

Duff-Norton[®] **Mechanical Actuators**

Rotating Ball Screw Actuators

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

***Publication Part No.
SK-2373-R***



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® rotating ball screw actuators. It describes and details procedures for installation, disassembly, cleaning, inspection, and assembly of these actuators.

1-2. Applications

Industrial Use Only 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 Company 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 3-1. Specifications

Standard Actuator Model Numbers	Upright	UM28632	KUM2803/UM9803	KUM28004/UM98004	KUM2804/UM9804	UM9806	UM98061	UM9811	UM98111	AUM9821	UM9826	UM2861
Special Actuator Model Numbers	Inverted	DM28632	KDM28031/UM98031	KDM28004/UM98004	KDM2804/DM98004	DM9806	DM98061	DM9811	DM98111	ADM9821	DM9826	DM2861
Capacity, Tons	Upright	UM38632	UM3803/UM9803	UM38004/UM98004	UM3804/UM108004	UM10806	UM10806	UM10811	UM10811	UM10821	UM10826	UM3861
Diameter of Lifting Screw (inches)	Inverted	DM32632	DM3803/UM9803	DM38004/UM98004	DM3804/DM108004	DM10806	DM10806	DM10811	DM10811	DM10821	DM10826	DM3861
		1/2	2	2	3	5	5	10	10	20	25	50
		5/8	1	1	1 11/64	1 1/2	1 1/2	1 1/2	1 1/2	2 1/4	3	4
		.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
		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	8 1/4 x 11	10 1/4 x 13 3/4	9 3/4 x 19 3/4
Worm Gear Ratios	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
	Optional	—	24:1	—	24:1	—	—	—	—	—	—	—
Turns of Worm For 1" Raise	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
	Optional	—	96	—	58.104	—	—	—	—	—	—	—
Maximum H.P. Per Actuator	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
	Optional	—	1/2	—	1/2	—	—	—	—	—	—	—
Starting Torque at Full Load (lb-ins)	Std Ratio	10.5	50	180	110	220	500	350	800	700	925	2,700
	Optional	5.0	30	80	68	90	206	175	400	325	475	1,500
	Optional	—	25	—	50	—	—	—	—	—	—	—
Running Torque at Full Load (lb-ins)	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
	Optional	—	20	—	45	—	—	—	—	—	—	—
Actuator Efficiency Rating (%)	Std Ratio	65	59	59	59	70	70	65	65	61	60	55
	Optional	38	44	33	44	39	39	42	42	44	39	33
	Optional	—	33	—	33	—	—	—	—	—	—	—
Weight with Base Raise of 6" (lbs)		2.75	20	20	21	40	40	50	50	115	235	520
Weight for Each Additional 1" of Raise (lbs)		0.10	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
	Optional	—	0.5	—	0.5	—	—	—	—	—	—	—

