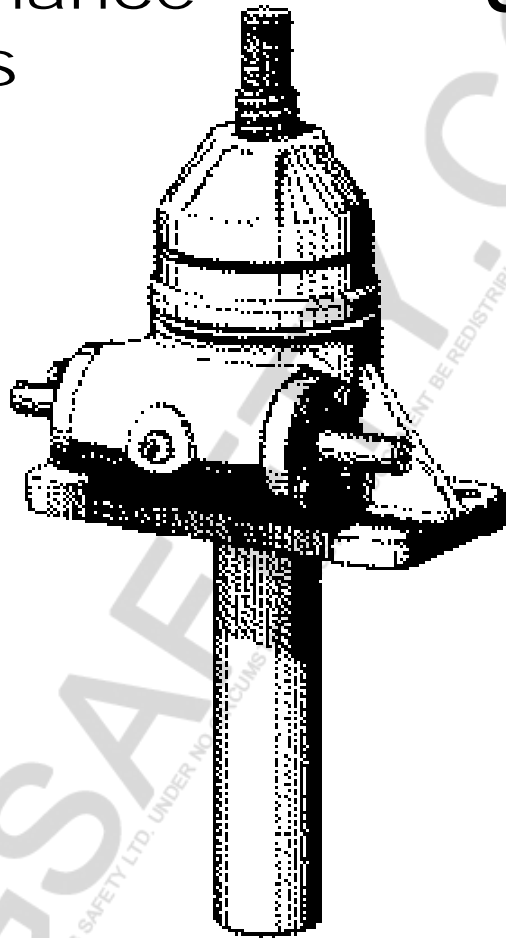




Installation, Operating and Maintenance Instructions

Translating Ball Screw Actuators



1/2 ton
through
50 Ton

Publication Part No. SK-2373



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.

