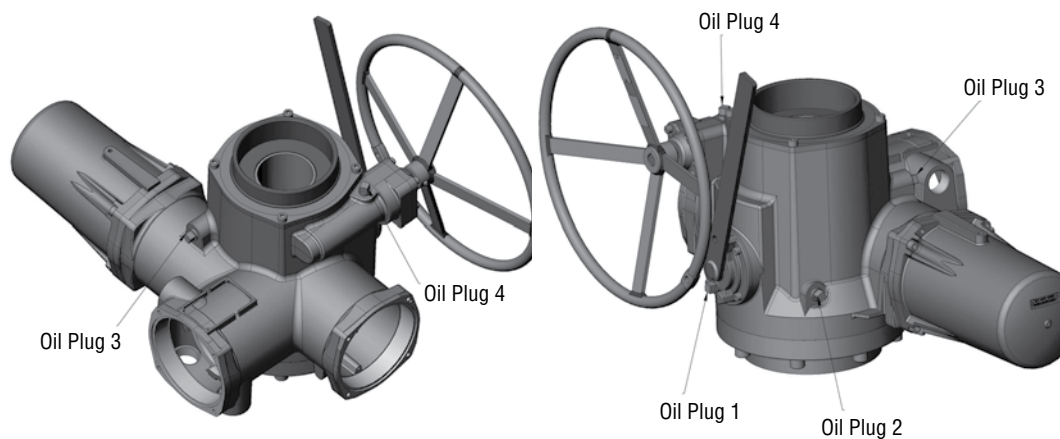
(Reference Table 2.3 for oil capacities when mounted in varying positions)

- 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.



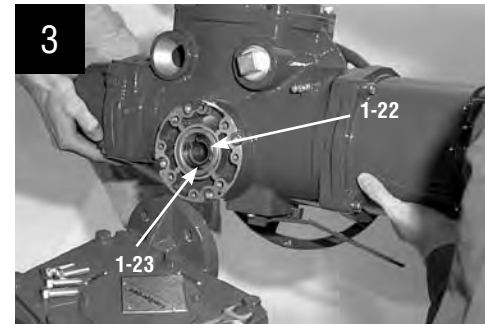
**STEP 2**

- ⚠ **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

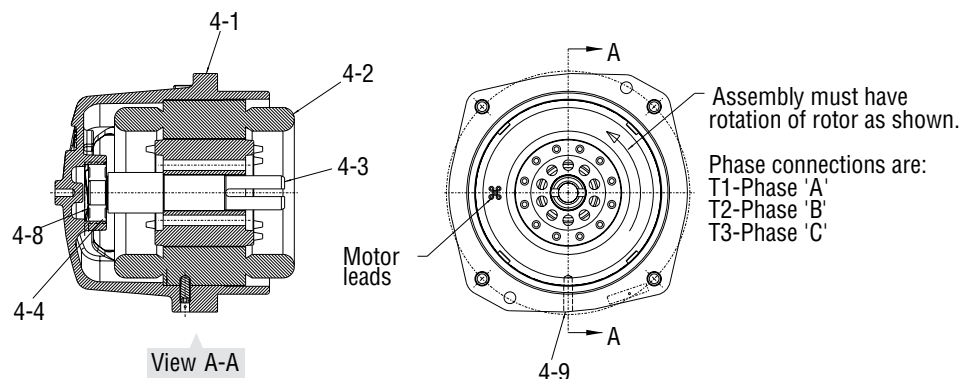
4.1 Motor

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)





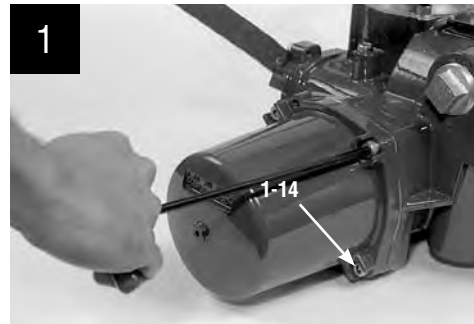
4.1.1 Removal

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.

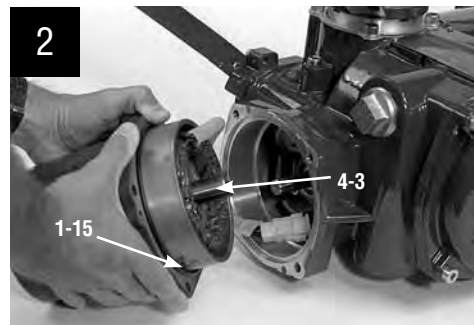
MX-85 requires an M8 hex key and uses an M10 screw.



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.



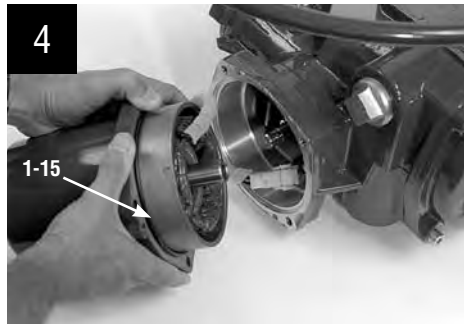


4.1.2 Remounting

STEP 4

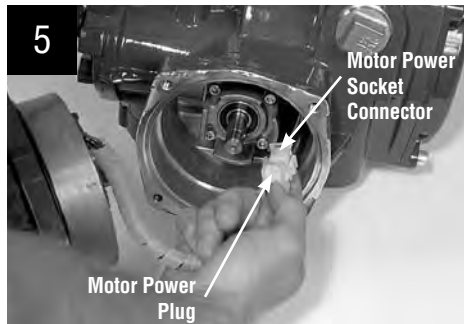
⚠ WARNING: Hazardous Voltage! Turn off all power sources to actuator before removing motor assembly. Power sources may include main power or control power.

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



STEP 5

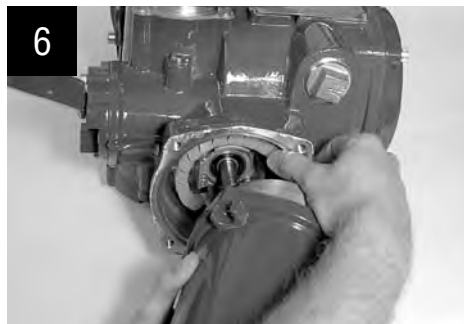
Hold the motor assembly (housing/stator/rotor) close to the actuator housing and reconnect the motor power plug to the motor power socket connector.



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°.

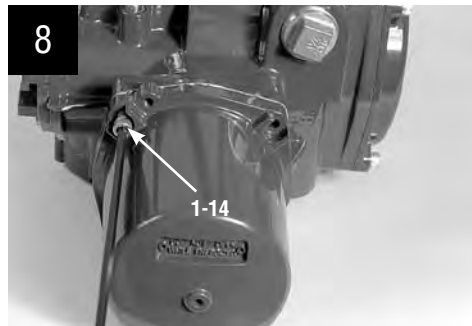


STEP 7

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.

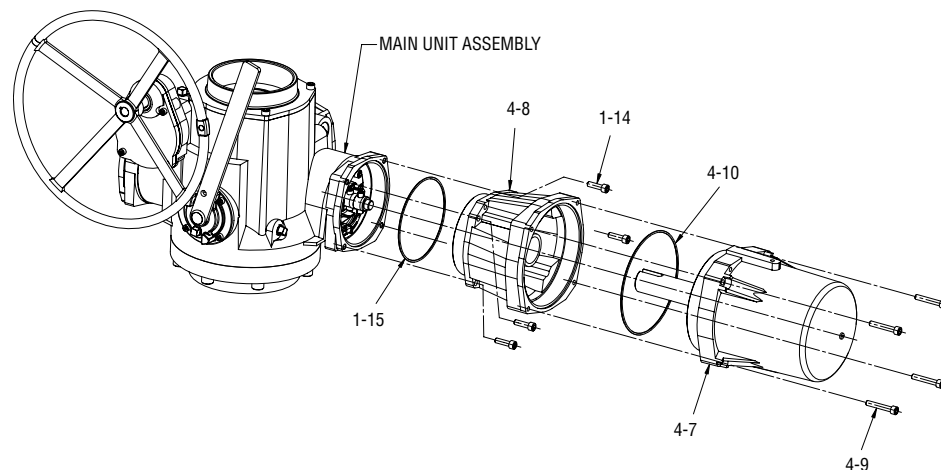


4.1.3 Removal and mounting of MX-140 motor (40 RPM and greater)

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

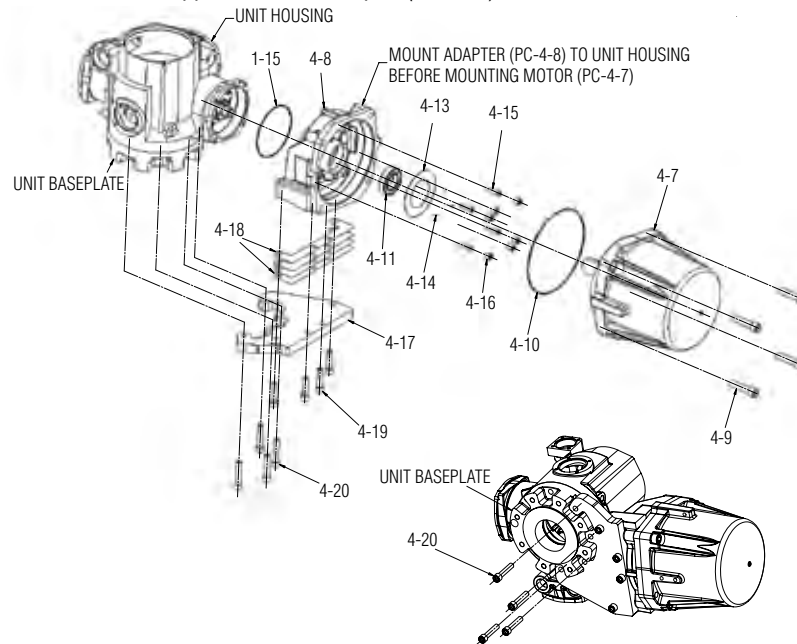
The assembly of the MX-150 motor is a two-phase process. Phase 1 includes the mounting of the motor support plate (#4-17), motor adapter (#4-8), and selection of a quantity of shims required to offset any gap between the motor support plate and the motor support. Phase two includes removal of the motor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

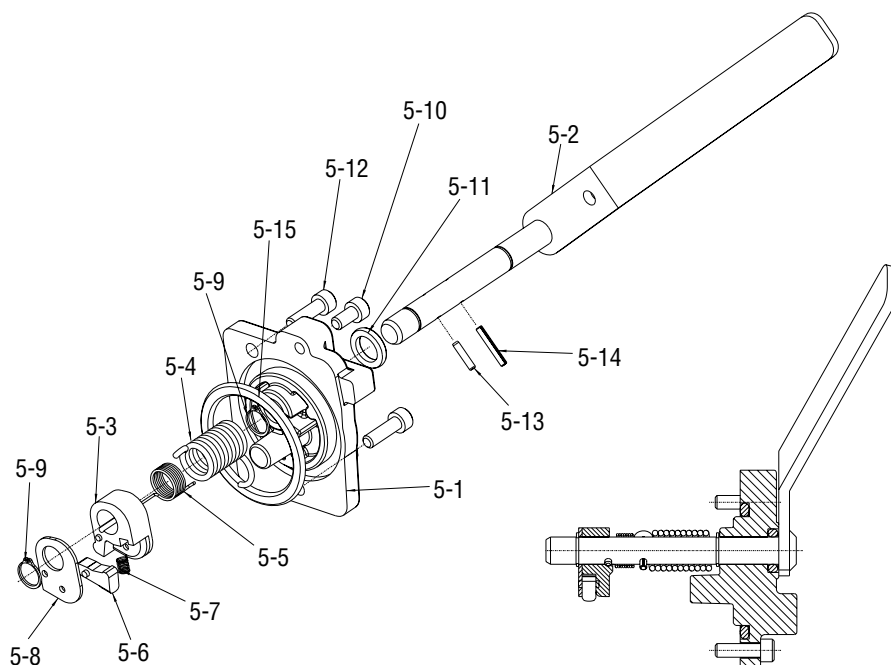
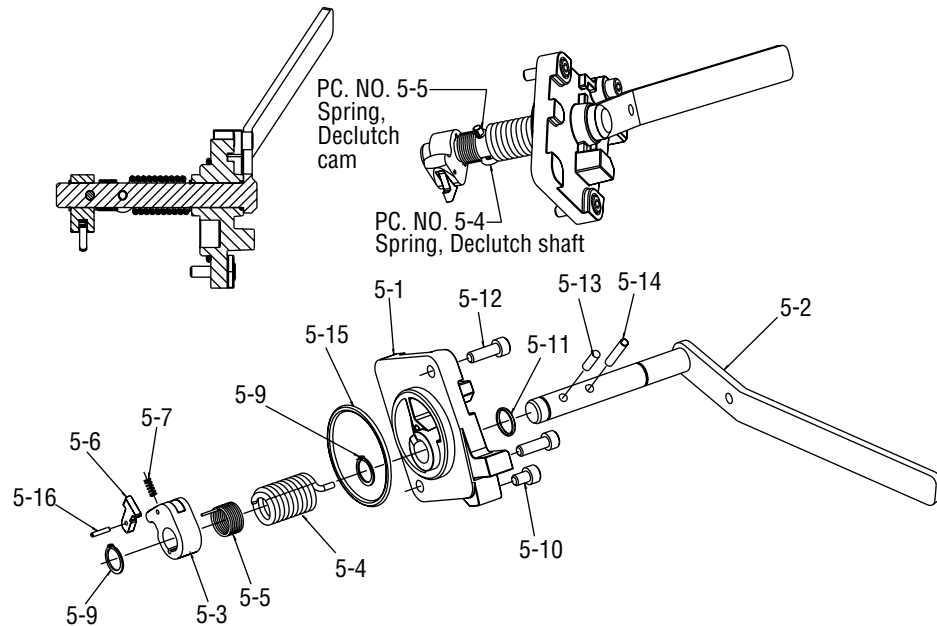



Table 4.5 – Declutch Parts List (MX-20 and -40)

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)


This diagram shows an exploded view of a mechanical assembly. The components are labeled with callouts 5-1 through 5-16. The assembly includes a central housing (5-1) with a flange, a shaft (5-2) with a key, a bearing (5-3), a nut (5-4), a washer (5-5), a seal (5-6), a pin (5-7), a bush (5-8), a pin (5-9), a pin (5-10), a pin (5-11), a pin (5-12), and a pin (5-13). The diagram illustrates the relative positions and assembly sequence of these parts.

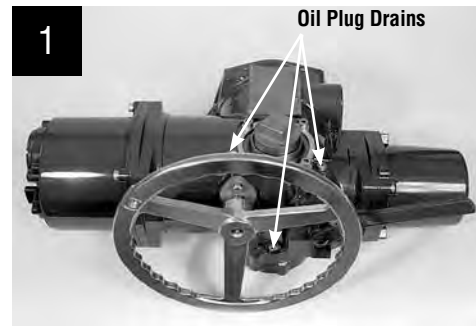
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**STEP 1**

⚠ 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.

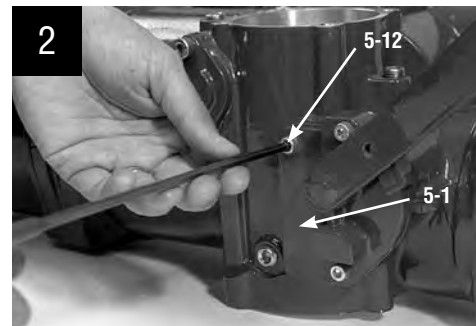
NOTE: Oil removal is not necessary on MX-05, -10, -85, -140, and -150 if actuator is mounted with declutch lever up.

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.

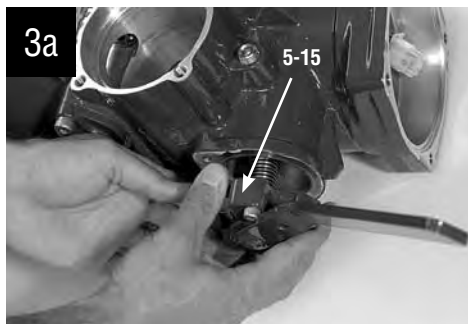
Using a 5 mm (MX-05 and -10) or 6 mm (MX-20, -40, -85, -140, and -150) hex key, remove the two M6 (MX-05 and -10) screws (#5-12), M8 (MX-20 and -40) or the four M8 (MX-85, -140, and -150) screws that retain the declutch assembly cover (#5-1) on the actuator housing.




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.



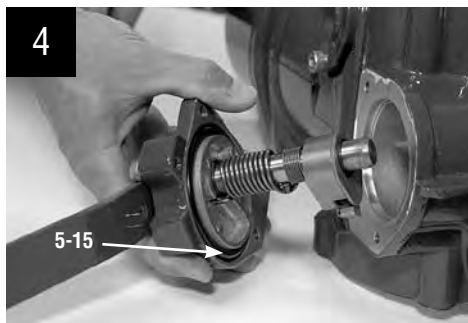
4.2.2 Remounting

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

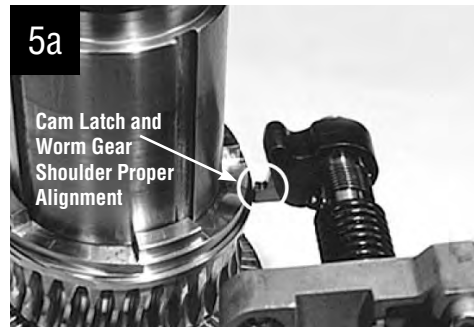
▲ CAUTION: (MX-20 and -40 only) To create proper mating between the cam latch (#5-6) and the shoulder on the worm gear, ensure cam latch is positioned below the worm gear shoulder (see Picture 5a).

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.



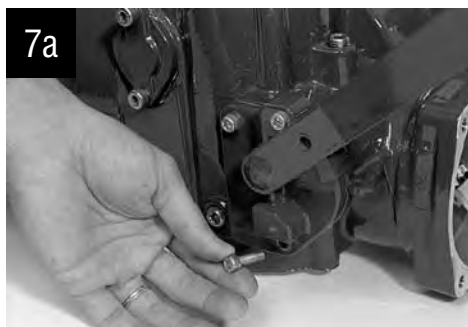

STEP 6 (MX-85, -140, AND -150 ONLY)

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 $\frac{1}{4}$ turn, plus or minus $\frac{1}{8}$ 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.)

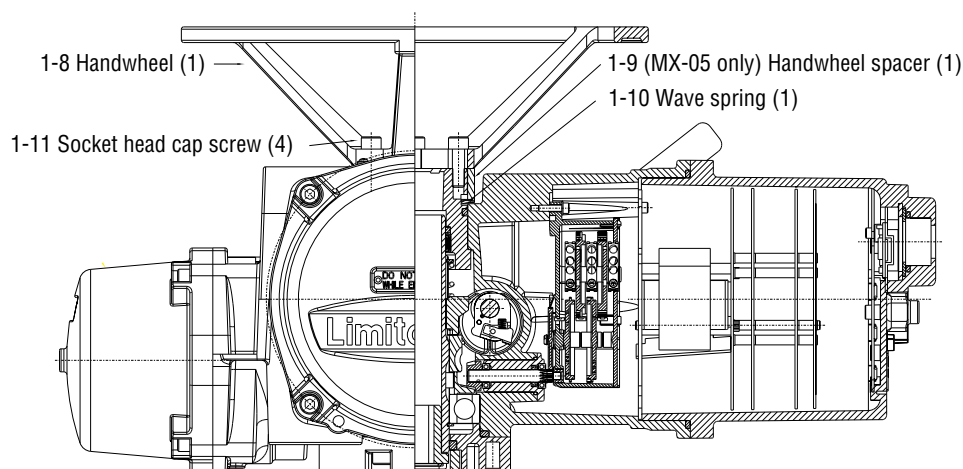
1. Handwheel (subassembly #13). (See Section 4.3.2.)
2. Handwheel adapter (subassembly #12). (See Section 4.4.2, 4.4.3, and 4.5.3.)
3. Clutch and clutch ring (subassembly #16). (See Section 4.15.2.)

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.

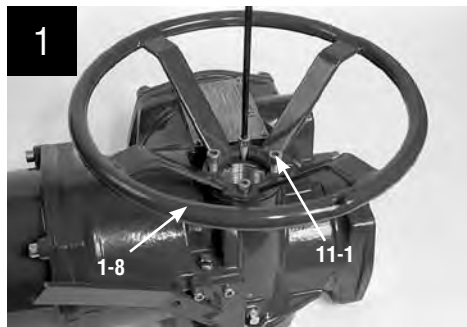


4.3.1 Removal

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

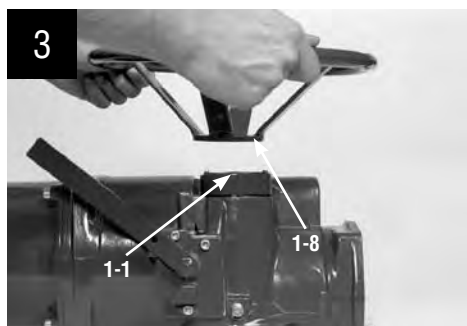
Lift the handwheel (#1-8) off the handwheel adapter (#1-1).



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.

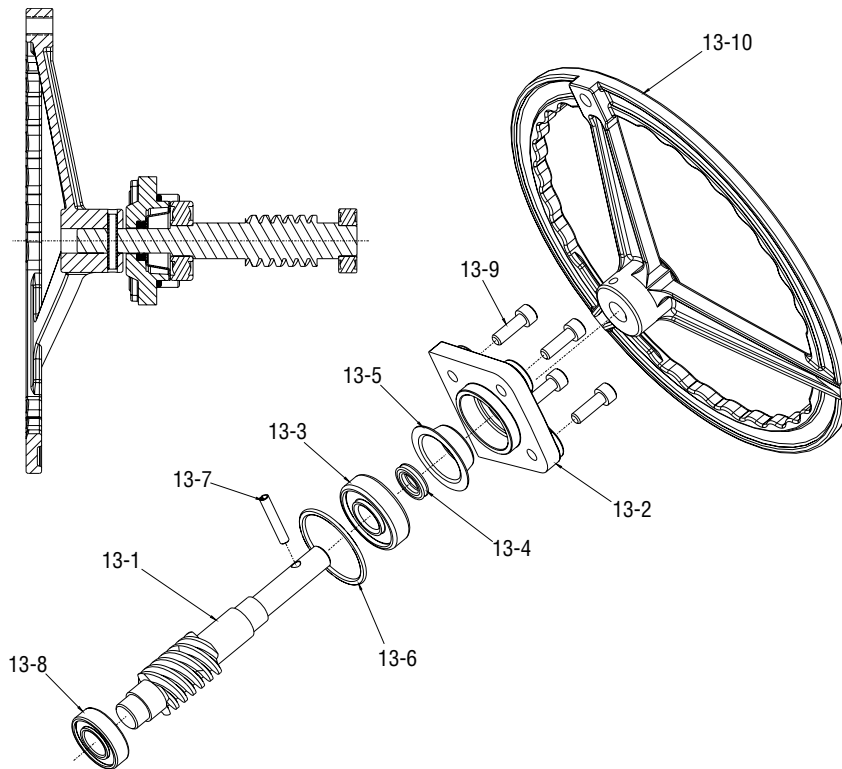


4.4 Side-Mounted Handwheel Without Spur Gear Attachment (MX-10, -20, -85, -140, and -150)

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.

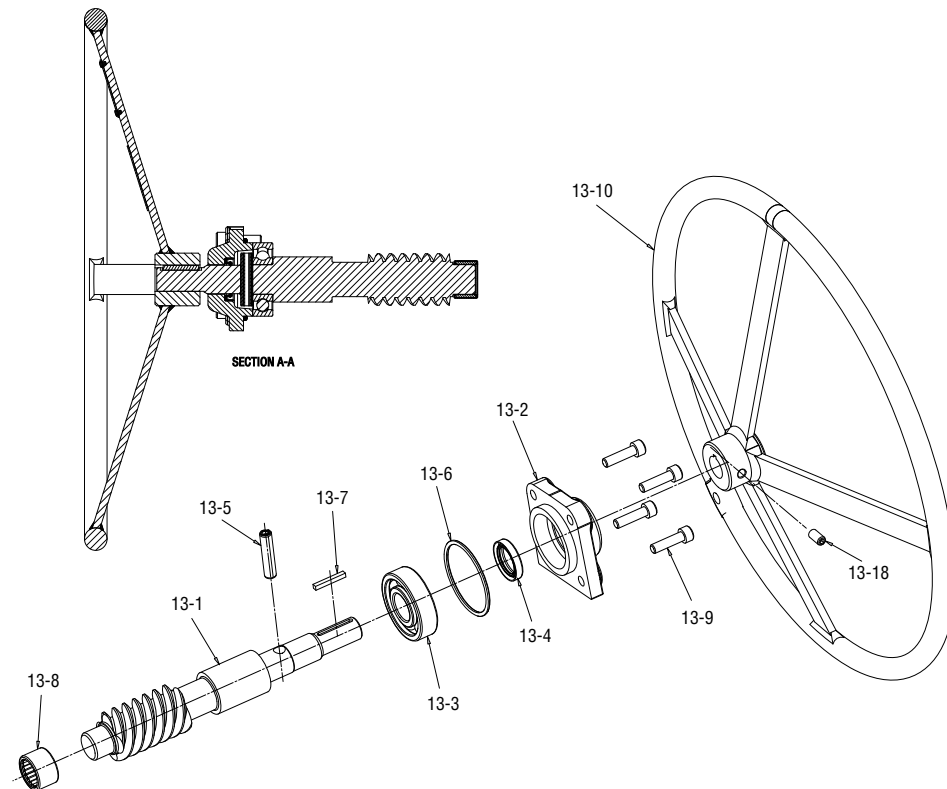
4.4.1 Side-Mounted Handwheel Without Spur Gear Attachment (MX-85, -140, and -150)

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.



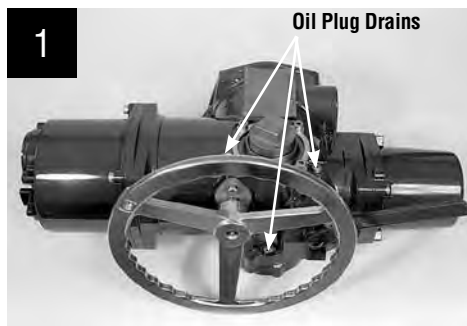
4.4.3 Removal

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.

