

Maintenance and Service

If proper attention is paid to ball bearing screw selection and installation, virtually no maintenance will be required except for routine lubrication.

All Thomson ball screw assemblies are designed for maximum life and trouble-free operation when adequately serviced and maintained. Ball screw disassembly should be attempted only after complying with the general inspection and maintenance instructions outlined in this section. Be positive that the ball screw is at fault. Disassembly should be done only by persons familiar with ball screw assembly principles. In any unusual circumstances, contact Thomson.

Troubleshooting

Misalignment is one of the most common problems. Evidence of misalignment can generally be detected by one of the following situations:

- Squealing noise caused by the balls sliding in one or more of the circuits.
- Roughness in the form of vibrations or slightly erratic operation. This can normally be detected by "feel" when placing your hand on the return circuits.
- Excessive heat at the ball nut. Any appreciable temperature above the ambient of adjacent components should be considered excessive.

Gouging or scoring marks on the ball contact area of the screw may be caused by trapped balls between the circuits, broken balls, broken pick-up fingers or deflectors, or foreign objects which may have been digested by the ball nut.

When any of these conditions are encountered, examine the installation and, if necessary, immediately take corrective action to eliminate the cause and prevent further damage.

General Inspection of the Screw Shaft

Inspect the shaft ball grooves for signs of excessive wear, pitting, gouges, corrosion, or brinelling. Normally, where any of these conditions exist on most Thomson Precision units, it may be more economical and advisable to replace the screw shaft. Consult Thomson for evaluation and possible repair of Precision Plus units.

Backlash

Secure the screw shaft rigidly in a table clamp or similar device. Make sure it cannot rotate. Push firmly on the ball nut, first in one direction, then in the opposite direction. The axial movement of the ball nut is the backlash. This measurement can be taken with a dial indicator. Make sure that neither member rotates while the readings are taken.

Backlash with the following limits is considered acceptable:

Ball Diameter	Max. Permissible [†] Lash (used unit)	Max. Lash (new unit)
0 - 1/8"	.008	.005
5/32" - 1/4"	.014	.007
9/32" - 15/32"	.025	.010
1/2" and up	.050	.015

[†] Values based on wear resulting from foreign material contamination and/or lack of lubrication.

If, after inspection, the screw shaft appears to be usable but has excessive backlash, proceed with further disassembly and component inspection.

Disassembly

General Instructions: Have a clean container, such as a tote tray or cardboard box, handy for each ball return circuit of the ball nut assembly. A piece of clean cloth should be placed on the work table and gathered around the edge to form a pocket to retain the balls. Place the ball nut assembly over the cloth and remove the clamp.

Where more than one guide is held in place by a single clamp, secure each remaining guide with a strip of tape around the diameter of the ball nut to prevent accidental guide removal before you are ready for that circuit.

Remove both halves of the guide simultaneously to prevent distortion to either half. Catch all the balls from this circuit on the cloth by rotating the screw or ball nut slowly. Place the removed components into a container. Identify the container, the guide, and the circuit of the ball nut so the components can be reassembled in the same circuit from which they were removed. Repeat for each circuit.

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General Description

A Thomson ball screw is a force and motion transfer device belonging to the family of power transmission screws. It replaces sliding friction of the conventional power screw with the rolling friction of bearing balls. The balls circulate in hardened steel races formed by concave helical grooves in the screw and nut. All reactive loads between the screw and nut are carried by the balls which provide the only physical contact between these members.

As the screw and the nut rotate relative to each other, the balls are diverted from one end and carried by ball guides to the opposite end of the nut. This recirculation permits unrestricted travel of the nut in relation to the screw.

Method I: Ball nuts using a deflector return system are identified by threaded deflector studs extending through holes in the nut and the guide clamp. Lock nuts on the deflector studs are used to secure the clamps that hold the guides in place.

Method II: Ball nuts with pick-up fingers are identified by the finger projections integral with the guide. In this method, capscrew fasteners are used to fasten the clamp that holds the guide in place.

Pick-up Finger Method: Refer to the Component Inspection section.

Deflector Method: To remove the deflectors from the ball nut assembly, remove the ball nut from the screw shaft. The ball nut must be rotated since the deflectors engage loosely in the screw ball grooves and act as a thread. The deflectors now can be removed from the opposite ends of the ball nut so that you can use them for reference during component inspection.