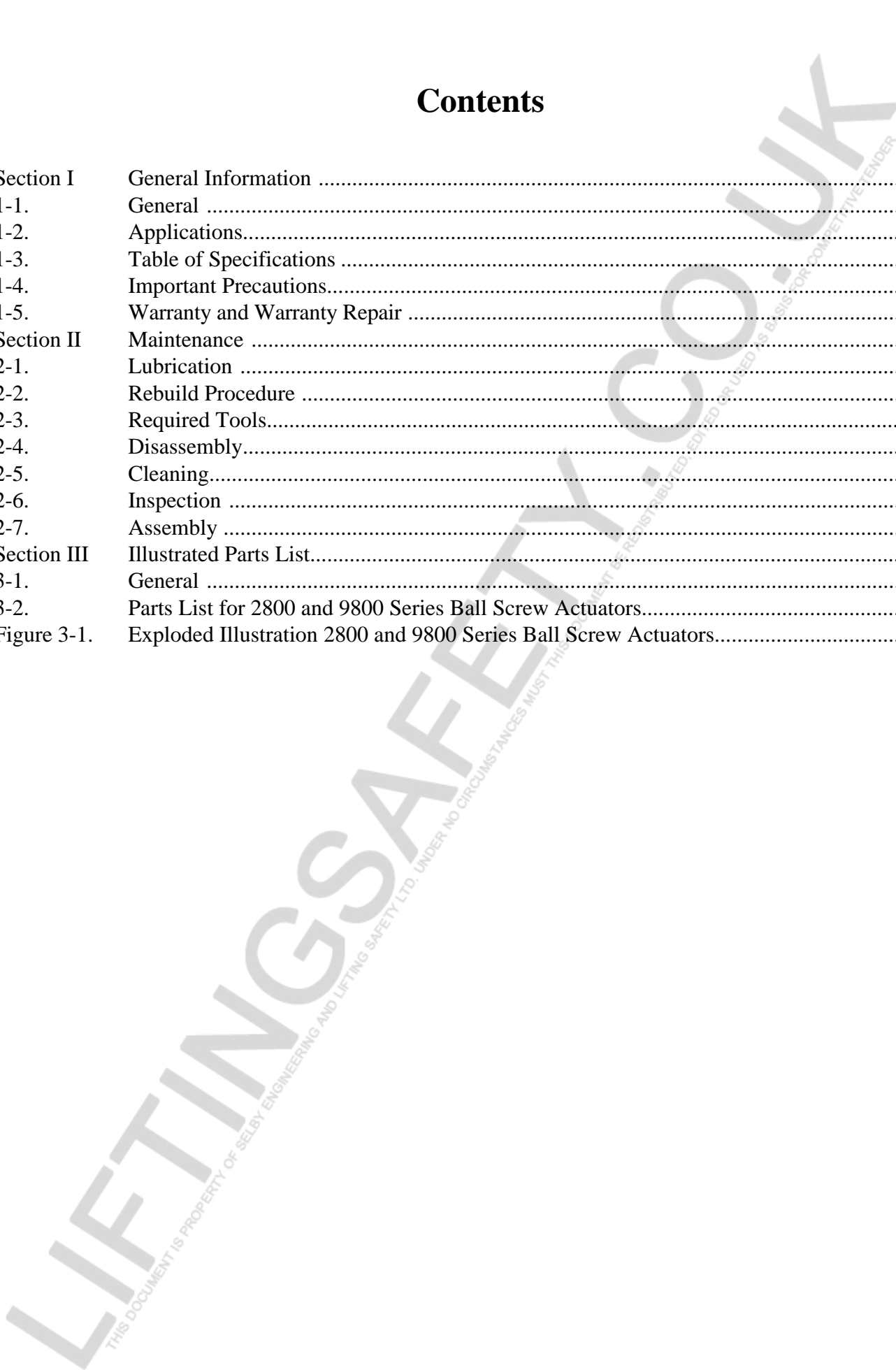


The equipment shown in this manual is intended for industrial use only and should not be used to lift, support, or otherwise transport people.



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Section I General Information

1-1. General

This manual contains maintenance instructions for Duff-Norton translating ball screw actuators. It describes and details procedures for installation, disassembly, cleaning, inspection, 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.

