

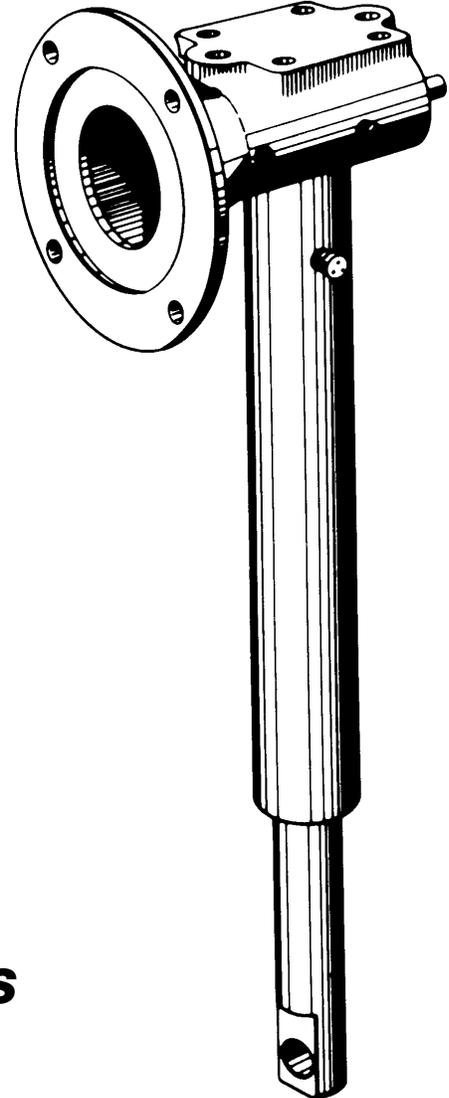


Duff-Norton®

Mechanical Actuators

Modular Ball Screw Actuators

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



Translating Tube Actuators

Model Numbers

BM-2464

BM-2465

Rotating Screw Actuators

Model Number

BM-2462

Publication Part No. SK-2463-22BS

⚠ 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.

Contents

Section I	Introduction	
1-1.	General.....	3
1-2.	Intended Use.....	3
1-3.	Safety Considerations.....	3
1-4.	Unwarranted Applications.....	3
1-5.	Warranty and Warranty Repair.....	3
Section II	Installation	
2-1.	Brake Motor Installation.....	3
2-2.	Installation of the Actuator.....	3
2-3.	Limit Switches.....	3
Section III	Dimensions and Specifications	
Figure 3-1.	Dimensions — Rotating Ball Screw Actuators (Models BM-2462 and BM-2463).....	4
Figure 3-2.	Dimensions — Translating Tube Ball Screw Actuators (Models BM-2464 and BM-2465).....	5
Table 3-1.	Specifications.....	5
Section IV	Operation, Maintenance, And Inspection	
4-1.	Improper Loading.....	6
4-2.	Clevis Pins.....	6
4-3.	Lubrication.....	6
4-4.	Inspection.....	6
Section V	Disassembly And Assembly	
5-1.	Lubricant.....	7
5-2.	Required Tools.....	7
5-3.	General Procedures.....	7
5-4.	Disassembly — Rotating Ball Screw Actuators (Models BM-2462 and BM-2463).....	7
5-5.	Disassembly of Ball Nut.....	8
5-6.	Cleaning.....	9
5-7.	Inspection.....	9
5-8.	Assembly of Ball Nut.....	9
5-9.	Assembly — Rotating Ball Screw Actuators (Models BM-2462 and BM-2463).....	10
5-10.	Disassembly — Translating Tube Ball Screw Actuators (Models BM-2464 and BM-2465).....	12
5-11.	Assembly — Translating Tube Ball Screw Actuators (Models BM-2464 and BM-2465).....	13
Section VI	Illustrated Parts List	
6-1.	General.....	14
Table 6-1.	Parts List For Rotating Ball Screw Actuators (Models BM-2462 and BM-2463).....	15
Figure 6-1.	Exploded Illustration of Rotating Ball Screw Modular Actuator.....	15
Table 6-2.	Parts List For Translating Tube Ball Screw Actuators (Models BM-2464 and BM-2465).....	16
Figure 6-2.	Exploded Illustration of Translating Tube Ball Screw Modular Actuator.....	16
Figure 6-3.	Ball Nut and Ball Screw Assembly.....	17
Figure 6-4.	Ball Nut Storage Arbor.....	17

Section I Introduction

1-1. General

This manual provides instructions for the installation, operation, and maintenance of the Duff-Norton® Ball Screw Modular Actuator. It includes proper procedures for the disassembly, cleaning, inspection, rebuilding, lubrication, and assembly of the actuator. To ensure efficient and long satisfactory use of this unit, read and understand the information herein, and follow the instructions closely.

1-2. Intended Use

The Duff-Norton® Ball Screw Modulator Actuators described and illustrated in this manual are intended for industrial use only and should not be used to lift, transport, or otherwise support people.

1-3. Safety Considerations

1. Avoid touching the exterior surfaces of the actuator. Surface temperatures may reach 230°F during prolonged use.
2. Make certain that the electric brake motor used conforms to the requirements of the actuator.

1-4. Unwarranted Applications

CAUTION

These actuators are not recommended or warranted for use in applications involving the following activities or conditions:

1. Lifting, supporting or positioning of people where a malfunction might result in bodily injury.
2. Side loading or binding of the actuator. (See paragraph 4-1, "Improper Loading.")

NOTE

If in doubt about the suitability of the actuator for your application, consult the Duff-Norton Engineering Department.

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 consult a Duff-Norton Warehouse and Customer Service Center for the name and address of your nearest Duff-Norton actuator warranty repair facility.

Authorization for return must be granted by the Duff-Norton Company before any equipment may be returned for inspection or warranty repair.

Section II Installation

Duff-Norton's Ball Screw Modular Actuator is designed to be a versatile piece of equipment which can be used in many different applications; consequently, installation procedures will vary widely with customer requirements.

2-1. Brake Motor Installation

The Modular Ball Screw Actuator is designed to accept a standard NEMA 56 frame electric brake motor with C-face mounting, to be supplied by the customer. *For instructions on installing the motor on the actuator, see Paragraph 5-9, steps 17-19.

2-2. Installation of the Actuator

The actuator has two bolt patterns for convenient attachment of the actuator to the application: both the two-hole pattern (17/32-inch unthreaded holes 4 inches apart) and the four-hole pattern (1/2-20 threaded holes

