



# **Duff-Norton®**

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## **Mechanical Actuators**

### ***Translating Machine Screw Actuators***

***100-Ton, 150-Ton & 250-Ton Capacity***

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***Installation, Operation &  
Maintenance Instructions***

***Publication Part No. SK-2389-100***

#### **CAUTION**

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

#### **WARNING**

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

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# Section I General Information

## 1-1. General

This manual contains maintenance instructions for Duff Norton® 100-ton, 150-ton, and 250-ton translating machine screw actuators. It describes and details procedures for installation, disassembly, cleaning, inspection, rebuilding and assembly of these actuators.

## 1-2. Applications

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

These actuators are intended for a clean, non-corrosive environment with ambient temperatures ranging from -20 to 200 ° F. If your environment is dirty and/or contains abrasive particles it is important to protect the screw with a boot. If your atmosphere is corrosive it is important to specify a non-corrosive material or finish. Duff-Norton can provide stainless steel, nickel plated or epoxy coated actuators. If your duty is high or your use severe, more frequent lubrication should be employed. Duff-Norton publishes a Mechanical Actuator Design Guide, Catalog No. 2003, which you may find helpful in the selection and application of mechanical actuators. If you need additional help, please contact Duff-Norton at (800) 477-5002.

## 1-3. Specifications

**Table 1-1. 100 Ton, 150 Ton and 250 Ton Translating Machine Screw Actuators**

Actuator Number		Rated Load (tons)	Diameter of Lifting Screw (in)	Closed Height ** (in)	Base Size (in)	Worm Gear Ratios		Turns of Worm For 1" Raise		Maximum HP Per Actuator		Torque at Full Load* (in-lbs)		Actuator Efficiency Rating (%)		Weight with Base Raise of 6" (lb)	Weight For Each Additional 1" Raise (lb)
Upright	Inverted					Std. Ratio	Optional	Std. Ratio	Optional	Std. Ratio	Optional	Std. Ratio	Optional	Std. Ratio	Optional		
9099	9098	100	6 .750 Pitch Square	24	20.75 X 24.5	12:1	36:1	16	48	25	11	16,000	8,600	13.0	8	1,200	9
18150	18149	150	7 1.000 Pitch Square	24	20.75 X 24.5	12:1	36:1	12	36	25	11	28,100	15,500	14.1	8.6	1,350	12.6
2250	2249	250	9 1.000 Pitch Square	30	29.5 X 41	50:1	—	50	—	35	—	20,000	—	8.0	—	2,700	23

\* For loads of from 25% to 100% of Actuator load rating. Torque requirements are approximately proportional to the load.

\*\* Closed heights are for standard upright top plate models and may vary with different screw ends, inverted models, or when bellows boot is used.

**Table 1-2. Anti-Backlash Actuators**

Actuator Number	Rated Load (tons)	Torque at Full Load (in-lbs)		Actuator Efficiency Rating %		Closed Height (in)	Weight with Base Raise of 6" (lb)
		Std. Ratio	Optional	Std. Ratio	Optional		
9499	100	17600	9460	11.7	7.2	26.5	1325
48150	150	30900	17050	12.7	7.7	26.25	1475
2250	250	22000	—	7.2	—	36.6	2975

Note: Additional specifications are same as in Table 1.

## 1-4 Important Precautions

Actuator life is dependent on many factors such as loading, alignment, speed, lubrication, cleanliness of lubrication, side loading and heat. In order to ensure that maximum actuator operational life is achieved the following precautions should be taken:

1. The maximum load to which the actuator may be exposed does not exceed the actuator load rating.

2. The structure on which the actuator is mounted has ample strength to carry the maximum load and is rigid enough to prevent undue deflection or distortion of the actuator supporting members.
3. It is essential that the actuator be aligned during installation such that the lifting screw is vertically plumb and the connecting shafts are in line with the

actuator worm shaft. The actuator lifting screw must pass freely through the housing without signs of rubbing or binding.

4. The actuator should have a greater raise than is needed in the application. Should it be necessary to operate the actuator at the extreme limits of travel, it should be done cautiously.

**⚠ CAUTION**

Travel beyond design closed height may result in serious damage to the actuator's internal mechanism.

5. Dust, dirt and other debris should not be allowed to accumulate on or around the actuator or its drive components as this will result in higher operating temperatures and possible damage to the actuator. Cleaning should be done as necessary.
6. The actuator lifting screw should be kept free from dust, grit and other debris.