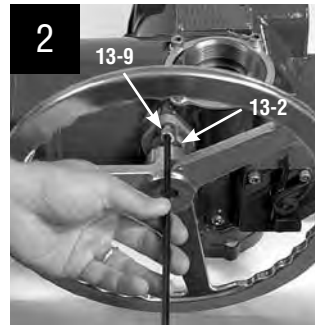


**STEP 2 (MX-10 AND -20)**

▲ CAUTION: Be aware of inner bearing (#13-8) when removing the side-mounted hand-wheel. 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.





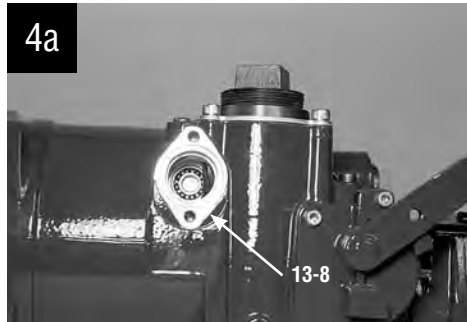
4.4.4 Remounting

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.



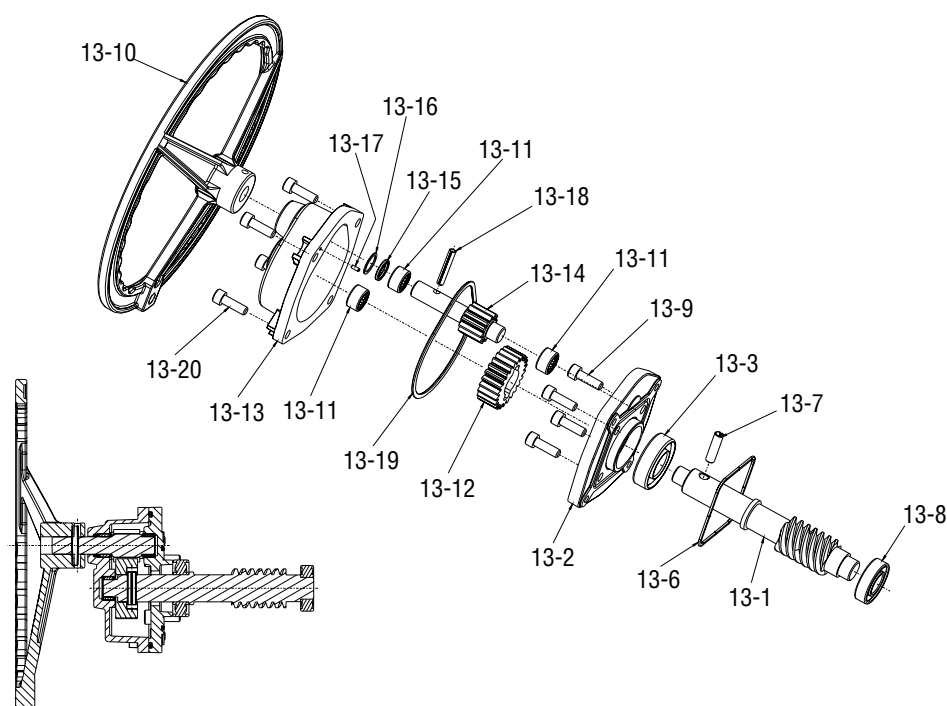
4.5 Side-Mounted Handwheel With Spur Gear Attachment (MX-40, -85, -140, and -150)

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)



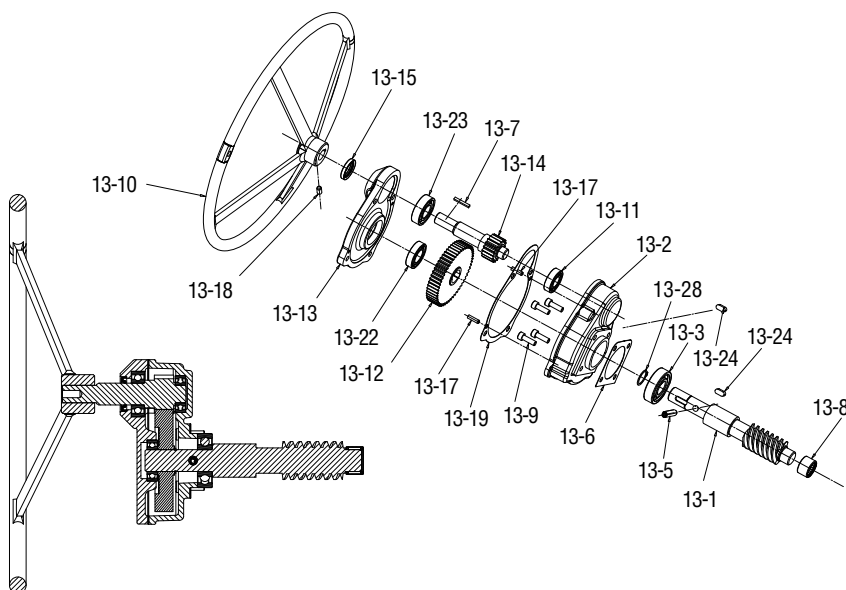
4.5.1 MX-85, -140, and -150 Handwheel with SGA

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).

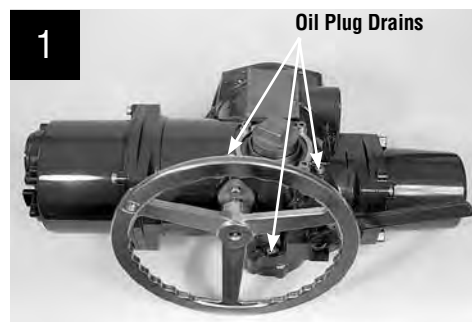
4.5.3 Removal

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.

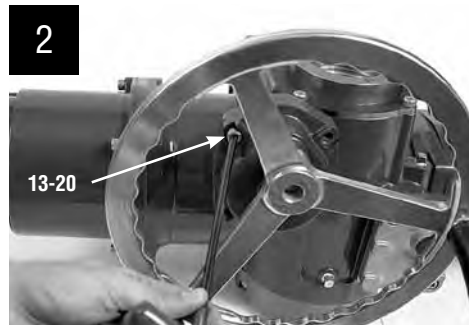
Drain oil from actuator using the lowest of three plugs in your application orientation.



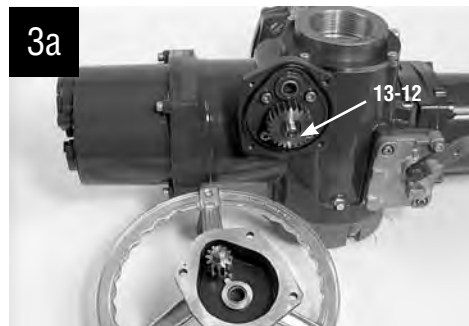

STEP 2

▲ CAUTION: Be aware of inner bearing (#13-8) when removing the side-mounted hand-wheel. 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.

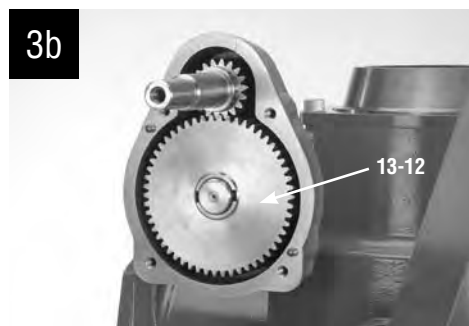
Remove the four screws (#13-20) from the handwheel spur gear cap (#13-13).


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.



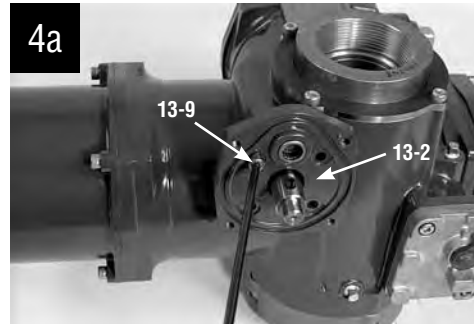
MX-40



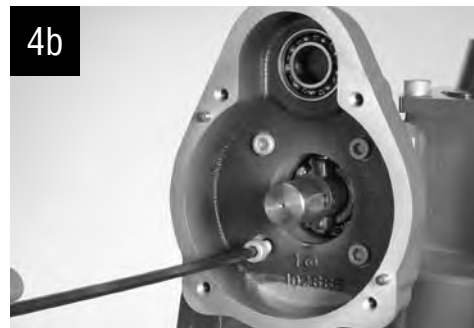
MX-85/140/150


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.)

6

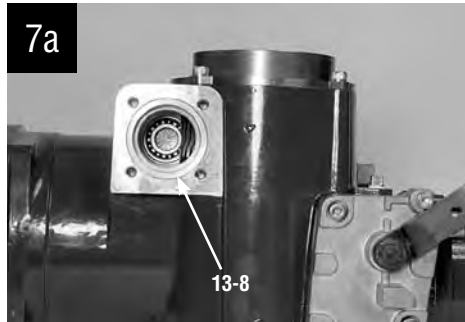
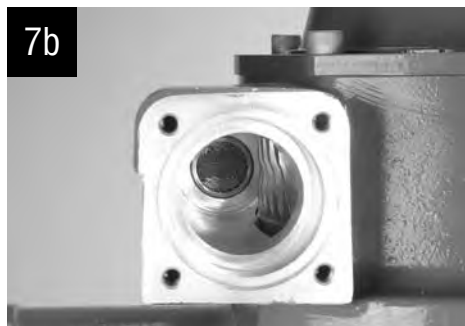

4.5.4 Remounting

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).

7a

7b

STEP 8

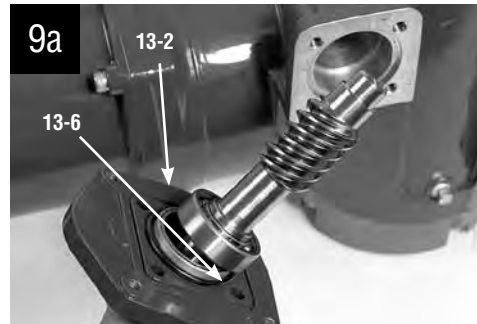
If previously removed, install handwheel worm gear assembly (#12-1). (See Section 4.14.2 for remounting procedure.)

8

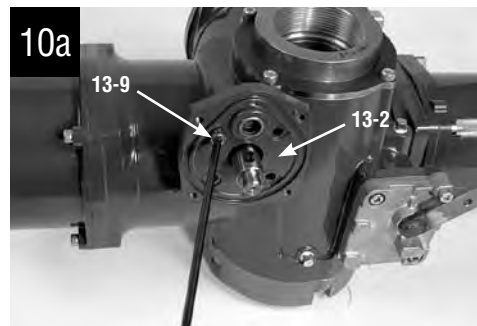

**STEP 9**

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).

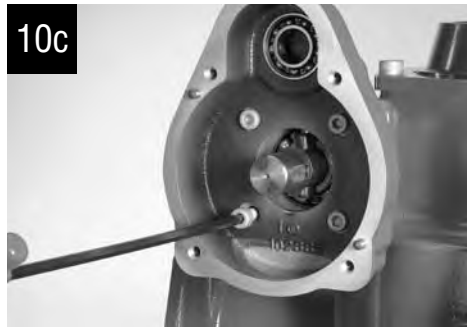
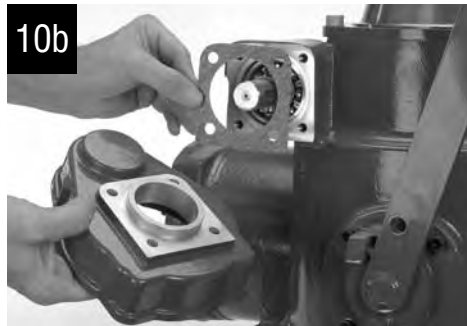
**STEP 10A - MX-40**

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).

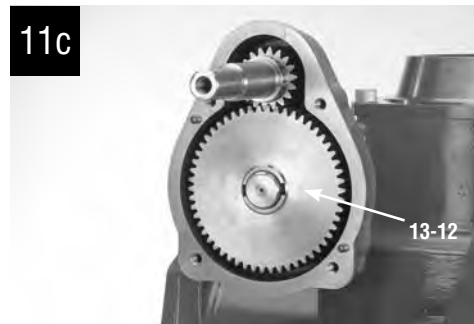
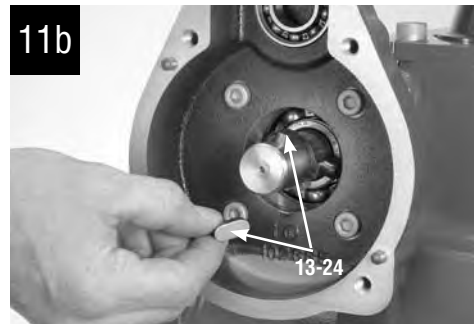
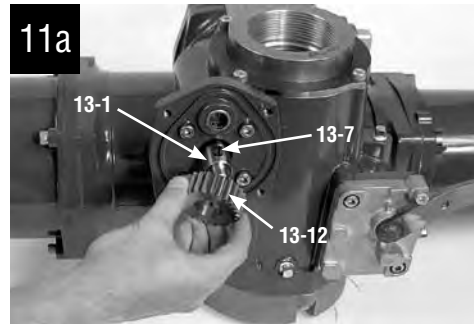


**STEP 11****MX-40 (11a)**

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

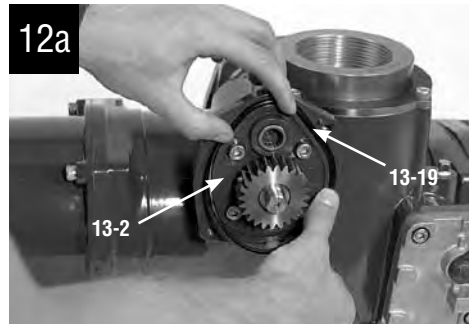
MX-85, -140, and -150 (11b and 11c)

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).

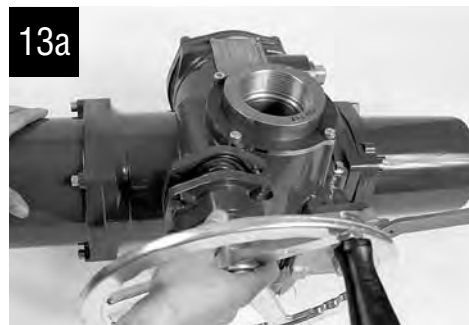

STEP 12B - MX-85, -140, AND -150

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.

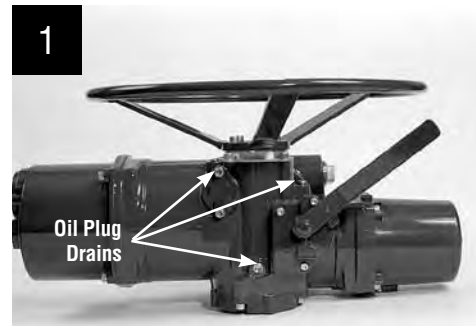
STEP 1

⚠ 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.

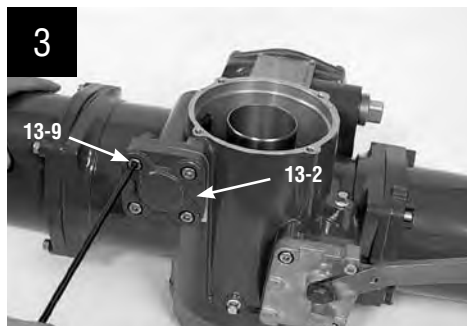



STEP 2

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.

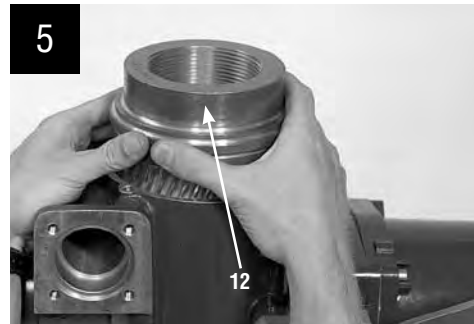
MX-10, -20 and -40: the bearing is a slip fit into the housing.

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



**STEP 5**

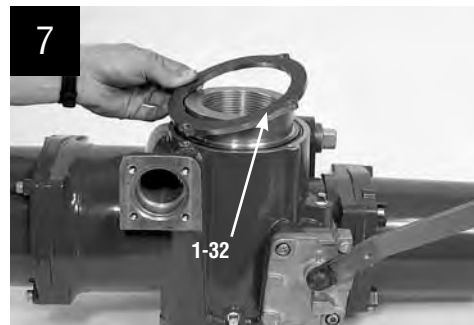
Replace the handwheel adapter (#12-5) with the handwheel worm gear (#12-1) that is included in the side-mounted handwheel adapter kit.

**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**

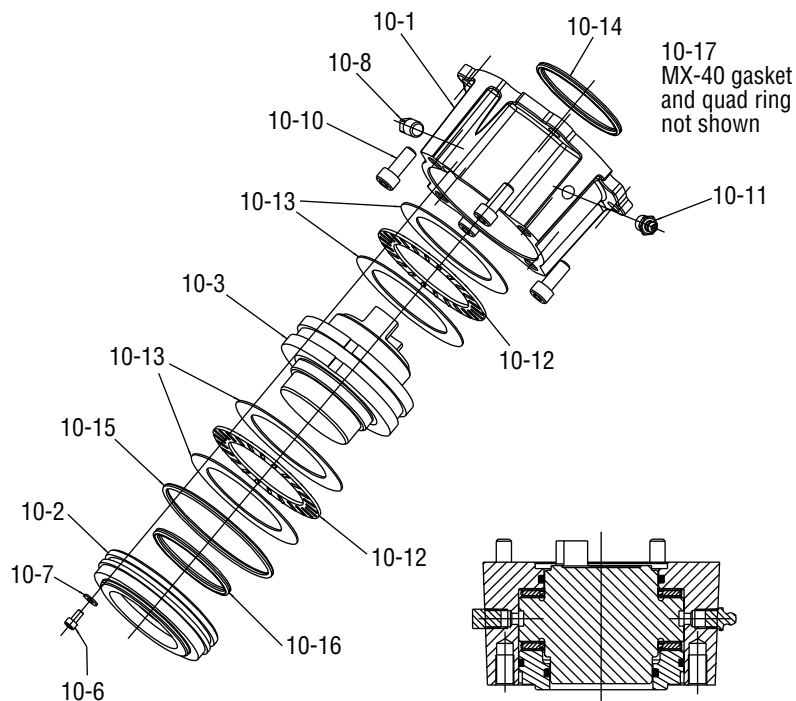
Complete the remounting procedure for side-mounted handwheel assembly #13A (MX-10 and -20) or #13B (MX-40) as detailed in Section 4.4.3 or Section 4.5.3.

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

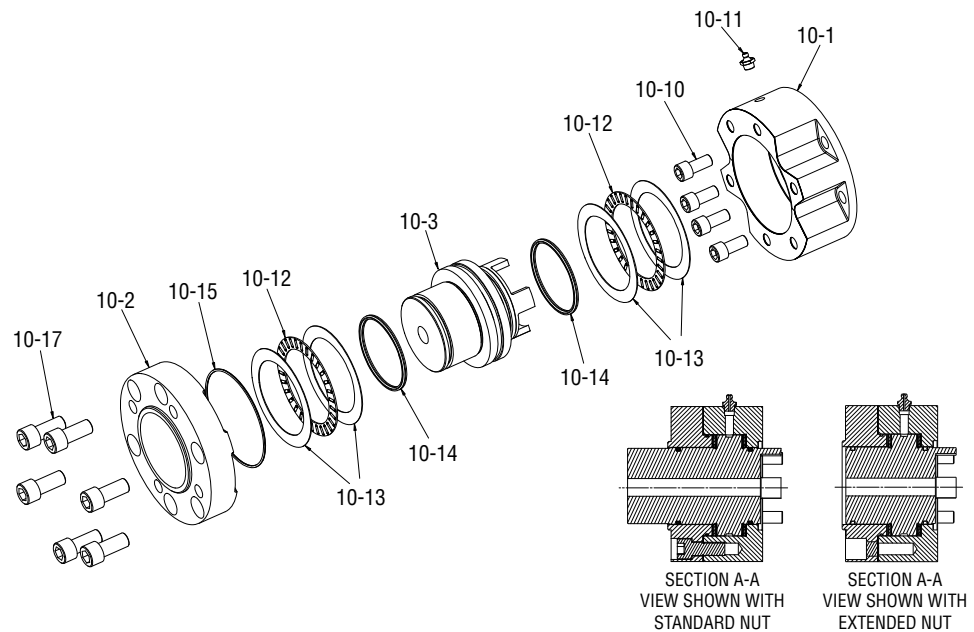
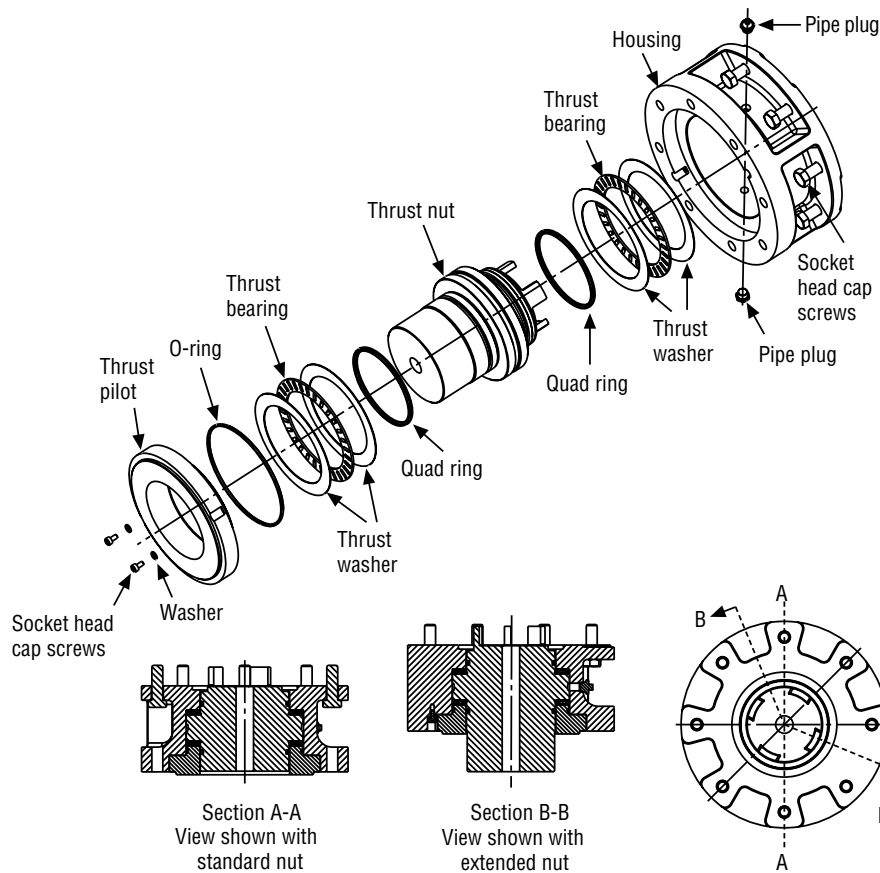


Table 4.14 – Type A1 Thrust Base Parts List (MX-85, -140, and -150) - F25 Flange

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

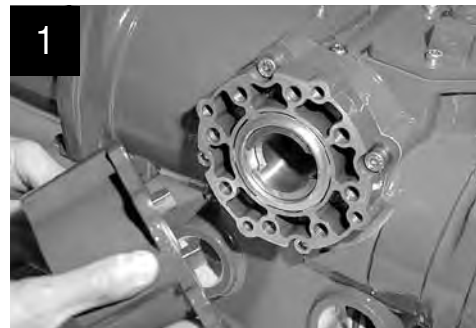
First Remove

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).

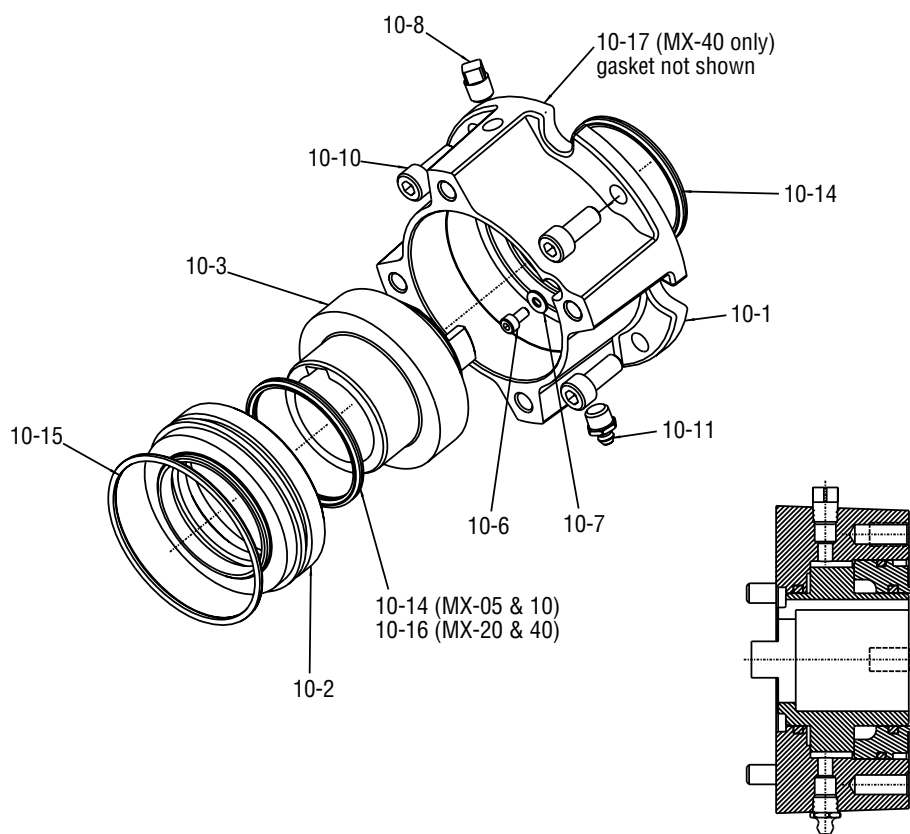


4.8 Torque Base Type B1

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).