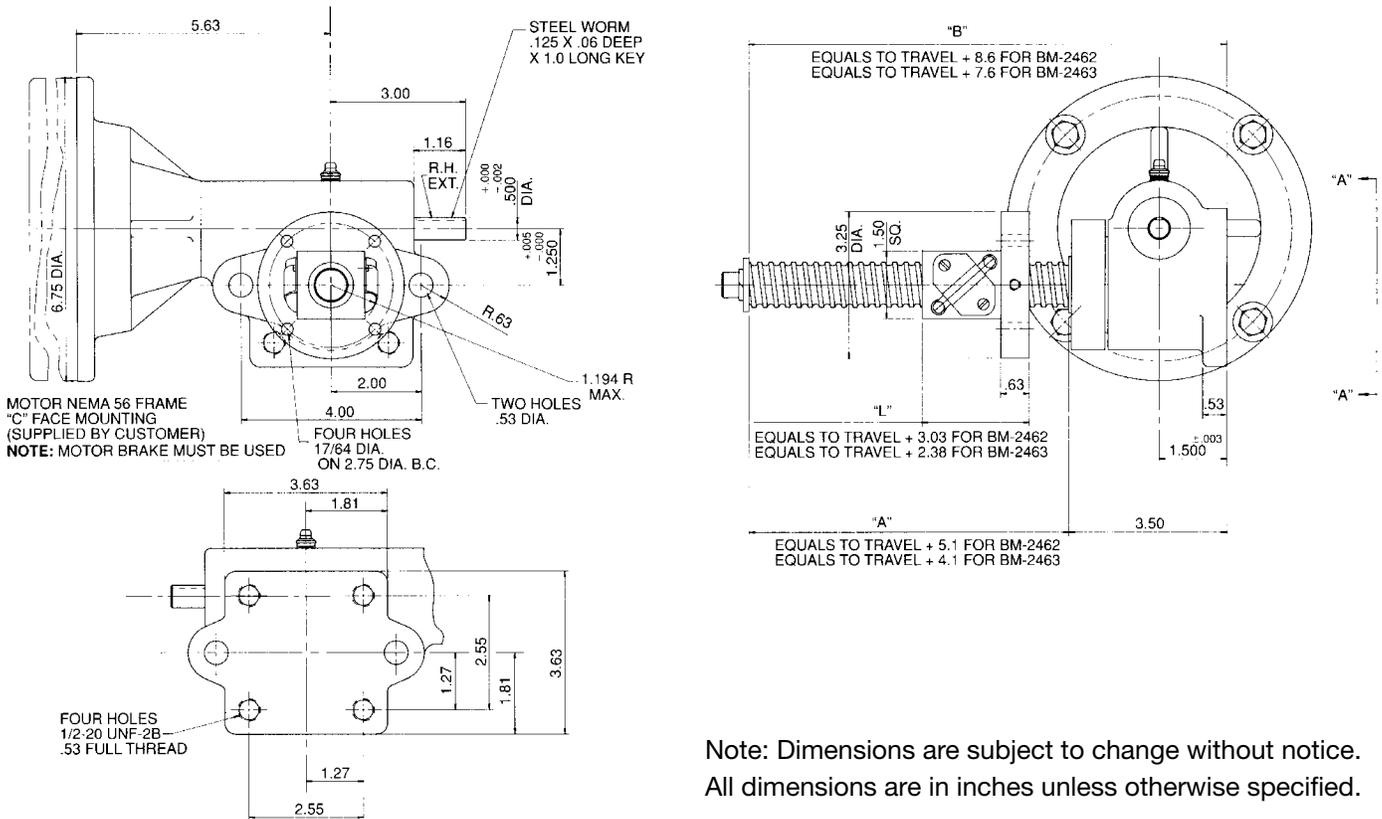
on a 2.55 inch square) can be used to bolt the actuator to a wide variety of mounting points; the four-hole pattern will also accept standard hydraulic type end fittings.

The ball nut (on rotating ball screw actuators) and the clevis end (on translating tube actuators) must be restrained against rotation in order for the actuator to lift its load.

2-3. Limit Switches

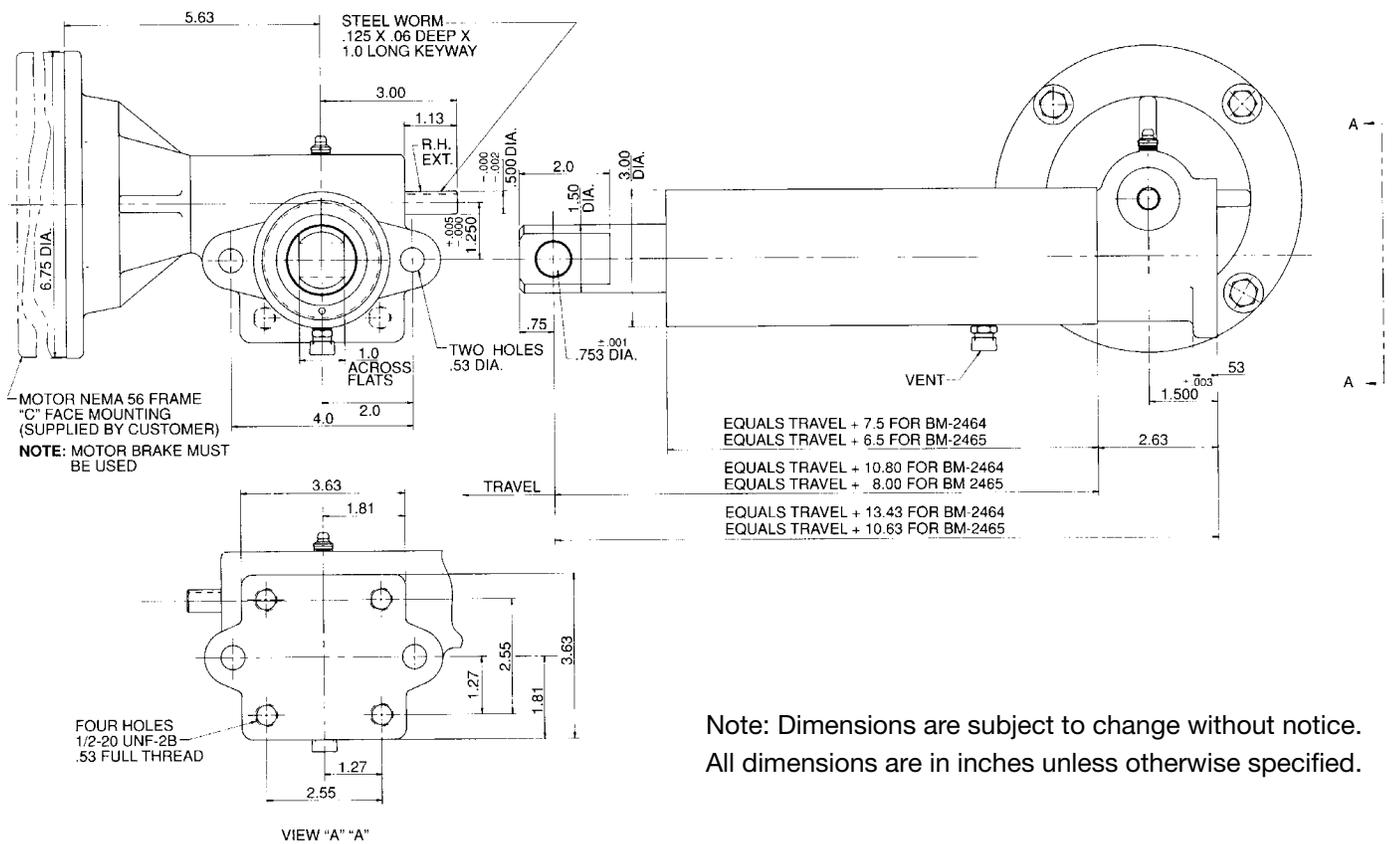
Duff-Norton recommends that limit switches be incorporated in the installation to prevent overtravel of the actuator in either direction and to protect the actuator against internal jamming. Duff-Norton limit switches to fit this actuator are available at additional cost.

Section III Dimensions and Specifications



Note: Dimensions are subject to change without notice. All dimensions are in inches unless otherwise specified.

**Figure 3-1. Dimensions — Rotating Ball Screw Actuators
(Models BM-2462 and BM-2463)**



**Figure 3-2. Dimensions — Translating Tube Ball Screw Actuators
(Models BM-2464 and BM-2465)**

Table 3-1. Specifications

Model No.	Lifting Screw	Turns of Worm/1" Travel		Torque per 100 lb Load (lb-in)		Motor RPM	Lifting Speed (In/Min)		Rated Load (lbs)							
		Ratio		Ratio			Ratio		1/4 HP Motor		1/3 HP Motor		1/2 HP Motor		3/4 HP Motor	
		5:1	20:1	5:1	20:1		5:1	20:1	5:1	20:1	5:1	20:1	5:1	20:1	5:1	20:1
		5:1	20:1	5:1	20:1		5:1	20:1	5:1	20:1	5:1	20:1	5:1	20:1	5:1	20:1
BM-2462	1.0 Dia.	5	—	.5	—	1725	345	—	100	—	200	—	300	—	500	—
BM-2464	1.000 Lead					1140	228	—	200	—	300	—	500	—	—	—
BM-2463	1.0 Dia.	20	80	1.3	.6	1725	86	21	600	1500	900	2000	1300	—	2000	—
BM-2465	.250 Lead					1140	57	14	1000	—	1300	—	2000	—	—	—

Section IV Operation, Maintenance, And Inspection

4-1. Improper Loading

WARNING

The actuator must NOT be subjected to side loading or binding (i.e., a bending moment across the actuator) at any point in its travel. It is the responsibility of the installer to ensure that the mounting points cannot transmit such loading to the actuator anywhere between full retraction and full extension. Failure to observe this warning will void the warranty on the actuator.