NOTE

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

*Dimensionally same as Model 2803

† Dimensionally same as Model 9806

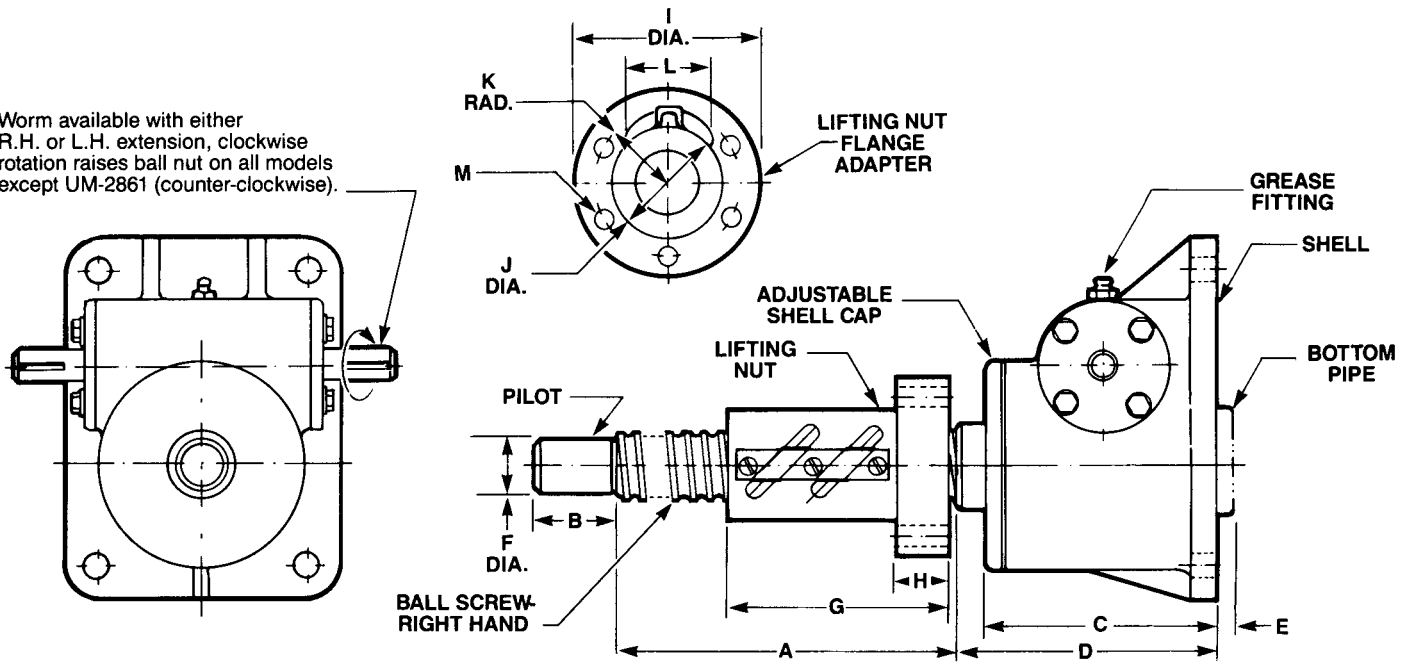
‡ Dimensionally same as Model 9811

** 9803 Base is 4 1/8" x 6"

Δ Prefix for these model numbers is KUM for upright units and KDM for inverted units.

1-4. Dimensions

Worm available with either R.H. or L.H. extension, clockwise rotation raises ball nut on all models except UM-2861 (counter-clockwise).



NOTE

Ball nut must be kept from rotating to prevent it from self-lowering.

Worm and gear set is not self-locking.

Use brake on worm shaft or motor.

Housing dimensions and base configurations vary.

Table 3-2. Upright Models

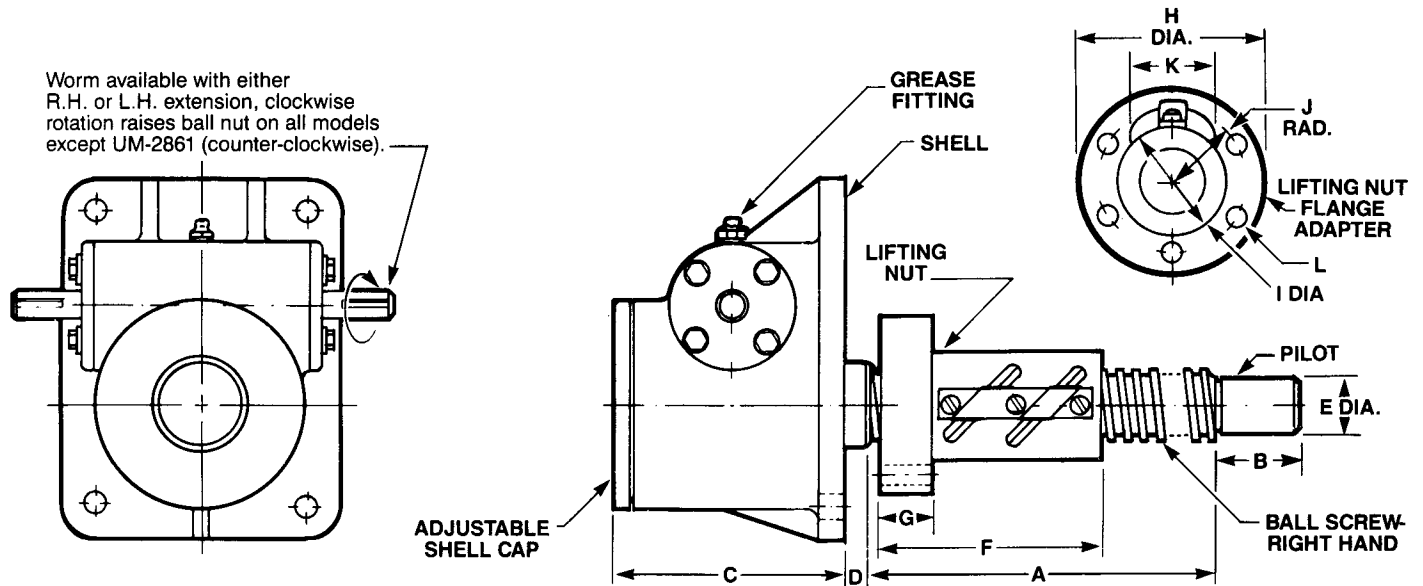
Model Number	Rating	Drawing Ref.	A	B	C	D	E	F	G	H	I	J	K	L
UM-28632	1/2 TON	28631	RAISE + 2	5/8	2 3/8	C	0	.437	1.740	.530	2.600	1" Sq.	.797	.822
UM-9803 & KUM-2803	2 TON	9802 & 2802	RAISE + 3 1/16	1 1/8	4 1/16	C	0	.750	2.377	.630	3 1/4	1.500 Sq.	1.194	1.104
UM-98031* & KUM-28031*	2 TON	9802 & 2802	RAISE + 3 11/16	1 1/8	4 1/16	C	0	.750	3.030	.630	4 13/64	1.500 Sq.	1.194	1.104
UM98004 & KUM-28004	3 TON	28003	RAISE + 3 3/4	1 1/8	4 1/16	4 1/2	0	.750	3.395	.832	4 15/16	2.125	1.386	1.587
UM-9806	5 TON	9805	RAISE + 4 5/8	1	5 1/4	C	0	1.000	4.333	.895	4 15/16	2.625	1.690	1.981
UM-98061*	5 TON	9805	RAISE + 4	1	5 1/4	C	0	1.000	3.648	1.020	4 15/16	2.625	1.720	1.718
UM-9811	10 TON	9810	RAISE + 6	1	5 5/8	C	0	1.000	4.333	.895	4 15/16	2.625	1.690	1.981
UM-98111*	10 TON	9810	RAISE + 5	1	5 5/8	C	0	1.000	3.648	1.020	4 15/16	2.625	1.720	1.718
AUM-9821	20 TON	9820	RAISE + 8	2 1/2	7 1/8	8 1/8	1 3/4	1.750	6.706	1.582	5 3/8	3.375	2.272	2.561
UM-9826	25 TON	9825	RAISE + 10	2 1/4	8 7/8	10 1/2	2	2.250	9.395	2.020	7 3/8	4.751	3.076	3.349
UM-2861*	50 TON	2860	RAISE + 15	3 1/4	10 7/8	12	3/4	3.250	12.625	2.020	9 3/4	5.880	3.756	4.029