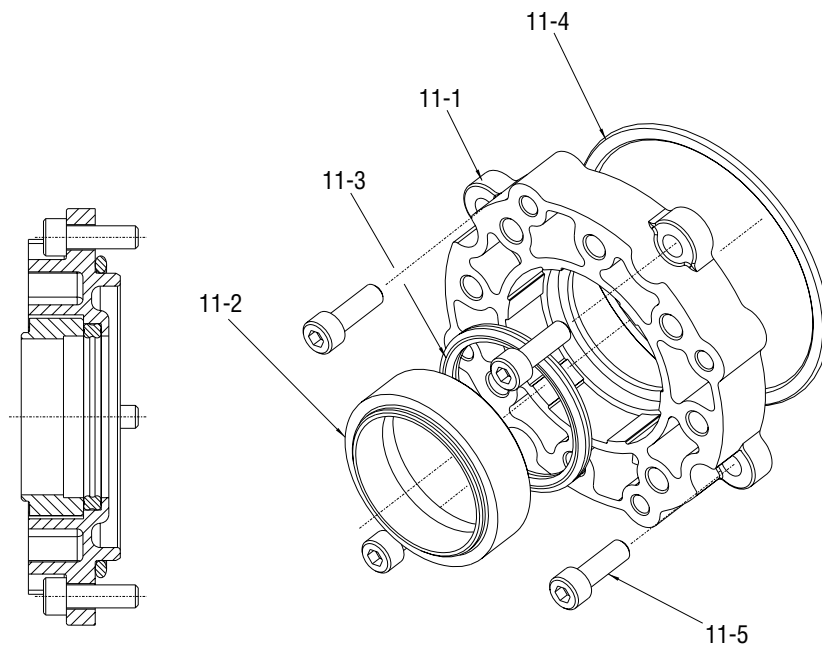


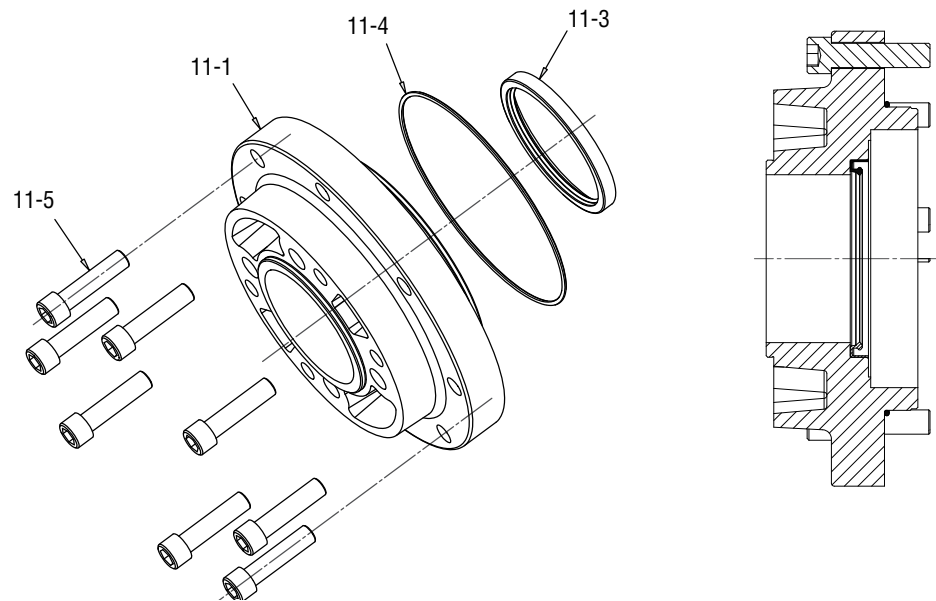
4.9 Baseplate Type B4

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

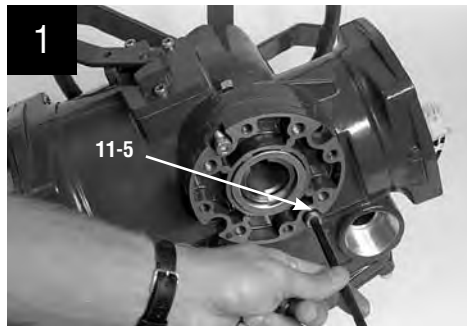
First Remove

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

**STEP 1**

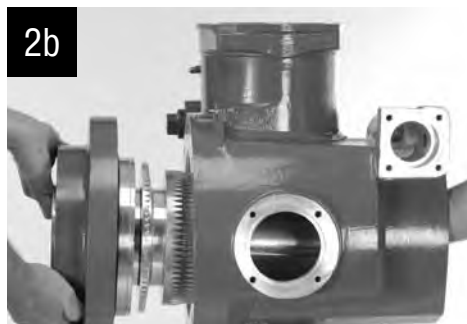
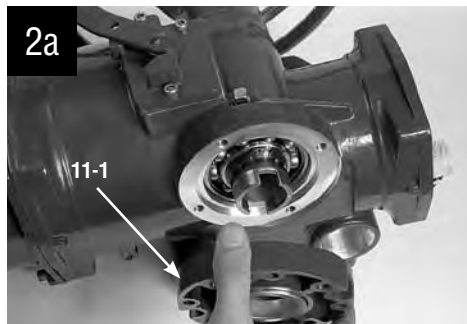
⚠ WARNING: Potential to operate while dangerous mechanical parts are exposed during subassembly removal. To prevent injury, turn off all power sources to actuator before removing base plate assembly. Power sources may include main power or control power.

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

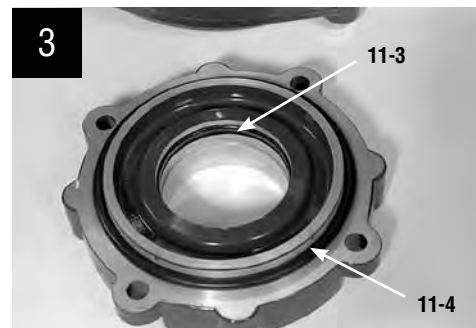
▲ CAUTION: To ensure actuator is fully secured on mounting plate, ensure baseplate (#11-1) is tightened with the following torque values on mounting screws (#11-5):

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).

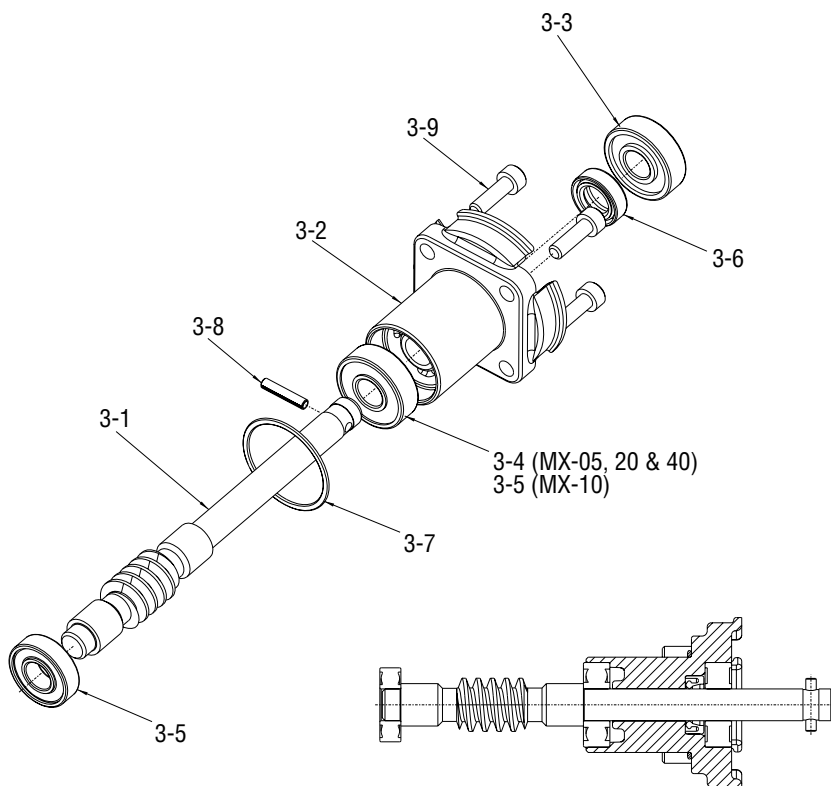


4.10 Worm Shaft

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

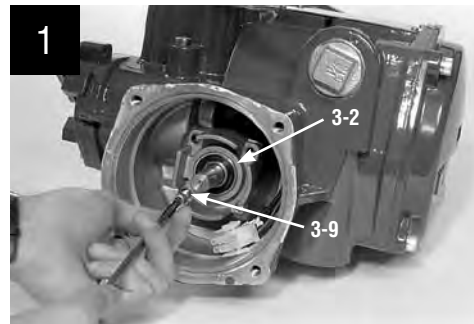
First Remove

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.

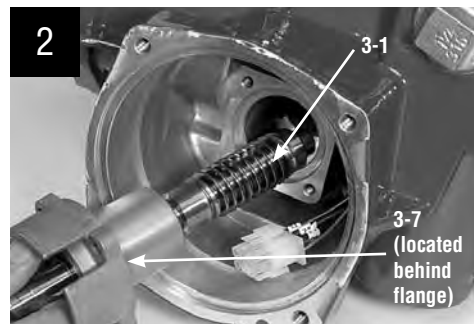
Remove the four screws (#3-9) that secure the worm shaft cap (#3-2) to the actuator housing.



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.

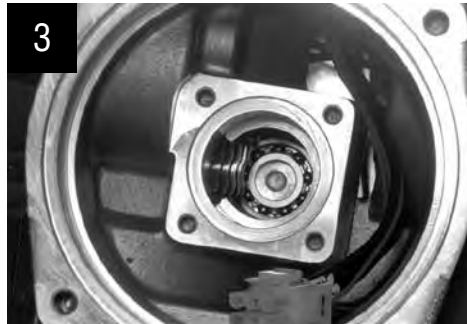




4.10.2 Remounting

STEP 3

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



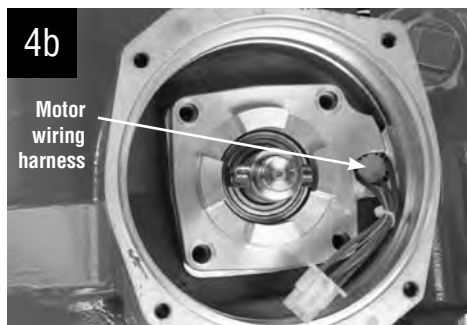
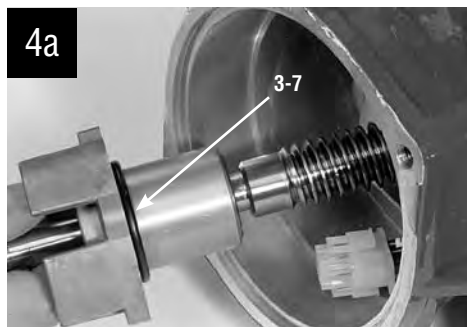
STEP 4

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).

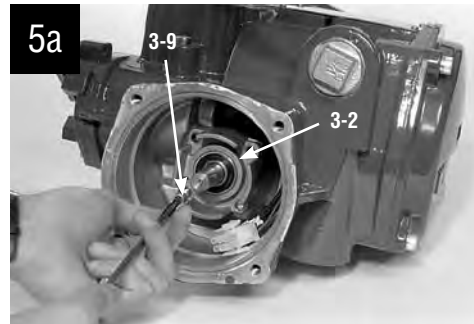
MX-85, -140, AND -150 ONLY

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.

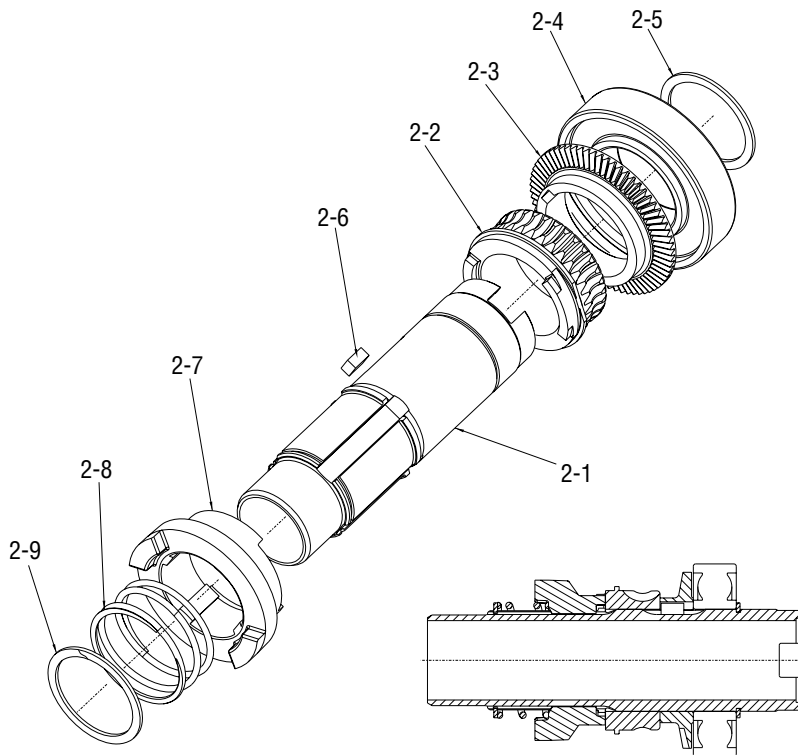


4.11 Drive Sleeve (MX-05 and -10)

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.



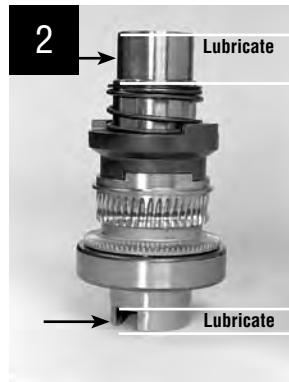


4.11.2 Remounting

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

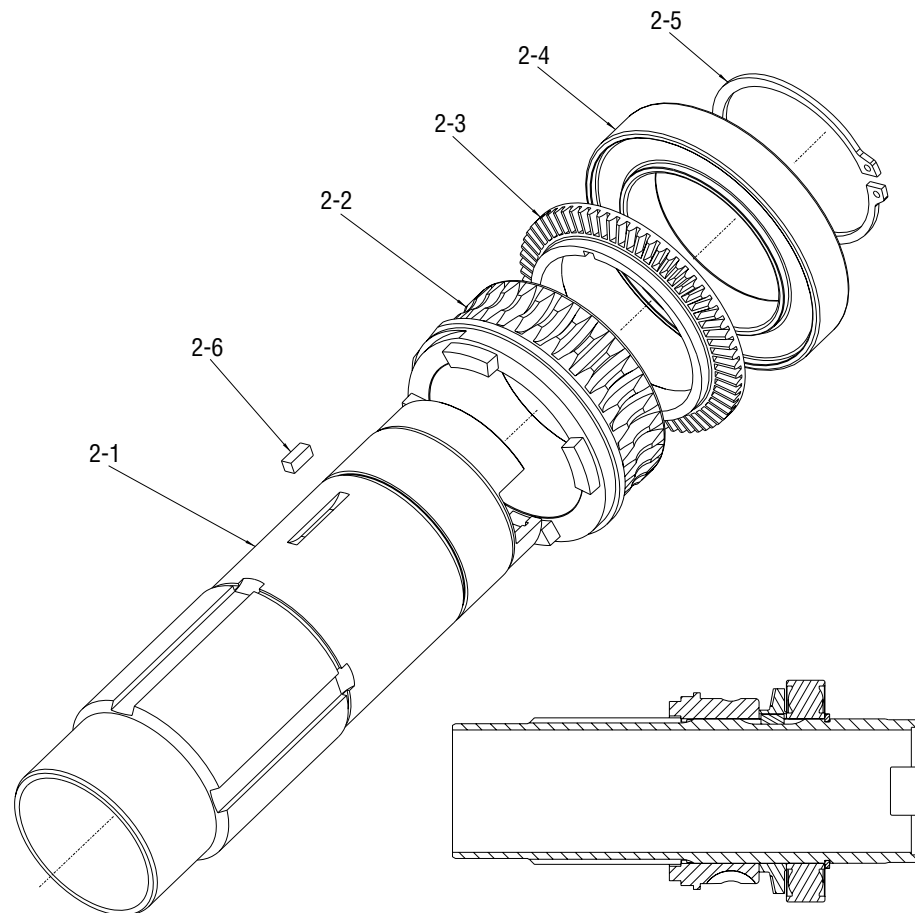
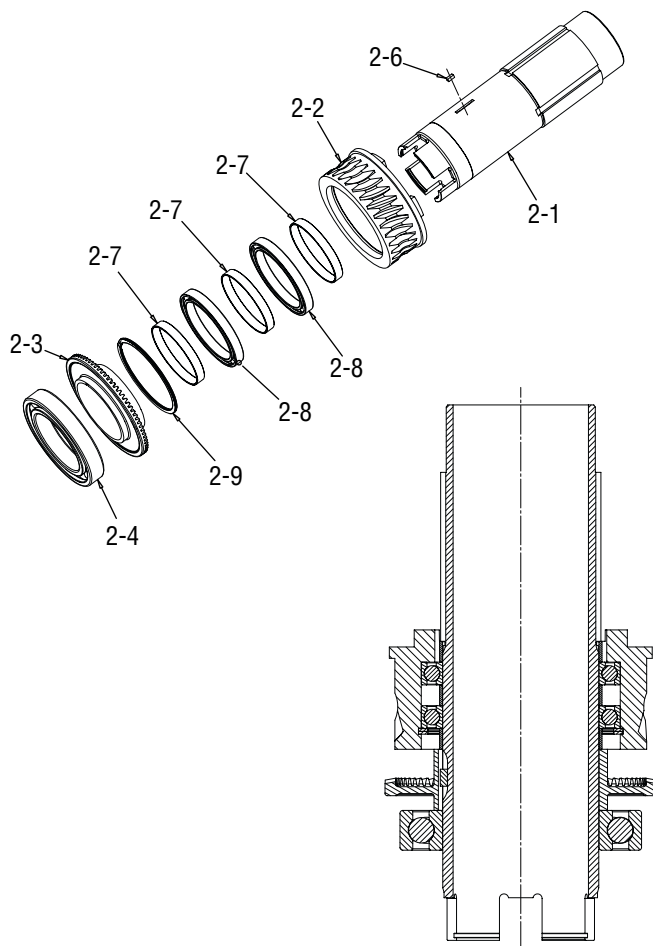




Figure 4.21 – MX-85, -140, and -150 10:1 and 13:1 ratios



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)



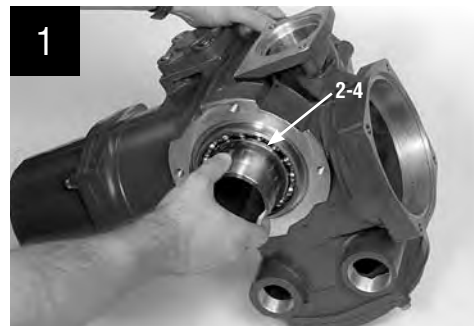
- ⚠ **WARNING:** (MX-85, -140, and -150) The drive sleeve assembly may slip and fall out of housing when removing baseplate assembly. Hold the drive sleeve assembly in from opposite end when removing baseplate assembly. See optional drive sleeve and baseplate removal Section 4.12.3 and 4.12.4.

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.

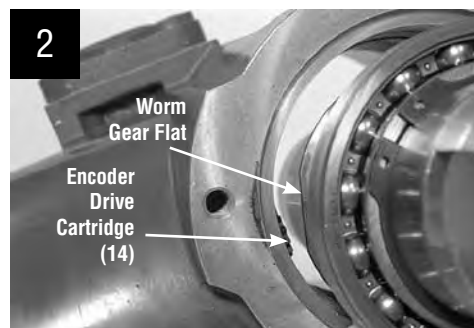
MX-85, -140, and -150: Optional drive sleeve and baseplate removal instructions.



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.

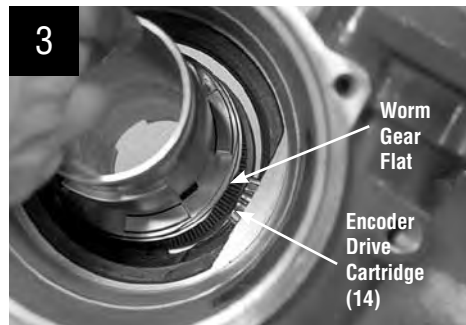
TIP: To avoid interference between drive sleeve assembly and encoder drive cartridge (subassembly #14), turn flat on worm gear to be parallel and on same side as encoder bevel gear.



**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.

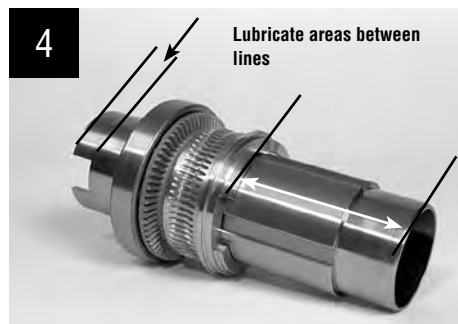


4.12.2 Remounting

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.)

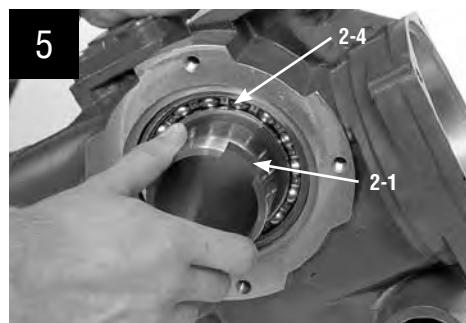
Lightly lubricate the top and bottom of the drive sleeve assembly as shown.

**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.





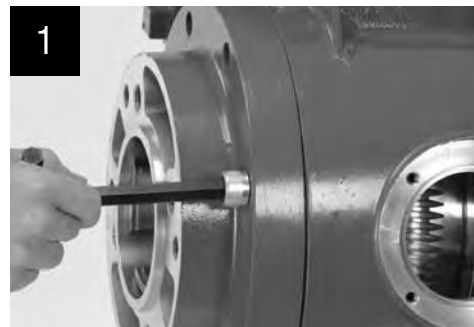
4.12.3 MX-85, -140, and -150 Optional Drive Sleeve and Baseplate Removal

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).



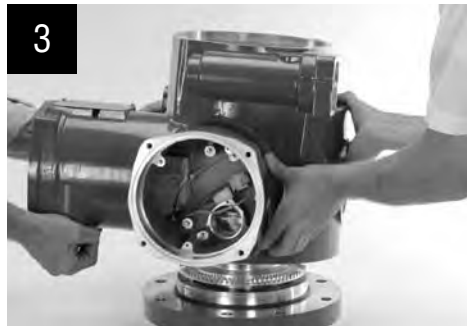
STEP 2

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.



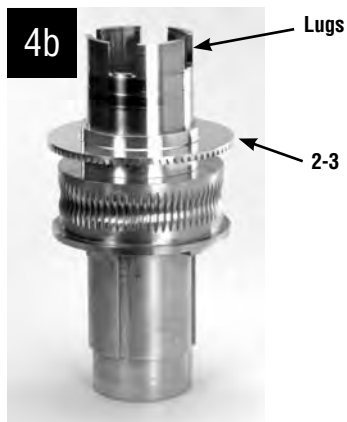

STEP 3

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)

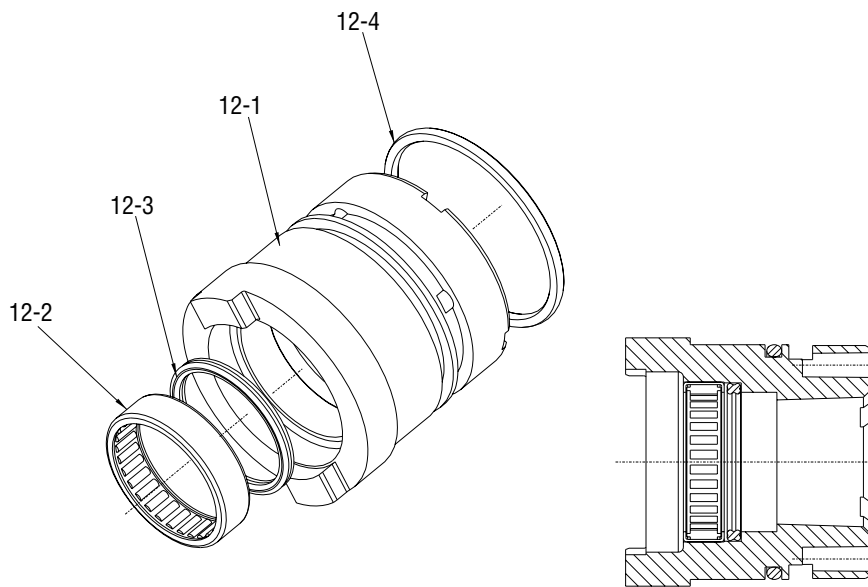
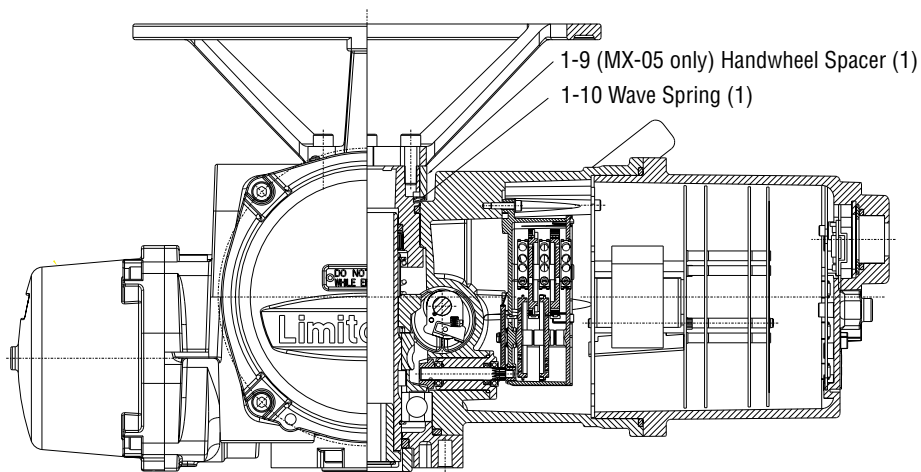


Figure 4.23 – Handwheel (MX-05)





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

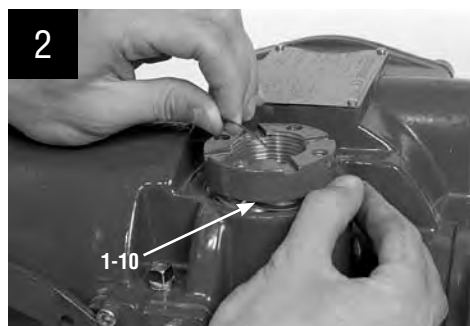
⚠ WARNING: Potential to operate while dangerous mechanical parts are exposed during subassembly removal. To prevent injury, turn off all power sources to actuator before removing handwheel adapter assembly. Power sources may include main power or control power.