1-3. Table of Specifications

| Standard Actuator Model Numbers | Upright | 28631 | 2802/9802 | 28021/98021* | 28003/98003 | 9805 | 98051† | 9810 | 98101‡ | 9820 | 9825 | 2860 |
|--|-----------|-----------|-----------|--------------|--------------|-----------|------------|---------------|---------------|-------------|-----------------|----------------|
| Special Actuator Model Numbers | Inverted | 28630 | 2801/9801 | 28011/98011 | 28002/98002 | 9804 | 98041 | 9809 | 98091 | 9819 | 9824 | 2859 |
| Special Actuator Model Numbers | Upright | 38631 | 3802/9802 | 3802/9802 | 38003/108003 | 10805 | 0805 | 10810 | 10810 | 10820 | 10825 | 3860 |
| Special Actuator Model Numbers | Inverted | 38630 | 3801/9801 | 3801/9801 | 38002/108002 | 10804 | 10804 | 10809 | 10809 | 10819 | 10824 | 3859 |
| Rated Load (tons) | | 1/2 | 2 | 2 | 3 | 5 | 5 | 10 | 10 | 20 | 25 | 50 |
| Diameter of Lifting Screw (inches) | | 5/8 | 1 | 1 | 1 11/64 | 1 1/2 | 1 1/2 | 1 1/2 | 1 1/2 | 2 1/4 | 3 | 4 |
| Closed Height (inches) | | .200 Lead | .250 Lead | 1.000 Lead | .413 Lead | .474 Lead | 1.000 Lead | .474 Lead | 1.000 Lead | .500 Lead | .660 Lead | 1.000 Lead |
| Base Size (inches) | | 5 | 7 1/2 | 7 1/2 | 9 1/4 | 10 3/4 | 10 3/4 | 10 3/8 | 10 3/8 | 16 1/2 | 19 3/4 | 25 3/8 |
| Worm Gear Ratios | | 2 1/4 x 4 | 3 1/2 x 7 | 3 1/2 x 7 | 3 1/2 x 7 | 6 x 8 | 6 x 8 | 7 1/2 x 8 3/4 | 7 1/2 x 8 3/4 | 48 1/4 x 11 | 10 1/4 x 13 3/4 | 9 3/4 x 19 3/4 |
| Turns of Worm For 1" Raise | Std Ratio | 5:1 | 6:1 | 6:1 | 6:1 | 6:1 | 6:1 | 8:1 | 8:1 | 8:1 | 10 2/3:1 | 10 2/3:1 |
| | Optional | 20:1 | 12:1 | 24:1 | 12:1 | 24:1 | 24:1 | 24:1 | 24:1 | 24:1 | 32:1 | 32:1 |
| Maximum H.P. Per Actuator | Std Ratio | 25 | 24 | 6 | 14.526 | 12.667 | 6 | 16.888 | 8 | 16 | 16.16 | 10.66 |
| | Optional | 100 | 48 | 24 | 29.052 | 50.667 | 24 | 50.667 | 24 | 48 | 48.48 | 32 |
| Starting Torque at Full Load (lb-ins) | Std Ratio | — | 96 | — | 58.104 | — | — | — | — | — | — | — |
| | Optional | — | 24:1 | — | 24:1 | — | — | — | — | — | — | — |
| Running Torque at Full Load (lb-ins) | Std Ratio | 1/3 | 2 | 2 | 2 | 4 | 4 | 5 | 5 | 5 | 8 | 15 |
| | Optional | 1/6 | 3/4 | 1/2 | 3/4 | 3/4 | 3/4 | 1 1/2 | 1 1/2 | 1 1/2 | 2 1/2 | 6 |
| Actuator Efficiency Rating (%) | Std Ratio | — | 1/2 | — | 1/2 | — | — | — | — | — | — | — |
| | Optional | 10.5 | 50 | 180 | 110 | 220 | 500 | 350 | 800 | 700 | 925 | 2,700 |
| Weight with Base Raise of 6" (lbs) | Std Ratio | 5.0 | 30 | 80 | 68 | 90 | 206 | 175 | 400 | 325 | 475 | 1,500 |
| | Optional | — | 25 | — | 50 | — | — | — | — | — | — | — |
| Weight for Each Additional 1" of Raise (lbs) | Std Ratio | 9.5 | 45 | 160 | 100 | 180 | 410 | 300 | 700 | 650 | 825 | 2,200 |
| | Optional | 4.5 | 25 | 70 | 60 | 80 | 183 | 150 | 290 | 300 | 425 | 1,200 |
| Hold-Back Torque at Rated Load (lb-ft) | Std Ratio | — | 20 | — | 45 | — | — | — | — | — | — | — |
| | Optional | 65 | 59 | 59 | 59 | 70 | 70 | 65 | 65 | 61 | 60 | 55 |
| Weight for Each Additional 1" of Raise (lbs) | Std Ratio | 38 | 44 | 33 | 44 | 39 | 39 | 42 | 42 | 44 | 39 | 33 |
| | Optional | — | 33 | — | 33 | — | — | — | — | — | — | — |
| Hold-Back Torque at Rated Load (lb-ft) | Std Ratio | 2.75 | 20 | 20 | 21 | 40 | 40 | 50 | 50 | 115 | 235 | 520 |
| | Optional | 0.1 | 0.3 | 0.3 | 0.4 | 0.9 | 0.9 | 0.9 | 0.9 | 1.5 | 2.9 | 5.0 |
| Hold-Back Torque at Rated Load (lb-ft) | Std Ratio | 1 | 2 | 2 | 7 | 8 | 8 | 11 | 11 | 24 | 24 | 92 |
| | Optional | 0.5 | 1 | 0.5 | 2 | 0.5 | 0.5 | 0.5 | 0.5 | 2 | 2 | 33 |
| Hold-Back Torque at Rated Load (lb-ft) | Std Ratio | — | 0.5 | — | 0.5 | — | — | — | — | — | — | — |
| | Optional | — | — | — | — | — | — | — | — | — | — | — |

Note: Hold back torque is restraining torque at the worm shaft, to keep load from running down.