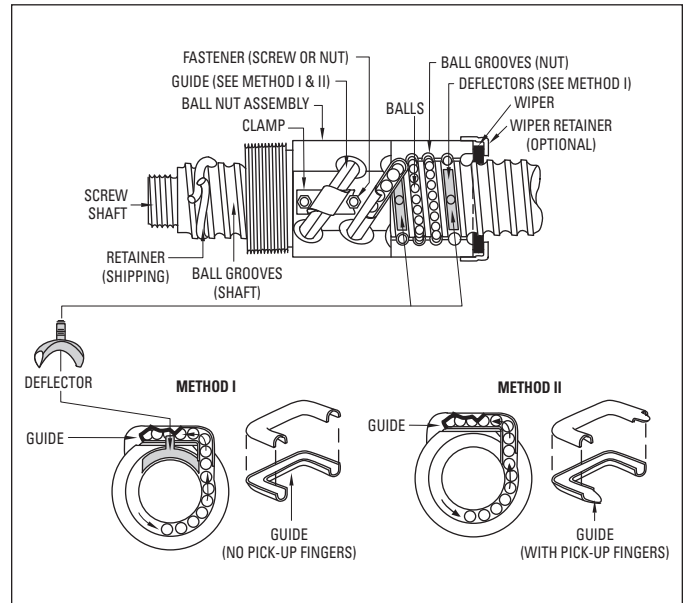


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Component Inspection and Replacement

Balls: If there is more than one circuit in the ball nut, count the balls in each of the separate containers to be sure each has the same number (within a variation of three balls). Check random samples (about 1/4 of the balls for a circuit) for the following:

- True roundness, with a .0001 in. maximum variation.
- Signs of scuffing or fish scaling.
- More than .0001 in. diameter variation between balls of the same circuit.

Where the random sampling shows balls out of round, signs of scuffing or variation of diameter in excess of .0001 in., or short count in any circuit, all balls in the unit must be replaced with a complete set of new balls. Ball kits are available from Thomson.

To ensure 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 in. If Thomson kits are not used for service, make sure the balls meet the above specification. (Note: Use only chrome alloy steel balls, Grade 25 or better. Carburized balls or carbon steel balls will not provide adequate life.) See Ball Chart table.

Deflectors: Examine the ends of the deflectors for wear or brinelling. Wear can be determined by comparison with the unused ends of the two outside deflectors. Since these ends have not been subjected to wear from balls, they are in a like-new condition. Where wear or brinelling is evident, it is best to replace the deflectors with new ones.

Pick-up Fingers: Inspect the pick-up fingers, which consist of short extensions at the end of the guides. Replace with new guides if a ball brinell impression appears on the tip. Remove any burrs on the fingers. If the guides were distorted during removal, replace with new guides.

Ball Nut: Inspect the internal threads of the ball nut for signs of excessive wear, pitting, gouges, corrosion, spalling, or brinelling in the ball groove area. On large ball nuts, running the tip of your finger along the groove which is accessible will enable you to detect a secondary ridge in the ball groove area when wear is excessive or brinelling has occurred. (The extended lead of a mechanical pencil can also be used as a groove probe.) If inspection indicates any of these flaws, the ball nut assembly should be replaced.

Wipers: Prolonged use and environmental conditions will generally determine the condition of wipers. After cleaning wipers, reassemble over the screw shaft to determine whether a snug fit is maintained over the complete contour of the screw shaft. Any loose fitting or worn wipers should be replaced. Wiper kits are available for Thomson ball screws.

Note: If the assemblies have had extended use, it is recommended that all low cost items be replaced with new parts (i.e., balls, guides, deflectors, clamps). These can be ordered by simply referring to the assembly part number purchased.

Reassembly

Cleaning: Clean all components with a commercial solvent and dry thoroughly before reassembly.

Deflector Method: Where the ball nut is equipped with deflectors, install these and secure temporarily by running the lock nuts down the studs and tightening.

General Instructions: Position the ball nut on the screw shaft. Ball nuts with deflectors have to be screwed on. Other ball nuts will slide on.

Using dowels with an O.D. approximately equal to the diameter of the balls, center the ball nut grooves with the 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 holes up, fill the circuit with 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 ball in the container should fit into one of the halves of the return guide with space for about three to six 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 the circuit.