**⚠ CAUTION**

Where the actuator lifting screw is exposed to airborne dirt, dust, etc., a bellows boot should be used.

7. The actuator should be lubricated per Section II, paragraph 2-1. The actuator lifting screw must be kept lubricated. Frequent inspections for proper lifting screw lubrication are recommended.

**⚠ CAUTION**

The actuator lifting screw should never be run dry.

8. The actuator should not be operated at a duty cycle which causes heat build-up beyond 200° Fahrenheit. It is recommended that the actuator temperature be monitored using a temperature probe located in the actuator grease in the vicinity of the worm.

**⚠ CAUTION**

It is especially important that the actuator temperature be monitored during the initial wear-in period as an abnormally high wear rate, due to high spots on the threads, causes a higher temperature. Depending on loading, this wear-in period could require several thousand inches of actuator travel.

9. Control limit switches should be checked monthly or more frequently for proper operating performance and to ensure that debris does not build up around them which might prevent proper performance.
10. All mounting bolts for the actuator and drive components should be tightened to proper assembly torque values monthly.

11. The bronze actuator worm gear is intended to be a replaceable wear member. The internal thread wears from working against the hardened steel lifting screw and the gear teeth wear from working against the hardened steel worm. External measurements for wear should be made on a periodic basis and charted. The required frequency of measurements will vary with the application. It is recommended that, initially, wear measurements be performed on a monthly basis until a consistent wear rate pattern has developed. The wear measurements should be made per Section II, paragraph 2-2.

### 1-5. Warranty and Warranty Repair

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

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

If you have any questions concerning warranty repair, please contact Duff-Norton Customer Service. Authorization for return must be received from Duff-Norton before returning any equipment for inspection or warranty repair.

## Section II Maintenance

### 2-1. Lubrication

Unless otherwise specified, actuators are shipped packed with grease which should be sufficient for one month of normal operation. For normal operation, the actuator should be lubricated once a month using Mobil XHP461 or XPH462 Extreme Pressure grease.

For severe service conditions, the actuators should be lubricated daily to weekly depending upon the conditions. If duty is heavy, an automatic lubrication system is strongly recommended.

If ambient temperatures exceed 200° F, consult lubricant manufacturers

#### NOTE

Finely ground bronze particles in the actuator grease is the result of normal wear of the bronze worm gear. However, chips or shavings are an indication of abnormal wear, the cause of which should be immediately investigated. This could be caused by lack of lubrication, misalignment, jamming, contamination or overheating.

#### 2-1a. Lubrication Procedure

Remove the level plug or relief fitting from the housing. Pump grease into both grease fittings until it flows out the level plug or relief fitting hole. Install the level plug of relief fitting. With the lifting screw extended, clean off any contaminated grease. Apply new grease with a brush to coat the power threads.

**Table 2-1. Maximum Free Vertical Movement Of Actuator Lifting Screw**

Actuator Model	Free Movement (in)
100-ton	.18
150-ton	.23
250-ton	.23

**Table 2-2. Maximum Free Rotational Movement Of Actuator Worm Shaft**

Actuator Model/Ratio	Free Movement (deg)
100-ton 12:1 Ratio	20
36:1 Ratio	45
150-ton 12:1 Ratio	20
36:1 Ratio	45
250-ton 50:1 Ratio	45

### 2-2 External Actuator Wear Measurements

Wear between the actuator lifting screw and the internal

thread of the worm gear and wear between the actuator worm and worm gear teeth can be measured externally. It is suggested that both of the measurement procedures be done three times with results averaged for better accuracy.

A. Measurement of wear between actuator lifting screw and worm gear internal thread may be performed as follows:

1. Remove the load from the actuator.
2. Apply a jack or hoist to move the actuator lifting screw vertically. Do not allow any screw rotation. If screw cannot be restrained from rotation use a dial indicator to detect the onset of any rotation.
3. Mount a dial indicator so that it indicates the vertical travel of the actuator lifting screw. It is recommended measurements be made using a magnetic base indicator applied to the actuator housing so that actuator mounting structure deflection will not be measured.
4. Actuate the jack or hoist to move the actuator lifting screw vertically and record the indicator reading between the limits of free movement. Be careful to ensure only vertical movement as any side movement or rotation will cause a false reading.
5. If the free vertical movement of the actuator lifting screw exceeds the values shown in Table 2-1 the actuator must be removed from the mounting structure, disassembled, inspected and rebuilt using a new worm gear.