Remove handwheel spacer (#1-9).



STEP 2

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

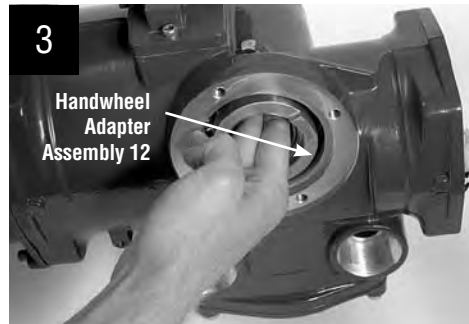




STEP 3

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

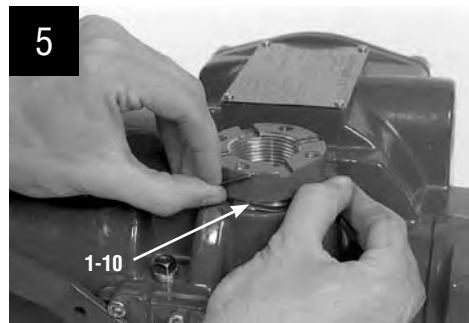
NOTE: Lightly lubricate quad rings/O-rings before remounting subassemblies.

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.



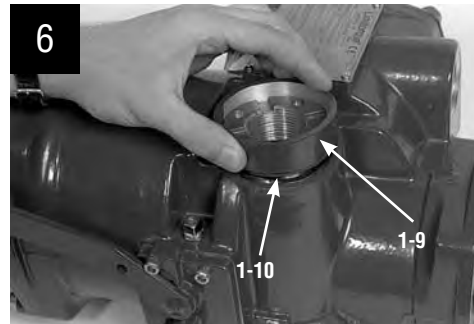
STEP 5

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

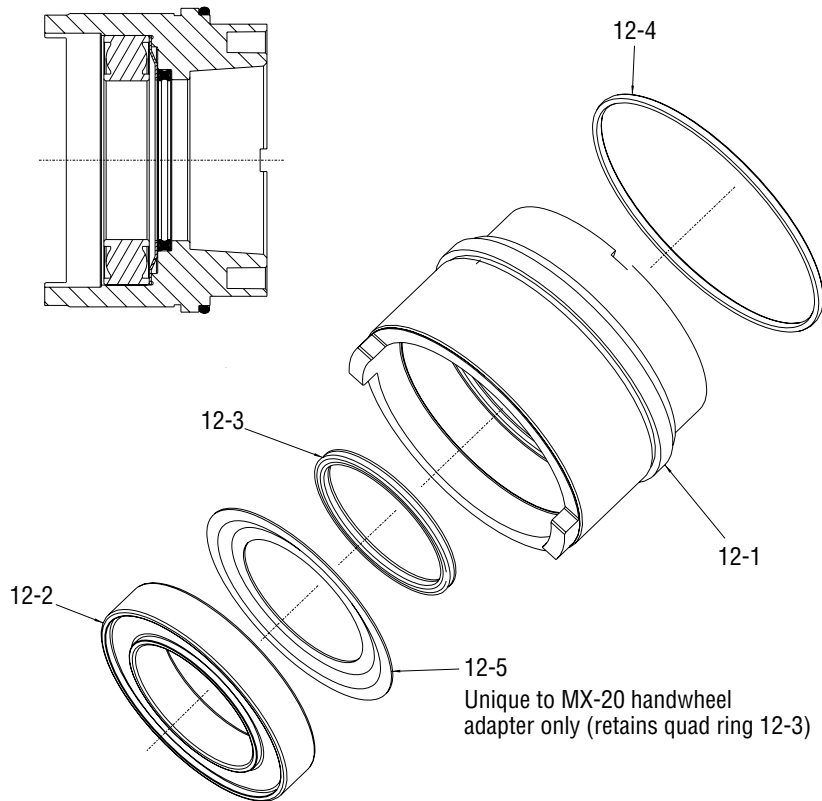
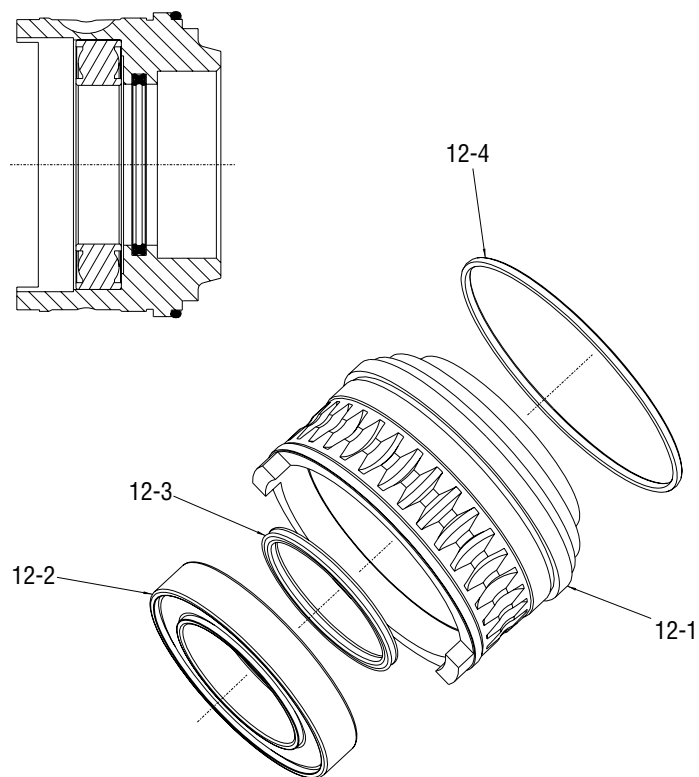


Table 4.22 – Handwheel Worm Gear Assembly Parts List

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.

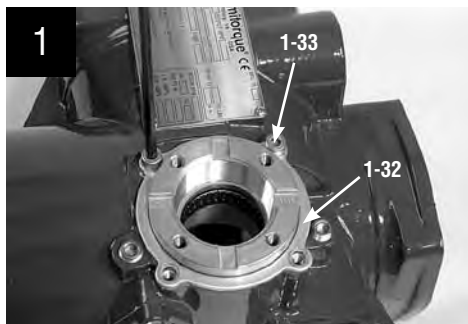
The handwheel adapter assembly and the handwheel worm gear assembly procedures are interchangeable. The parts within the assembly are the same with exception to the handwheel adapter (#12-1) and the handwheel worm gear adapter (#12-1). The handwheel adapter assembly is used when the handwheel is top-mounted.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

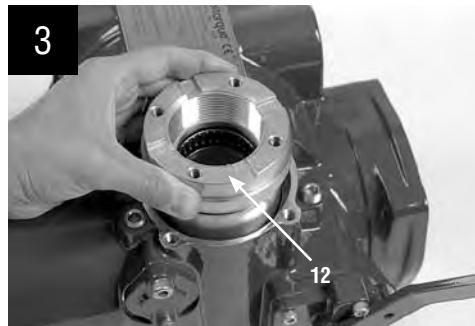


**STEP 2**

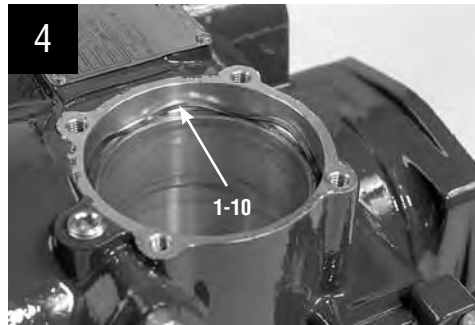
Lift off the retainer plate (#1-32).

**STEP 3**

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

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

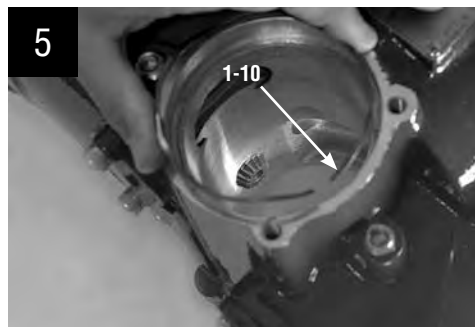
Lift out wave spring (#1-10) from the actuator housing.



4.14.2 Remounting

STEP 5 (MX-10 ONLY)

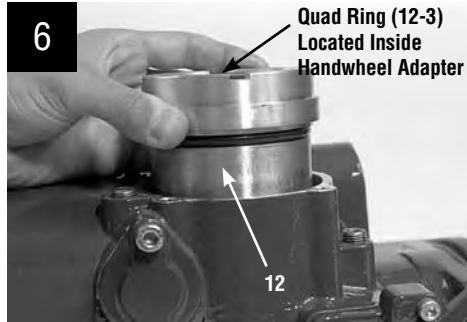
Insert the wave spring (#1-10) onto the shoulder of the actuator housing.




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.

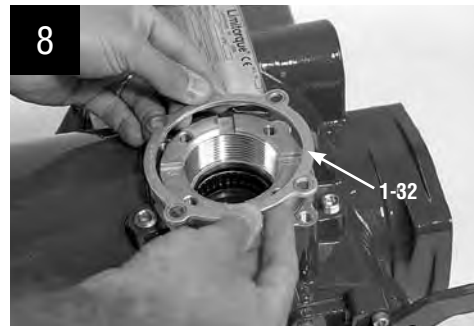


**STEP 8**

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

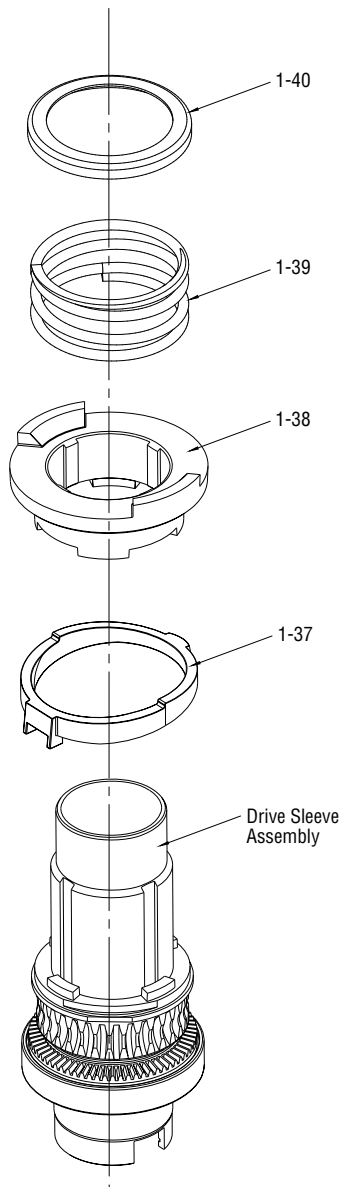
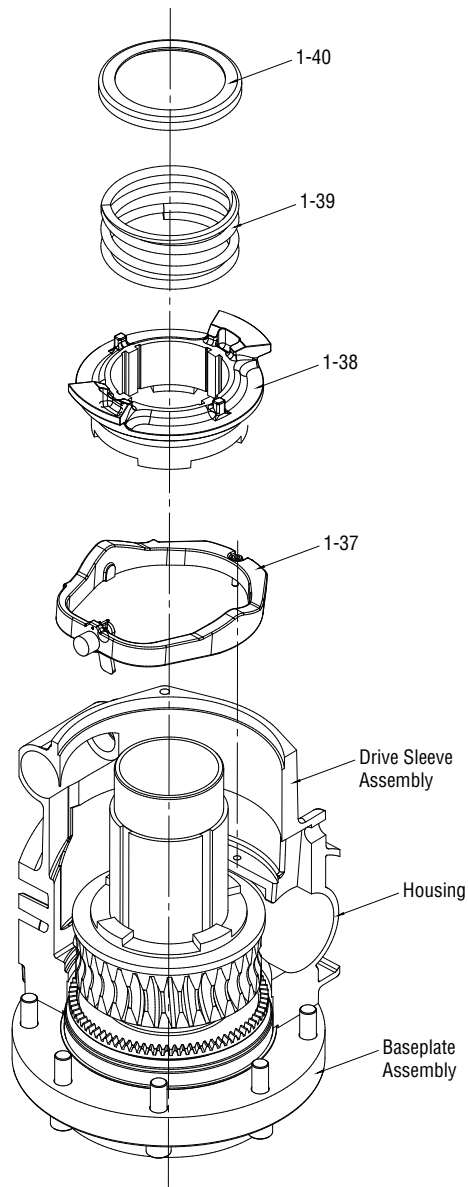


Figure 4.27 – MX-85, -140, and -150 Clutch and Ring Components





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.

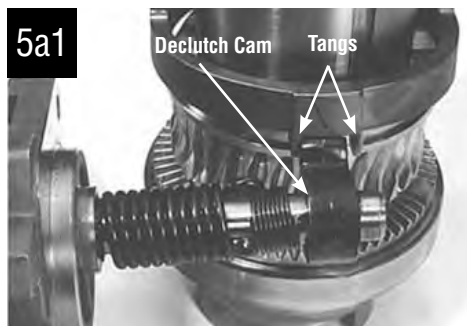
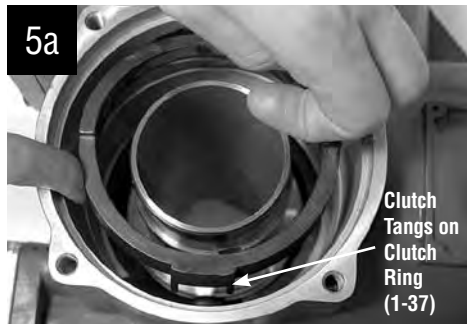
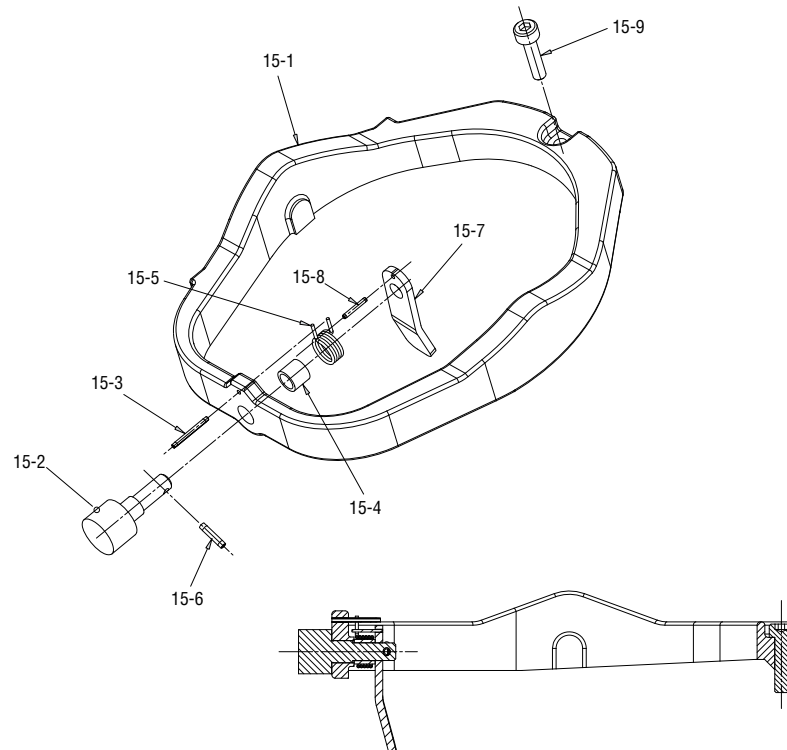
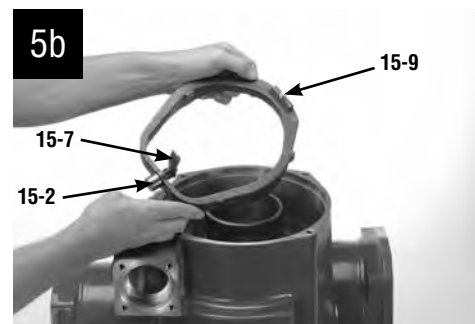



Table 4.24 – Clutch Ring Assembly Parts List

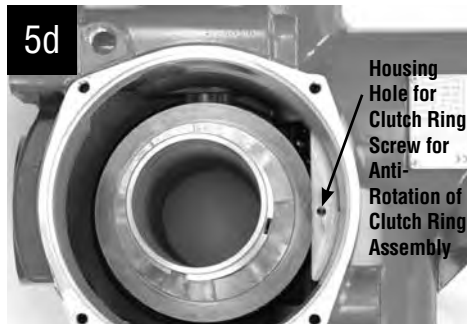
Part Number	Description	Qty.
15-1	Clutch ring	1
15-2	Roller	1
15-3	Roll pin	1
15-4	Spacer	1
15-5	Latch spring	1
15-6	Roll pin	1
15-7	Latch	1
15-8	Roll pin	1
15-9	Socket head cap screw	1

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.

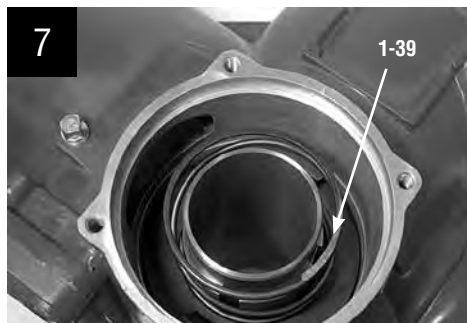
NOTE: The clutch ring socket head cap screw (#15-9) must fit into hole in housing to keep ring from rotating. See picture 5d. See warning Note in Section 4.14.2, Step 8.


STEP 6

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

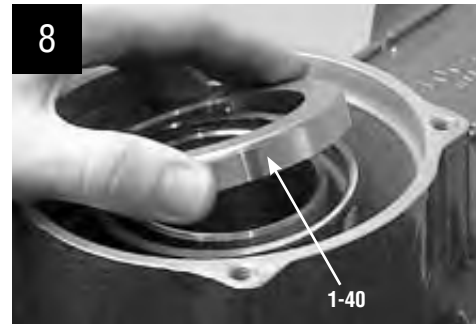

STEP 7

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

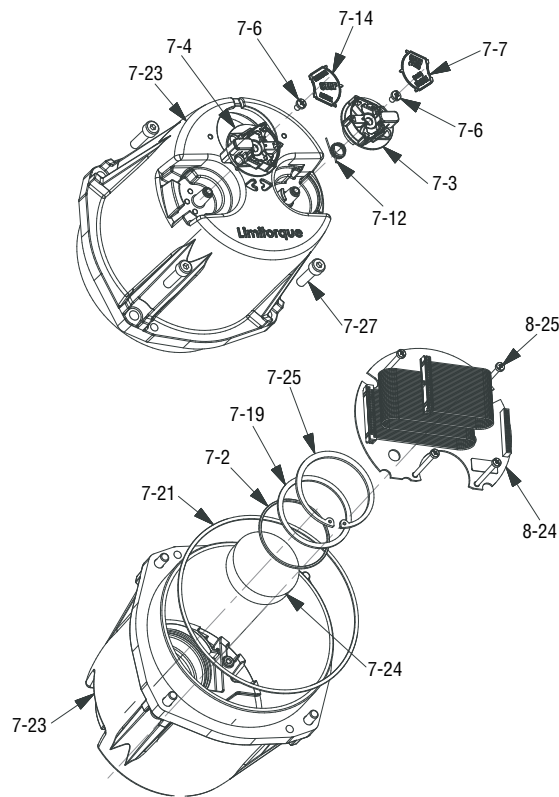
Electronic Assemblies

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

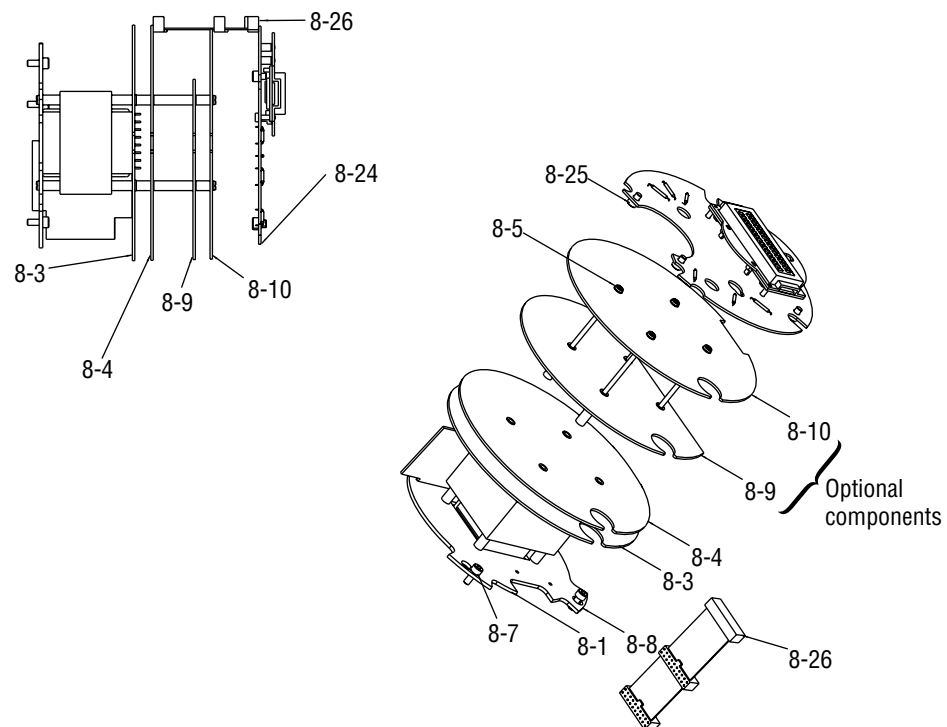


5.2 Control Module (Units Supplied Before September 2003)

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



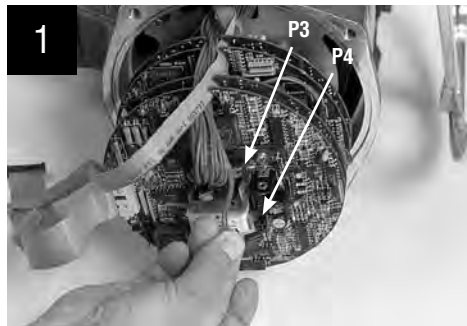
5.2.1 Removal

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.

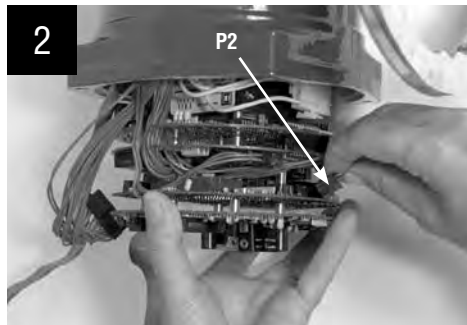
⚠ CAUTION: Potential to cause electrostatic damage to electronic components. Before handling electronic components, ensure that you are discharged of static electricity by briefly touching a grounded metal object.

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



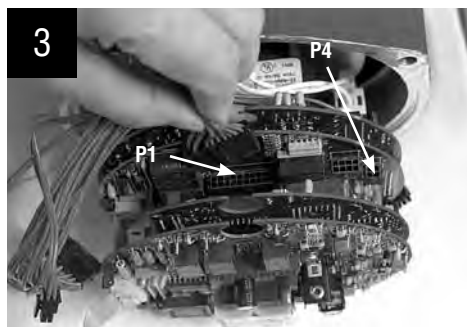
STEP 2

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



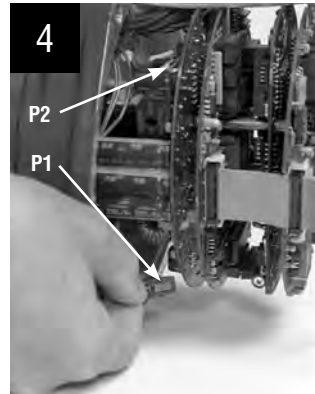
STEP 3

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

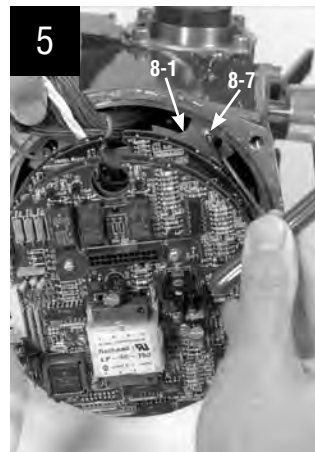


**STEP 4**

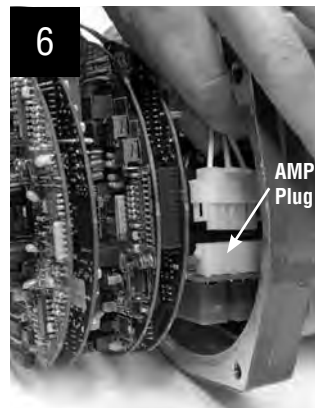
Disconnect wire harness plugs P1 and P2 from the main power board.

**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**

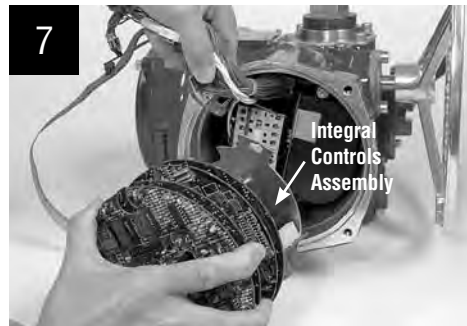
Disconnect the AMP® power connector from the fuse section of the main power board.



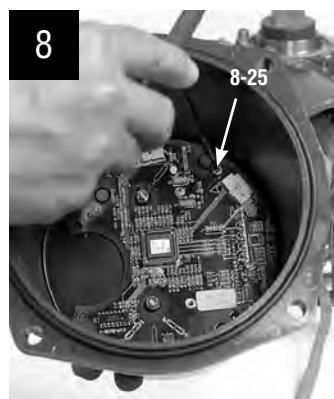
STEP 7

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.

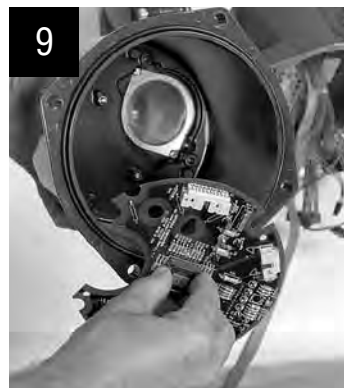

STEP 9

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.