4-2. Clevis Pins

The axes of the clevis pins should be parallel so that the actuator can pivot without binding. A few drops of oil should be applied to the clevis pins on installation and periodically thereafter.

4-3. 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 Mobile XHP461 or XHP462 Extreme Pressure grease.

Periodically lubricate the rotating ball screws with a cloth dampened with a good grade 10W30 oil. 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.

To lubricate the lifting screw and nut on a translating tube actuator, first loosen the set screws and unscrew the outer tube from the shell cap to expose the ball screw threads.

The actuator should be disassembled, cleaned, inspected, and re-lubricated after 500,000 inches of travel under normal conditions, or earlier if the need is indicated by inspection or by a squealing from the ball screw and ball nut area. Follow the instructions in Section V to overhaul the actuator.

4-4. Inspection

The actuator should be inspected periodically (see Note below), with attention given to the following items:

1. Clevis ends for wear, cracks, distortion, or other degradation or damage.
2. Loose bolts, screws, or other hardware on the actuator or its mounting points.
3. Limit switches (if so equipped) for proper setting and operation.
4. Ball screw, ball nut, and gear set for excessive wear or lack of lubrication (see instructions under Paragraph 4-3, "Lubrication").

Any of the above deficiencies should be corrected before the actuator is returned to service.

NOTE

Periodic Inspection and Lubrication: The exact periods for inspection and lubrication of the actuator cannot be predetermined because of the many variables involved, such as frequency of operation, type and magnitude of loading, and operational environment. Determination should be based on the user's experience. It is recommended that the user begin with a weekly inspection, extending the inspection period to monthly, quarterly, or annually, based on his weekly experience.

Section V Disassembly And Assembly

5-1. Lubricant

When rebuilding this actuator, use Mobile XHP461 or XHP462 Extreme Pressure grease.

5-2. Required Tools

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

5-3. General Procedures

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

1. Tag critical parts to facilitate reassembly.
2. Mark mating surfaces to ensure proper meshing.
3. Clean and lubricate parts as required.
4. Replace all seals at time of rebuild.
5. Replace any screws, washers, and other small common parts that are damaged in any way.

5-4. Disassembly — Rotating Ball Screw Actuators (Models BM-2462 and BM-2463)

Disassemble the Duff-Norton® Rotating Ball Screw Modular Actuator as follows, referring to Figure 6-1 on page 13. Read the instructions thoroughly before disassembling the actuator.

NOTE
For disassembly procedures for translating tube actuators, see Paragraph 5-10.

NOTE
Disassembly should be undertaken on a clean cloth.

1. Remove the four cap screws (B) with lock washers (F) that attach the motor (A) to the shell (9) flange, and remove the brake motor from the shell. Half the flexible coupling (5a) will come with the brake motor shaft, and the other half (5a) will remain on the worm shaft (4). The flexible spider (5b) may stay with either half of the coupling.
2. Remove the set screw (5c) from the motor half of the coupling (5a), and remove the coupling half and the key (E) from the motor shaft.
3. Remove the pipe plug (7) and the grease fitting (8) from the shell (9).
4. Remove the set screw (5c) from the worm half of the coupling (5a) by inserting the set screw wrench through the pipe plug hole.

5. Remove the coupling half (5a) and the key (6) from the worm shaft (4).

When disassembling an actuator equipped with limit switches, follow steps 6 and 7 below. If the actuator is not equipped with limit switches, proceed directly to step 8.

6. Remove the two socket head cap screws (32) and the one long hex head cap screw (30) from the limit switch adapter (33), and remove the limit switch box (D) from the limit switch adapter.
7. Remove the two half dog point set screws (34) from the shell (9) and remove the limit switch adapter (33) from the shell (see NOTE below).

NOTE
It may be necessary to use heat to overcome the adhesive in order to remove the limit switch adapter from the shell.

8. Remove the two set screws (10) from the shell (9), and unscrew the shell cap (16) from the shell.
9. Remove the shell cap, ball screw, bearing, ball nut and gear assembly from the shell (9).
10. Remove the retaining ring (1) from the shell (9).
11. Remove the worm (4) by pressing on the brake motor end of the worm shaft. The worm bearing (2) next to the retaining ring (1) groove will be driven out by the worm. The other worm bearing (2) should remain in the shell until the load bearing cup (13) has been removed.
12. Press the worm bearing (2) off the worm (4).

NOTE
Refer to paragraphs 5-5, 5-6 and 5-7 for ball nut disassembly, cleaning and inspection.

13. Remove the load bearing cup (13) out of the shell (9).
14. Remove the remaining worm bearing (2) from the shell (9).
15. Clamp the ball screw (18) in a vise, using soft jaws to prevent damage to the screw.

 CAUTION
It is very important that the ball screw (18) not be allowed to run out of the ball nut assembly (17). At this point, it is advisable to wrap tape around the last few ball screw threads between shell cap and ball nut to prevent this from happening.

16. Remove the lock nut (12), and remove the gear (14), key (19), and spacer (15) from the ball screw (18).

17. Remove the shell cap (16) from the ball screw (18).

5-5. Disassembly of Ball Nut

NOTE

Disassembly should be accomplished on a clean cloth. This is particularly important when disassembling the ball nut assembly (17).

1. Disassembly Inspection (Refer to Figures 6-1 and 6-3.) To determine the need for replacement of the ball screw (18) or the ball nut (17) the following inspection should be made prior to disassembly of the ball nut from the ball screw: Inspect the ball nut assembly (B) and ball screw (A) as follows:
 - a. Lubricate the ball nut assembly and ball screw. See paragraph 4-3.
 - b. Inspect the ball screw grooves (J) 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 exist. 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 ball screw appears usable, order a replacement ball nut.
 - e. If the ball screw and lifting nut assembly do not show signs of excessive wear or damage, proceed to Step 3 and disassemble the lifting nut (17) from the ball screw (18).
2. Disassembly of Ball Nut - Unless the maintenance personnel are trained in servicing ball screws, we do not recommend disassembling the ball nut assembly (17). Follow Cleaning Step 1, paragraph 5-7, to ascertain that the ball nut assembly is faulty before disassembling it. If inspection determines the ball nut assembly to be defective and trained personnel

are not available, we recommend that both the ball nut assembly and ball screw (18) be replaced. When trained personnel are available, disassemble as follows:

- a. Remove ball guide clamp(s) (G) by removing the attaching screws (D).

CAUTION

Ball nuts for models BM-2462 and BM-2464 have two ball circuits. Balls from each circuit must be kept separated in order to reassemble them in the proper circuit.

- b. Remove both halves of one ball return guide (C) simultaneously to prevent distortion.
 - c. Remove bearing balls (E) from this circuit by rotating the ball screw (A) or the ball nut (H) slowly and allowing the balls to drop onto the cloth on which disassembly is taking place.
 - d. For models BM-2462 and BM-2464 repeat steps a through c for the other ball circuit.
 - e. Remove the ball nut (H) from the ball screws (A)

NOTE

Identify the two ball return guides removed from the opposite sides of the ball nut so that they can be used for reference during the Inspection and reassembly.

3. Disassembly of Ball Nut (17) From Ball Screw (18) (Refer to Figure 6-4).
 - a. Slide a tubular arbor (7/8 in. O.D. x 9/16 in. min. I.D. x 6-8 in. length) over gear journal at end of ball screw.

NOTE

Apply tape to arbor O.D. at end away from ball screw gear journal to prevent ball nut from accidentally running off of arbor during disassembly (an O-ring with a large cross section, stretched over the arbor, is ideal for this purpose.)

- b. Remove tape applied earlier during actuator disassembly from the ball screw. Holding arbor firmly against shoulder of ball screw (18) gear shaft, unthread ball nut (17) from ball screw (18) onto arbor, then remove from ball screw.