#### NOTE

This procedure does not apply for anti-backlash actuators. These actuators are designed to be adjusted for minimum backlash. A clearance gap between surfaces on the worm gear and the backlash nut is reduced as adjustments are made. When the clearance gap is used up the actuator must be removed from the mounting structure, disassembled, inspected and rebuilt using a new worm gear and nut assembly.

B. Measurement of wear between actuator worm and worm gear teeth may be performed as follows:

1. Disconnect drive shafts from the actuator worm shaft.

2. Check actuator worm shaft for free axial play. If axial play is detected remove shims from between actuator worm flange and housing until the end play is eliminated.
3. Restrain actuator lifting screw to prevent rotation.
4. Rotate the actuator worm shaft clockwise by hand until a hard stop is felt. Match mark the actuator worm and worm flange.
5. Rotate actuator worm shaft counter clockwise until a hard stop is felt. Mark the actuator worm flange to match the mark on the worm made in step 4.
6. Estimate or measure the free rotational movement of the actuator worm shaft as indicated by the marks on the worm flange.
7. If the free rotational movement of the actuator worm shaft exceeds the values shown in Table 2-2 the actuator must be removed from the mounting structure, disassembled, inspected and rebuilt using a new worm gear.

### 2-3. Rebuild Procedure

Duff-Norton recommends the following procedures for assembly and disassembly of actuators.

1. Tag critical parts to facilitate reassembly.
2. Mark mating surfaces to ensure proper meshing.
3. Clean and lubricate all parts as required.
4. All seals must be replaced when rebuilding.
5. All screws, washers and other small common parts must be replaced if damaged in any way.
6. Replace damaged or frozen lubrication fittings with new ones.

### 2-4 Required Tools

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

### 2-5. Disassembly (Refer to Figure 3-1)

1. Remove lifting screw(5) from shell(3).
2. Remove bottom pipe (4) from shell (3) or base plate as applicable.
3. Loosen the lock screw(18) in the shell(3) and unscrew (counterclockwise) the base plate(2) from the shell.

#### NOTE

It may be necessary to break base plate loose with a hammer.

4. Remove gear (6A) or worm gear and nut assembly (6B) from shell (3).

#### NOTE

To facilitate removal of the gear from the shell, partially reassemble the lifting screw into the worm gear (or worm gear and nut assembly) and use a hoist or pulley block to lift on the screw.)

5. Remove top load bearing (8) which may be attached to either shell cap (2) or worm gear (6A) or anti-backlash nut.

#### NOTE

Use only a soft face hammer to tap bearings loose.

6. Remove bottom load bearing (7) which may be attached to either base plate or worm gear (6A).
7. Remove six cap screws (9) from each of the two worm flanges (11) and remove flanges.

#### NOTE

Be careful not to lose flange shims (12).

8. Press oil seal (13) out of flange (11).
9. Remove worm (14) and worm bearings (15) from shell (3) by striking one end of worm with a soft face hammer.
10. Remove worm bearings (15) from worm (14) with bearing puller or press. (Note: This step will not be necessary if worm or worm bearings are not damaged.
11. If actuator is keyed, remove screw from shell and tap key out of keyway.

### 2-6. Cleaning

1. Use degreasing solvent to remove grease or oil from all parts.

#### NOTE

Remove grease from unit and do not reuse old grease.

#### WARNING

Provide adequate ventilation during the use of cleaning agents. Avoid prolonged breathing of fumes and contact with skin. Read and follow manufacturer's instructions.

2. Use clean hot water or a soap solution for general cleaning of painted surfaces.

3. Dry parts thoroughly after cleaning.

**NOTE**

Before installing new parts, remove any rust preventive, protection grease, etc.