*1" Lead Screw Models

Note: Dimensions are subject to change without notice.

All dimensions in inches unless otherwise specified.

1-4. Dimensions (cont.)



NOTE

Ball nut must be kept from rotating to prevent it from self-lowering.

Worm and gear set is not self-locking.

Use brake on worm shaft or motor.

Housing dimensions and base configurations vary.

Table 3-3. Inverted Models

Model Number	Rating	Drawing Ref.	A	B	C	D	E	F	G	H	I	J	K	L
DM-28632	1/2 TON	28631	RAISE + 2	5/8	2 3/8	3/8	.437	1.740	.530	2.600	1" Sq.	.797	.822	4 Holes - 17/64 Dia. On 2 3/32 Dia. B.C.
DM-9803 & KDM-2803	2 TON	9802 & 2802	RAISE + 3	1 1/8	3 3/4	5/8	.750	2.377	.630	3 1/4	1.500 Sq.	1.194	1.104	4 Holes - 17/64 Dia. On 2 3/4 Dia. B.C.
DM-98031* & KDM-28031*	2 TON	9802 & 2802	RAISE + 3 5/8	1 1/8	3 3/4	5/8	.750	3.030	.630	4 13/64	1.500 Sq.	1.194	1.104	4 Holes - 17/64 Dia. On 2 3/4 Dia. B.C.
DM98004 & KDM-28004	3 TON	28003	RAISE + 3 3/4	1 1/8	3 3/4	1	.750	3.395	.832	4 15/16	2.125	1.386	1.587	4 Holes - 25/64 Dia. On 3 7/16 Dia. B.C.
DM-9806	5 TON	9805	RAISE + 4 5/8	1	5 1/4	3/4	1.000	4.333	.895	4 15/16	2.625	1.690	1.981	4 Holes - 17/32 Dia. On 4 1/16 Dia. B.C.
DM-98061*	5 TON	9805	RAISE + 4	1	5 1/4	3/4	1.000	3.648	1.020	4 15/16	2.625	1.720	1.718	4 Holes - 17/32 Dia. On 4 1/8 Dia. B.C.
DM-9811	10 TON	9810	RAISE + 6	1	5	1 1/8	1.000	4.333	.895	4 15/16	2.625	1.690	1.981	4 Holes - 17/32 Dia. On 4 1/16 Dia. B.C.
DM-98111*	10 TON	9810	RAISE + 5	1	5	1 1/8	1.000	3.648	1.020	4 15/16	2.625	1.720	1.718	4 Holes - 17/32 Dia. On 4 1/8 Dia. B.C.
ADM-9821	20 TON	9820	RAISE + 8	2 1/2	7 1/8	1 5/8	1.750	6.706	1.582	5 3/8	3.375	2.272	2.561	6 Holes - 21/32 Dia. On 4 3/8 Dia. B.C.
DM-9826	25 TON	9825	RAISE + 10	2 1/4	8 7/8	2 1/2	2.250	9.395	2.020	7 3/8	4.751	3.076	3.349	8 Holes - 25/32 Dia. On 6 1/4 Dia. B.C.
DM-2861*	50 TON	2860	RAISE + 15	3 1/4	11	2 1/2	3.250	12.625	2.020	9 3/4	5.880	3.756	4.029	6 Holes - 1 1/32 Dia. On 8 Dia. B.C.