CAUTION

Lift arbor and ball nut together, holding in place to prevent lifting nut from sliding off of arbor.

- c. Pass binding wire through arbor and bind ball nut and arbor together.

NOTE

Keeping assembly together in this manner will eliminate the need to complete assembly of the ball nut during reassembly of the actuator.

- d. If necessary remove socket head cap screw (22), lock washer (21), and stop disc (20) from ball screw (18).

5-6. Cleaning

1. Use degreasing solvent to remove dirt, grease or oil from all parts. Be sure to flush the ball nut assembly (17) thoroughly while turning the assembly over the arbor several times.

WARNING

Provide adequate ventilation during the use of cleaning agents; avoid prolonged breathing of fumes and contact with skin.

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.

5-7. Inspection

1. Make a visual inspection of shell (9) for broken, cracked or distorted areas. Check threads of all bores for burrs or broken threads.
2. Check shell cap (16), worm gear (14) for burrs or scratches on their working or mating surfaces.
3. Check small common components (screws, etc.) and replace as required.
4. Check bearings (2 and 13) for seizure, galling or play and replace as required.
5. Inspect the ball nut components (B) as follows:
 - a. Inspect ball return guides (C) for distortion or excessive wear.
 - b1. For models BM-2462 and BM-2462 count the bearing balls from each circuit. Each circuit should have the same number (within a variation of three balls).
 - b2. Check random samples (about 1/4 of the balls from a circuit) for the following:
 - True roundness (.0001 inch maximum variation allowed).
 - Signs of scuffing or fish scaling.

- More than .0001 inch diameter variation between balls of the same circuit.

Where the random sampling shows ball out of round, signs of scuffing or variation of diameter in excess of .0001, or short count in any circuit, replace all balls in the unit with a complete set of new bearing balls.

CAUTION

In order to ensure proper operation and long life of the serviced assembly. It is imperative that the diameters of all replacement balls do not vary in excess of .00005 inch. Make certain that balls used meet the above specification. (Note: Use only Chrome Alloy Steel Balls — carbonized balls or carbon steel balls will not provide adequate life.)

Casic Actuator No.	Nominal Ball Diameter	Number of Circuits	Approximate No. of Balls
BM-2463 BM-2465	5/32 in.	1	98
BM-2462 BM-2464	5/32 in.	2	85

- d. Inspect pick-up fingers (short extensions at the end of the ball return guides), for brinell impressions at the tips. Remove any burrs on the fingers.
- e. Inspect the internal grooves of the ball nut for sings of excessive wear, pitting, gouges, corrosion, spalling or brinelling in the ball groove area. When wear is excessive, the extended lead of a mechanical pencil can be used as a groove probe. If inspection indicates any of these flaws, all components of the ball nut assembly should be replaced. The exact ball nut assembly (17) is available on an arbor.

5-8. Assembly of Ball Nut

Assembly of ball nut (17) or ball screw (18) — If ball nut has been disassembled, reassemble on ball screw per paragraph 5-8, step 1. If ball nut was not disassembled and was removed on an arbor tube, reassemble on ball screw per paragraph 5-8, step 2.

1. Refer to Figure 6-3 and assemble the ball nut (17) as follows:
 - a. Position the ball nut (H) on the ball shaft.

NOTE

For models BM-2462 and BM-2463 ball nut flange is oriented toward gear journal end of ball screw. For models BM-2464 and BM-2465 ball nut O.D. thread is oriented toward ball screw end opposite gear journal.

- b. Using dowels with an outside diameter approximately equal to the diameter of the bearing balls, center lifting nut grooves with the ball shaft grooves by inserting dowels into each of the ball nut return circuit holes. Remove the second dowel from one end. With the ball return holds up, fill the circuit with bearing balls from the container corresponding to that circuit. Turning the screw in the ball nut will help to feed the balls into the groove. When the circuit is full, the balls will begin to lift the end dowel from its position. To be sure there are no voids, lightly tap the top bearing ball and see if the end dowel moves. The remaining balls in the container should fit into one of the halves of the return guide with space for about two to four balls left.

NOTE

There must be some free space in the ball circuit so the balls will roll and not skid. Do not try to add extra balls into a circuit.

- c. Place a dab of bearing grease at each end of the half return guide (C) to hold the balls in place. Now, take the other half of the return guide and place it over the ball nut circuit that has been filled with bearing balls and insert the two ends of the ball guide into the respective holes in the ball nut. Sear by tapping gently with a rawhide or plastic mallet.

NOTE

Where more than one ball circuit must be filled in the ball nut, secure ball return guide (C) with retaining clamp (G) and screws (D).

- d. For models BM-2462 and BM-2464 repeat the filling procedure for the other ball circuit.

⚠ CAUTION

Care should be taken to insure that balls are not accidentally trapped between circuits.

- e. Wrap tape around the ball grooves end near gear journal to prevent the ball nut from accidentally rolling off. Inspect the assembly for free movement of the ball nut assembly along the entire stroke. There should be no binding, squeal, or roughness at any point.
- f. Check backlash per paragraph 5-5, step 1-c. If backlash exceeds .010 inch, one of the two corrective steps may be followed.
 - 1) The ball nut assembly and/or ball screw may be replaced

- 2) Backlash can be reduced by replacing all the bearing balls with a larger size. If the diameters of the bearing balls are increased by .001 inch, backlash is decreased by .003 inch.

⚠ CAUTION

In order to insure proper operation and long life of the serviced assembly, it is imperative that the diameters of all the replacement balls do not vary in excess of .00005 inch. Make certain that balls used meet this specification. Use only chrome alloy steel balls—carbonized balls or carbon steel balls will not provide adequate life.

- 2. Refer to Figure 6-1 for reassembly of ball nut (17) from tube arbor to ball screw (18).
 - a. Assemble stop disc (20) to ball screw (18) using lock washers (21) and screw (22).
 - b. Clamp ball screw (18) in vice (using soft jaws to prevent damage to screw) leaving gear journal end exposed several inches.
 - c. With ball nut centered on arbor tube, grasp ball nut and arbor to prevent ball nut from running off of arbor, and remove binding wire.
 - d. Position arbor over ball screw (18) gear shaft.

NOTE

For models BM-2462 and BM-2463 ball nut flange is oriented toward gear journal end of ball screw. For models BM-2464 and BM-2465 ball nut O.D. thread is oriented toward ball screw end opposite gear journal.

⚠ CAUTION

Wrap tape around ball screw threads near gear journal end to prevent ball nut from running off of ball screw during installation of unit.

5-9. Assembly — Rotating Ball Screw Actuators (Models BM-2462 and BM-2463)

Assemble the Duff-Norton® Rotating Ball Screw Modular Actuator as follows, referring to Figure 6-1 on page 13. Read the instructions thoroughly before assembling the actuator.

NOTE

For assembly procedures for translating tube actuators, see Paragraph 5-10.

NOTE

Be sure all parts are clean and dry before assembling the actuator.

Refer to paragraph 5-8 for assembly of the ball nut.

1. Assemble one load bearing cup (13) into the shell (9), and the other load bearing cup into the shell cap (16).
2. Assemble one worm bearing (2) into the brake motor mounting flange end of the shell (9) (see Note below).

NOTE

The bearing must be installed from the opposite end of the shell.