Place a dab of bearing grease at each end of the half return guide to hold the balls in place. Now, take the other half of the return guide and place it over the half guide you have filled with balls and insert two ends of the ball guide into the respective hole in the ball nut. Seat by tapping gently with a rawhide or plastic mallet.

Note: Where more than one ball circuit must be filled in the ball nut, tape the ball return circuit to the ball nut to prevent accidental removal. Repeat the filling procedure for the remaining circuits.

With all ball circuits filled and all return guides in place, secure the return guides with the retaining clamp.

CAUTION: Care should be taken to ensure that balls are not accidentally trapped between circuits in units having pick-up fingers. In deflector units, the deflectors will fill this space.

Inspection: Wrap tape around the ball grooves at the ends of the screw shaft to prevent the ball nut from rolling off. Now inspect the assembly for free movement of the ball nut along the entire stroke. There should be no binding, squeal, or roughness at any point.

Reducing Backlash: Backlash can be reduced by replacing all the balls with a larger size. If the diameters of the bearing balls are increased by .001 in., backlash is decreased by .003 in. (Ball kits are available for these applications.)

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Ball Chart (Grade 25 or Better)

Size (Inches)	Part Number	Nominal Diameter (Inches)	Number of Balls
.187 x .050	7821609	0.039	30
.187 x .062	7821579	0.039	30
.375 x .125	5709574	0.063	62
.375 x .125	5709576	0.063	62
.375 x .125	5709578	0.063	62
.375 x .125	8103-448-003	0.078	108
.375 x .125	8103-448-013	0.078	108
.500 x .200	8105-448-013	0.125	96
.500 x .200	8105-448-008	0.125	192
.500 x .500	8105-448-014	0.125	108
.500 x .500	8105-448-011	0.125	146
.500 x .500	8105-448-016	0.125	146
.631 x .200	8106-448-022	0.125	68
.631 x .200	8106-448-026	0.125	68
.631 x .200	5707645	0.125	67
.631 x .200	8106-448-009	0.125	70
.631 x .200	8106-448-008	0.125	70
.631 x .200	8106-448-015	0.125	140
.631 x .200	8106-448-019	0.125	140
.631 x .200	7832872	0.138	42
.631 x 1.000	7826713	0.125	46
.631 x 1.000	7827531	0.125	92
.750 x .200	8107-448-018	0.125	86
.750 x .200	8107-448-026	0.125	86
.750 x .200	8107-448-016	0.125	86
.750 x .200	8107-448-027	0.125	172
.750 x .200	8107-448-046	0.125	172
.750 x .200	8107-448-025	0.125	172
.750 x .500	8107-448-014	0.156	152
.750 x .500	8107-448-020	0.156	152
.750 x .500	8107-448-049	0.156	152
.750 x .500	8107-448-048	0.156	152
.750 x .500	8107-448-011	0.156	304
.875 x .200	5708277	0.125	184
1.000 x .250	8110-448-055	0.156	86
1.000 x .250	8110-448-032	0.156	89
1.000 x .250	8110-448-030	0.156	89
1.000 x .250	8110-448-056	0.156	171
1.000 x .250	8110-448-026	0.156	182
1.000 x .250	8110-448-024	0.156	182
1.000 x .250	8110-448-087	0.156	182
1.000 x .250	8110-448-088	0.156	182
1.000 x .250	8110-448-092	0.156	168
1.000 x .250	8110-448-089	0.156	168
1.000 x .250	8110-448-097	0.156	170
1.000 x .500	8110-448-022	0.156	196
1.000 x .500	8110-448-016	0.156	392
1.000 x 1.000	8110-448-086	0.156	100
1.000 x 1.000	8110-448-020	0.156	152
1.000 x 1.000	8110-448-034	0.156	152