*1" Lead Screw Models

Note: Dimensions are subject to change without notice.

All dimensions in inches unless otherwise specified.

1-5. Important Precautions

In order 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 actuator supporting members.
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.
4. The 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 lifting nut travel to go beyond catalog closed height (A) of actuator or serious damage to lifting nut or the internal actuator mechanism may result. Refer to table of specifications (par. 1-3) for closed height (A) of respective units.

5. 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.
6. The lifting screw should not be permitted to accumulate dust and grit on the threads. If possible, screws should be protected by some means such as a boot.
7. The ball screw and lifting nut should be checked periodically for excessive backlash and spalling of race ways.
8. The lubrication procedures for normal and severe service conditions, as described in Section II, paragraph 2-1, should be closely followed.
9. Due to high efficiency of Ball Screw actuators, a brake must be used in conjunction with the motor selected for actuator positioning (refer to current catalog for brake selection data).

1-6. 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, the Duff-Norton Company.

Authorization for return must be received from the Duff-Norton Company 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 Mobile XHP461 or XHP462 Extreme Pressure Grease.

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 not be used.

For severe service conditions, the actuators should be lubricated more frequently using the above grease (daily to weekly depending on conditions). If duty is heavy, an automatic lubrication system is strongly recommended.

For most applications 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.

2-2. Rebuild Procedure

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

1. Disassembly Inspection (Refer to Figure 3-1). To determine the need for replacement of the ball screw (5) or the lifting nut (24) the following inspection should be made prior to disassembly of the lifting nut from the ball screw: Inspect the lifting nut assembly (24) and ball screw (5) as follows:
 - a. Lubricate the lifting nut assembly and ball screw. See paragraph 2-1.
 - b. Inspect the ball screw grooves for signs of excessive wear, pitting, gouges, corruptions, 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 lifting nut assembly, first in one direction and then in the opposite direction. This axial movement of the lifting 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.

- a. If the backlash is over .010" and the ball screw appears usable, replace ball nut.
2. Disassembly of Lifting Nut (24) From Ball Screw (5) (Refer to Figure 2-1).
 - a. Refer to Table 2-1 and select a tubular arbor with an I.D. slightly larger than the screw pilot diameter. The arbor O.D. should allow it to slide into the lifting nut between the screw and the bearing

balls. The arbor should be long enough to extend 1 1/2" to 2" beyond each end of the lifting nut.

NOTE

Apply tape to arbor O.D. at end away from ball screw pilot to prevent lifting 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.)

Table 2-1. Dimensions Ball Nut Storage Arbor

Actuator Model No.	Ball Screw Root Dia. (in)	Arbor O.D. (in)
28632	.480	.500
9803 / 2803	.820	.889
98031 / 28031	.820	.889
28004 / 98004	.870	.889
9806	1.140	1.156
9811	1.140	1.156
98111	1.140	1.156
9821	1.850	1.884
9826	2.480	2.500
2861	3.338	3.366

- b. Holding arbor firmly against shoulder of ball screw pilot (5), unthread lifting nut (24) from ball screw (5). As lifting nut bearing balls disengage from ball screw grooves (5), center lifting nut on arbor and remove arbor from ball screw pilot.

NOTE

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

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

NOTE

Keeping assembly together in this manner will eliminate the need for complete assembly of the lifting nut during reassembly go the actuator. Complete actuator disassembly as follows:

- 4. Remove pipe (4) from shell (3) [upright units] or from shell cap (2) [inverted units].

