Mechanical Actuator Design Guide

Duff-Norton®

Engineered to last a lifetime

Reference Guide and Index

Contents

Application Analysis Forms

Duff-Norton engineers will be pleased to make recommendations for your specific requirements.
Complete the appropriate form and mail or fax it to the Duff-Norton Company.
There is no obligation for this service.
Use a separate sheet to sketch your application, or send us your design drawings in complete confidence.
On the following pages you will find these forms:

Mechanical Actuator Application Analysis Form

AC Motor Controls Order Form

Mechanical Actuator Application Analysis Form

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Company: _____

Address: _____

_____

Phone Number: _____ **Fax Number:** _____

Contact: _____

Email Address: _____

1. **Type of application:** _____
2. **How many actuator units are needed?** _____
3. **Raise / Unit:** _____ **In.** _____
4. **How many mitre gear boxes are needed?** _____
5. **Total working load:** _____ **Working load per unit:** _____
6. **Total static load:** _____ **Static load per unit:** _____
7. **Side thrust on lifting screw:** ☐ Yes ☐ No _____ lbs.

   Off-center load on lifting screw: ☐ Yes ☐ No _____ in. / lbs.
8. **Operating Cycles:** _____ **per hour** _____ **hours per day** _____ **days per week**
9. **Life expectancy:** _____ **in.** *(inches per cycle x cycles per hour x hours per day x days per years x years of service required)*
10. **Lifting speed desired:** _____ **in./min.**
11. **Are controls required for your system:** ☐ Yes ☐ No
12. **Drive:** ☐ Manual ☐ Motor-driven
13. **Load type:** ☐ Guided ☐ Unguided ☐ Compression ☐ Tension ☐ Both compression & tension
14. **Conditions:** ☐ Vibration ☐ Impact ☐ Wet ☐ Corrosive ☐ Explosion Proof ☐ Other _____
15. **Temp. Range:** _____
16. **Std. actuator model best suited to application:** _____
17. **Ultimate use of actuator units:** ☐ In-plant ☐ Resale ☐ Lift people
18. **Quotation desired on the following quantities:** ☐ **Total** ☐ **Per System**

If you have any questions or are in need of assistance please call our Application Engineers at 1-800-477-5002

Please mail or fax completed sheet to:

P.O. Box 7010 • Charlotte, NC 28241-7010 • FAX 1-704-588-1994
www. duffnorton.com

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Mechanical Actuator Controls

Duff-Norton®

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Company: _____

Address: _____

_____

Phone Number: _____ **Fax Number:** _____

Contact: _____

Email Address: _____

1. Comments: _____

_____

2. If environment is explosive or hostile, where will the operator be located? _____

_____

3. Motor Enclosure: ☐ Open Drip Proof ☐ Totally Enclosed ☐ Wash Down

4. Controls Enclosure: ☐ NEMA 1 ☐ NEMA 12/13 ☐ NEMA 4 ☐ NEMA 4X ☐ NEMA 3R

5. Motor Mounting: ☐ Separate ☐ C-Face ☐ Right Angle ☐ In Line ☐ Other: _____

6. Additional Gearing: ☐ None ☐ In Line ☐ Right Angle ☐ Integral ☐ Ratio

7. Orientation *(Description)*: _____

8. Controls Mounting: ☐ Wall ☐ Floor ☐ Free Standing ☐ Pedestal ☐ Console ☐ Other: _____

9. Control Requirements: _____ Volts _____ Phase _____ Hz

10. Operation: ☐ Variable Speed ☐ Constant Speed ☐ Multiple Speed ☐ Inch/Jog
☐ Maintained ☐ Position ☐ Velocity ☐ Torque

11. Features: ☐ Soft Start; Acceleration Rate _____ in/min^2
☐ Soft Start; Acceleration Rate _____ in/min^2 ☐ Remote Control

☐ Indicators (specify): _____

☐ Alarms (specify): _____

☐ Communication (specify): _____

☐ Limit Switches (specify voltage & mounting position if mounted on actuator worm shaft extension): _____