*Dimensionally same as Model 2802/9802

† Dimensionally same as Model 9805

‡ Dimensionally same as Model 9810

1-4. Important Precautions

To ensure that actuators provide good service over a period of years, the following precautions should be taken:

1. Select an actuator that has a rated capacity greater than the maximum load that may be imposed on it.
2. The structure on which the actuators are mounted should have ample strength to carry the maximum load, and should be rigid enough to prevent undue deflection or distortion of the

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.

3. It is essential that the actuators be carefully aligned during installation so that the lifting screws are perfectly plumb and the connecting shafts are exactly in line with the worm shafts. After the actuators, shafting, gear boxes, etc., are coupled together, it should be possible to turn the main drive shaft by hand. If there are no signs of binding or misalignment, the actuator system is then ready for normal operation.

- The ball screw actuators should have a greater raise than is needed in the actual installation. Should it be necessary to operate the actuators to the extreme limits of travel, it should be done cautiously.



Caution

Do not allow actuator travel to go beyond catalog closed height of actuator or serious damage to internal actuator mechanism may result. Refer to table of specifications (par. 1.3) for closed height of respective units.

- The worm shaft speed for these actuators should not exceed 900 RPM for heavy loads, or 1800 RPM for light loads of one-fourth (or less) of the actuator capacity.
- The lifting screw should not be permitted to accumulate dust and grit on the threads. If possible, lifting screws should be returned to closed position when not in use.
- The ball screw should be checked periodically for excessive backlash and spalling of race ways.
- The lubrication procedures for normal and severe service conditions, as described in Section II, paragraph 2-1, should be closely followed.
- Due to high efficiency of Ball Screw actuators, a brake must be used in conjunction with motor selected to position actuator (refer to current

catalog for brake selection data).

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 heat, 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 Customer Service for the name and address of your nearest Duff-Norton warranty repair facility.

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 Extreme Pressure grease Shell Oil Co. Shell Albida LC EP #2, (Shell Product Code 70311).

This grease has been thoroughly evaluated in Duff-Norton actuators and has demonstrated superior lubricating properties affecting both wear life and maximum duty cycle. **Duff-Norton is not aware of an equivalent grease.** If this grease is not available in your area please contact your local supplier for their recommendations. Greases containing molybdenum disulfide should never be used.

For severe service conditions, the actuators should be lubricated more frequently (daily to weekly depending on conditions). If duty is heavy,

an automatic lubrication system is strongly recommended.

Lubricate periodically the exposed ball screw grooves with a cloth dampened with a good grade 10W30 oil for most applications. An instrument grade oil should be used in dirty and heavy dust environments, while bearing grease is recommended for operating environments at extremely high temperatures. Extremes of temperature and other environmental conditions should be referred to Duff-Norton for recommended lubrication procedures.



Caution

Where the screw is not protected from airborne dirt, dust, etc., do not leave a heavy film of lubricant on the screw. Keep the ball screw barely damp with the lubricant. Inspect at regular intervals to be certain a lubricating film is present. Ball screws should never be run dry.

2-2. Rebuild Procedure

Duff-Norton recommends the following procedures for assembly and disassembly of 2800 and 9800 Series actuators.

1. Tag critical parts to facilitate reassembly.
2. Mark all 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.

2-3. Required Tools

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

2-4. Disassembly

Refer to Figure 3-1. When a numerical index number is referred to, the reference is to Figure 3-1.

Note

Disassembly should be accomplished on a clean cloth. This is particularly important when disassembling the ball nut assembly (7).

Disassemble as follows:

1. Remove any attachments that may be fastened to the end of the ball screw (6).
2. Loosen and remove set screws (1) in shell cap (2) and remove the shell cap from shell (3).