NOTE

Some models have an expansion plug (4a) in place of pipe (4). If the expansion plug must be replaced, it will be removed later per Step 18.

- 5. Remove set screw (10 from shell cap (2) and remove shell cap from shell (3).

NOTE

It may be necessary to tap shell (2) with a hammer to loosen shell cap.

- 6. Remove ball screw (5) and gear assembly (6) from shell. For ease in removing ball screw and gear assembly, loosen cap screws (9) holding flanges (11) and shift worm (14) slightly.

NOTE

On some models it may be necessary to remove worm before moving ball screw and gear assembly (see Step 7 and 8).

- 7. Remove top bearing (7) which may be attached to either shell cap (2) or worm gear assembly (6).
- 8. Remove cap screws (9), lockwashers (10) and flanges (11).

NOTE

Be careful not to lose flange shims (12).

For 1/2-ton Models - Remove four set screws (9a) from shell (3) and unthread bushings (11a) from shell.

- 9. Remove worm (14) and worm bearings (15) from shell (3) by striking end of worm shaft with a soft-head mallet or hammer.
For 1/2-Ton Model - Remove worm (14) with needle bearings (15a) and races (15b) from shell (3) and remove needle bearings and races from worm.
- 10. Remove bottom load bearings (8) which may be attached to either shell (3) or gear (6).
- 11. Press oil seals (13) out of flanges (11).
- 12. Remove bearings (15) from worm (14) with puller or press.

NOTE

This step is not necessary if worm (14) or bearings (15) are not damaged.

- 13. Remove set screw (21) from locknut (20).

NOTE

Some models may not utilize a set screw.

- 14. Restraining ball screw (5) from turning (use soft jaws), remove locknut (20) from ball screw (5).

NOTE

If all parts are to be reused, match-mark end of screw and locknut so that they can be reassembled in the same order.

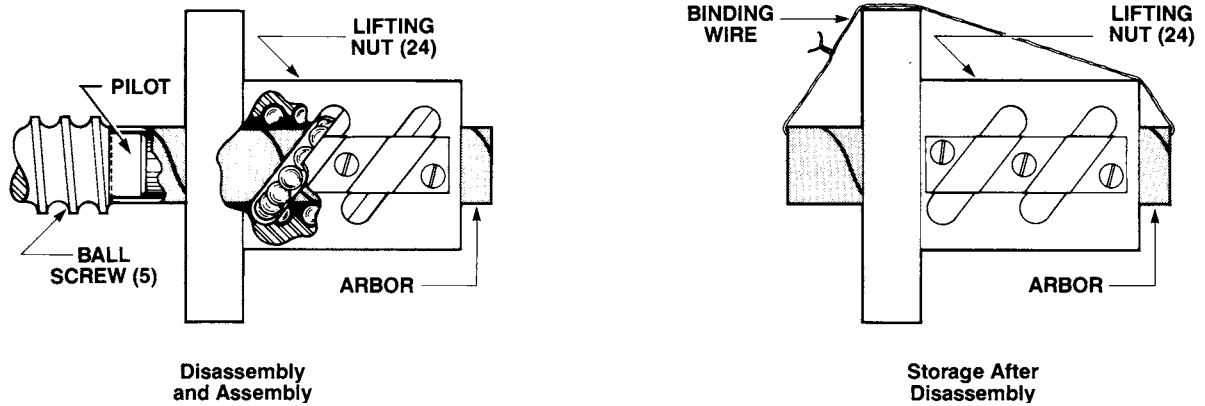


Figure 2-1. Ball Nut Storage Arbor

15. Remove worm gear (6) from ball screw (5).

NOTE
It may be necessary to tap on worm gear assembly to remove it. Use a soft face hammer. Do not tap on gear teeth.

16. Remove key (22) from ball screw (5).
17. Remove spacer (23) from ball screw.

NOTE
On some models spacer is threaded.

NOTE
Some models do not have a spacer.

18. Inverted Models - Remove guide bushing (16) from shell (3).
19. For units with an expansion plug (4a) in shell (3) or shell cap (2), damaged plugs must be removed. Drive or press plug out of shell or shell cap with a large diameter punch (1").

Disassembly is now complete.

2-5. Cleaning

1. Use degreasing solvent to remove dirt, grease or oil from all parts. Be sure to flush the lifting nut assembly (24) thoroughly while running 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.

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 (4), worm gear assembly and flanges (11) for burrs or scratches on their working or mating surfaces.
3. Check small common components (screws, etc.) and replace as required.
4. Check bearings (7), (8), and (15) for seizure, galling or play and replace as required.