Size (Inches)	Part Number	Nominal Diameter (Inches)	Number of Balls
1.150 x .200	8111-448-006	0.125	252
1.150 x .200	8111-448-014	0.125	224
1.150 x .200	8111-448-004	0.125	504
1.171 x .413	5707511	0.281	60
1.500 x .250	7833233	0.156	230
1.500 x .250	5701990	0.156	230
1.500 x .250	7833234	0.156	464
1.500 x .250	5704573	0.156	464
1.500 x .473	5707513	0.344	86
1.500 x .500	8115-448-016	0.312	140
1.500 x .500	8115-448-018	0.312	140
1.500 x .500	8115-448-006	0.312	280
1.500 x 1.000	8115-448-074	0.344	60
1.500 x 1.000	8115-448-080	0.344	60
1.500 x 1.000	8115-448-076	0.344	60
1.500 x 1.000	8115-448-014	0.344	68
1.500 x 1.000	8115-448-049	0.344	68
1.500 x 1.000	8115-448-075	0.344	120
1.500 x 1.000	8115-448-011	0.344	136
1.500 x 1.875	5707654	0.281	84
1.500 x 1.875	5704272	0.281	168
1.500 x 2.000	8115-448-056	0.281	96
1.500 x 2.000	8115-448-057	0.281	96
2.000 x .500	8120-448-011	0.375	150
2.000 x .500	8120-448-013	0.375	150
2.000 x .500	8120-448-006	0.375	300
2.000 x .500	8120-448-007	0.375	300
2.000 x 1.000	8120-448-021	0.375	160
2.000 x 1.000	8120-448-019	0.375	320
2.250 x .500	7833235	0.375	154
2.250 x 1.000	5704555	0.375	164
2.500 x .250	5703243	0.156	468
2.500 x .250	7823590	0.156	936
2.500 x .500	8125-448-010	0.375	184
2.500 x 1.000	8125-448-008	0.375	194
3.000 x .660	8130-448-007	0.500	180
3.000 x 1.500	5704986	0.500	166
4.000 x 1.000	5703258	0.625	186
.375 x 3	5706900 / 7828127	0.156	54
.625 x 3	5707445 / 7828128	0.187	60
.625 x 6	5708943 / 7828129	0.187	120
1.000 x 3	5707472 / 7828130	0.187	78
1.000 x 6	5708944 / 7828131	0.187	156
1.500 x 3	5707528 / 7828132	0.250	84
1.500 x 6	5708945 / 7828133	0.250	168
2.000 x 3	5707530 / 7828134	0.312	72
2.000 x 6	5708946 / 7828135	0.312	144
2.500 x 3	5707532 / 7828136	0.375	66
2.500 x 6	5708947 / 7828137	0.375	132
4.062 x 6	5708330 / 7828138	0.375	180
6.000 x 8	5704798 / 7828140	0.500	224

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Size (mm)	Part Number	Nominal Diameter (mm)	Number of Balls
25 x 10	7832938	3.500	164
32 x 10	7832801	5.556	54
40 x 5	7832807	3.500	180
40 x 20	7832813	5.556	156
40 x 40	7832816	7.144	96
12 x 5	7832773	2.381	48
16 x 5	7832777	3.500	42
20 x 5	7832780	3.500	54
20 x 20	7832784	3.500	100
25 x 5	7832787	3.500	66
25 x 10	7832791	3.500	164
25 x 25	7832794	3.500	120
32 x 5	7832796	3.500	116
32 x 10	7832799	5.556	54
32 x 20	7832803	5.556	136
32 x 32	7833300	3.969	124
40 x 5	7832805	3.500	180
40 x 10	7832809	7.144	72
40 x 20	7832812	5.556	156
40 x 40	7832815	7.144	96
50 x 10	7832818	7.144	88
50 x 20	7832821	6.350	164
63 x 10	7832823	7.144	140
63 x 20	7832826	7.144	186
80 x 10	7832828	7.144	210
80 x 20	7832831	12.700	80
16 x 5	7832835	3.500	56
20 x 5	7832838	3.500	108
25 x 5	7832841	3.500	132
32 x 5	7832862	3.500	232
32 x 10	7832844	5.500	108
40 x 5	7832847	3.500	360
40 x 10	7832850	6.350	160
50 x 10	7832853	7.144	176
63 x 10	7832856	7.144	280
80 x 10	7832859	7.144	420
16 x 5	KGF-D-1605-RH-EE	3.500	45
16 x 10	KGF-D-1610-RH-EE	3.000	102
20 x 5	KGF-D-2005-RH-EE	3.500	48
25 x 5	KGF-D-2505-RH-EE	3.500	63
25 x 10	KGF-D-2510-RH-EE	3.500	75
25 x 20	KGF-D-2520-RH-EE	3.500	80
25 x 25	KGF-D-2525-RH-EE	3.500	130
25 x 50	KGF-D-2550-RH-EE	3.500	130
32 x 5	KGF-D-3205-RH-EE	3.500	140
32 x 10	KGF-D-3210-RH-EE	7.140	42
32 x 20	KGF-D-3220-RH-EE	5.000	84
32 x 32	KGF-D-3232-RH-EE	3.969	124
40 x 5	KGF-D-4005-RH-EE	3.500	180
40 x 10	KGF-D-4010-RH-EE	7.140	54
40 x 20	KGF-D-4020-RH-EE	5.000	104
40 x 40	KGF-D-4040-RH-EE	3.500	360
50 x 10	KGF-D-5010-RH-EE	7.140	115
50 x 20	KGF-D-5020-RH-EE	7.140	100