_____

Accuracy for Positioning (in.): _____

Number of Positions: _____

Velocity Regulation: _____

Duty Cycle (from above): _____

Acceleration and Deceleration rates (from above): _____

Line Shaft Accuracy: _____

Load Conditions (from above): _____

_____

Duff-Norton Actuators most appropriate for this application: _____

_____

_____

Controls Needed: _____

_____

_____

Comments: _____

_____

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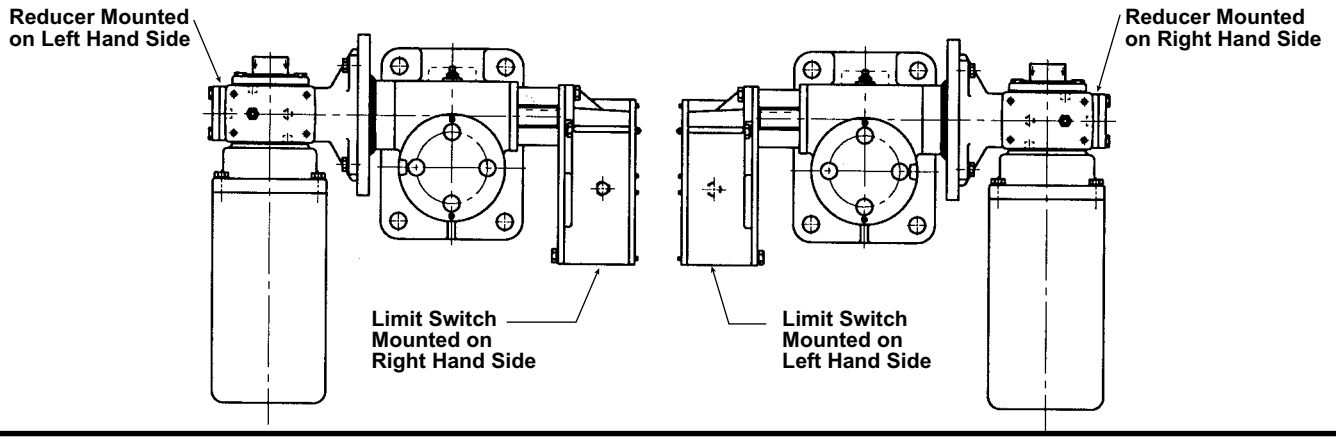
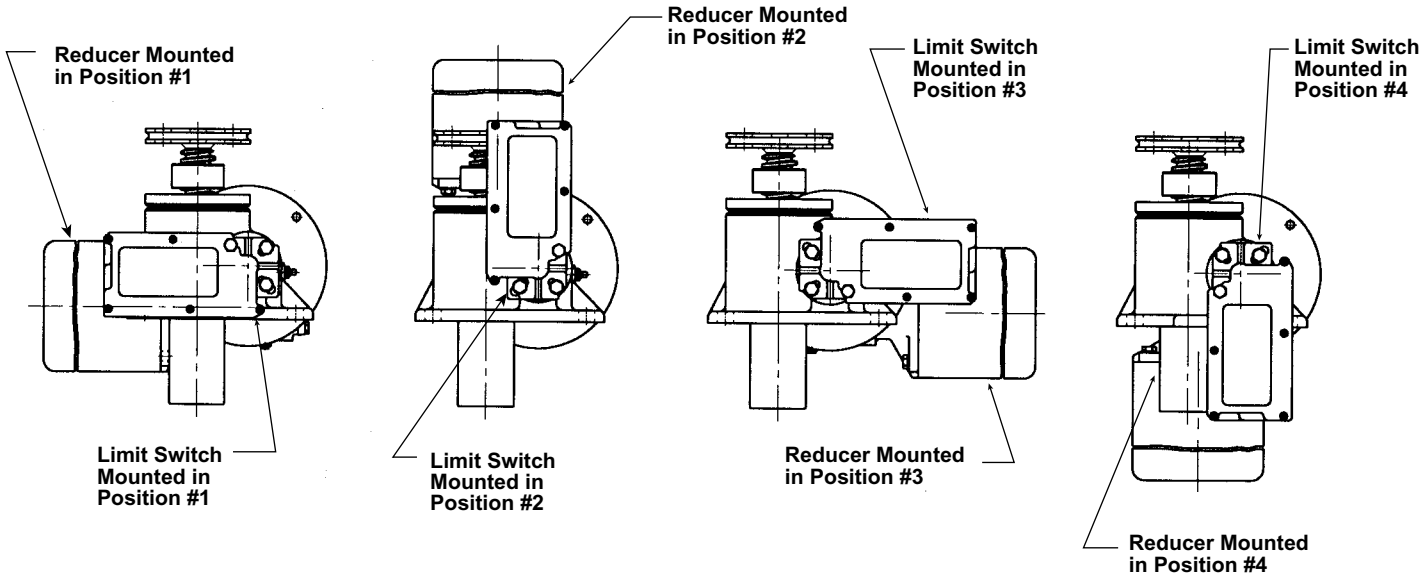
Limit Switch and Reducer Positioning