3. Notice that one end of the worm (4) has a hole in the center of the shaft, and one end does not. Press the remaining worm bearing (2) onto the end of the shaft WITH the hole. [If the unit has a limit switch make sure that pin (3) is installed in worm (4) shaft (should be flush with shaft O.D.)].
4. Assemble the worm (4) into the shell (9) and worm bearing (2), and then install the retaining ring (1) in the shell.
5. Grease the two load bearing cones (13) and install them on the worm gear (14) bearing journals.
6. Slide the shell cap (16) and bearing cup assembly over the ball screw [with ball nut (17) already in place — see paragraph 5-8 for instructions], with the bearing cup (13) facing the turned end of the ball screw.
7. Slip the spacer (15) over the end of the ball screw (18), with the flange toward the shoulder.
8. Install the key (19) in the keyway in the ball screw (17).
9. Slide the gear (14) and load bearing (13) cone assembly over the end of the ball screw (17).
10. Thread the lock nut (12) onto the end of the ball screw (18) and tighten the lock nut to 30 ft-lb.
11. Install the ball screw, shell cap, and gear assembly in the shell (9), taking care to mesh the gear teeth and the worm properly.
12. Pack the gear housing with Shell Albida EP2 (or equivalent) grease.
13. Coat the shell cap (16) threads with aluminum antiseize compound. Thread the shell cap into the shell (9), and torque it to 40 ft-lb. Spot drill the shell cap thread O.D. in two places, and install the two set screws (10). Tighten the set screws to hold the shell cap in place.
14. Install the key (6) in the end of the worm (4) shaft on the flange side of the shell (9), and slide a coupling

half (5a) onto the worm shaft. The inside face of the coupling should be flush with the worm shaft end. Tighten the coupling set screw (5c) against the key by inserting the set screw wrench through the pipe plug (7) hole in the shell.

15. Install the pipe plug (7).
16. Install the grease fitting (8).
17. Install the key (E) in the brake motor shaft and slide the second coupling half (5a) onto the brake motor shaft, with the inside face of the coupling flush with the end of the brake motor shaft. Tighten the coupling set screw (5c) against the key to lock it in place.
18. Assemble the flexible spider (5b) on to the brake motor coupling half (5c).
19. Align the brake motor coupling half (5a) with the worm coupling half (5a) and assemble the brake motor (A) to the shell (9), aligning the holes in the flange with the tapped holes in the face of the brake motor. Make sure that the brake motor is centered in the counterbore, and then install and tighten the four 3/8-16 x 7/8 inch hex head cap screws (B) with lock washers (F) that attach the brake motor to the flange. Release the brake and turn the worm shaft extension by hand to be certain that there is no binding of the brake motor and the actuator.
20. Remove tape from ball screw (18).

This completes the assembly procedures for actuators not equipped with limit switches. When assembling and actuator equipped with limit switches, continue with the instructions below.

21. Apply two or three drops of Loc-Tite No. 35 Extra Strength Retaining Ring Compound to the shell bore.

If a new (replacement) limit switch adapter is being installed, follow steps 22 and 23 below. If a used (previously spot drilled) adapter is being installed, proceed directly to step 24.

22. Install the limit switch adapter (33) in the shell (9), making sure that the adapter bottoms out against the retaining ring (1). Orient the four tapped holes in the limit switch adapter to line up with the four brake motor mounting holes in the housing flange.
23. Spot drill the limit switch adapter (33) in two places and install the two half dog point set screws (34). Proceed directly to step 26.
24. Install the limit switch adapter (33) in the shell (9), aligning the spot drilled holes in the adapter with the tapped holes in the shell.

25. Install the two half dog point set screws (30).
26. Aligning the slot in the limit switch worm shaft with the pin (3) in the actuator worm (4), install the limit switch box on the adapter (33) in the desired position and secure with screws (30 and 32) and lock washers (31).

5-10. Disassembly — Translating Tube Ball Screw Actuators (Models BM-2464 and BM-2465)

Disassemble the Duff-Norton® Translating Tube Ball Screw Modular Actuator as follows, referring to Figure 6-2 on page 14. Read the instructions thoroughly before disassembling the actuator.

NOTE

For disassembly procedures for the rotating screw actuators, see Paragraph 5-4.

NOTE

Disassembly should be undertaken on a clean cloth.

1. Remove the four cap screws (B) with lock washers (F) that attach the brake motor (A) to the shell (9) flange, and remove the brake motor from the shell. Half the flexible coupling (5a) will come with the brake motor shaft, and the other half (5a) will remain on the worm shaft (4). The flexible spider (5b) may stay with either half of the coupling.
2. Remove the set screw (5c) from the brake motor half of the coupling (5a), and remove the coupling half and the key (E) from the motor shaft.
3. Remove the pipe plug (7) and the grease fitting (8) from the shell (9).
4. Remove the set screw (5c) from the worm half of the coupling (5a) by inserting the set screw wrench through the pipe plug hole.
5. Remove the coupling half (5a) and the key (6) from the worm shaft (4).

When disassembling an actuator equipped with limit switches, follow steps 6 and 7 below. If the actuator is not equipped with limit switches, proceed directly to step 8.

6. Remove the two socket head cap screws (32) and the one long hex head cap screw (30) from the limit switch adapter (33), and remove the limit switch box (D) from the limit switch adapter.
7. Remove the two half dog point set screws (34) from the shell (9) and remove the limit switch adapter (33) from the shell (see Note below).

NOTE

It may be necessary to use heat to overcome the adhesive in order to remove the adapter from the shell.

8. Remove the two set screws (24) from the outer tube (26). Remove outer tube by unthreading it from shell cap (16) and sliding it off over the translating tube (25) brake.
9. Remove guide bushing (28) from outer tube (26). Remove wiper scraper seal 929) from guide bushing (28).

NOTE

If seal is not damaged it is not necessary for it to be removed from guide bushing.

10. Remove the two set screws (10) from the shell (9), and unscrew the shell cap (16) from the shell.
11. Remove the shell cap (16), translating tube (25), ball nut (17), lifting screw (18), bearing (13), and gear (14) assembly from shell (9).
12. Remove the retaining ring (1) from the shell (9).
13. Remove the worm (4) by pressing on the brake motor end of the worm shaft. The worm bearing (2) next to the retaining ring (1) groove will be driven out by the worm. The other worm bearing (2) should remain in the shell until the load bearing cup (13) has been removed.
14. Press the worm bearing (2) off the worm (4).
15. Remove the load bearing cup (13) from the shell (9).
16. Remove the remaining worm bearing (2) from the shell (9).
17. Clamp the ball screw (18) in a vise, using soft jaws to prevent damage to the screw.

NOTE

Wrap tap around the ball grooves between shell cap and ball nut to prevent ball nut from rolling off screw.

18. Remove the lock nut (12), the gear (14), key (19), spacer (15), and shell cap (16) from the lifting screw (18).
19. Remove the two load bearing cones (13) from the gear (14).
20. Remove ball screw (18), ball nut (17), and translating tube (25) assembly from vice and reclamp in vice on flats of ball nut (17). Take care not to damage ball returns.
21. Remove two set screws (24) from threaded coupling (23) at translating tube (25) end and unthread translating tube (25) from threaded coupling (23).

⚠ CAUTION

Use nylon or leather strap wrench on translating tube to prevent damage to translating tube finish.

- 22. Remove the other two set screws (24) from threaded coupling (23) and unthread threaded coupling (23) from ball nut (17).

Refer to paragraphs 5-5, 5-6 and 5-7 for ball nut disassembly, cleaning and inspection.

5-11. Assembly — Translating Tube Ball Screw Actuators (Models BM-2464 & BM-2465)

Assemble the Duff-Norton® Translating Tube Ball Screw Modular Actuator as follows, referring to Figure 6-2 on page 14. Read the instructions thoroughly before assembling the actuator.

NOTE

For assembly procedures for rotating screw actuators, see Paragraph 5-9.

NOTE

Be sure all parts are clean and dry before assembling the actuator.

- 1. Assemble a load bearing cup (13) into the shell (9).
- 2. Assemble one worm bearing (2) into the motor mounting flange end of the shell (9) (see Note below).

NOTE

The bearing must be installed from the opposite end of the shell.

- 3. Notice that one end of the worm (4) has a hole in the center of the shaft, and one end does not. Press the remaining worm bearing (2) onto the end of the shaft WITH the hole. [If unit has limit switch, make sure hat pin (3) is installed in worm (4) shaft (should be flush with shaft O.D.).]
- 4. Assemble the worm (4) into the shell (9) and worm bearing (2), and then install the retaining ring (1) in the shell.
- 5. Install wiper scraper seal (29) in guide bushing (28) (scraper should be facing outward).
- 6. Install guide bushing (28) and the wiper scraper seal (29) in the end of the outer tube (26) opposite the end of outer tube with 1/8" pipe thread.
- 7. Spot drill guide bushing (28) thread and lock guide busing in place with set screw (24).
- 8. Grease the two load bearing cones (13) and install them on the worm gear (14) bearing journals.