Size (mm)	Part Number	Nominal Diameter (mm)	Number of Balls
16 x 5	KGF-N-1605-RH-EE	3.500	45
20 x 5	KGF-N-2005-RH-EE	3.500	48
20 x 20	KGF-N-2020-RH-EE	3.500	100
20 x 50	KGF-N-2050-RH-EE	3.500	140
25 x 5	KGF-N-2505-RH-EE	3.500	63
32 x 5	KGF-N-3205-RH-EE	3.500	140
32 x 10	KGF-N-3210-RH-EE	7.140	42
32 x 40	KGF-N-3240-RH-EE	3.500	168
40 x 5	KGF-N-4005-RH-EE	3.500	180
40 x 10	KGF-N-4010-RH-EE	7.140	54
50 x 10	KGF-N-5010-RH-EE	7.140	115
63 x 10	KGF-N-6310-RH-EE	7.140	140
16 x 5	KGM-D-1605-RH-EE	3.500	45
16 x 10	KGM-D-1610-RH-EE	3.000	102
20 x 5	KGM-D-2005-RH-EE	3.500	48
25 x 5	KGM-D-2505-RH-EE	3.500	63
25 x 10	KGM-D-2510-RH-EE	3.500	75
25 x 20	KGM-D-2520-RH-EE	3.500	80
25 x 25	KGM-D-2525-RH-EE	3.500	130
25 x 50	KGM-D-2550-RH-EE	3.500	130
32 x 5	KGM-D-3205-RH-EE	3.500	140
40 x 5	KGM-D-4005-RH-EE	3.500	180
40 x 10	KGM-D-4010-RH-EE	7.140	54
40 x 20	KGM-D-4020-RH-EE	5.000	104
40 x 40	KGM-D-4040-RH-EE	3.500	360
12 x 5	KGM-N-1205-RH-OO	2.000	60
20 x 5	KGM-N-2005-RH-EE	3.500	48
20 x 20	KGM-N-2020-RH-EE	3.500	100
20 x 50	KGM-N-2050-RH-EE	3.500	140
25 x 5	KGM-N-2505-RH-EE	3.500	63
32 x 5	KGM-N-3205-RH-EE	3.500	140
32 x 10	KGM-N-3210-RH-EE	7.140	42
32 x 20	KGM-N-3220-RH-EE	5.000	84
32 x 40	KGM-N-3240-RH-EE	3.500	168
40 x 5	KGM-N-4005-RH-EE	3.500	180
50 x 10	KGM-N-5010-RH-EE	7.140	115
50 x 20	KGM-N-5020-RH-EE	7.140	100
12 x 4	7832771	1.984	57
16 x 5	7832778	3.500	56
20 x 5	7832781	3.500	72
25 x 5	7832788	3.500	110
25 x 10	7832792	3.500	55
32 x 5	7832797	3.500	145
32 x 10	7832800	5.556	72
40 x 5	7832806	3.500	180
40 x 10	7832810	7.144	90
50 x 10	7832819	7.144	132
63 x 10	7832824	7.144	168
80 x 10	7832829	7.144	210
80 x 20	7832832	12.700	100
20 x 5	7832782	3.500	54
20 x 20	7832785	3.500	100
25 x 5	7832789	3.500	66

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Inspection and Existing Preload Check: Whenever possible, the complete ball screw assembly should be removed from the machine prior to a thorough inspection. Preliminary screw inspection can be made while the unit is still in the machine. Preload can be determined by measuring movement of the nut in respect to the screw shaft. Clamp an indicator to the screw shaft with its probe resting on the face of the nut. Apply a load to the machine carriage in both directions. Be sure that the screw cannot rotate or move axially. Any measurable backlash between the ball nut and screw is an indication that preload does not exist. (See Figure 18.)