Side



Position



Recommendations/Restrictions on Limit Switch Position

	Right Hand				Left Hand			
Actuator Model	1	2	3	4	1	2	3	4
1802, 2802, 28021, 7002, 7802, 78021, 9802, 98021, 28003 & 98003	C	A&B	B&C	-	B&C	A&B	C	-
9005 & 9805	X	A	C	C	C	A	X	C
9010 & 9810	X	A	C	C	C	A	X	C
9015	X	A	C	C	C	A	X	C
9020 & 9820	X	A	X	C	X	A	X	C
9025 & 9825	X	X	X	C	X	X	X	C
9035	X	X	X	C	X	X	X	C
1850 & 2860	X	X	X	C	X	X	X	C

Restrictions:

For 2 and 3 Ton Inverted units, Position #2 is the only one practical

A. Special Closed Height

B. Boot Interference

C. Limit Switch Extends Below Mounting Base

X. Recommended

-. Not Recommended

Note: 4800 and 9400 Series same as 1800 and 9000 Series
Close Mountingis available on special applications

Applications

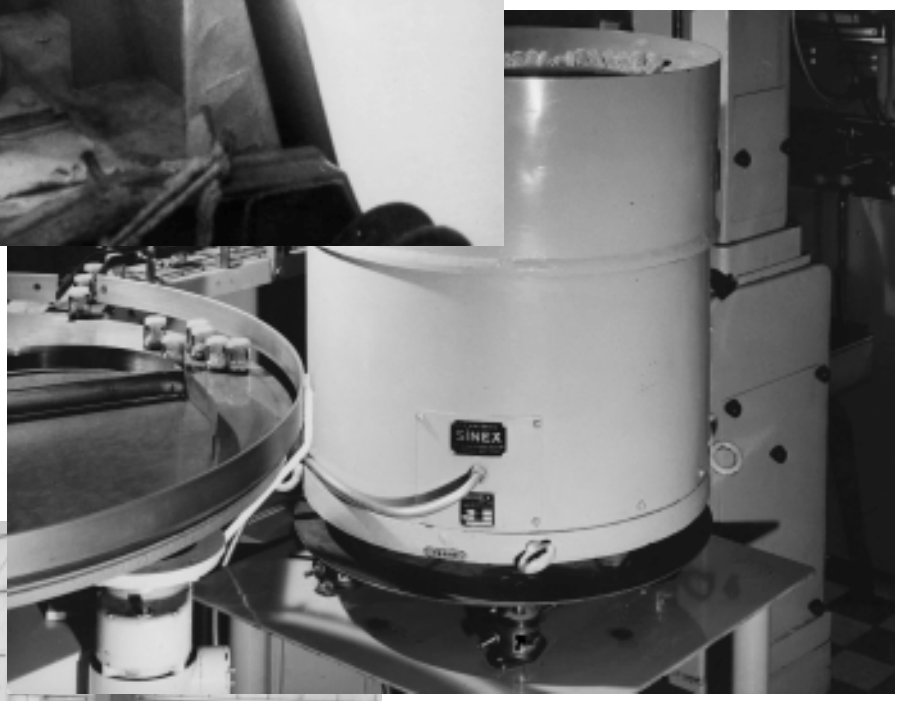
- **Large dish antenna movement (Top, Center, Bottom)**
- Workplace table adjustments
- Drive wheel adjustment to change conveyor flow stops
- Conveyor lifts, diverters
- Knife blade filter drum skimmer
- Furnace combustion gun adjustment
- Mechanical clutch linkage

- Vacuum furnace lid lifters
- Roll lifts
- Mandrel pushers Sluice gates
- Low temperature valve operators