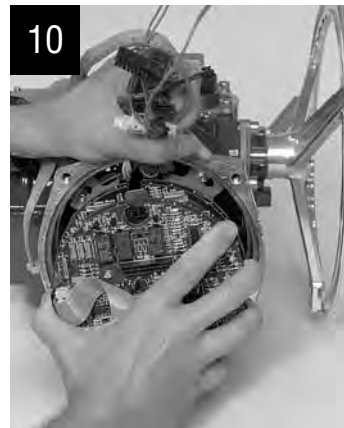
STEP 10

⚠ 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

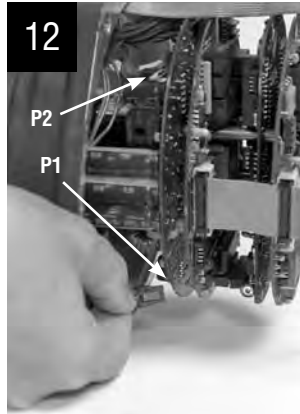
Tighten the three screws (#8-7) with a 3 mm hex key.



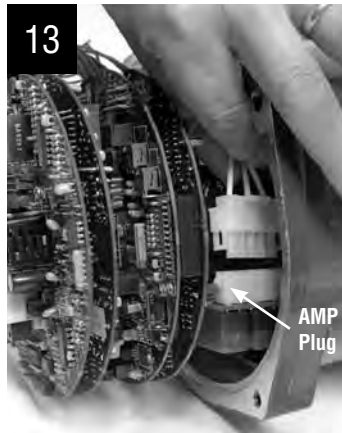
**STEP 12**

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

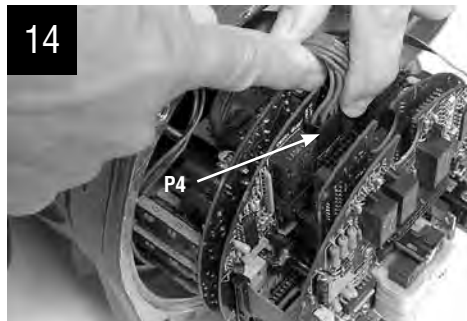
Connect the 6-pin Molex® wire harness to plug P1 and 14-pin Molex® harness to plug P2 on main power board.

**STEP 13**

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

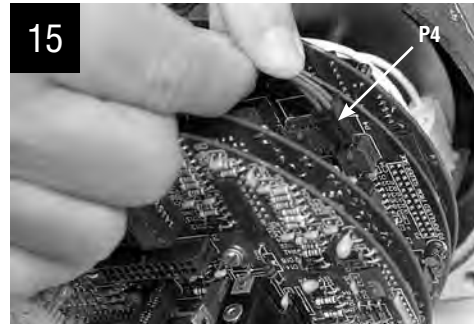
**STEP 14**

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

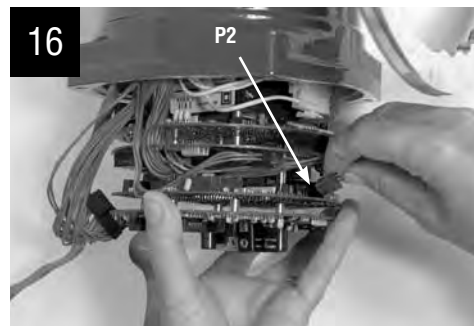


STEP 15

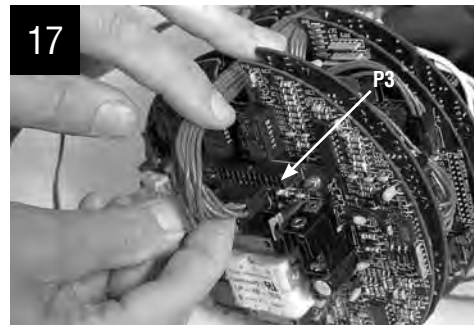
Connect the 4-pin Molex® harness to plug P4 on the main processor board.

**STEP 16**

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

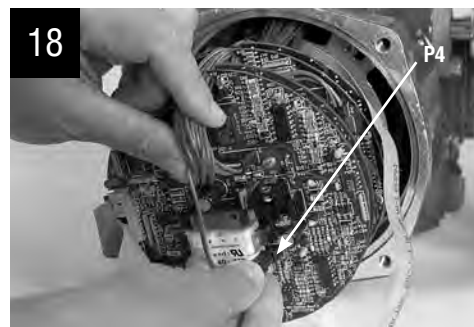
**STEP 17**

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

**STEP 18**

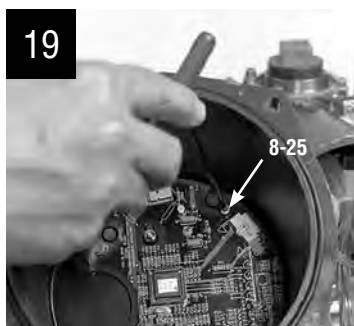
... and connect 2-pin Molex® harness to plug P4 on I/O option board.

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.

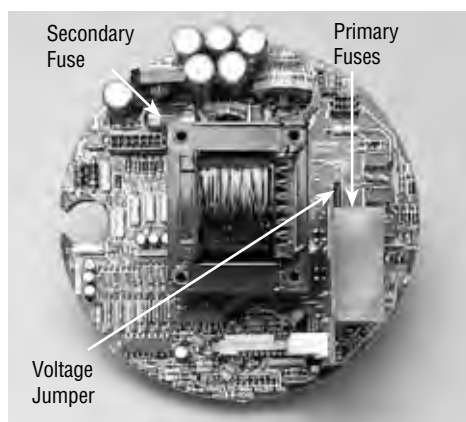
**STEP 21**

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

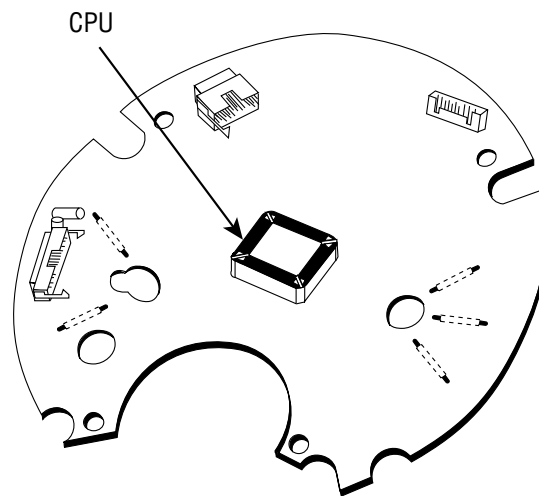
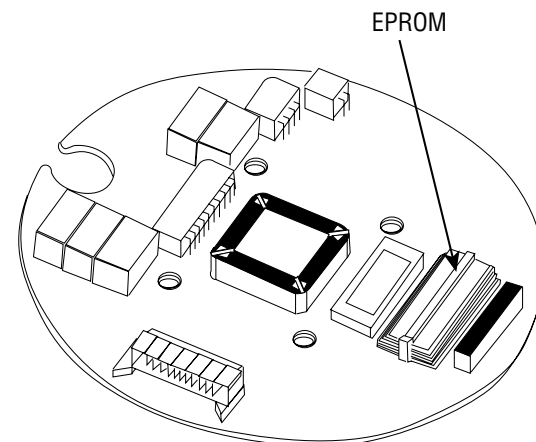


Figure 5.5 shows the location of the Main CPU Board EPROMs.

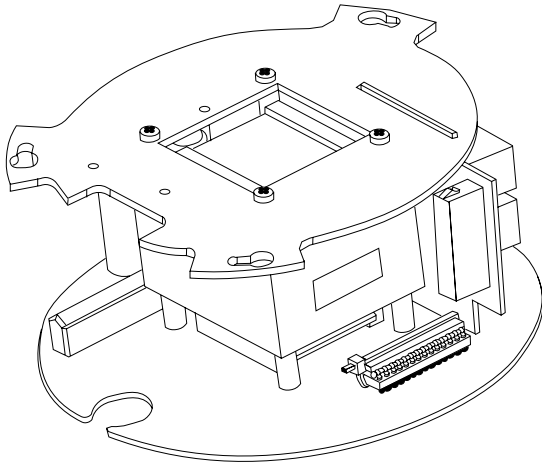
Figure 5.5 – Main CPU Board



NOTE: Remove and replace tie wrap.

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

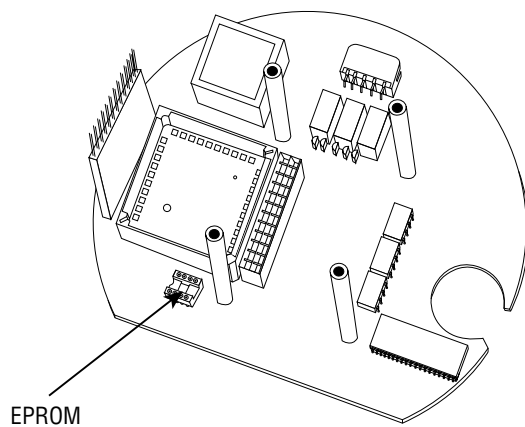
Figure 5.6 – Power Board



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.

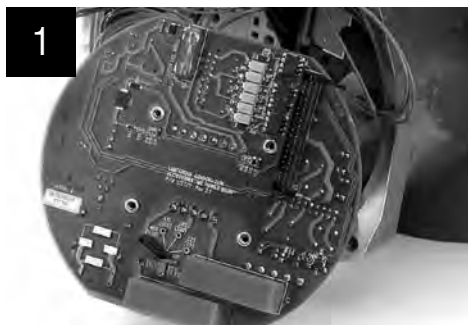
5.3 Installation and Removal of SMT Controls (most units supplied after September 2003 and before September 2007)

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

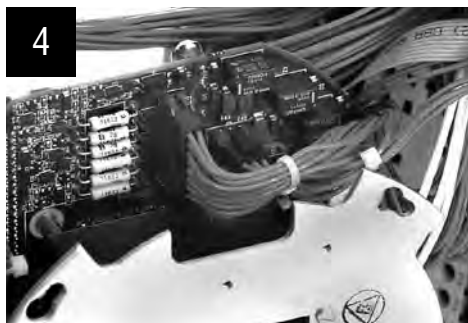
Attach the SMT terminal block conversion wiring harness (P/N 64-825-0010-4) to the existing through hole wiring harness. Connect each through hole Molex connector to its corresponding SMT Molex connector.

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.



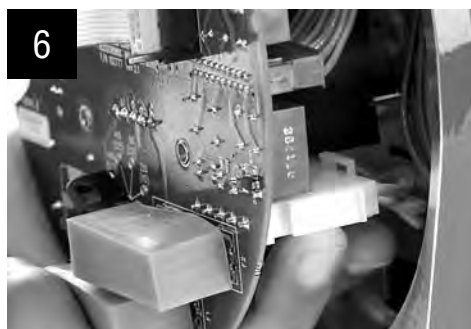
STEP 5

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).

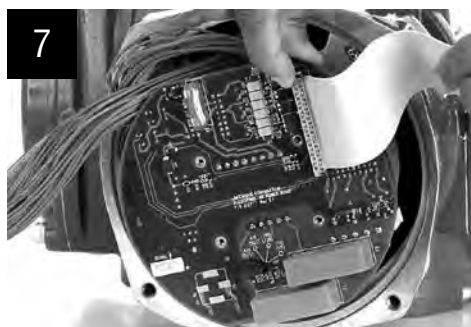
Tighten the three screws (#1-45) with a 3 mm hex key.

**STEP 6**

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

**STEP 7**

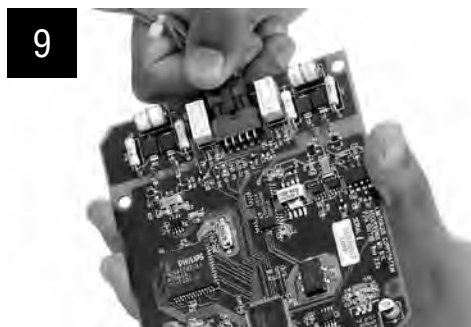
Connect the 10-pin encoder ribbon cable to plug P3 on the Main/LCS processor board. Align the polarization plug with the slot in the center of connector J1.

**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

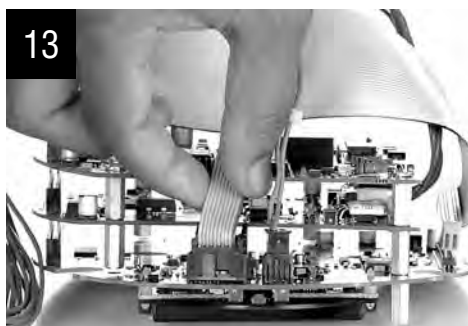
Using a screwdriver, install the four M4 screws (#7-44) to retain the LCS/Main board inside the CP cover. Select the screws based upon the number of option boards in the actuator; M4 X 6 mm for standard set, M4 X 25 mm for one option board, and M4 X 45 mm for two option boards.

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.



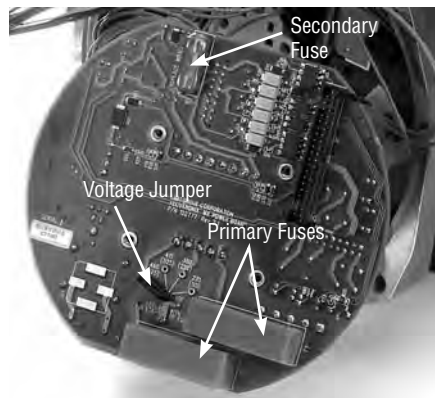
5.3.2 Removal

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

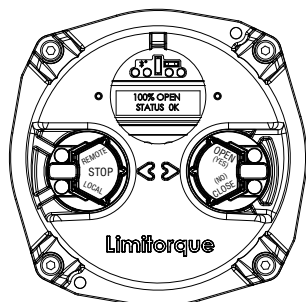
Remove and replace in proper slots according to nameplate voltage.

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

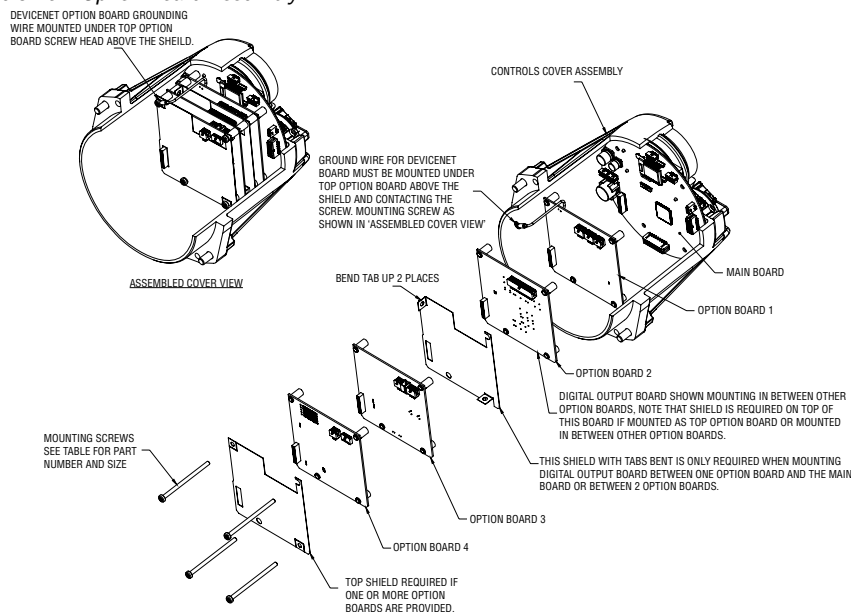
Connect to the control cover using four (4) M4x25 pan head screws if one DeviceNet board is installed. Ensure that both jumpers are in the “A” position. Connect the 6-pin cable from the terminal block to socket J8. Set aside yellow ground wire to be fastened to top of option board stack per Figure 5.10.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

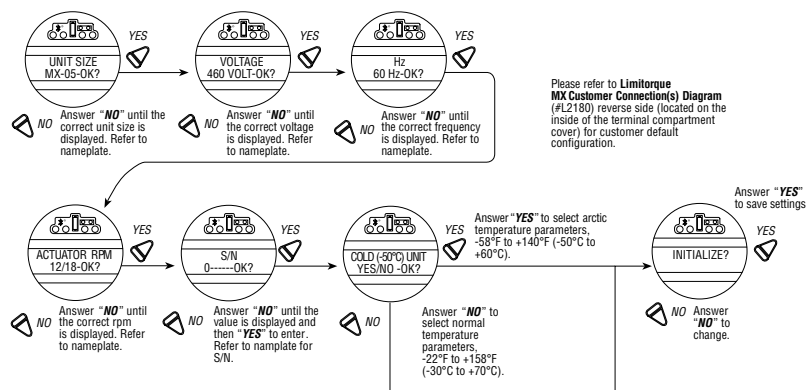
- For adding the Modutronic and two-speed timer options, the actuator QA Stamp ID must be supplied in order to acquire the necessary keycode.
- Each MX actuator is supplied a unique “QA Stamp ID”. This number is assigned during the end-of-line test sequence for each unit.
- This serial number is located 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 from 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



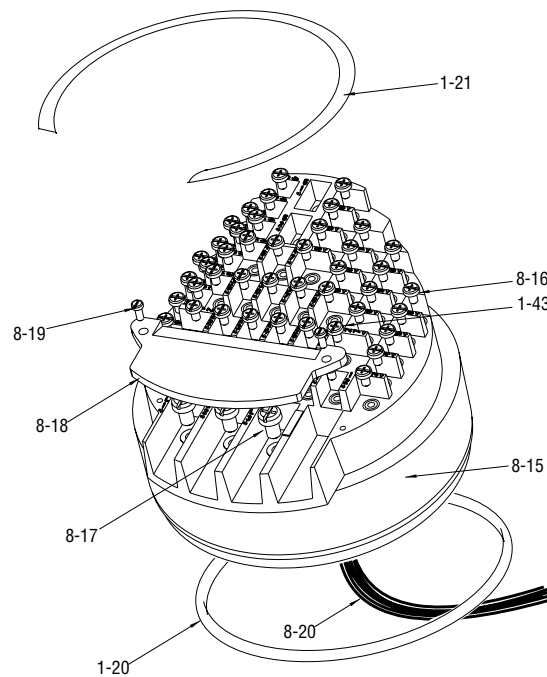
5.8 Terminal Block (prior to March 2007)

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

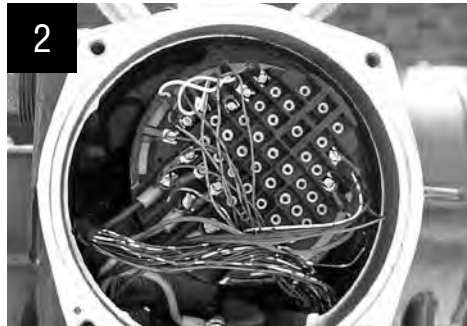
☠ WARNING: Hazardous Voltage! Turn off all power sources to actuator before removing terminal block assembly. Power sources may include main power or control power.

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

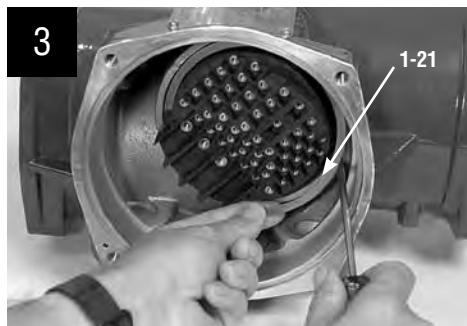



STEP 2

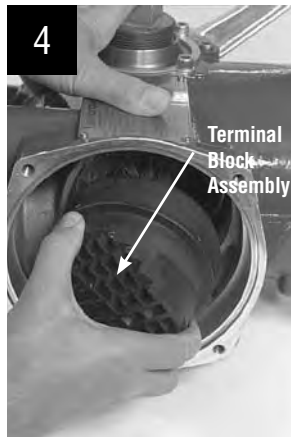
If actuator is already in service, disconnect incoming power leads L1, L2, and L3 (and control wiring from the terminal block if terminal block replacement is required).


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

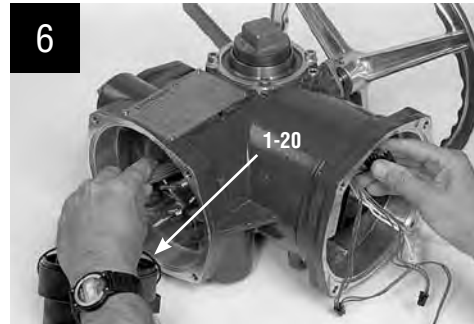
Disconnect leads L1, L2, and L3 from back of terminal block.




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.

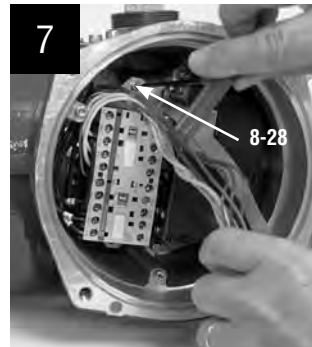


5.8.2 Remounting

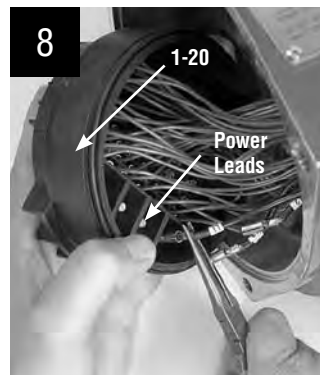
STEP 7

⚠ 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.

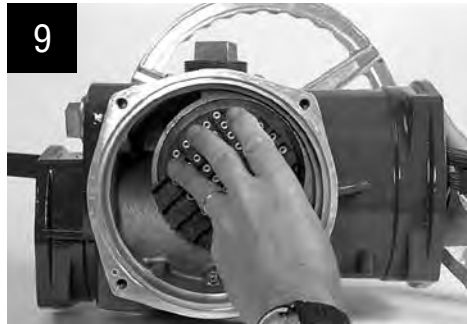

STEP 8

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

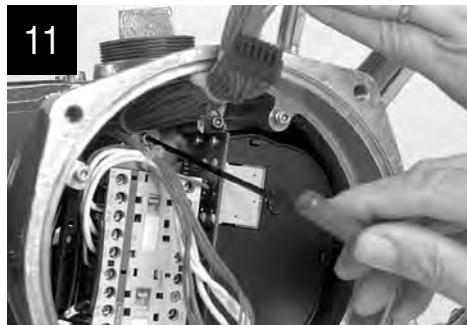
Insert the terminal block into the terminal block mounting cavity.


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.

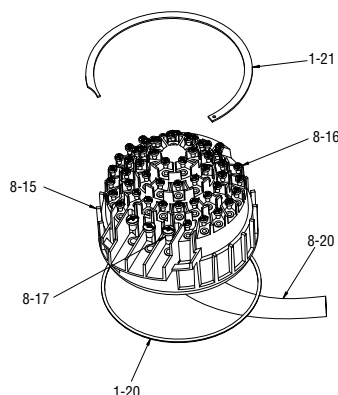


5.9 MX Terminal Block (Supplied With Most Actuators Since March 2007)

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.