### 2-7 Inspection (Refer to Figure 3-1)

Inspect actuator parts as follows:

1. Shell (3) must be replaced if it is broken, cracked or distorted or has stripped threads. Burrs and galling on threads and mating surfaces must be removed before reassembly.
2. Base plate (2) must be replaced if it is broken, cracked or distorted or has stripped threads. Burrs and galling on threads and mating surfaces must be removed before reassembly.
3. Lifting screw (5) must be replaced if any of the following conditions exist .
  - a. Part is broken, cracked or bent.
  - b. The thread is broken, cracked or deformed. It is permissible to machine or file off extruded ridge on thread outside diameter at the thread corners.
  - c. The thread has excessive wear. Rounded corners indicate this condition.
  - d. The thread working surfaces are rough from abrasive wear, rusting or gouging by floating debris.
  - e. The thread working surfaces have embedded debris.
4. Worm gear (6A) or worm gear and nut assembly (6B) must be replaced if any of the following conditions exist.
  - a. The internal thread is worn such that the ID land width (thread thickness) is less than the minimum thread thickness per Table 2-4.
  - b. The gear teeth are worn such that the OD land width (tooth thickness) at the center is less than the minimum gear tooth thickness per Table 2-4.
  - c. The internal thread or any gear teeth are broken. It is permissible to grind or machine away up to 1/2 turn of broken internal thread at the gear ends.
  - d. The internal thread or any gear teeth are bent.
  - e. The internal thread or gear teeth working surfaces are rough from abrasive wear or gouging by floating debris.

- f. The working surfaces of the internal thread or gear teeth have embedded debris.

5. Load bearings (7 & 8) and worm bearings (15) must be replaced if broken, seized, galled or have excessive play. Generally it is a good practice to replace all bearings at each rebuild.
6. Hardware items and other miscellaneous parts should be replaced if necessary.

**Table 2-3. Minimum Gear Internal Thread Thickness At ID Land**

Actuator Model	Minimum Thread Thickness (in)
100-ton	.18
150-ton	.23
250-ton	.23

**Table 2-4. Minimum Gear Tooth Thickness At OD Land At Center**

Actuator Model	Minimum Gear Thickness (in)
100-ton	.14
150-ton	.14
250-ton	.18

### 2-8. Assembly (Refer to Figure 3-1)

1. Press worm bearings (15) onto worm shaft (14), making sure that bearings are seated properly against shoulder.

**NOTE**

When tapered roller bearings are used, the small end of the cone should point to the worm end.

2. Position worm shaft end (14) in shell (3).

**NOTE**

When tapered roller bearings are used, tap worm bearing cups into place in the shell.

3. Press oil seals (13) into worm flange (11).

**NOTE**

The sealing element should point inward.

4. Position worm flanges (11) with shims (12) and affix in place using screws (9) and lock washers (10).
5. Position top load bearing (8) (bearing cup on 100 and 150-ton models) in shell (3).
- 5a. On 100-ton and 150-ton, press load bearing cones onto worm gear (6A) or worm gear nut assembly (6B). Small end of bearing cone should face away from gear teeth.
6. Install worm gear (6A) or worm gear and nut assembly (6B) in shell (3).

### NOTE

Strike each end of worm shaft sharply with a soft face hammer to seat bearing properly. Recheck flange bolts for tightness. Worm should turn freely with minimum drag and end play. If end play is present, remove shims as required. If worm does not turn freely, add shims as required.

7. Install bottom load bearing (7) (load bearing cup on 100 and 150-ton models) on worm gear (6A) or worm gear and nut assembly (6B).
8. Fill housing fully with grease.
9. Install base plate and screw down base plate until tight.

### NOTE

This should put a slight drag on the worm. If the worm is hard to turn, back off slightly on the base plate. Be sure base plate does not project past base surface of housing.

10. Lock base plate (2) in place with lock screw(18).

### NOTE

If new parts have been installed, it may be necessary to respot hole for screw.

11. Screw bottom pipe into base plate (upright models) or into shell (inverted models).
12. Brush lifting screw (5) with a light film of grease and install in actuator. On inverted models, install guide bushing (16) and then install lifting screw (5).
13. If actuator is keyed, install key in shell and bolt in place.
14. Remove grease level plug and add additional grease until grease flows out the level plug hole.
15. Operate unit to ensure proper functioning of all components prior to reinstallation.

## 2-9. Anti-Backlash Nut Function

As shown in Figure 2-1, the worm gear (2) and anti-backlash nut (3) are pinned together with guide pins. The threads in the anti-backlash nut work in opposition to the threads in the worm gear as they engage the threads of the lifting screw (1). Adjustment of backlash is made by running down on the shell cap of the actuator. This forces the anti-backlash nut threads into closer contact, reducing clearance and thus reducing backlash.

## 2-10. Anti-Backlash Nut Adjustment

1. To minimize backlash remove the two set screws (4) and tighten down on shell cap until the desired

backlash is obtained. Spot drill top of shell through set screw holes, then replace set screws and tighten to prevent shell cap backing off.