- 9. Clamp ball nut (17) in vice on flats. Use soft jaws and take care not to damage ball returns.
- 10. Thread coupling (23) on ball nut (17). Spot drill ball nut (17) in two places (use carbide tip drill) (through set screw holes) and lock coupling (23) in place with two set screws (24).

⚠ CAUTION

Be sure ball screw is clean of any chips.

- 11. Fill the translating tube (25) approximately half full of Shell Albida EP2 (or equivalent) grease.
- 12. Slide the translating tube and clevis end assembly over the lifting screw (18) and thread into coupling (23). Spot drill translating tube in two places (through set screw holes) and lock in place with two set screws (24).

⚠ CAUTION

Do not spot too deep on translating tube as drill may break through and contaminate ball screw.

- 13. Make sure load bearing (13) cup has been installed in shell cap (16) and slip shell cap (16) over ball screw (18) end with bearing cup away from ball nut (17).
- 14. Slip the spacer (15) over the end of the ball screw (18), with the flange toward the ball screw shoulder.
- 15. Install the key (19) in the keyway in the ball screw (18).
- 16. Slide the gear and load bearing cone assembly over the end of the ball screw (18).
- 17. Thread the lock nut (12) onto the end of the ball screw (18). Clamp the ball screw between soft jaws in a vise, and tighten the lock nut to 30 ft-lb,
- 18. Install the ball screw, translating tube and gear assembly in the shell (9), taking care to mesh the gear teeth and the worm properly.
- 19. Pack the gear housing with Shell Albida EP2 (or equivalent) grease.
- 20. Thread the shell cap (16) into the shell (9), and tighten it to 40 ft-lb. Spot drill the shell cap thread in two places, and install and tighten the two set screws (10) to hold the shell cap in place.

⚠ CAUTION

If tape has not been removed, remove tape from ball screw.

- 21. Assemble outer tube (26) over translating tube (25) and thread on shell cap (16).
- 22. Spot drill shell cap (16) thread and lock in place with set screw (24).

23. Install air vent (27) in outer tube (26).
24. Install the key (6) in the end of the worm (4) shaft on the flange side of the shell, and slide a coupling half (5a) onto the worm shaft. The inside face of the coupling should be flush with the worm shaft end. Tighten the coupling set screw (5c) against the key by inserting the set screw wrench through the pipe plug (7) hole in the shell.
25. Install the pipe plug (7).
26. Install the grease fitting (8).
27. Install the key (E) in the brake motor shaft and slide the second coupling half (5a) onto the brake motor shaft, with the inside face of the coupling flush with the end of the motor shaft. Tighten the coupling set screw against the key to lock it in place.
28. Assemble the flexible spider (5b) onto the brake motor coupling half (5c).
29. Align the brake motor coupling half (5a) with the worm coupling half (5a) and assemble the brake motor to the shell (9), aligning the holes of the flange with the tapped holes in the face of the brake motor. Make sure that the brake motor is centered in the counterbore, and then install and tighten the four 3/8 - 16 x 7/8 inch hex head cap screws (B) with lock washers (F) that attach the brake motor to the flange. Release the brake and turn the worm shaft extension by hand to be certain that there is no binding of the brake motor and the actuator.

This completes the assembly procedures for the actuators not equipped with limit switches. When assembling an actuator equipped with limit switches, continue with the instructions below.

30. Apply two or three drops of Loc-Tite No. 35 Extra Strength Retaining Ring Compound to the shell bore.
- If a new (replacement) limit switch adapter is being installed, follow steps 31 and 32 below. If a used (previously spot drilled) adapter is being installed, proceed directly to step 33.
31. Install the limit switch adapter (33) in the shell (9), making sure that the adapter bottoms out against the retaining ring (1). Orient the four tapped holes in the limit switch adapter to line up with the four brake motor mounting holes in the housing flange.
 32. Spot drill the adapter (33) in two places and install the two half dog point set screws (34). Proceed directly to step 35.
 33. Install the limit switch adapter (33) in the shell, aligning the spot drilled holes in the adapter with the tapped holes in the shell.
 34. Install the two half dog point set screws (30).
 35. Aligning the slot in the limit switch worm shaft with the pin (3) in the actuator worm, install the limit switch box on the adapter (33) in the desired position.

THE ACTUATOR ASSEMBLY IS COMPLETE.

Section VI Illustrated Parts List

6-1. General

This section contains exploded illustrations of Duff-Norton® Rotating Ball Screw and Translating Tube Ball Screw Modular Actuators. The numbers adjacent to each of the parts on the illustrations is the index number. On the parts listed on the following page, these numbers are keyed to the individual part names.

Table 6-1. Parts List For Rotating Ball Screw Actuators (Models BM-2462 and BM-2463)

Index No. Fig. 6-1	Part Name	Qty Req.	Part Number
1	Retaining Ring	1	SK-2501-1
2	Worm Bearing	2	SK-2501-10
3	Spring Pin (Worm)	1	S-50-56
4	Worm 5:1 Ratio	1	SK2465-43
	Worm 20:1 Ratio	1	SK2465-53
	Worm 5:1 Single End	1	SK-3501-2
	Worm 20:1 Single End	1	SK3501-3
5+	Flexible Coupling	1	SK-2465-21
6	Key	1	SK-10-2
7	Pipe Plug	1	SK-25-13
8	Grease Fitting	1	SK-974-32
9	Shell	1	SK-2465-1
10	Set Screw	2	S-7-10
11	Decal	1	SK-2433-19
12	Locknut	1	H-3965-P
13	Load Bearing	2	SK-2501-9
14	Worm Gear 5:1 Ratio	1	SK3502-4
	Worm Gear 20:1 Ratio	1	SK-2502-14

Index No. Fig. 6-1	Part Name	Qty Req.	Part Number
15	Spacer	1	SK-2465-23
16	Shell Cap	1	SK-2463-12
17	Ball Nut (BM-2462)	1	SK-2803-3B
	& Flange (BM-2563)	1	SK-2803-3A
18	Assembly		
	Ball Screw (BM-2462)	1	SK2554-25-*
	Ball Screw (BM-2463)	1	SK-2465-25-*
19	Key (Screw)	1	S-10-72
20	Stop Disc	1	SK-2802-8-1
21	Lock Washer	1	H-4005-P
22	Soc. Head Cap Screw	1	S-49-16
30	Hex Head Cap Screw	1	S-44-157
31	Lock Washer	3	H-4084-P
32	Soc. Head Cap Screw	2	H-2201
33	Limit Switch Adapter	1	SK-2465-11
34	Set Screw	2	S-52-1