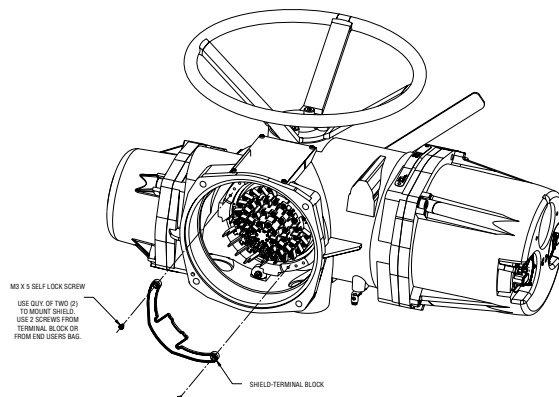
STEP 2

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

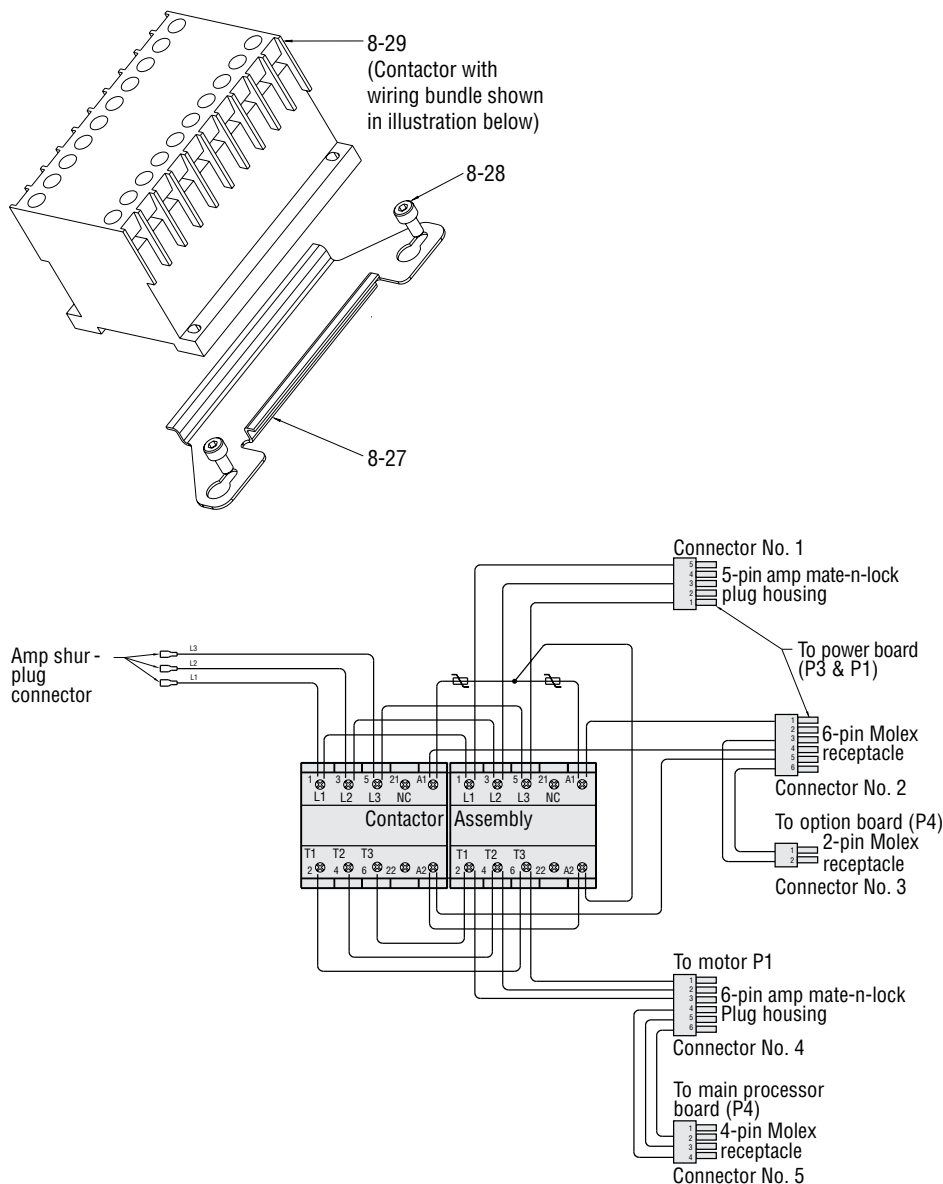
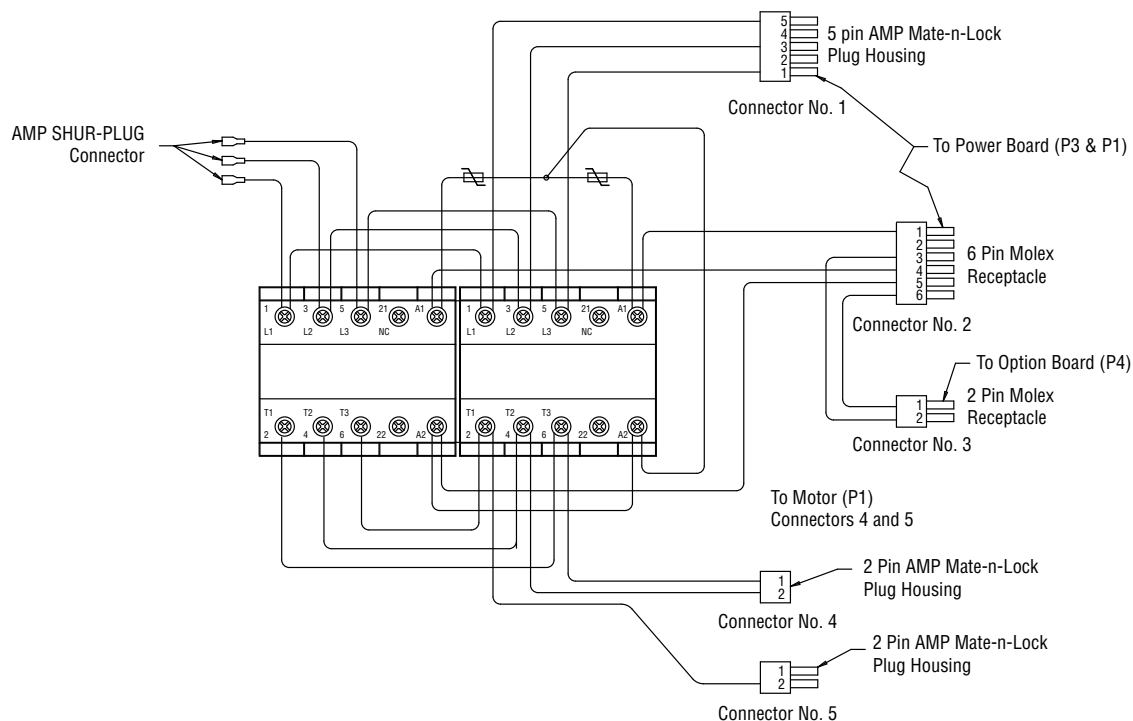




Figure 5.15 – (continued)



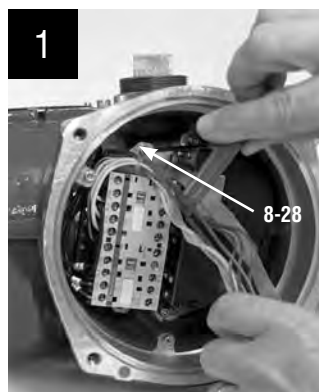
5.10.1 Removal

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.

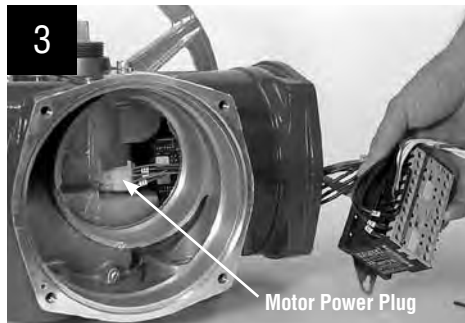

STEP 3

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

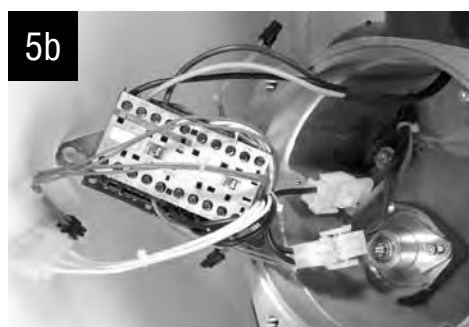
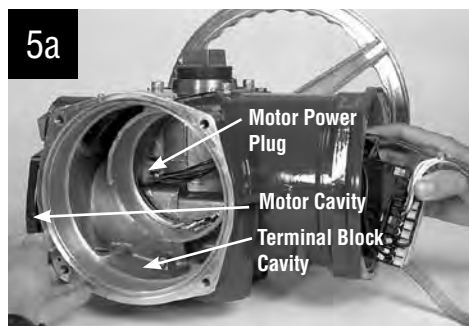
Route leads L1, L2, and L3 (input power) to the terminal block cavity.

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.

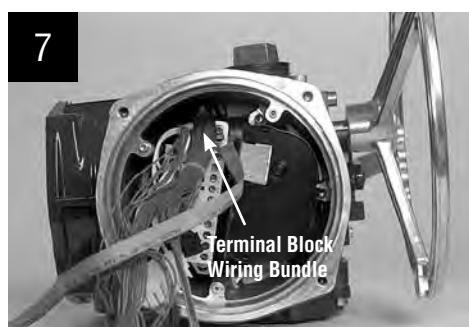

STEP 6

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

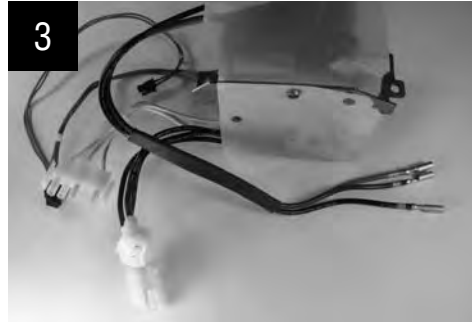
Follow the steps in 5.10.1. Remove control cover and disconnect the encoder and controls package. Remove controls package from MX housing.

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.

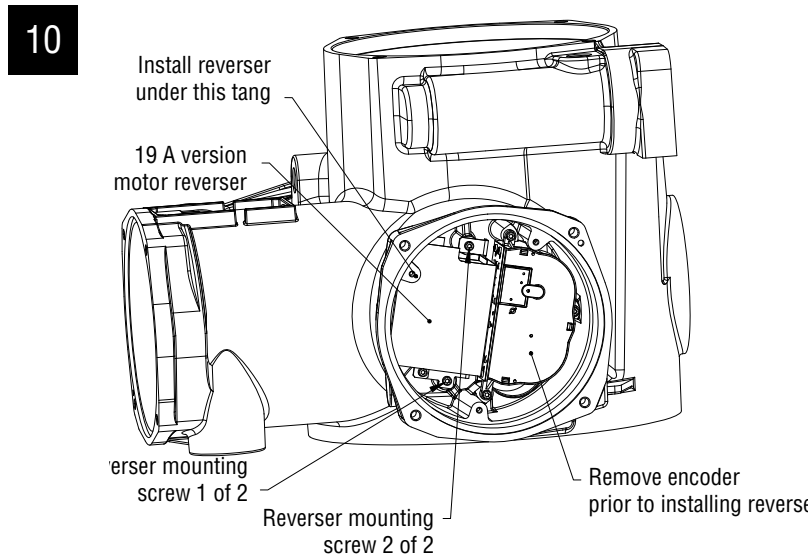
**STEP 9**

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

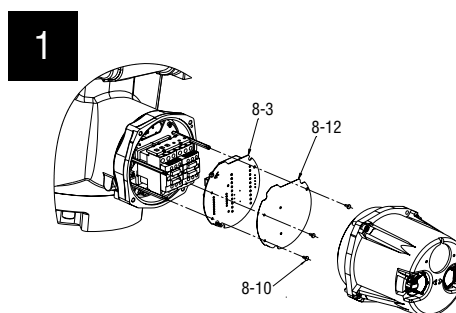
Table 5.9 – 19 Amp Power Assembly

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

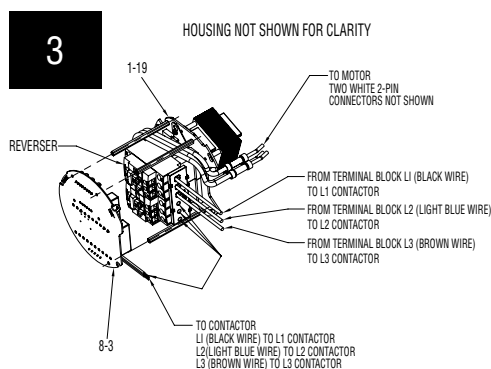
Remove the ACP controls cover assembly

**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.

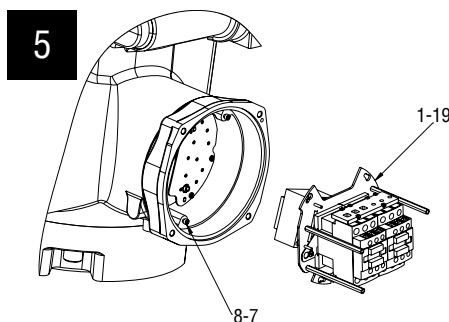
Remove the 19 amp controls assembly (1-19) by loosening the three M4 mounting plate screws (8-7) and slightly rotating the controls assembly counterclockwise (CCW) direction until the keyhole slots in the baseplate allow the heads of the screws to pass through the baseplate.

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

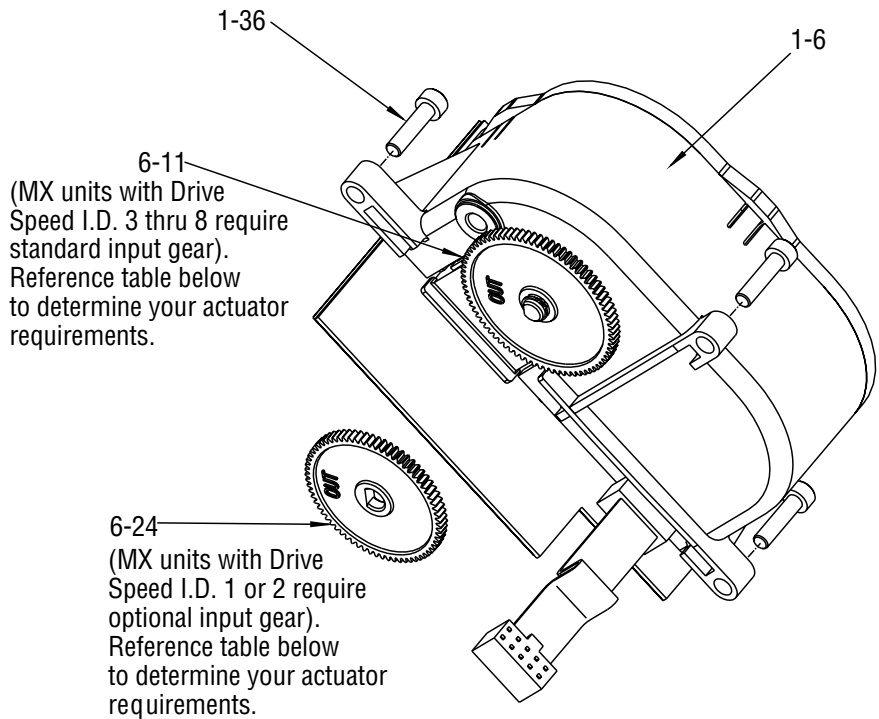


Table 5.11 – Encoder Drive Sleeve Speed (RPM)

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.)

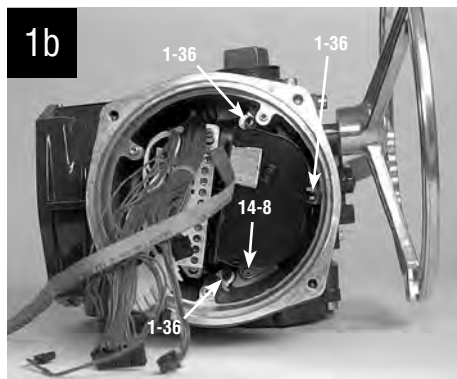
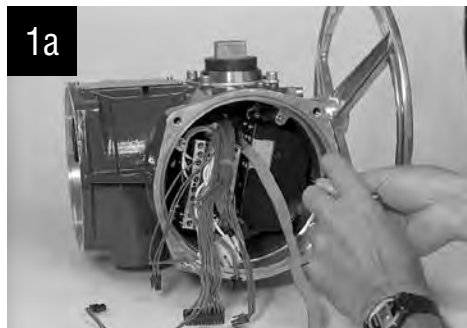
NOTE: The encoder is a sealed assembly of high-precision components and not suitable for repair. Should the encoder fail, it will be necessary to install a factory replacement.


STEP 1

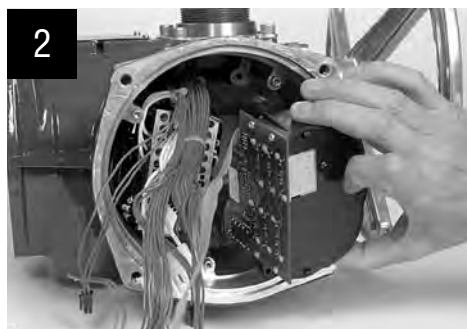
⚠ WARNING: Hazardous Voltage! Turn off all power sources to actuator before removing encoder assembly. Power sources may include main power or control power.

⚠ 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.



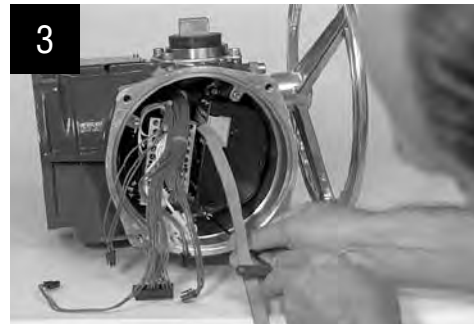


5.13.2 Remounting

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

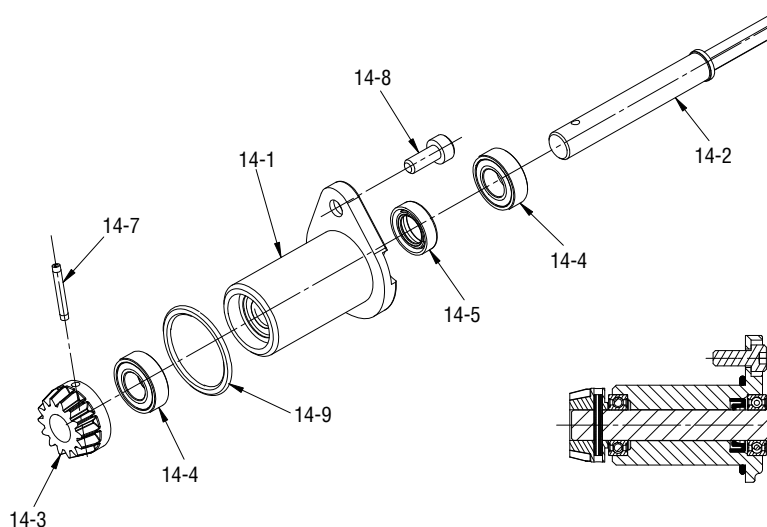
Drive Sleeve Speed I.D.	1	2	3	4	5	6	7	8
50 Hz RPM	15	22	33	43	65	84/110 ¹	127/143 ¹	165 ²
60 Hz RPM	18	26	40	52	77	100/131 ¹	155/170 ¹	200 ²

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

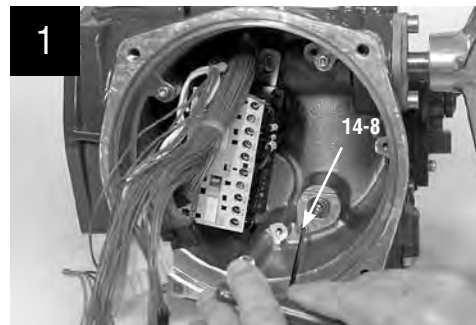
NOTE: Before removal you must:

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

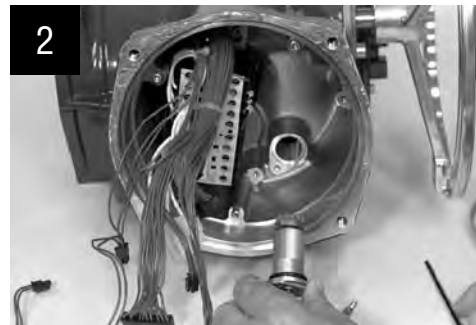
⚠ WARNING: Hazardous Voltage! Turn off all power sources to actuator before removing encoder drive cartridge. Power sources may include main power or control power.

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



STEP 2

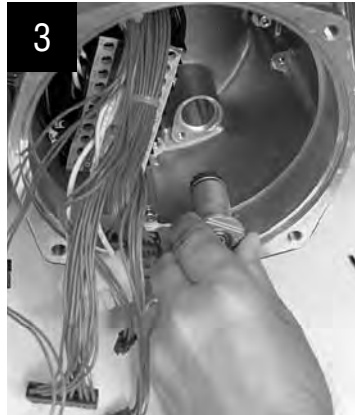
Withdraw the complete encoder drive cartridge from the actuator housing.



5.14.2 Remounting

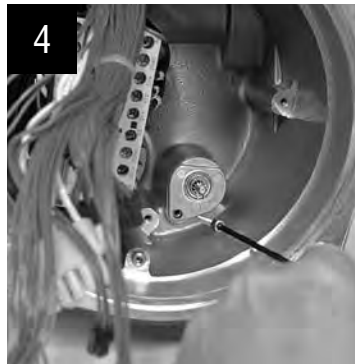
STEP 3

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

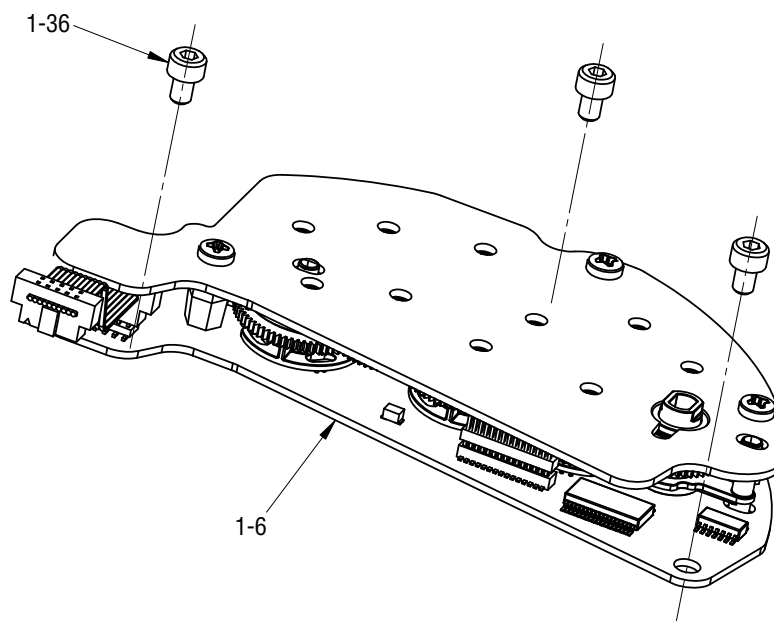


Table 5.15 – Encoder Drive Sleeve Speed (RPM)

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.

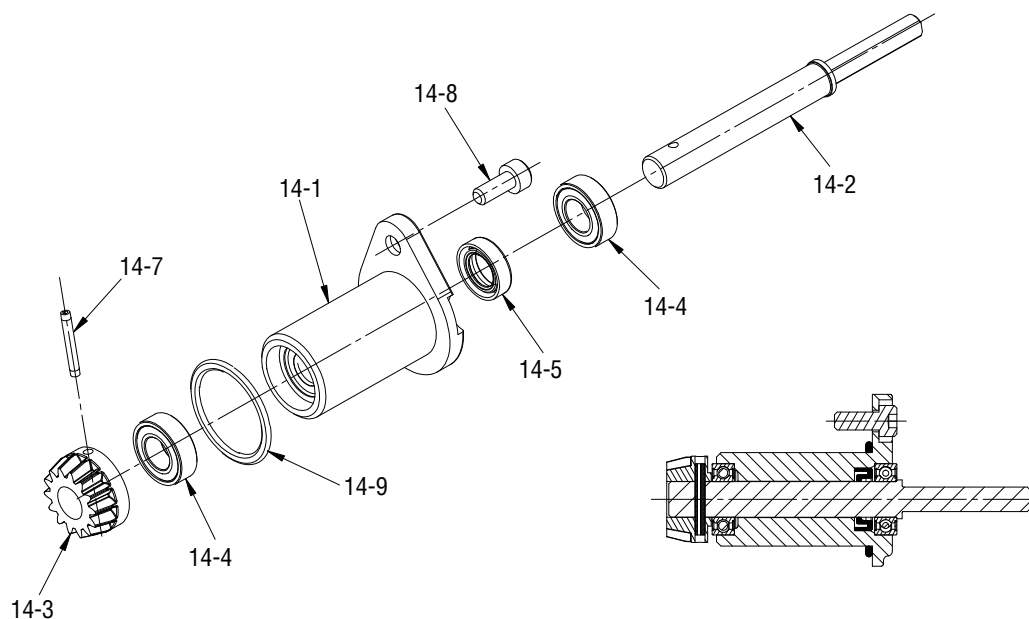
Align the three encoder mounting holes with the matching holes in the actuator housing and push the encoder straight on to the mounting boss, carefully positioning the encoder to ensure correct meshing with the encoder drive cartridge pinion. If needed to align gearing, declutch the actuator and turn 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

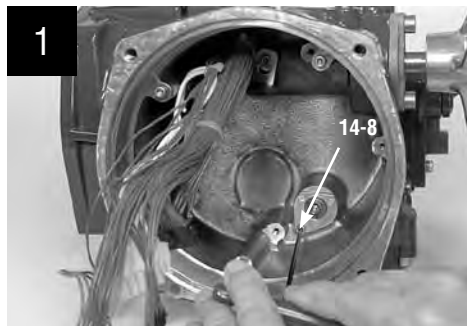
NOTE: Before removal you must:

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

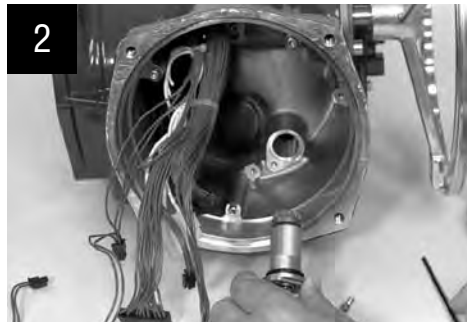
⚠ WARNING: Hazardous Voltage! Turn off all power sources to actuator before removing encoder drive cartridge. Power sources may include main power or control power.

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



STEP 2

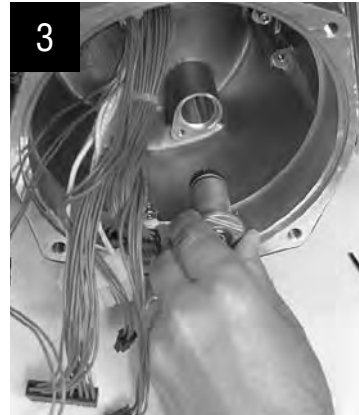
Withdraw the complete encoder drive cartridge from the actuator housing.



5.16.2 Remounting

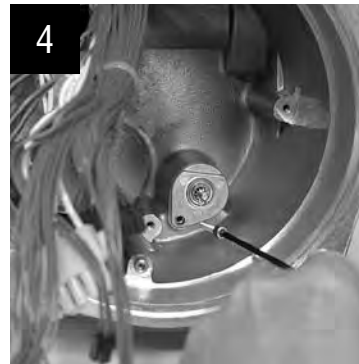
STEP 3

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

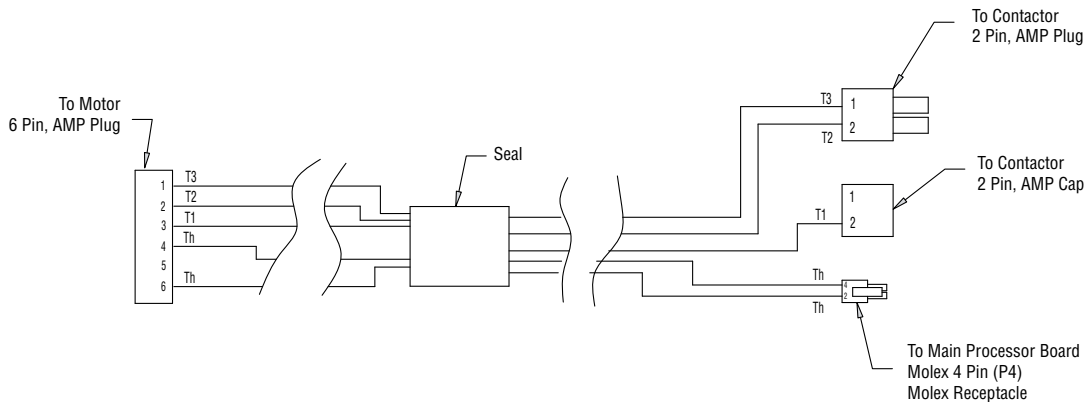
Using a 3 mm hex key, fit the M4 screw (#14-8) into the actuator housing to secure the encoder cartridge.





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

Figure 5.20 – Motor Lead Assembly



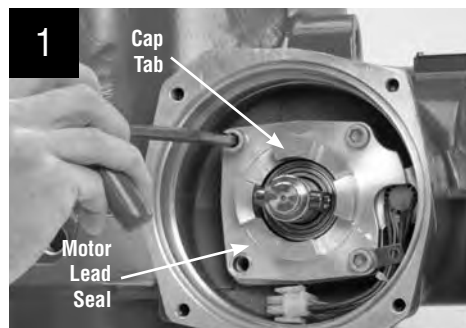
5.17.1 Removal

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.