If no backlash exists, proceed further as outlined to determine whether proper preload remains in the unit. Existing preload, W_p , can be determined by measuring torque, T_p , using the following formula:

$$W_p = \frac{T_p}{.007}$$

where: W_p = Preload force, in lb.

T_p = Torque, in lb-in. (due to preload only)

Note: The above check is to determine preload only, and does not take into account torque due to seal drag or operating load.

Torque can be measured by means of a spring scale mounted to any projection on the ball nut or by means of a lever or rod secured to the ball nut. In taking this measurement, be sure the exact lever arm distance is measured. (See Figure 18.) This measurement (inch) multiplied by the scale reading (lb.) equals T_p (torque lb-in.). Existing preload can now be determined using the above formula.

Preload adjustment of a Precision ball screw (Figure 18) requires no disassembly. Possible removal of the ball nut from the machine housing may be necessary to expose the adjusting nut.

Disassembly: If in doubt about disassembly of preloaded ball nuts, contact Thomson Application Engineering. If the unit is to be disassembled for general repair, follow the steps previously outlined in this section.

If being disassembled for preload adjustment, follow the guidelines except remove only one-half of the ball nut assembly to an arbor. If a standard arbor is not available, one can be made from a piece of shafting or tubing with a diameter approximately .005 inch less than the root diameter of the ball grooves in the screw shaft. Both halves of the ball nut will come apart as soon as the last ball in the nut is free of the grooves in the screw shaft. It is not necessary to remove the other half from the screw.

Preload Adjustment: The adjusting nut unit in Figure 18 can be adjusted to the desired preload with the use of additional shims. To make further adjustment, loosen the set screw lock located on the periphery of the lock nut. Use a spanner wrench to rotate the adjusting nut to the desired setting. Recheck the preload.

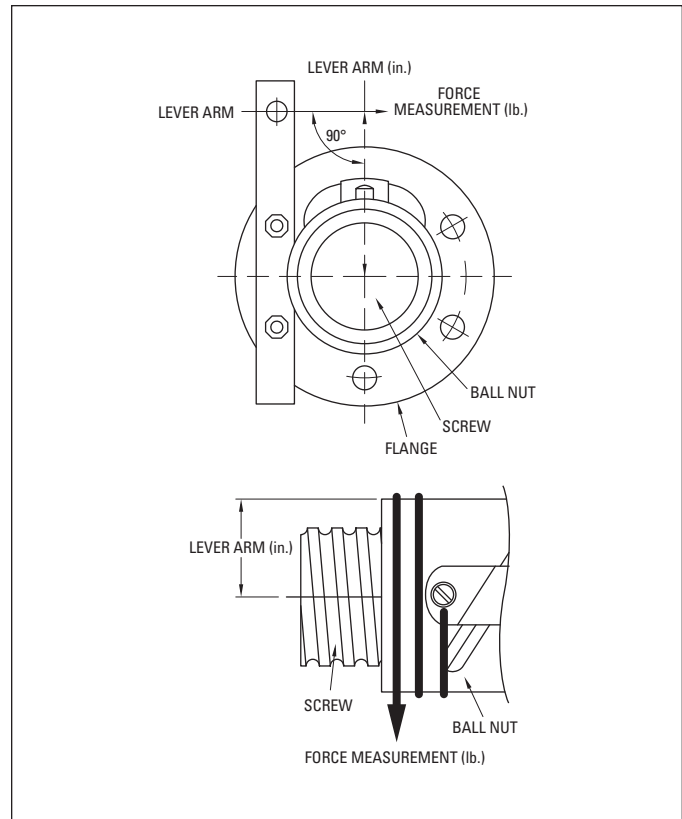


Figure 18

For all other standard units in Figure 18, a shim increase of .001 inch will, as a general rule, increase preload by 500 to 1,000 lb. This varies depending upon screw size; therefore, some judgement and trial and error may be necessary before the desired preload is achieved.

Preload force, W_p , can be determined by measuring torque, T_p , after the desired preload has been established using the following formula:

$$T_p = .007 \times W_p$$

where: T_p = torque, lb-in. (due to preload only)

W_p = preload force, lb.

This section is intended to provide basic necessary information to properly service and maintain Thomson ball screws. Other forms of preloaded units may be encountered which have been designed for particular applications. Please contact Thomson Application Engineering for other specific information.