*Dash No. Is Equal to Travel

+Consists of 5a Coupling Body, 5b Spider, 5c Set Screw

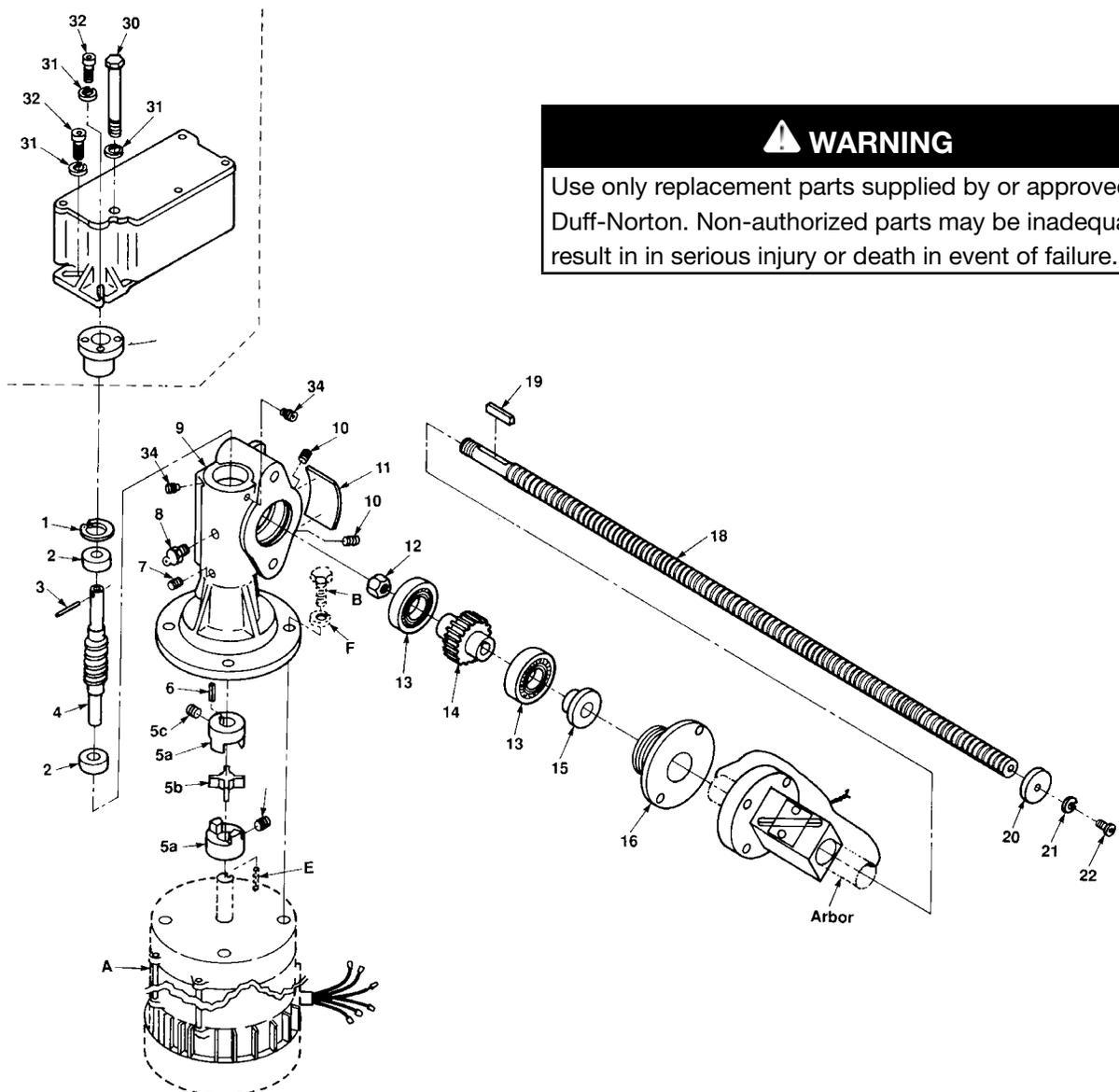


Figure 6-1. Exploded Illustration of Rotating Ball Screw Modular Actuator (Models BM-2462 and BM-2463)

**Table 6-2. Parts List For Translating Tube Ball Screw Actuators
(Models BM-2464 and BM-2465)**

Index No. Fig. 6-2	Part Name	Qty Req.	Part Number
1	Retaining Ring	1	SK-2501-11
2	Worm Bearing	2	SK-2501-10
3	Spring Pin (Worm)	1	S-50-56
4	Worm 5:1 Ratio	1	SK-2465-43
	Worm 20:1 Ratio	1	SK-2465-53
	Worm 5:1 Single End	1	SK-3501-2
5+	Worm 20:1 Single End	1	SK-3501-3
	Flexible Coupling	1	SK-2465-21
6	Key	1	SK-10-2
7	Pipe Plug	1	SK-25-13
8	Grease Fitting	1	SK-974-32
9	Shell	1	SK-2465-1
10	Set Screw	2	S-7-10
11	Decal	1	SK-2433-19
12	Locknut	1	H-3965-P
13	Load Bearing	2	SK-2501-9
14	Worm Gear 5:1 Ratio	1	SK-3502-4
	Worm Gear 20:1 Ratio	1	SK-2502-14
15	Spacer	1	SK-2465-23
16	Shell Cap	1	SK-2465-12

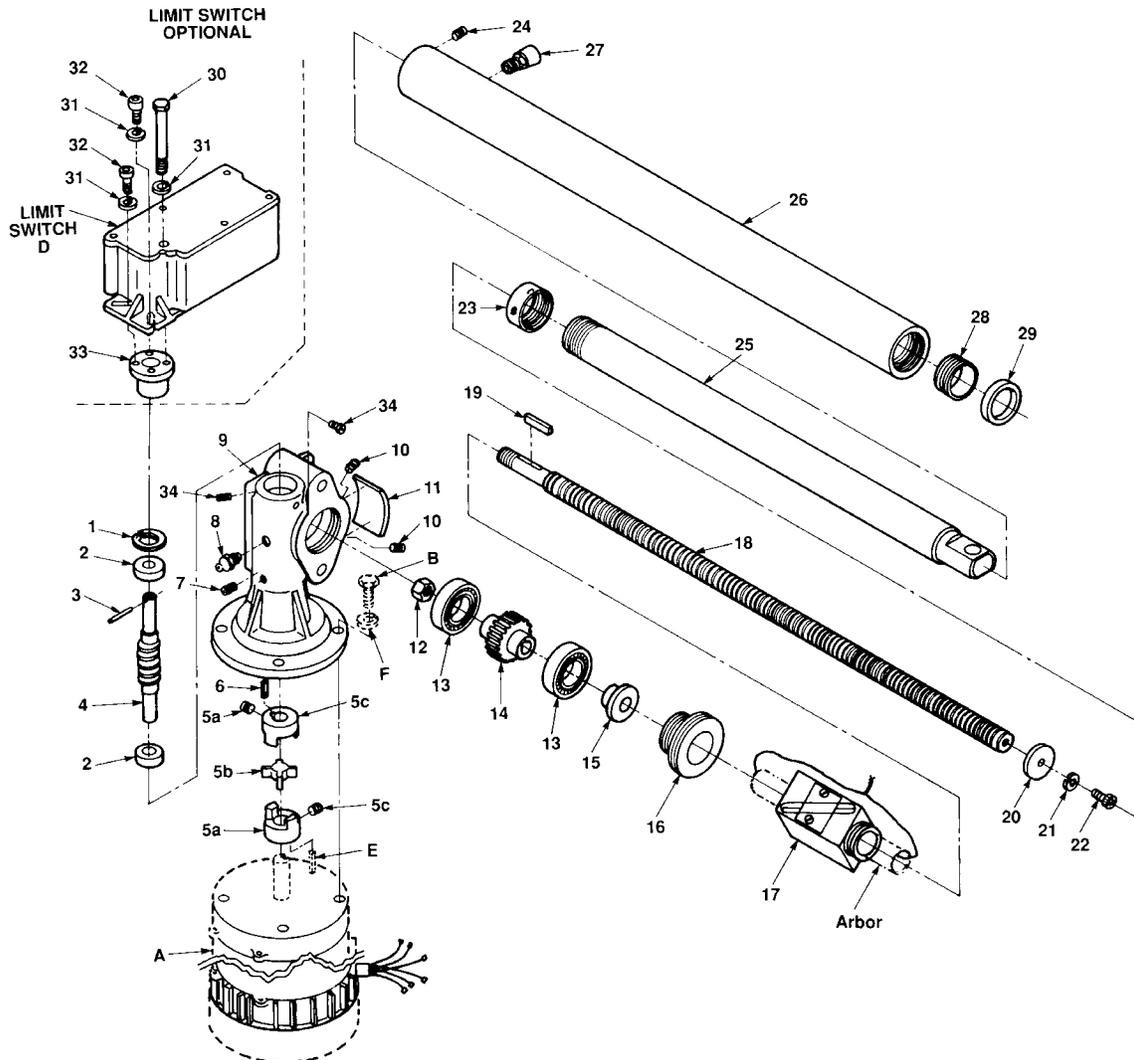
Index No. Fig. 6-2	Part Name	Qty Req.	Part Number
17	Ball Nut (BM-2464)	1	SK-3801-3
	Ball Nut (BM-2465)	1	SK-2802-6
18	Ball Screw (BM-2464)	1	SK-2554-25.*
	Ball Screw (BM-2465)	1	SK-2465-25.**
19	Key (Screw)	1	S-10-72
20	Stop Disc	1	SK-2802-8-1
21	Lock Washer	1	H-4005-P
22	Soc. Head Cap Screw	1	S-49-16
23	Tube Nut Coupling	1	SK-2465-24
24	Set Screw (Coupling)	6	S-7-89
25	Tube & Clevis Sub-Assembly	1	SK-2465-26.**A
26	Outer Tube	1	SK-2465-27.**
27	Air Vent	1	SK-2015-218
28	Guide Bushing	1	SK-2465-28
29	Wiper Scraper Seal	1	SK-6415-16
30	Hex Head Cap Screw	1	S-44-157
31	Lock Washer	3	H-4084-P
32	Soc. Head Cap Screw	2	H-2201
33	Limit Switch Adapter	1	SK-2465-11
34	Set Screw	2	S-52-1