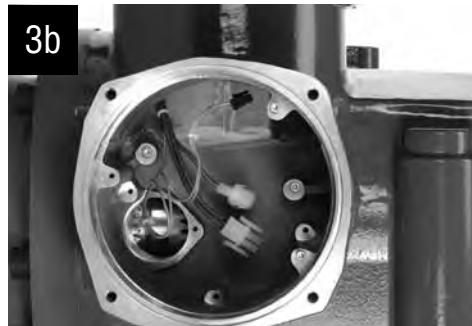


**STEP 2**

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.

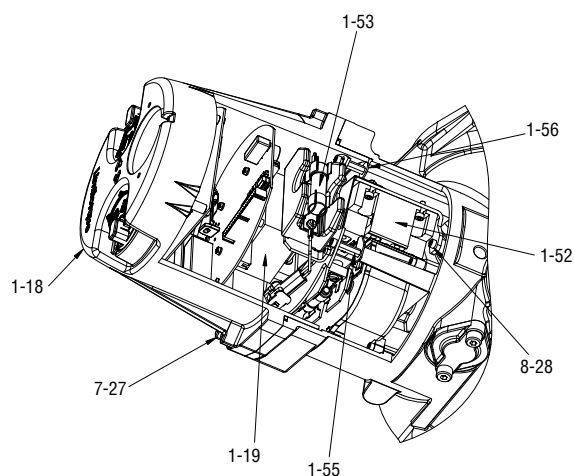
1. Contactor assembly (subassembly #8). (See Section 5.10.1)
2. Control module (subassembly #15). (See Section 5.6.1)
3. Control panel (subassembly #7). (See Section 5.1)
4. Motor (subassembly #4). (See Section 4.1.1)

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

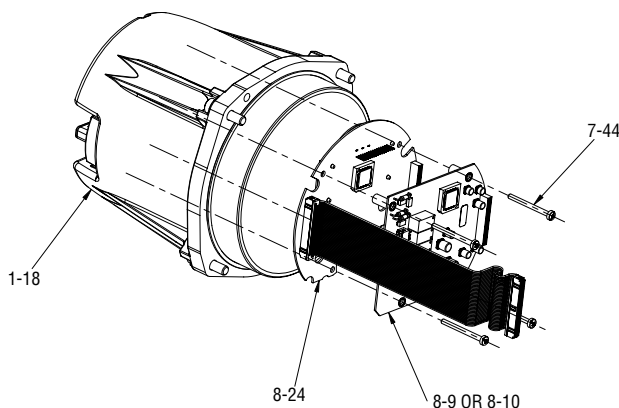



Tools required:

- 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

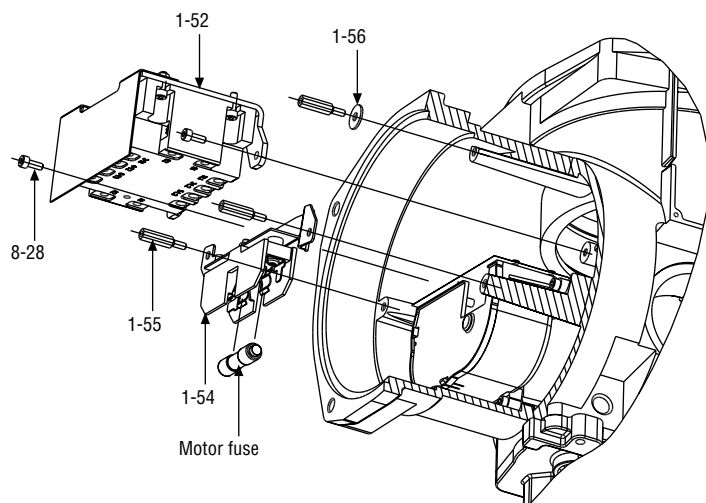
STEP 1

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.



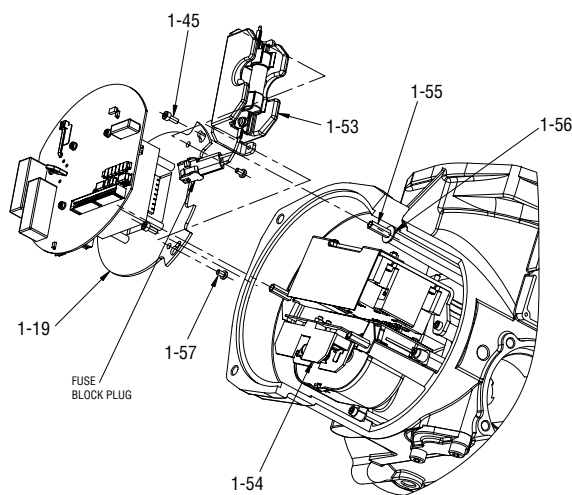
STEP 3

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.

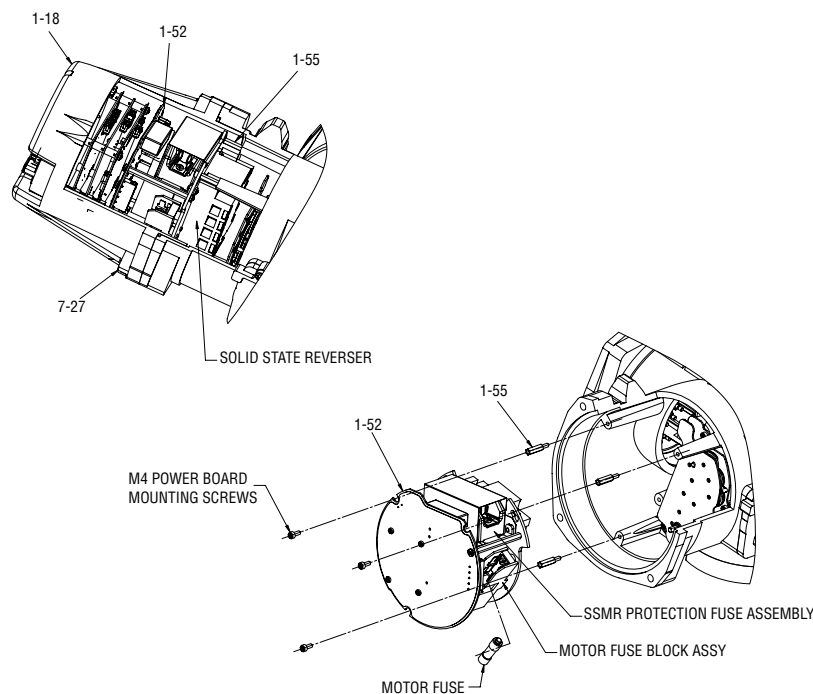
5.19 Mounting of SSMR (Solid State Motor Reverser) in units shipped after February 2008

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/contactors 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

Manufacturer's Name

Limitorque, a division of Flowserve Corporation

Manufacturer's Address

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 Lynchburg, VA 24502

Importer's Name

Limitorque International

Importer's Address

Euro House
 Abex Road
 Newbury
 Berkshire, RG14 5EY
 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:

(Signature)

Earnest Carey

(Full Name)

Manager, Product Management

(Title)

Flowserve Limitorque
 5114 Woodall Rd., Lynchburg VA 24502
 (Place)

December 9, 2005
 (Date)

Andy Hole
 (Authorized EU Representative)



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www.flowserve.com or www.limitorque.com
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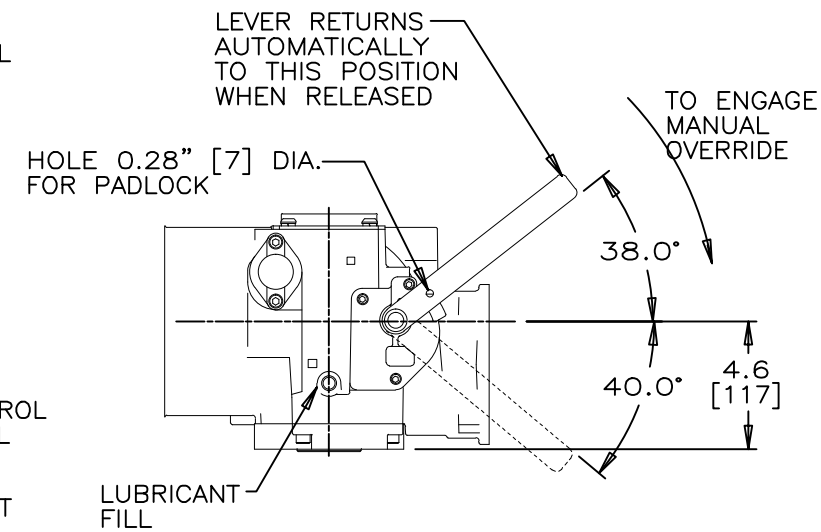
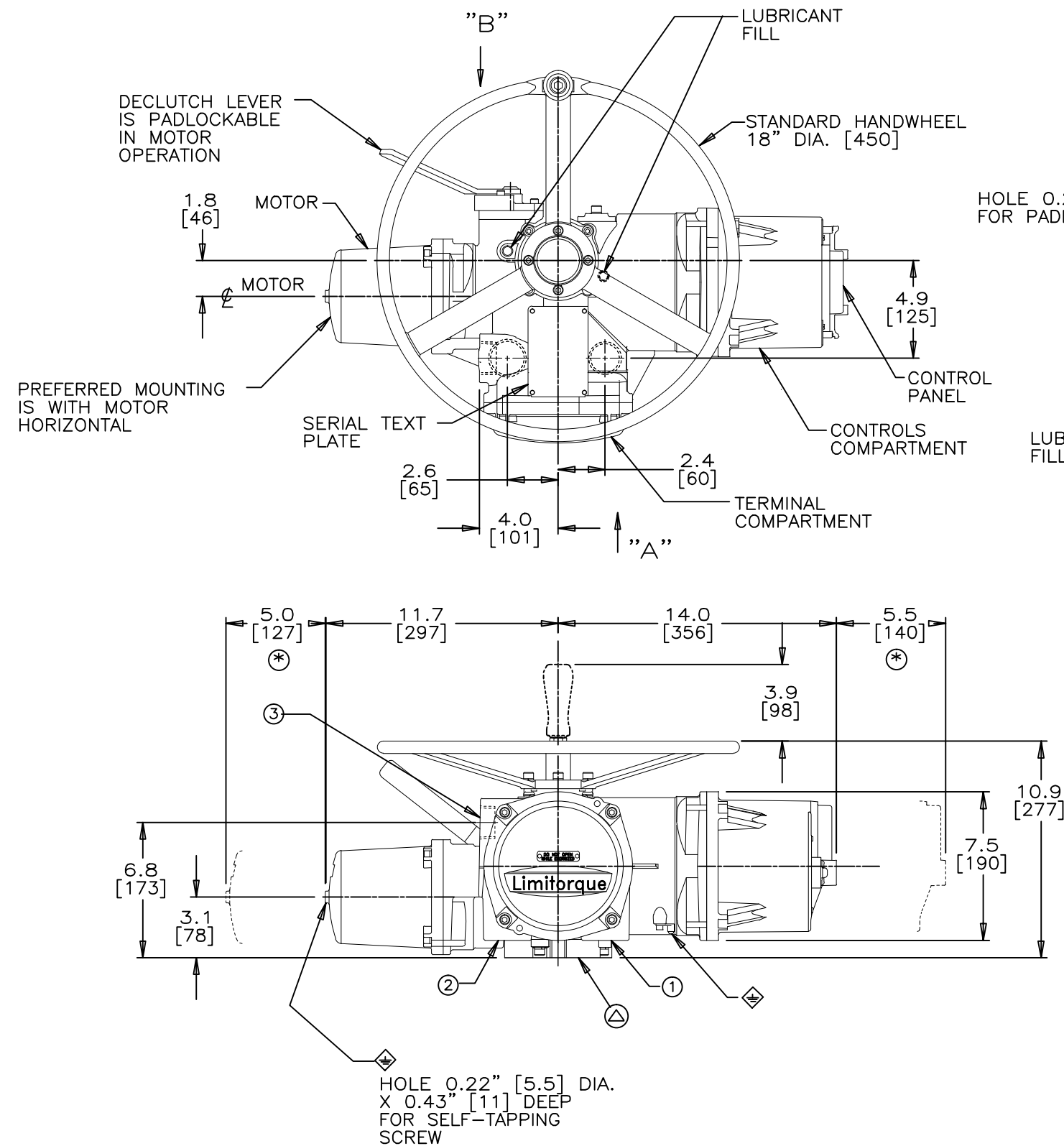
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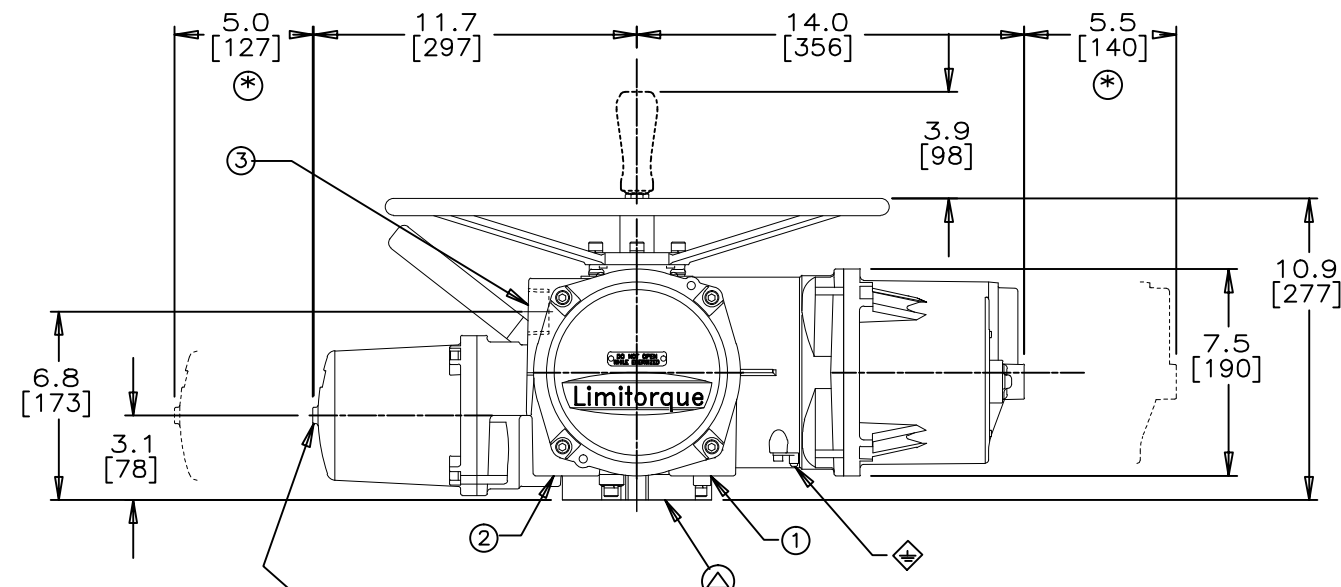
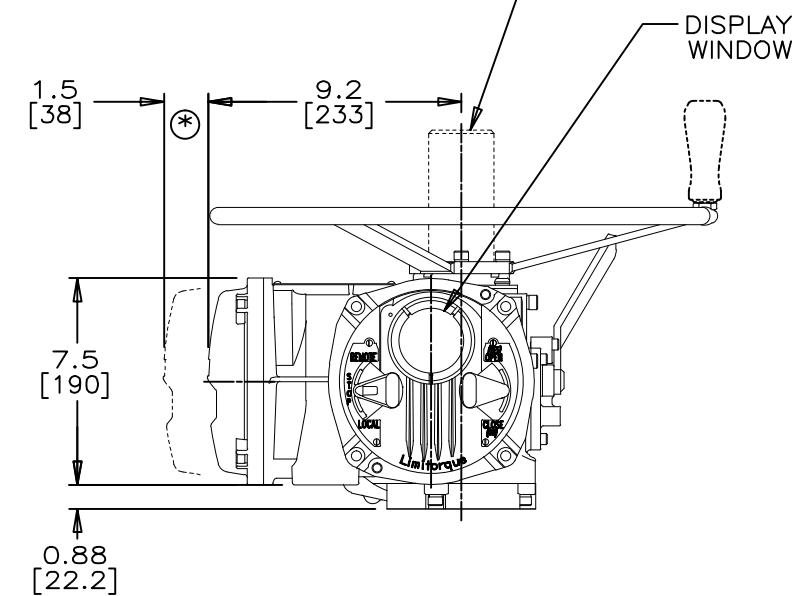
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3. Drawings

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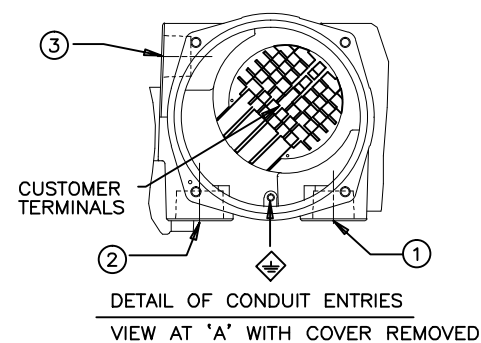
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STEM COVER (WHEN REQUIRED)
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OR FITTED WITH PIPE PLUG.



HOLE 0.22" [5.5] DIA.
X 0.43" [11] DEEP
FOR SELF-TAPPING
SCREW

SEE 03-615-0005-1 FOR
MOUNTING AND BORE INFORMATION

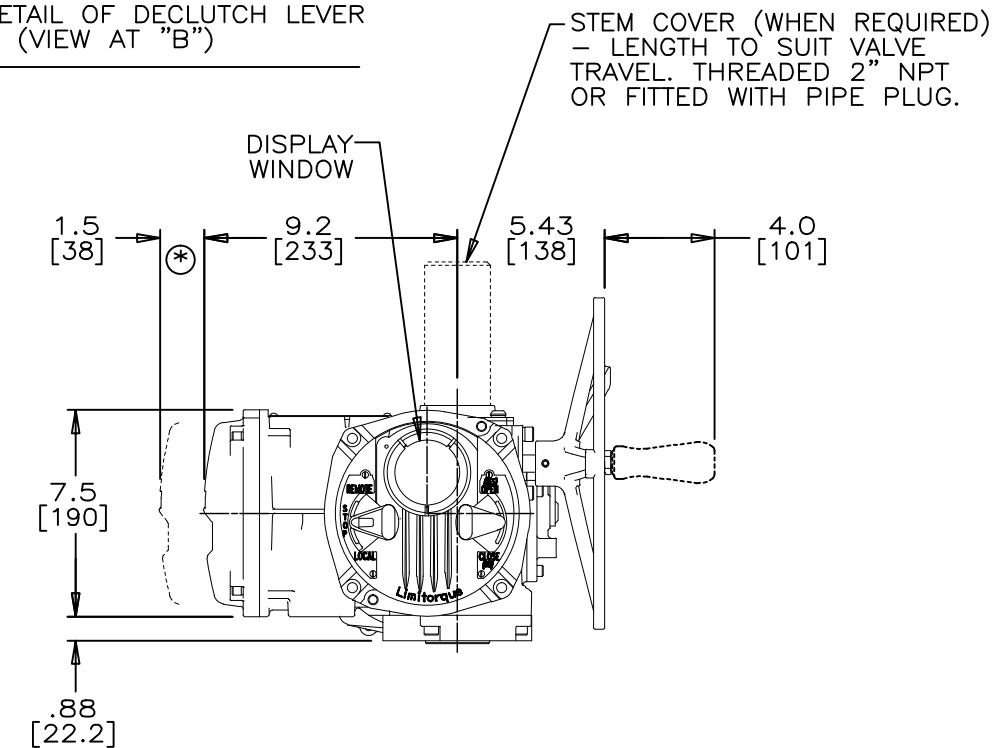
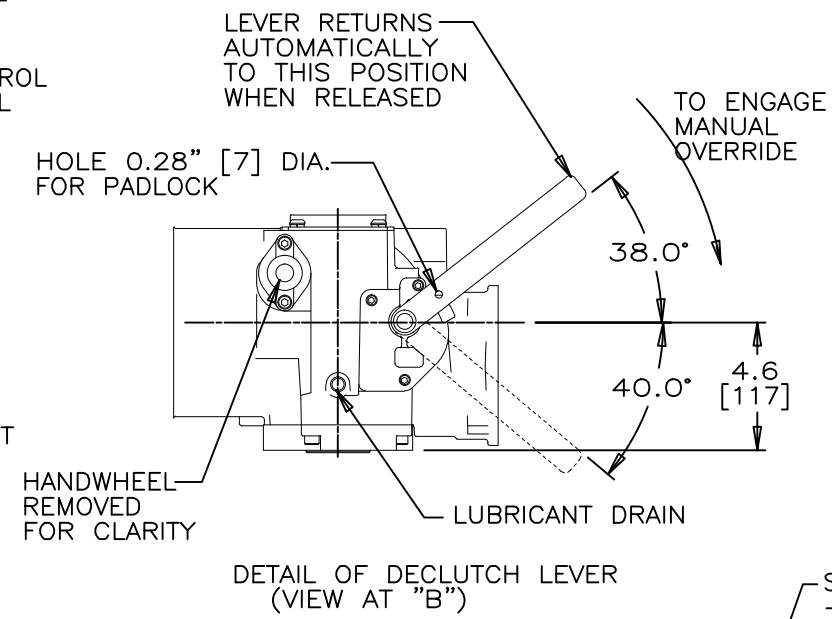
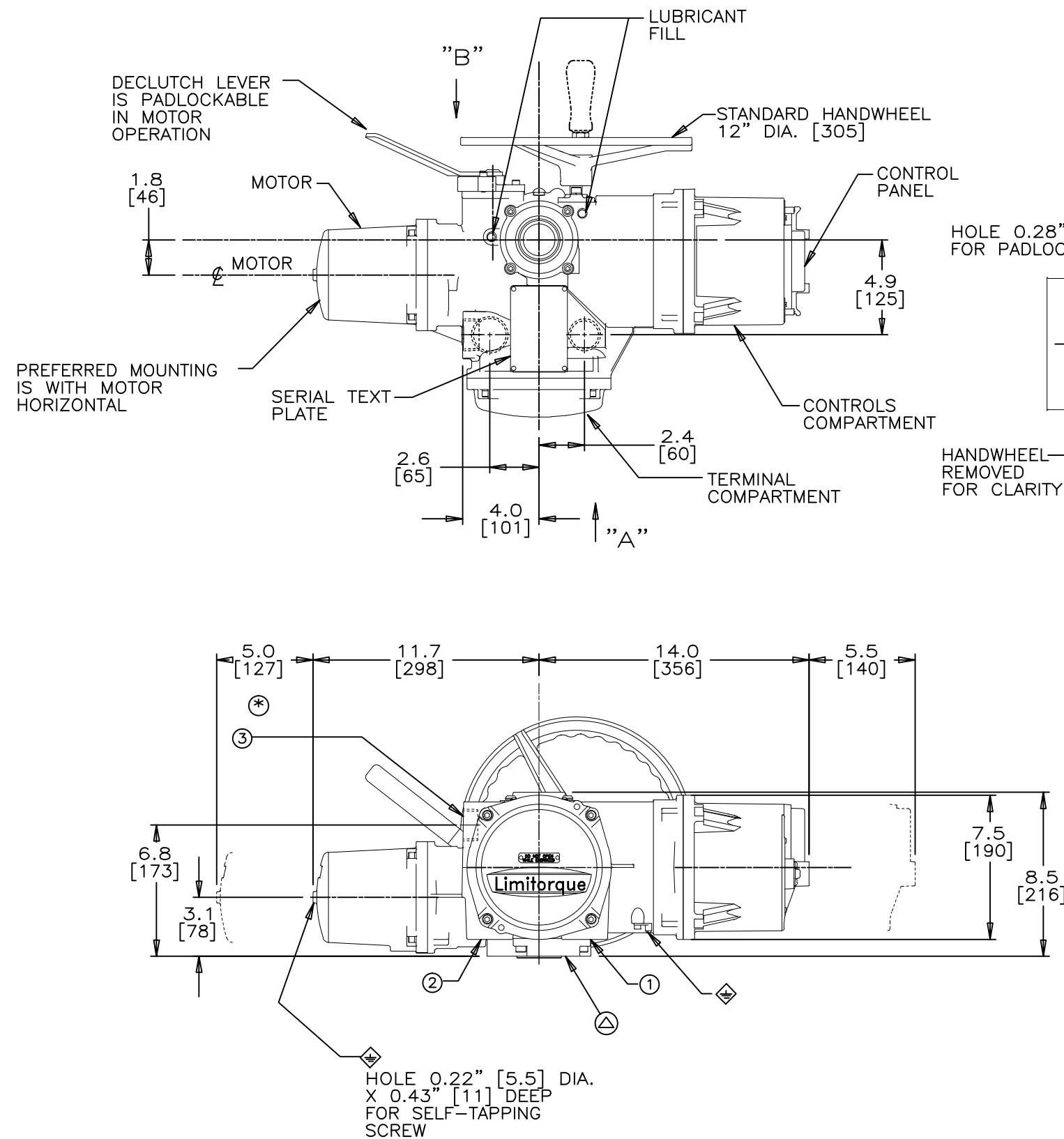


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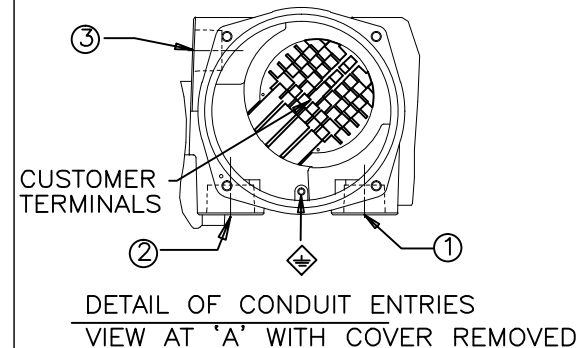
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- ⊛ RECOMMENDED CLEARANCE FOR COVER REMOVAL
- ⊙ MOUNTING FACE FOR ATTACHING TO VALVE FLANGE

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CHECKED	DATE	TITLE	
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APPROVED	DATE	SIZE	DWG NO
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		NONE	N/A