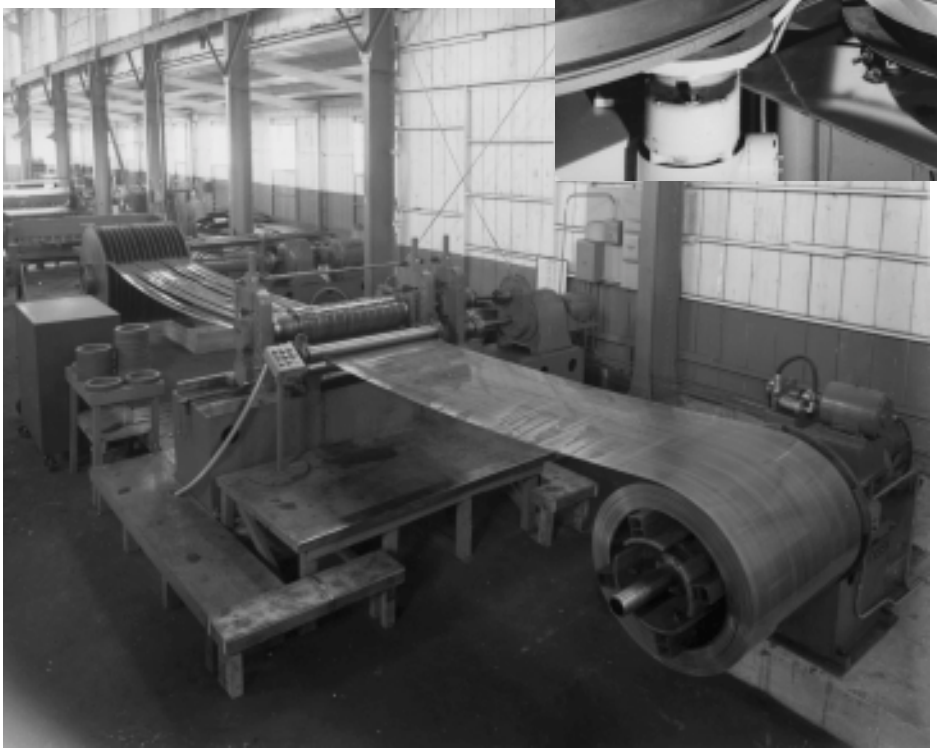
- Unwind stands
- Calender stacks
- High voltage switch gear Die set tables
- Electron beam adjustments
- Horizontal presses
- Saw blade tension
- Stage lifts for scenery changes
- Robotics manipulator
- Disc refiner blade adjustment
- Blast door locks

Applications

- **Headbox unit for paper machine (Left)**
- Tooling machine bed adjustment
- Textile, steel, rubber, plastics skewing roll adjustments
- Pinch valve control actuation, gate and ball valve
- Tension testing machines
- Packaging machinery
- Diagnostic scanners



- **Work platforms (Right)**
- Injection molding machines-head adjustment
- Mechanical brake linkage adjustment
- Curing processes-constant speed
- Feed rate movement
- Air dampers



- **Sheet Slitter (Left)**
- Angle tilt adjustments with double clevis models
- Remote contamination lifts
- Precision closures
- Solar panel actuation
- Tension adjustment of cables
- Welding positioners
- Centerless grinder positioner
- Locking indexing pins
- Batch control
- Palletizer indexing
- Oven lifters
- Door openers

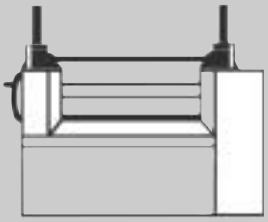
Flow Chart For System Building

Duff-Norton Mechanical Actuators Can:

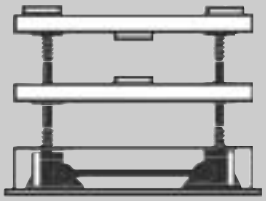
Position Precisely

- Move To A Position And Hold
- Be Programmed To Give Variations In Cycles And Positioning
- Apply A Force
- Be Coupled Together For Multiple Actuators
- Push And Pull At Rated Load

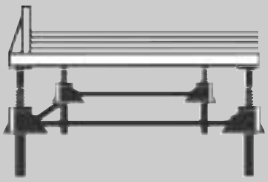
For



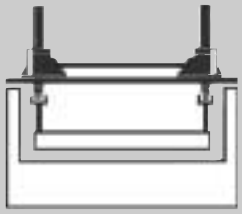
Precision Grinding



Holding



Indexing Table



Vertical Adjusting

Controlled by

Machine Operator Or Relays.

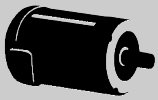
Activated By:
Pressure, Density, Temperature, Calibration, Counters, Photo Electrics, Switches And Color.

Or By:
Programmable Logic Controllers

Typical Applications Include:

- Tooling machine bed adjustment
- Diagnostic scanners
- Injection moulding machines-head adjustment
- Mechanical brake link - age adjustment
- Curing processes-constant speed
- Feed rate movement
- Air dampers
- Angle tilt adjustments with double clevis models
- Remote contamination lifts
- Precision closures
- Solar panel actuation
- Tension adjustment of cables
- Welding positioners
- Large dish antenna movement
- Centerless grinder positioner
- Work platforms
- Locking indexing pins
- Batch control
- Textile, steel, rubber, plastics skewing roll adjustments
- Paletizer indexing
- Oven lifters
- Door openers
- Workplace table adjustments

Along With These Devices:



C-Face Motor

Linear Variable Differential Transducer

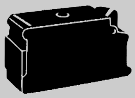
V-Belt Drive

C-Face Brake Motor

Four Output Encoder

Photoelectric Sensor

Magnetic Pick-Up



Limit Switch

Electric Brake

Speed Controller

Coupling

Optical Encoder

Air Motor / Hydraulic Motor

- Drive wheel adjustment to change conveyor flow stops
- Conveyer lifts, diverters
- Knife blade filter drum skimmer
- Furnace combustion gun adjustment
- Mechanical clutch linkage
- Vacuum furnace lid lifters
- Pinch valve control actuation, gate and ball valve
- Roll lifts
- Mandrel pushers
- Sluice gates
- Tension testing machines
- Low temperature valve operators
- Unwind stands
- Calender stacks
- High voltage switch gear
- Die set tables
- Electron beam adjustments
- Horizontal presses
- Packaging machinery
- Saw blade tension
- Stage lifts for scenery changes
- Robotic manipulator
- Disc refiner blade adjustment
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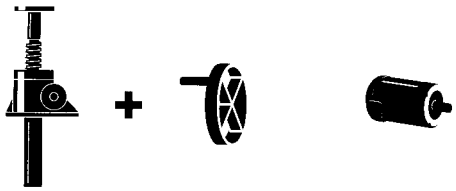
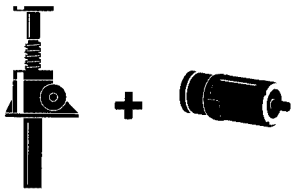
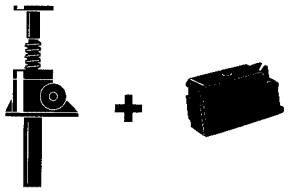
Capability Through Drive Methods



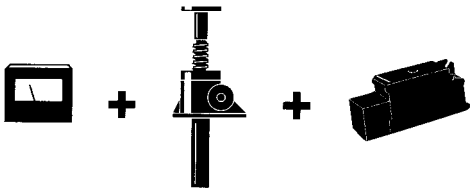
Powered by hand crank or motor, actuators raise, lower, open, close, push, pull or adjust



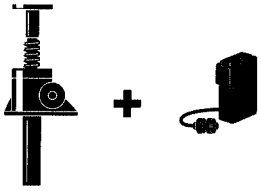
Brake motor used for stopping and precise positioning. Required for all ball screw actuators



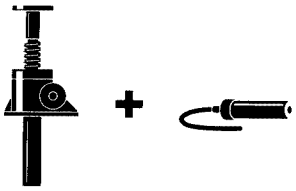
Factory-mounted adjustable limit switches for top and bottom stroke limits



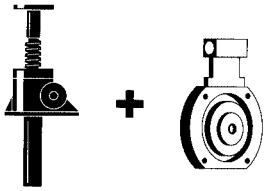
Optional limit switch with potentiometer and transducer for positioning with analog read out



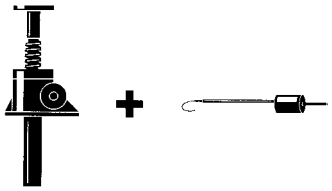
Precision positioning control with digital encoder



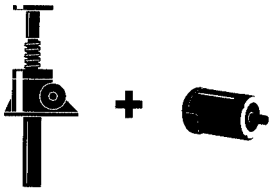
Shaft-mounted magnetic disc with sensor for speed, and position monitoring



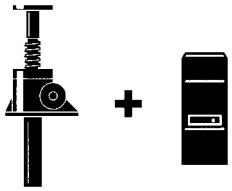
Pulse generator for PC input and / or LED readout



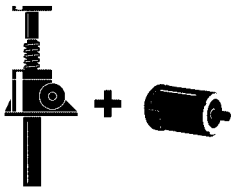
Linear variable differential transducer LVDT AC / DC - for precision measurement of actuator screw movement



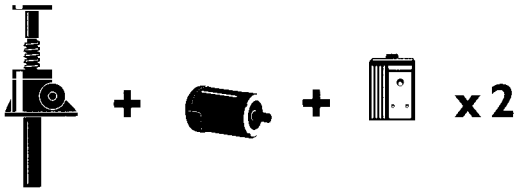
Stepping motors are used with PLC for precise incremental indexing with adjustable accelerate / decelerate modes



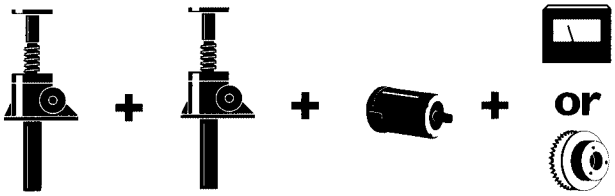
DC Speed Control



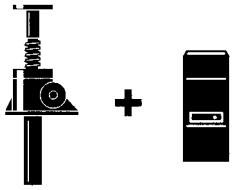
A C-face motor mount is available for motors, flange mounting motor directly to actuator, in capacities from 2 tons through 20 tons.