2-7. Assembly

1. Refer to Figure 2-2 for replacement of expansion plug (4a) in shell (3) for upright units or shell cap (2) for inverted units.
 - a. Set shell cap (2) [inverted models] or shell (3) [upright models] over a steel bar which is approximately 1/8" to 3/16" shorter in height than the shell or shell cap. The diameter of the bar should be close to the I.D. of the shell or shell cap.
 - b. Place expansion plug (4a) on the bar (concave surface down) and flatten against the bar with a large diameter punch or press making sure that the plug is flattened throughout its entire diameter.
2. For units with tapered roller load bearings, press bearing cones onto worm gear (6) with small end of cones away from gear face. Be sure that cones are seated properly against gear shoulder.
3. Assembly spacer (23) on ball screw (5).

NOTE

On models with threaded spacers, make sure that spacer is tightly threaded against ball screw shoulder.

NOTE

Some models do not have a spacer.

4. Insert key (22) in ball screw (5).
5. Assemble worm gear (6) on ball screw (5). For counterbored worm gears, face counterbore away from ball screw threads.
6. Thread locknut (20) on ball screw (5) and tighten securely against worm gear (6). Make certain that this assembly is tightly drawn up.

NOTE

On some locknuts the tapped set screw hole is not centered. In this case assemble the locknut with the tapped hole farthest away from the worm gear face.

7. Install set screw (21) in locknut (20) locking the nut in place (some models do not utilize a set screw).

NOTE

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

8. Press worm bearings (15) on worm (14) making sure that bearings are seated properly against worm shoulder.

NOTE

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

9. Inverted units only - Install guide bushing (16) in shell (3). Guide bushings must be flush with base. With a center punch, lock guide bushing in place by peening on thread O.D. of bushing and shell.
10. Install bottom load bearing (8) in shell (3).

NOTE

For actuators with tapered roller load bearings, install bearing cup.

11. Install worm (14) and bearing (bearing cone) assembly (15) in shell. For units with tapered roller worm bearings, installed bearing cups in shell.

For 1/2-ton Models - Slide thrust race (15b), needle bearing (15a) and second thrust race (15b) on each end of worm (14) and position worm in shell (3).

NOTE

For some units it is easier to assemble worm (14) and bearing assembly (15) after worm gear (6) is in place. See Step 11.

12. Press oil seals (13) in flanges (11).

NOTE

The sealing element of the seal should face inward. Seals are not required on 1/2-ton models.

13. Assemble worm flanges (11) with shims (12) and bolt in place with cap screws (9) and lockwashers (10). Care should be taken to prevent cutting of seal on worm keyway.

For 1/2-Ton Models - Slide bushings (11a) over each end of worm shaft (14) and thread bushings into shell (3) until they are positioned to control lateral movement of worm to within .002 inches. Bushings should be equally threaded into each end of shell. Lock bushings in place with set screws (9a).

NOTE

If new parts have been installed, lightly spot-drill bushings prior to locking in place with set screws.

14. Install ball screw (5) and worm gear assembly (6).

NOTE

For some units it is easier to install worm and bearing assembly after worm gear (6) and ball screw (5) assembly are in place. See Step 11.

NOTE

After worm, worm gear and ball screw assembly are in place and flanges (11) are assembled, 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 too much end play is present, remove shims as required. If worm does not turn freely, add shims as required.

15. Assemble top load bearing (7) on worm gear (6).

NOTE

For units with tapered load bearings, install bearing cup in shell cap (2).

16. Fill shell (3) approximately one half full of grease and install grease fitting (17).
17. 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 will put a light drag on worm. If worm is hard to turn, back off slightly on shell cap.

- 18. Install set screws (1) in shell cap (2). Tap shell cap sharply with hammer and re-tighten set screw.

NOTE

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

- 19. All models except those with expansion plugs - Install pipe (4) in shell (3) for upright models or in shell cap (2) for inverted models.
- 20. Refer to Figure 2-1 for reassembly of lifting nut (24) from tube arbor to ball screw (5).
 - a. With lifting nut centered on arbor tube, grasp lifting nut and arbor to prevent lifting nut from running off of arbor, and remove binding wire.
 - b. Position arbor over ball screw (5) pilot.

NOTE

Flange of lifting nut should face toward actuator shell and away from ball screw pilot.

- c. Gently slide lifting nut (24) down arbor and thread it onto ball screw (5). After lifting nut is completely threaded onto ball screw, remove arbor from ball screw pilot.