2. To avoid binding and excessive wear, do not adjust lifting screw backlash to less than 0.0005 inch.
3. The clearance (A) designed into the worm gear and anti-backlash nut set is one-half the thread thickness. When adjustments have been made to use all this clearance replace the worm gear and anti-backlash nut as a set.

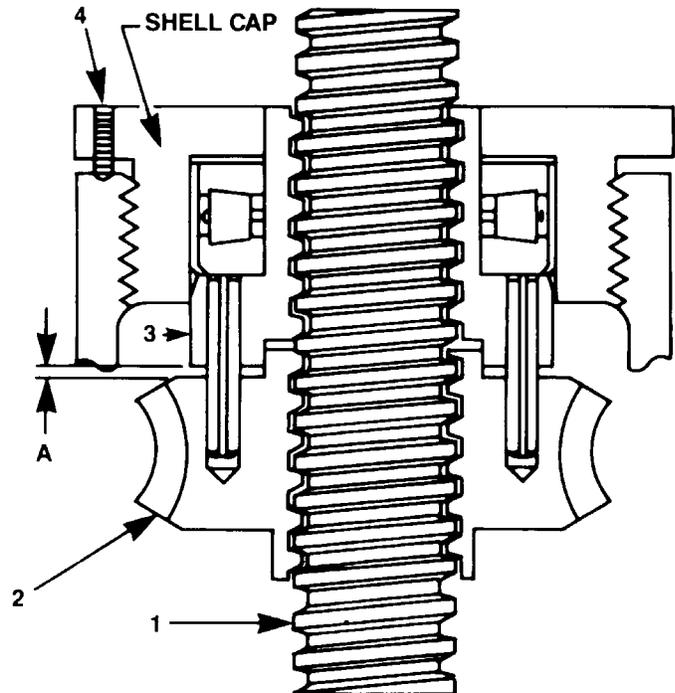


Figure 2-1. Anti-Backlash Nut Adjustment

## Section III Illustrated Parts List

### 3-1. General

This section contains an exploded illustration of the 100-ton, 150-ton, and 250-ton translating machine screw actuators. The number adjacent to each part on the illustration is the index number. Keyed to this index number on the parts list is the part name.