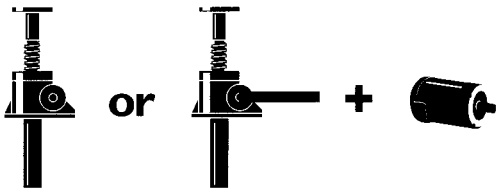
Stepping motors for independent positioning with separate controllers for uniform positioning of both actuators, where connecting shafting is not possible



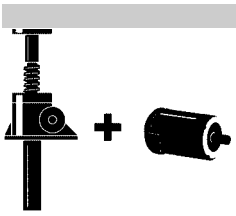
Protect a system from overload with motor current limiter or clutch



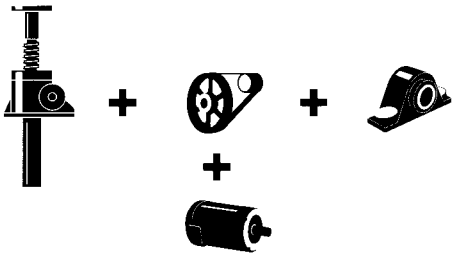
AC frequency inverter provides constant torque with varying speed



Actuators used in isolated environments, sometimes connected by a drive shaft, shield and protect against fumes, temperature, radiation, vacuum, hostile environment



Air motor for clamping with preset valve. Air motor goes into stall to maintain force



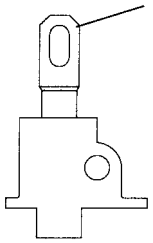
Sprocket V-belt drive, motor, pillow blocks

Special Variations Of The Duff-Norton Actuator

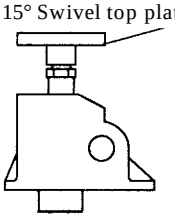
Duff-Norton can adapt the standard actuator to meet your special requirements. Standard models can be modified and furnished with keyed lifting screws, with clevis screw, plain screw or threaded screw end. Other modifications may include stain- less or alloy steel lifting screws, top plates and/or worms, hollow lifting screws and other variations.

Single end worm shafts with left-hand or right-hand extensions are supplied at no extra cost. Consult factory for details.

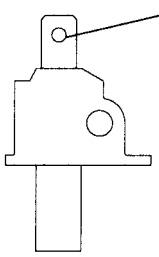
Special clevis end



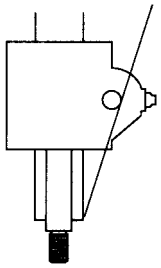
15° Swivel top plate



Self-aligning ball bushing

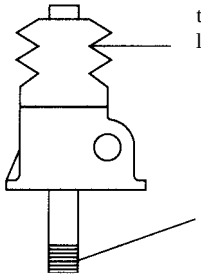


Special wiper seal

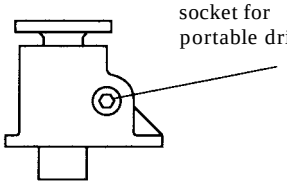


Inverted jack with boot replacing top pipe for limited space

Screw end



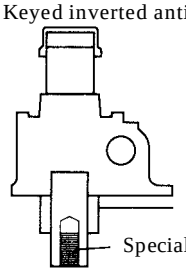
Hexworm shaft for hand crank or socket for portable drill



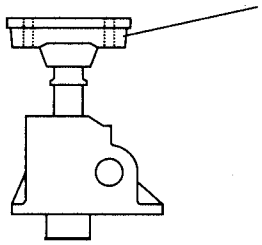
Keyed inverted anti-backlash

Key adaptor

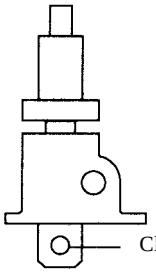
Special tap-in screw



Ball socket keyed lifting screw

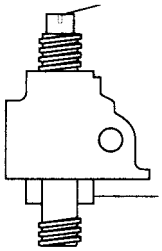


Clevis plug in base



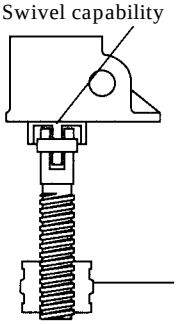
Tapped hole

Guide bushing

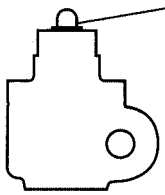


Swivel capability

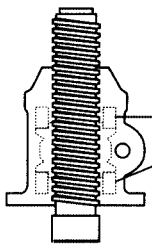
Lifting nut



Spherical radius keyed screw



Thrust washers instead of ball bearing, for impact loading



Frequently Asked Questions

1. What is the lifting torque required?

The lifting torque for a single actuator depends on the load, the worm gear ratio, type of screw (machine cut or ball screw) and the pitch of the lifting screw. Torques are listed in the specification chart (pages 31, 50, 59, 62, 67, 85 and 94) based on capacity loads. For loads from 25% to 100% of actuator model capacity, torque requirements are approximately proportional to the load.