*Dash No. Is Equal to Travel

**For Model BM-2465 Dash No. Is Equal to travel.

+Consists of 5a Coupling Body, 5b Spider, 5c Set Screw

For Model BM-2464 Dash no is equal to travel plus 1



**Figure 6-2. Exploded Illustration of Translating Tube Ball Screw Modular Actuator
(Models BM-2464 and BM-2465)**

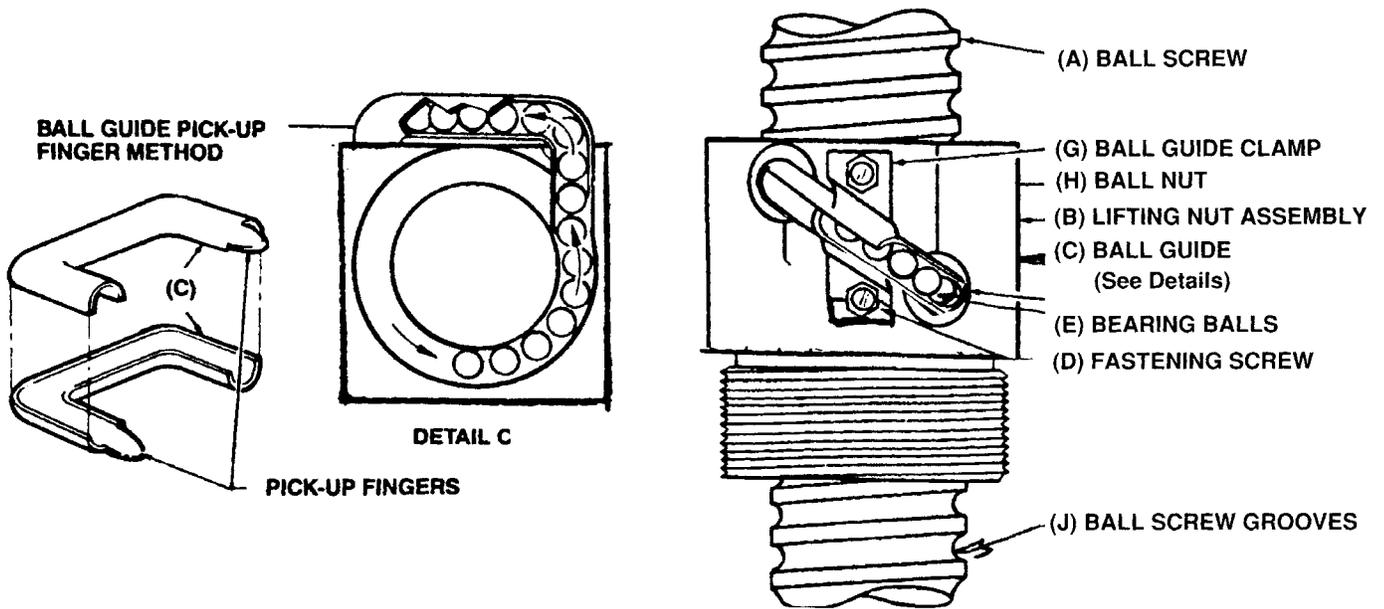


Figure 6-3. Ball Nut and Ball Screw Assembly

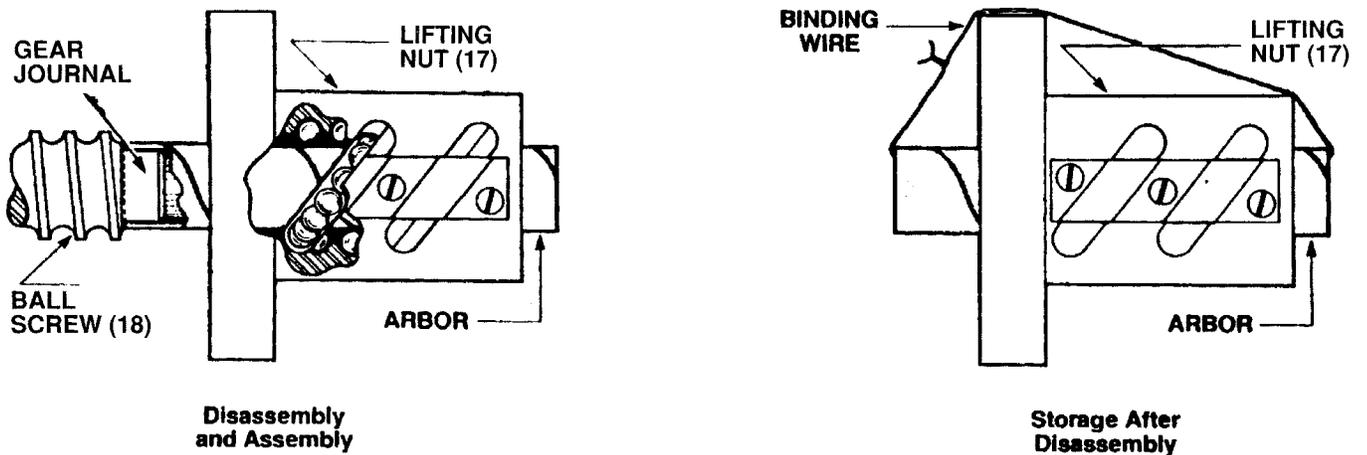


Figure 6-4. Ball Nut Storage Arbor

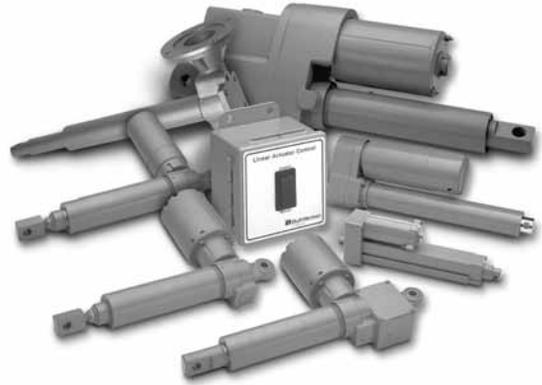
⚠ WARNING

Use only replacement parts supplied by or approved by Duff-Norton. Non-authorized parts may be inadequate, result in in serious injury or death in event of failure.

Duff-Norton also Manufactures



Mechanical Actuators



Electromagnetic Actuators



Rotary Unions



Mechanical Jacks

WARNING

The equipment shown in this catalog is intended for industrial use only and should not be used to lift, support, or otherwise transport people unless you have a written statement from the Duff-Norton Company which authorizes the specific actuator unit as used in your applications suitable for moving people.



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

Phone: (800) 477-5002 • (704) 588-4610

Fax: (704) 588-1994

Email: duffnorton@cmworks.com

www.duffnorton.com