Note

It may be necessary to break shell cap (2) loose with a hammer.

3. Remove the top load bearing (4) from the shell cap (2).

Note

It is very important that the ball screw (6) not be allowed to run out of the ball nut assembly (7). At this point, it is advisable to wrap tape around the last few ball screw threads to prevent this from happening.

4. Remove the bottom pipe (5) from the shell (3).
5. Grasp the top end of the ball screw (6) remove it, with the ball nut assembly (7) and worm gear assembly from the shell (3).
6. Remove the bottom load bearing (8) which may be attached to either the shell (3) or worm gear (10).

Note

Use only a soft face hammer to tap bearings

loose.

7. If the ball nut assembly (7) or the worm gear (10) appears to be worn or damaged, disassemble these parts from each other. To do this, lightly clamp ball nut in a table clamp just tight enough to prevent it from turning.

Note

Care should be taken not to damage the ball guides.

8. Remove the set screws (9) from the worm gear (10).
9. Unscrew (counter-clockwise) the worm gear (10) from the ball nut assembly (7). It will usually be necessary to use a large wrench on the gear to break these two pieces apart. If it is desirable to save the worm gear, a strap wrench should be used.
10. When the worm gear (10) is free from the ball nut assembly (7), remove the retaining disc (13). Slide the worm gear off the ball screw (6) and replace the retaining disc on the screw.

Note

Care should be taken to prevent the screw from running out of the ball nut.

11. Unscrew the four cap screws (14) from each of the worm flanges (16) and remove the flanges. Take care not to lose the flange shims (17).
12. Press the oil seal (18) out of each worm flange (16).
13. With a soft face hammer, drive the worm (19) and worm bearing (20) out of the shell (3) by striking one end of the worm.
14. If the worm (19) or worm bearings (20) are worn or damaged, remove the worm bearings with a puller or press.

2-5. Cleaning

1. Use degreasing solvent to remove dirt, grease or oil from all parts. Be sure to flush the ball nut assembly (7) thoroughly while running the assembly along the screw shaft (6) several times.



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 water or soap solution of 1/4 pound of soap chips to one gallon of hot water for general cleaning of painted surfaces.
3. Dry parts thoroughly with moisture-free com-

pressed air.

Note

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

2-6. Inspection

1. Make a visual inspection of shell (3) for broken, cracked or distorted areas. Check threads of all bores for burrs or broken threads.
2. Check shell cap (2), bottom pipe (5), worm gear assembly and flanges (16) for burrs or scratches on their working or mating surfaces.
3. Check small common components (screws, etc.) and replace as required.
4. Check bearings (4), (8), and (20) for seizure, galling or play and replace as required.
5. Inspect the ball nut assembly (7) and ball screw (6) as follows:
 - A. Lubricate the ball nut assembly and ball screw. See paragraph 2-1.
 - B. Inspect the ball screw grooves for signs of excessive wear, pitting, gouges, corrosion, spalling or brinelling. It is usually less expensive to replace the ball screw when any of the above conditions exists. If you feel, however, that it can be reworked, return it to Duff-Norton for final evaluation.
 - C. If none of the above conditions exist, check backlash. Secure the ball screw in a table clamp or similar fixture. Make sure that the screw shaft cannot rotate. Push firmly on the ball nut assembly, first in one direction and then in the opposite direction. This axial movement of the ball nut assembly is the backlash. While making sure that neither member rotates, measure the backlash with a dial indicator.

Note

Measure backlash at points of maximum usage. Backlash of .001" to .010" is acceptable.

- D. If the backlash is over .010" and the ball screw appears usable, order a replacement ball nut.

2-7. Assembly

1. Press worm bearings (20) onto worm shaft (19) making sure bearings are seated properly. When roller bearings are used, the small end of the cone should point to the worm end.

Note

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

2. Position worm (19) in shell (3).
3. Press oil seals (18) into worm flanges (16).

Note

The sealing elements should point inward.