2. Can the actuator be operated in multiple units?

Perhaps the greatest single advantage of Duff -Norton actuators is that they can be tied together mechanically, to lift and lower in unison. Typical arrangements involving the actuator units, mitre gear boxes, motors, reducers, shafting and couplings are shown on page 28.

3. How many actuators can be connected in series?

This will be limited by the input torque requirements on the first worm shaft in the line. The torque on the worm shaft of the first actuator unit should not exceed 300% of its rated full load torque based on the 1800 and 9000 Series. (This does not include the 1820 and 9020 Series.)

Torque can be reduced by using a double end gear motor at the center of the arrangement or a higher capacity actuator model can be used as the first unit in the line, provided the turns for 1" raise are the same as the lower capacity units.

If this is not possible, the actuators may be individually motorized and synchronized using electronic controls designed by the customer.

4. Can the Duff-Norton actuator operate at high speeds?

The input horsepower to these actuators should not exceed the hp rating shown in the specifications table. Maximum RPM should not exceed 1800. We cannot accept responsibility for the overheating and rapid wear that may occur should these limits be exceeded Horsepower increases in direct proportion to the speed, and the motor size will be out of proportion to the actuator model design rating should the speed become excessively high. When selecting the maximum permissible speed for an actuating arrangement, always check to see that the hp rating of the actuator model is not exceeded

5. Can Duff -Norton mitre gear boxes operate at high speeds?

The gear boxes can be run at the same speeds as the actuator models. Do not exceed torque ratings.

6. What is the efficiency of the actuator?

Actuator model efficiencies are listed in the specification charts on pages 31, 50, 59, 62, 67, 85, and 94. Where both starting and running torques are listed, use the starting torque for hp calculations.

7. What is the efficiency of the mitre gear boxes?

The efficiency of Duff -Norton gear boxes takes into consideration not only the theoretical efficiencies of the mitre gears, but also makes allowance for a normal amount of misalignment on the connecting shafts. We use 90% efficiency.

8. What is the efficiency of an actuator multiple-unit arrangement?

In addition to the efficiencies of the actuator units and the mitre gear boxes, the efficiency of the actuator multiple-unit arrangement must be taken into consideration. The arrangement efficiency allows for misalignment due to slight deformation of the structure under load, for the losses in couplings and bearings, and for a nor- mal amount of misalignment in positioning the actuators and gear boxes. We use the following efficiencies (all standard units):

Two Actuator Arrangement - 95%	Three Actuator Arrangement - 90%
Four Actuator Arrangement - 85%	Six or Eight Actuator Arrangement - 80%

Frequently Asked Questions *(continued)*

9. Can the actuator be used for continuous operation?

Recommendation should be obtained from the Duff-Norton Company on this type application and a completed application analysis form submitted. In general, semi- continuous operation can be permitted where load is light as compared to actuator model rated capacity. Units so used should be lubricated frequently and protected against dust and dirt. The Duff -Norton 7500 Series, oil-lubricated, high duty cycle actuator is designed for maximum duty cycles.

10. What is the maximum practical raise or working stroke?

Generally, standard raises are up to 12 inches on 1/4- and 1/2-ton models and 18 inches on the 2501 (one ton). Maximum raises available for the larger diameter screws are limited only by the available length of bar stock from suppliers. Practical length will be affected by whether the screw is to be subjected to compression or tension loads. Depending on diameter, the length can be limited due to deformation of material in the machining process or column strength of the screw when subjected to compression loads. Long raise applications should be checked with Duff -Norton for the following:

a) Side thrust on extended screw (see question 11)

b) b) Column strength of screw (see question 12)

c) Thermal rating of screw and nut (see question 13)

We suggest guides be used on all applications. The longer the raise, the more important this becomes.

11. Will the actuator withstand aside thrust?

Actuator units are designed primarily to raise and lower loads and any side thrust should be avoided. These units will withstand some side thrust, depending on diameter of the screw and the extended length of the screw. Where side thrusts are present, the loads should be guided and the guides, rather than the actuator units, should take the side thrust -particularly when long raises are involved. Even a small side thrust can exert great force on the housings and bearings and increase the operating torque. “Side Thrust Rating Charts” are included in this book on page 136 thru 138.