REVISIONS		BY	DATE	APPVD
REV	DESCRIPTION			



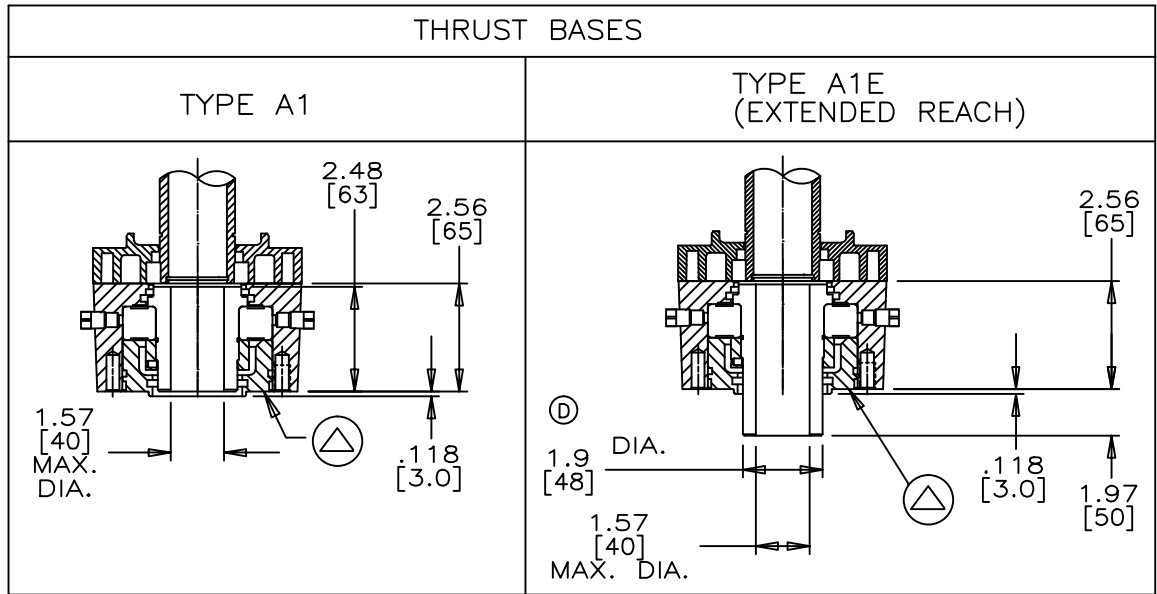
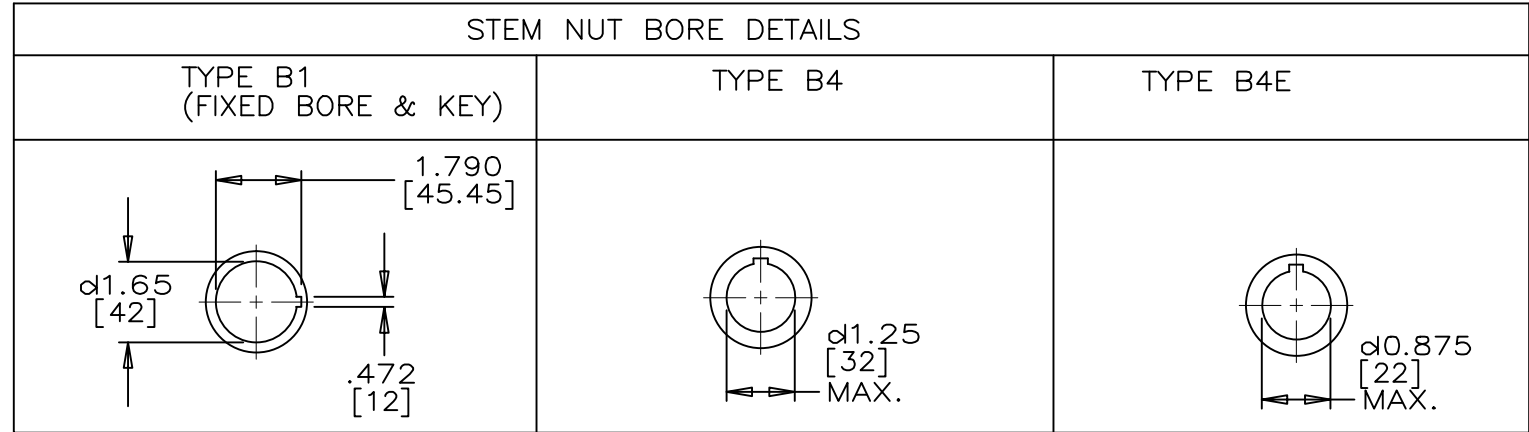
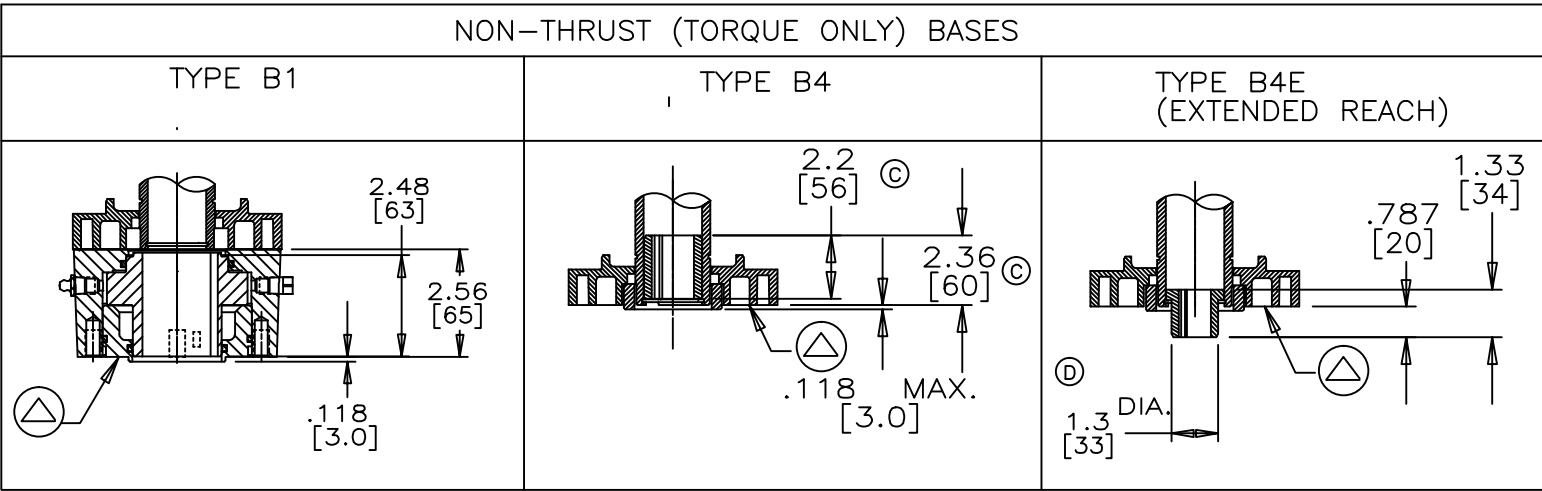
SEE 03-615-0005-1 FOR MOUNTING AND BORE INFORMATION



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OPTIONS	M32, M25 M20	M40, M32, M25, M20	M32, M25 M20
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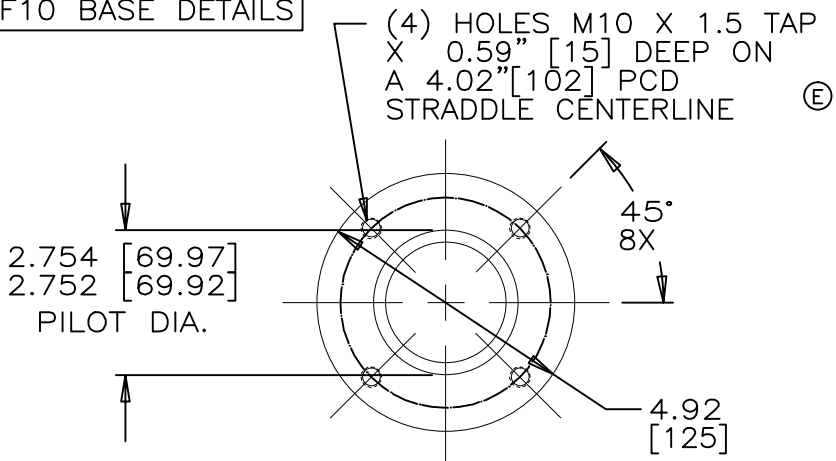
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- ⊛ RECOMMENDED CLEARANCE FOR COVER REMOVAL
- ⊕ MOUNTING FACE FOR ATTACHING TO VALVE FLANGE

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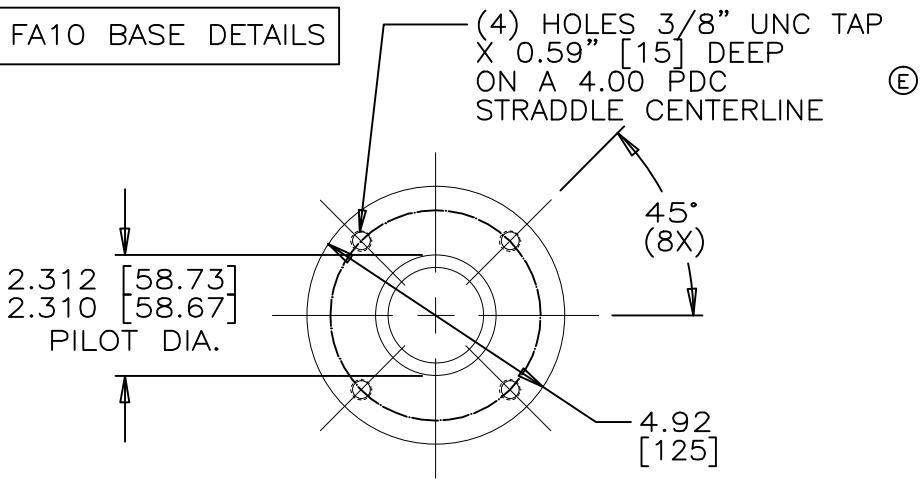


⊕ MOUNTING FACE FOR ATTACHING TO VALVE FLANGE

F10 BASE DETAILS

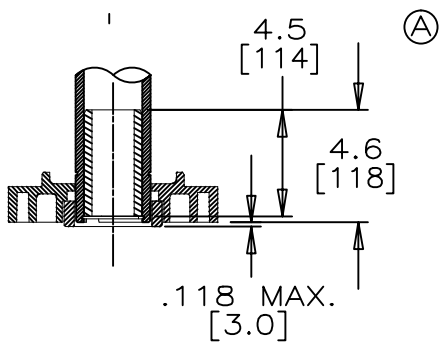


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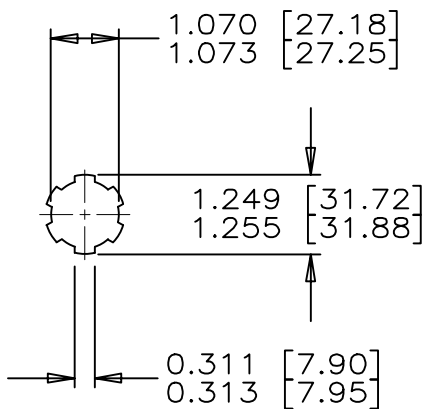


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B	ADD METRIC EQUIVALENT	CCR	2-6 1997	DJM
C	2.2[56] WAS 1.8[48]; 2.36[60] WAS 2.0[52]	CCR	8-12 1997	DJM
D	ADD O.D. FOR EXTENDED STEM NUTS	CCR	9-9 1997	DJM
E	ADD TAP DEPTH; (4) WAS (8)	CCR	12-15 1997	DJM

TYPE BL -SPLINED STEM NUTS



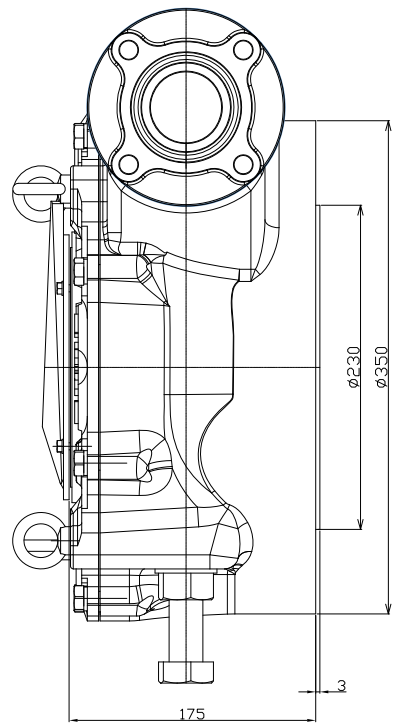
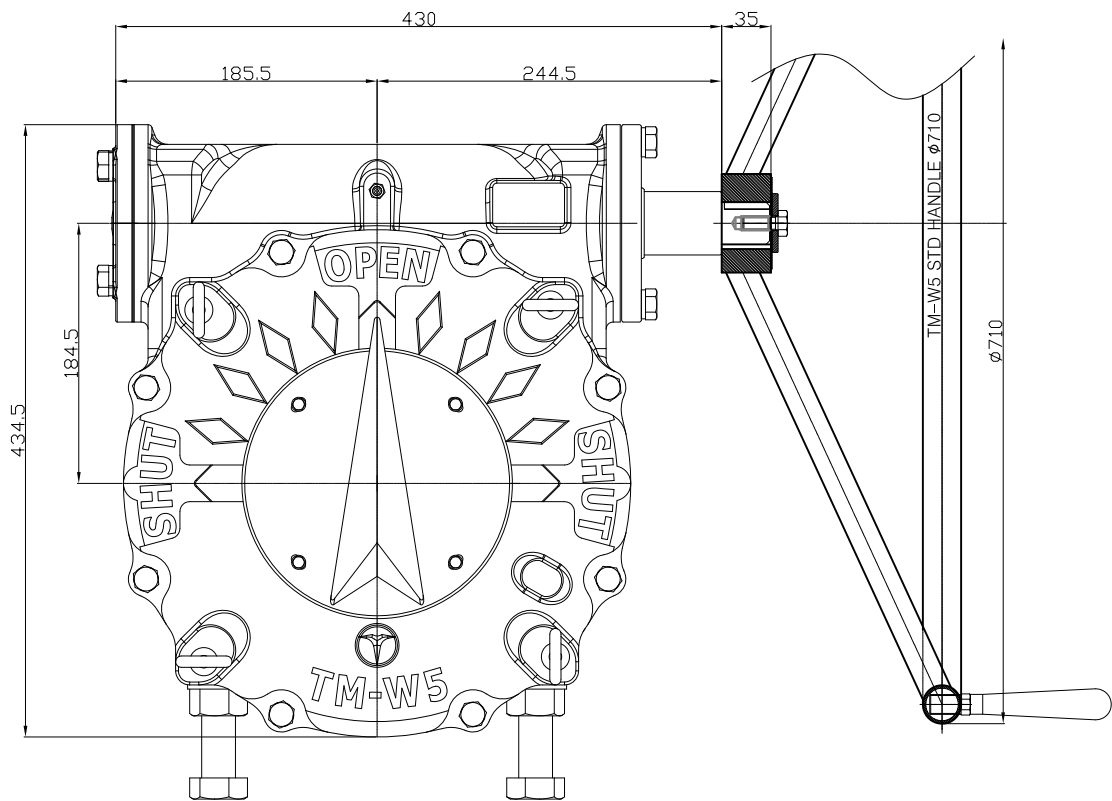
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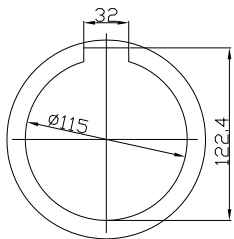
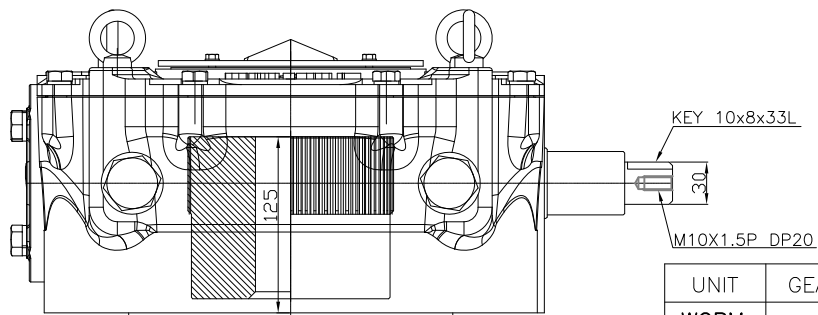
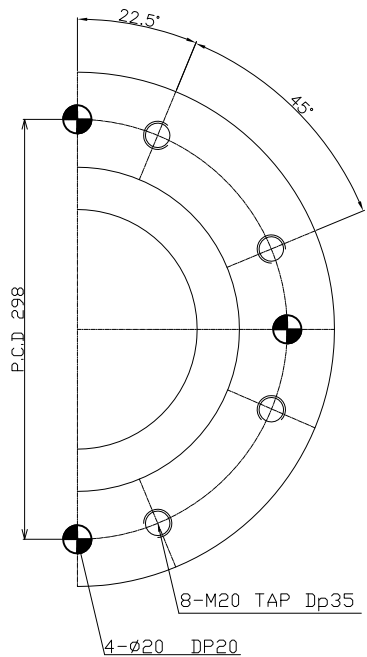
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SIDE FIT
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CCR	4-19-96	5114 WOODALL ROAD, LYNCHBURG, VIRGINIA 24506-1318		
CHECKED	DATE	TITLE		
DJM	12-6-96	MX-10 BASE DETAILS		
APPROVED	DATE	SIZE	DWG NO	REV
DJM	12-6-96	A	03-615-0005-1	E
[] = MILLIMETER VALUE UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		SCALE	ORDER NO	
		NONE	N/A	




REFERENCE



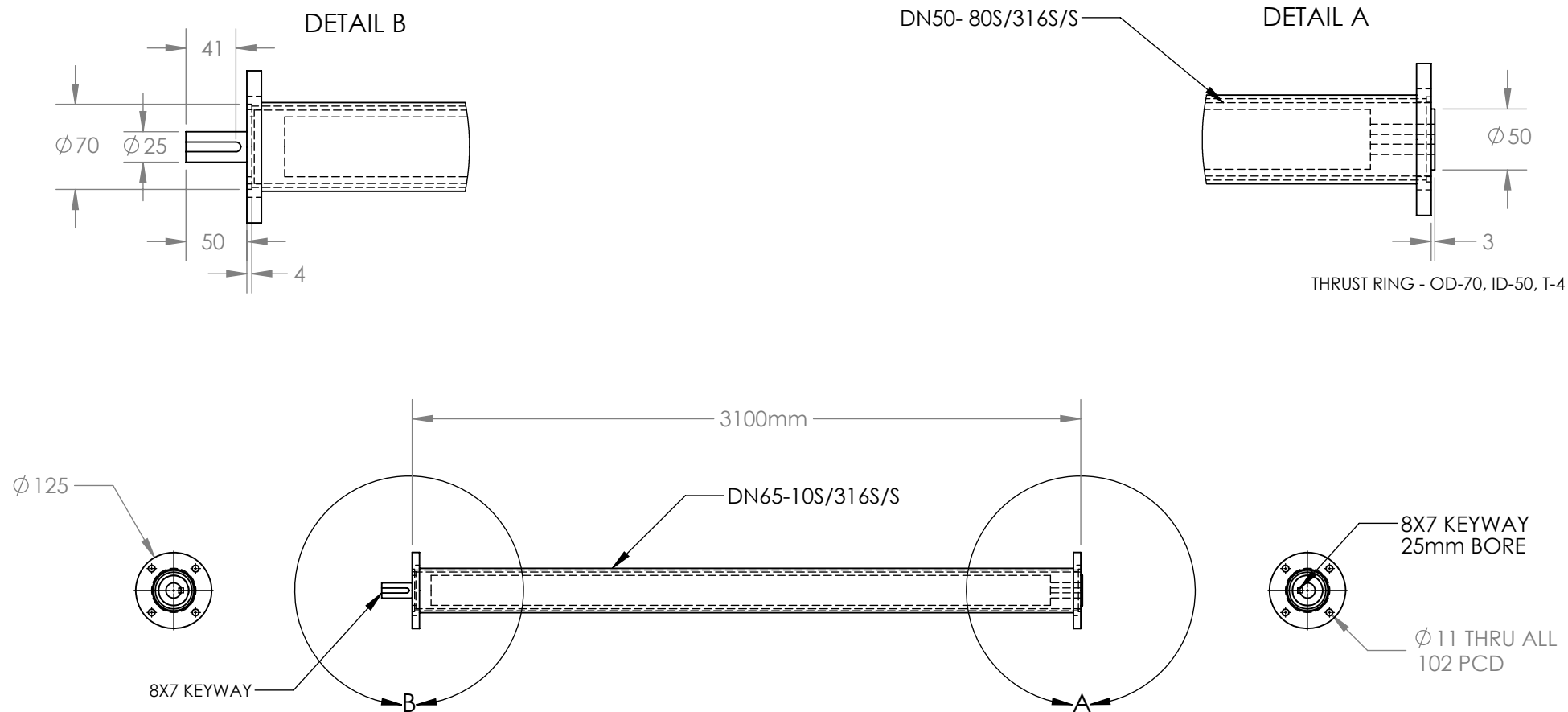
Bore Max Dia For Bushing : Ø115, 32x18

Mounting Flange For Valve	ISO F-30 RF
Mounting Flange For Valve	ISO F-25 FF

UNIT	GEAR RATIO	MAX. TORQUE	MAX.DIA	WEIGHT	MA
WORM	60 : 1	13,777.3(Lbf-ft)	Ø115	93 Kg	21.0
SPUR	-	18,679.5(Nm)	32x18		
SPUR	-	INPUT TORQUE	GREASE	PAINT	DIRECTION
TOTAL	60 : 1	889.5(Nm)	High CP2 Normal EP2	color N/A material Epoxy primer	RC

RevE	W5	GENERAL ASS'Y			
		WORM GEAR BOX			
DRA.			CHK.		
DATE	2013.11.07		APP.		
DWG/N	1234-1234-1234-1234				
 TMG KOREA CORP.					

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ACRODYNE PTY LTD
FACTORY 14,
11 HAVELOCK RD.
BAYSWATER, VICTORIA
TEL: (03) 8727 7800
FAX: (03) 9729 8699

DESIGNED	SC	17/02/2015
DRAWN	SM	17/02/2015
CHECKED	SC	17/02/2015
APPROVED	SC	17/02/2015
REVISION		

TITLE:
F10-F10-3100-EXT

MATERIAL: 316L S/S

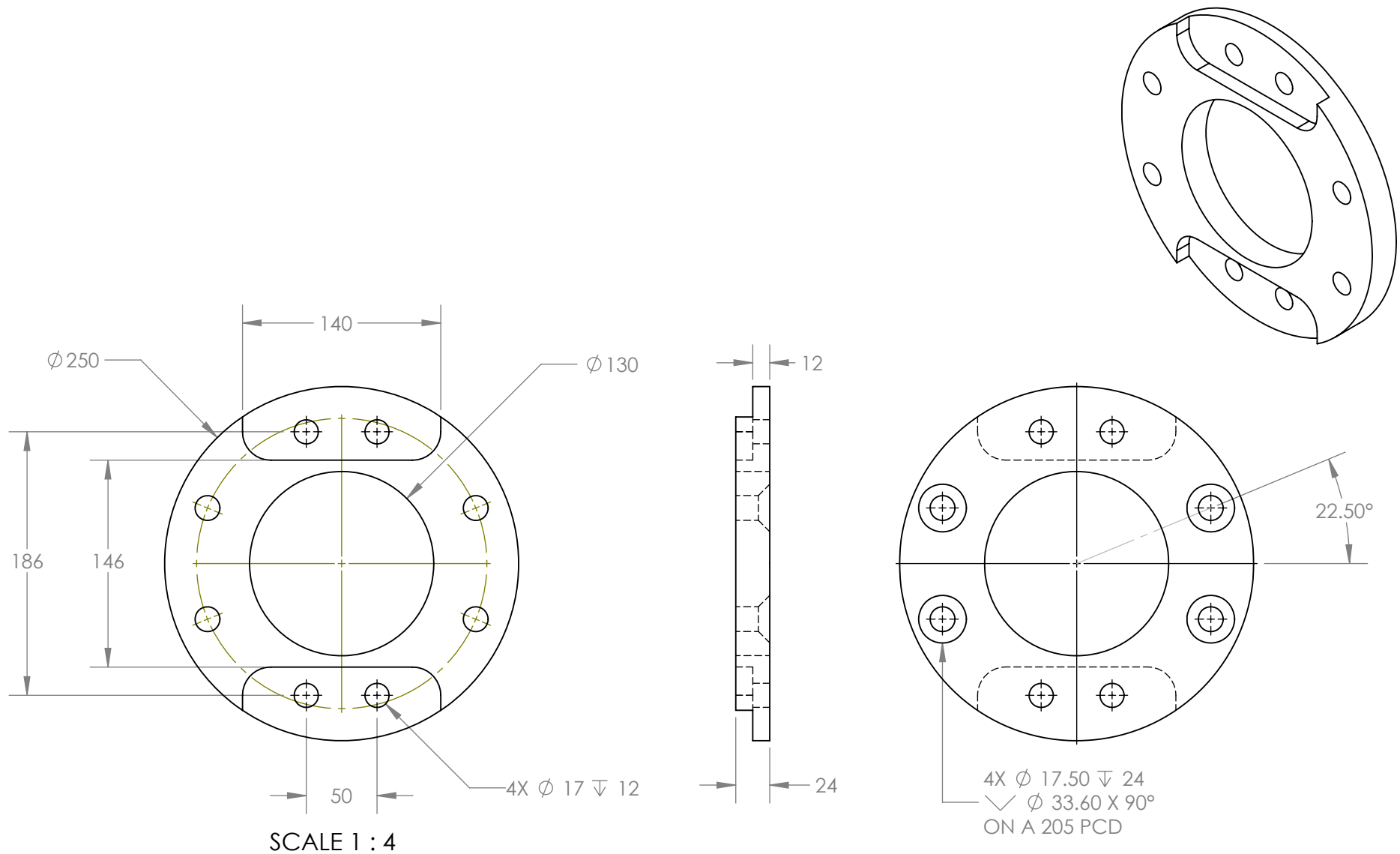
WEIGHT:

SCALE:
NOT TO SCALE

A4

DWG. NO:
2112468

SHEET 1



ACRODYNE PTY LTD
FACTORY 14,
11 HAVELOCK RD.
BAYSWATER, VICTORIA
TEL: (03) 8727 7800
FAX: (03) 9729 8699

DESIGNED	SC	18/02/2015
DRAWN	SC	18/02/2015
CHECKED	SC	18/02/2015
APPROVED	SC	18/02/2015
REVISION	A	

TITLE:
PL-250-F20-50-186-24

MATERIAL: 304 S/S

WEIGHT:

SCALE:
NOT TO SCALE

A4

DWG. NO:
2112468-2

SHEET 1