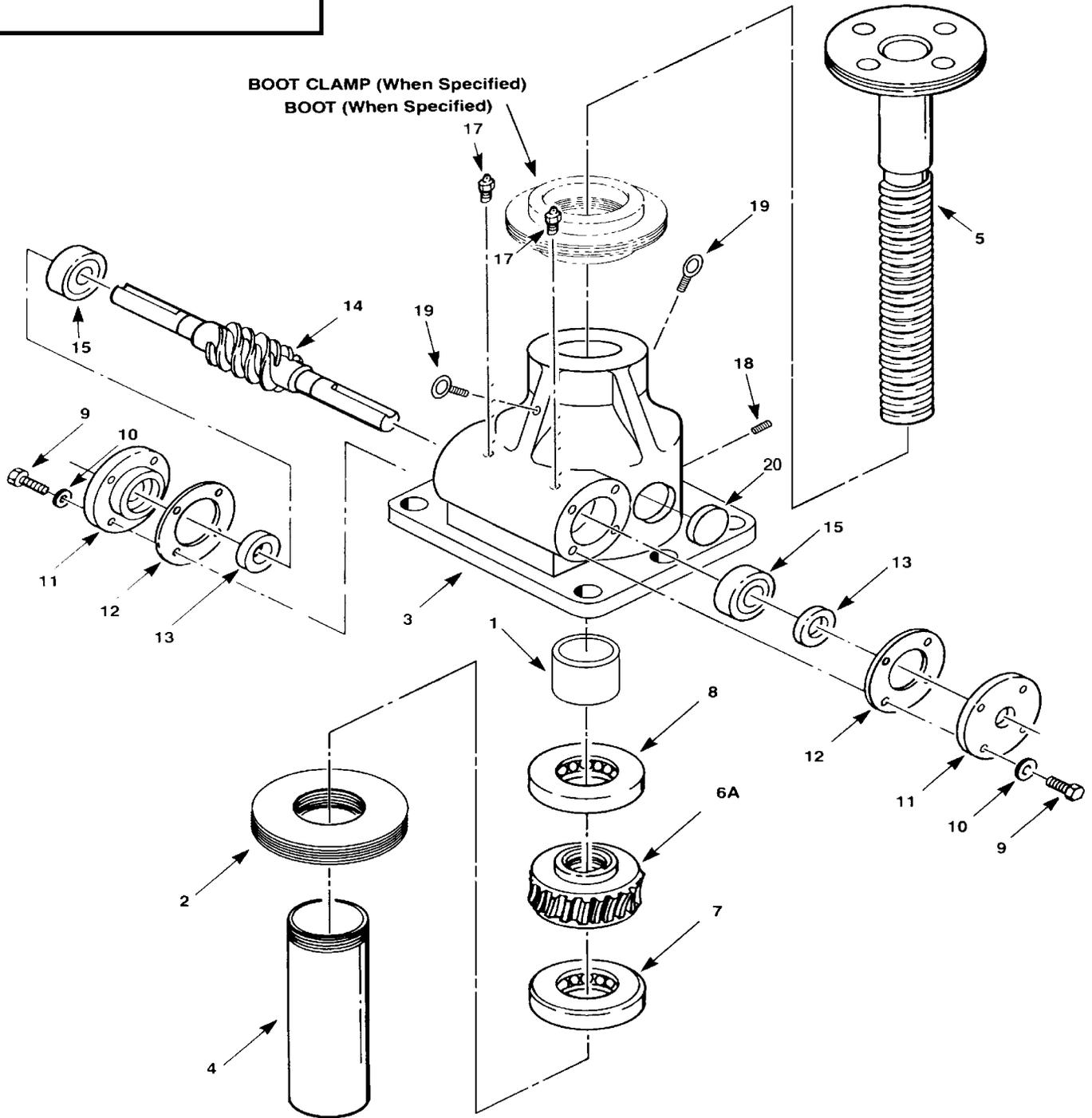
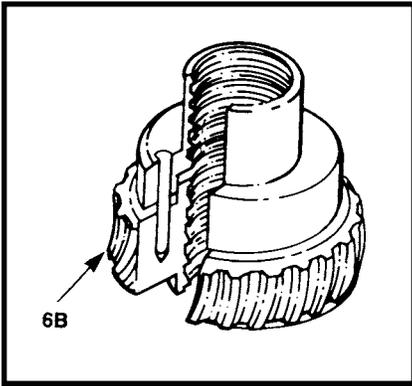
When ordering parts be sure to include:

1. The nameplate model of your unit.
2. Index number and name of part.

**Table 3-1. Parts List For 100-ton, 150-ton,  
and 250-ton Translating Machine Screw  
Actuators.**

Index No.	Part Name	Qty. Req.
1	Bushing	1
2	Base Plate	1
3	Shell, Actuator	1
4	Pipe, Bottom	1
5	Screw, Lifting	1
6A	Worm Gear	1
6B	Worm Gear and Anti-backlash Nut Assembly (Mfg'd and sold in sets only)	1
7	Bearing, Bottom Load	1
8	Bearing, Top Load	1
9	Screw, Cap	12
10	Washer, Lock	12
11	Flange, Worm	2
12	Shim, Flange	2
13	Seal, Oil	2
14	Worm	1
15	Bearing, Worm	2
17	Grease Fitting	2
18	Lock Screw	1
19	Eye Bolt (250 Ton Only)	2
20	Grease Level Plug	1
^	Shell Cap (Anti-Backlash Models)	1
^	Set Screw (Anti-Backlash Models)	2
^	Guide Bushing (Inverted Models)	1
^	Name Plate	1

\* Items Not Shown



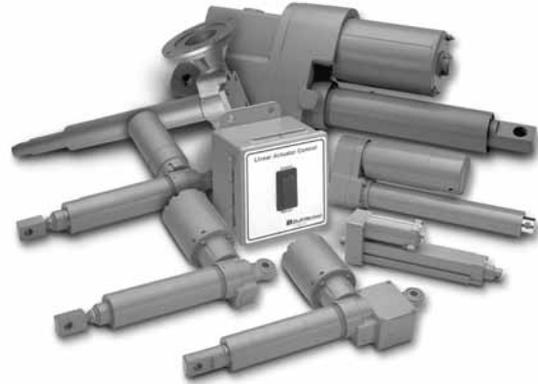
**Figure 3-1. Exploded Illustration 100-Ton, 150-Ton and 250-Ton  
Translating Machine Screw Actuators**



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