NOTE

Wrap tape around ball screw threads (below pilot and above lifting nut) to prevent lifting nut from running off of ball screw during installation of unit.

- 21. Manually operate actuator to insure proper functioning of all components prior to use.

ASSEMBLY IS NOW COMPLETE.

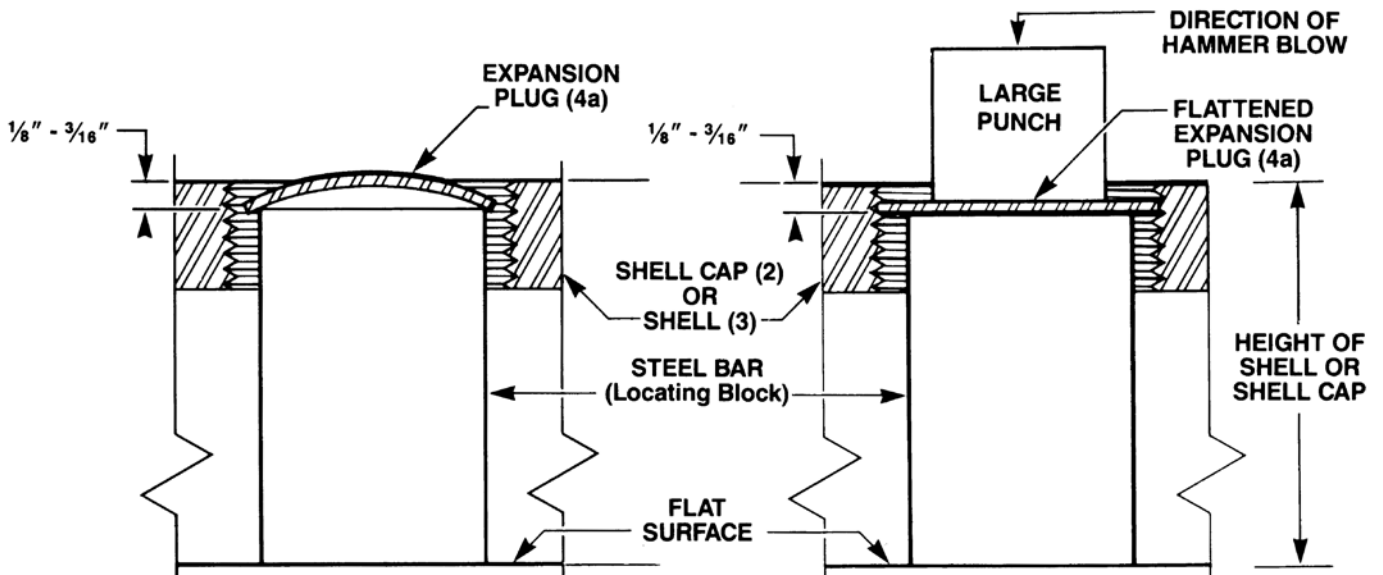


Figure 2-2. Expansion Plug Replacement

Section III Illustrated Parts List

3-1. General

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

Table 3-1. Parts List for 2800 and 9800 Series Rotating Ball Screw Actuators

Index No.	Part Name	Qty Req.
1	Screw, Set (Shell Cap)	2
2	Shell Cap	1
3	Shell, Actuator	1
4	Pipe, Bottom	1
4a	Plug, Expansion	1
5	Ball Screw	1
6	Worm Gear	1
7	Bearing, Top Load	1
8	Bearing, Bottom Load	1
9	Screw, Cap	8
9a	Screws, Set (1/2-ton model)	4
10	Washer, Lock	8
11	Flange, Worm	2
11a	Bushing, Worm (1/2-ton model)	2
12	Shim, Flange	2

Index No.	Part Name	Qty Req.
13	Seal, Oil	2
14	Worm	1
15	Bearing, Worm	2
15a	Bearing, Needle (1/2-ton model)	2
15b	Washer, Thrust (1/2-ton model)	4
16	Bushing, Guide (Inverted Models Only)	1
17	Fitting, Grease	1
18	Nameplate	1
19	Screws, Drive	2
20	Nut, Lock	1
21	Screw, Set (Locknut)	1
22	Key	1
23	Spacer	1
24	Lifting Nut	1

When ordering spare parts be sure to include:

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

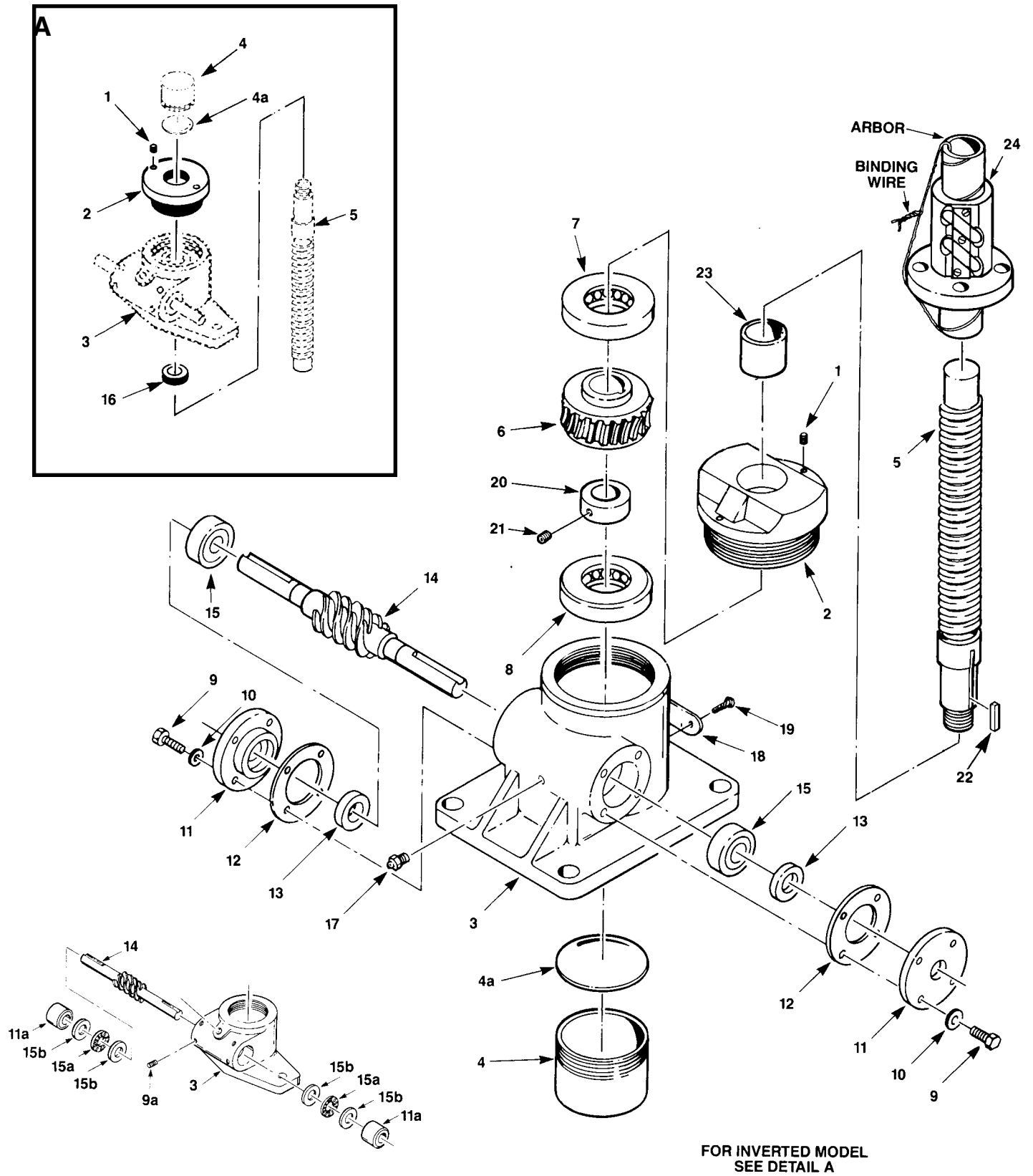
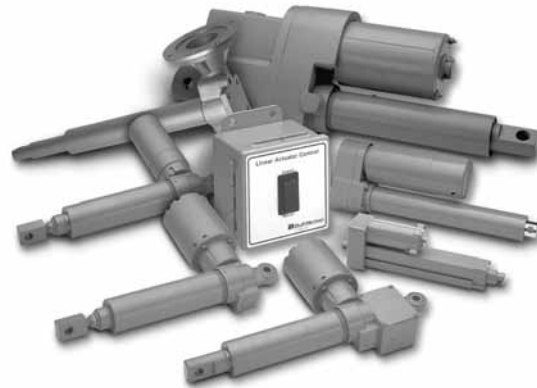


Figure 3-1. Exploded Illustration 2800 and 9800 Series Ball Screw Actuators

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