4. Position worm flanges (16), with shims (17), and bolt in place.
5. Strike each end of worm shaft sharply with a soft face hammer to seat bearings properly. Check flange bolts for tightness. Worm should turn freely with minimum drag and end play. If too much end play is present, remove shims as required. If worm does not turn freely, add shims as required.
6. Drop bottom load bearing (8) into shell (3).

Note

If the ball nut assembly (7) has not been removed from the ball screw (6), go on to step 8. If the ball nut assembly has been removed from the ball screw, proceed with step 7.

7. The ball nut assembly (7) should be on the ball screws (6). To assemble the worm gear (10) on the ball nut, remove the retaining disc (13) from the ball screw. Slip the worm gear onto the ball screw. Slip the worm gear onto the ball screw with the threaded counterbore facing the mating thread on the ball nut.
8. Replace the retaining disc (13) on the ball screw (6).
9. With the ball nut assembly (7) clamped in a table clamp, screw the worm gear (10) onto the ball nut assembly and draw up tight.
10. Tighten the worm gear set screws (9).

Note

If new parts have been installed, or if parts are not tightened to the original factory setting, it will be necessary to respot holes for these screws.

11. Install worm gear-ball nut and screw assembly into the shell. Be sure the gear is seated properly in the bottom load bearing (8).
12. Screw bottom pipe (5) into shell (3) (upright models) or into shell cap (2) (inverted models).
13. Fill housing approximately half-full with grease and brush a very light coat of lubricant on ball screws (6). See paragraph 2-1.
14. Remove tape from end of the ball screws (6) and slide top bearing (4) onto the screw. Be

careful that the ball screw does not run out of the ball nut assembly (7). Depending on the model of the jack, the top load bearing may fit either on top of the ball nut or the worm gear (10)

Note

If the top load bearing fits on the ball nut, the bearing should be approximately centered on the nut and the shell cap should be carefully slid onto the ball screw and screwed into the housing.

15. Install shell cap (2) and screw down tight.

Note

Shell cap flange does not necessarily have to bear against top of shell; there will usually be a gap. This should put a slight drag on the worm. If the worm is hard to turn, back off slightly on the shell cap.

16. Tighten shell cap set screws (1).

Note

If new parts have been installed, it may be necessary to respot holes for these screws.

17. Manually operate unit to ensure proper functioning of all components prior to installation.

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Section III Illustrated Parts List

3-1. General

This section contains an exploded illustration of the 2800 and 9800 Series ball 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

3-2. Parts List for 2800 and 9800 Series Ball Screw Actuators

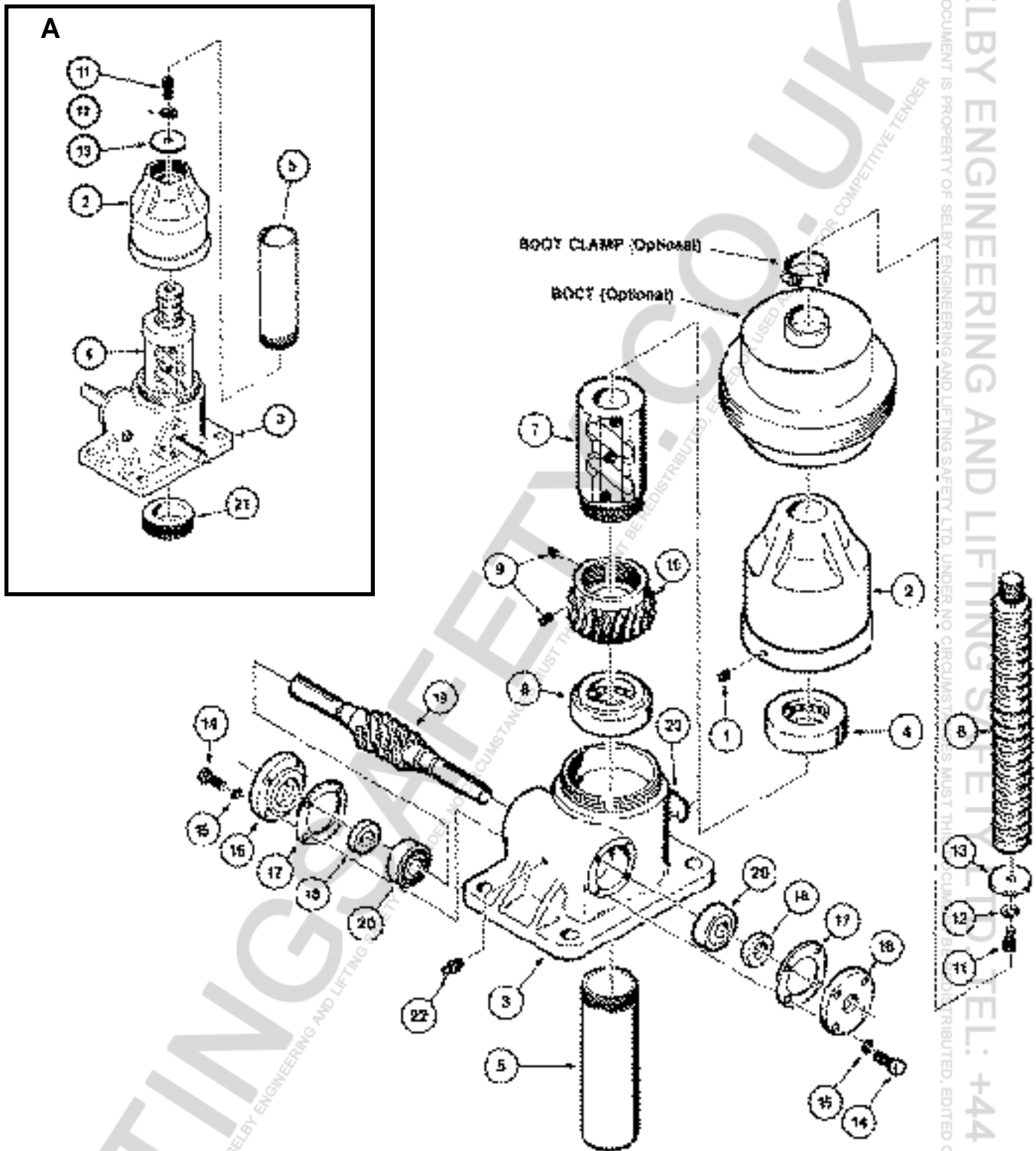
| Index No. | Part Name | Qty Req. |
|-----------|----------------------|----------|
| 1 | Screw, Set | 2 |
| 2 | Cap, Shell | 1 |
| 3 | Shell, Actuator | 1 |
| 4 | Bearing, L | 1 |
| 5 | Pipe, Bottom | 1 |
| 6 | Ball Screw | 1 |
| 7 | Ball Nut Assembly | 1 |
| 8 | Bearing, Bottom Load | 1 |
| 9 | Screw, Set | 2 |
| 10 | Worm, Gear | 1 |
| 11 | Screw, Cap | 1 |
| 12 | Washer, Lock | 1 |

| Index No. | Part Name | Qty Req. |
|-----------|--|----------|
| 13 | Disc, Retaining | 1 |
| 14 | Screw, Cap | 8 |
| 15 | Washer, Lock | 8 |
| 16 | Flange, Worm | 2 |
| 17 | Shim, Flange | 2 |
| 18 | Seal, Oil | 2 |
| 19 | Worm | 1 |
| 20 | Bearing, Worm | 2 |
| 21 | Bushing, Guide (Inverted Models Only) | 1 |
| 22 | Fitting, Grease | As Req. |
| 23 | Nameplate | 1 |

When ordering spare parts be sure to include:

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





For inverted model
see detail A

U.S. Patent No. 3,178,958
British Patent No. 1,042,441

Figure 3-1. Exploded Illustration 2800 and 9800 Series Ball Screw Actuators

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