12. How is the column strength of a lifting screw determined?

The column strength of a screw is determined by the relationship between the length of the screw and its diameter. A column strength nomograph is included in this book on page 140.

13. What is the cause of thermal or heat build-up in an actuator unit?

The duty cycle, the length of the screw, the magnitude of the load, and the efficiency of the actuator unit all have a direct influence on the amount of heat generated within the actuator model. Since most of the power input is used to overcome friction, a large amount of heat is generated in the worm gear set in both ball screw and machine screw actuator models, and in the lifting screw of machine screw actuator units. Long lifts can cause serious overheating.

14. What is the allowable duty cycle of a worm gear actuator?

Because of the low efficiency of worm gear actuators, the duty cycle is low at rated load. At reduced loading, the duty cycle may be increased. Consult Duff -Norton for more complete information.

15. What is the life of the worm gear actuator?

The life of a machine screw actuator screw, nut and worm gear set varies considerably due to extent of lubrication, abrasive or chemical action, overloading, eccentric loading, excessive heat, improper maintenance, etc.

16. Can the actuator be used to pivot a load?

The actuator can be furnished with a clevis at both ends. The bottom clevis is welded to the bottom end of an extra strong pipe which is threaded into the base of the actuator and welded This bottom pipe still performs its primary function of encasing the lifting screw in its retracted position. The design of the structure in which this type unit is to be used must be so constructed that the actuator unit can pivot at both ends. Use only direct compression or tension loads, thereby eliminating side thrust conditions. See the double clevis model illustrations on the dimensional drawings.

17. Can the actuator unit be used within rigid structures or presses?

We recommend that the actuator selected have a greater capacity than the rated capacity of the press or of the load capacity of the structure. We also recommend that a torque limiting clutch or similar device be used to prevent overloading of the actuator unit. Unless these precautions are taken, it is possible to overload the actuator unit without realizing it, because it is difficult to determine just what load is being imposed on the actuator unit.

18. Can the lifting screw be keyed to prevent rotation?

Yes, except for the ball screw; however, the keyway in the screw causes greater than normal wear on the internal threads of the worm gear. The ball screw cannot be keyed, as the keyway would interrupt the ball track, permitting loss of the recirculating balls. We recommend the following methods for preventing rotation. For multiple actuator model applications, bolt the lifting screw top plates to the member being lifted. For single actuator unit applications, bolt the lifting screw top plate to the load. And the load should be guided to prevent rotation.

19. Why is it ever necessary to use a keyed lifting screw?

When an actuator unit is operated, the rotation of the worm shaft causes the worm gear to rotate. The worm gear is threaded to accommodate the lifting screw thread; as the worm gear turns, the friction forces on the screw thread act to turn the screw also. The greater the load on the actuator unit, the greater the tendency of the screw to turn. It is obvious that if the screw turns with the nut (worm gear), it will not raise the load. In those cases where a single unit is used, and where the load cannot be restrained from turning, it is necessary to key the lifting screw. The lifting screw turning movement or key torque is shown on page 139.

20. Can an actuator model with an inverted lifting screw be keyed?

Yes, but the key is mounted in the shell cap, making it necessary to omit the dust guard as a standard item. If a dust guard is required, a special adaptor must be attached to permit mounting.

21. Can bellows boots be supplied for an actuator model with inverted screw?

Yes, but allowance must be made in the length of the lifting screw for both the closed height of the boot and structure thickness. Since we can make no provision for attaching a boot on the underside of your structure, we suggest that a circular plate similar to the lifting screw top plate be welded or bolted to the bottom of your structure supporting the actuator unit, thereby making it possible to use a standard bellows boot. (See page 112.)

22. Can stop discs, stop pins or stop nuts be used on the actuator unit?

Stop disc, pins or nuts can be recommended on the actuator unit that is hand operated. For motor driven units, the full capacity of the actuator unit or even a greater force (depending on the power of the motor) can be applied against the stop, thereby jamming so tightly it must be disassembled in order to free it. It is suggested that external stops be used where possible. Under ideal conditions where a slip clutch or torque limiting device is used, a stop pin or stop nut may be used -but the Duff - Norton Company should be consulted. The stop disc used on the bottom of the lifting screw in our ball screw units are not power stops. These are used to ensure that the lifting screw will not run out of the ball nut during shipping and handling, thereby permitting loss of the recirculating balls.

Frequently Asked Questions *(continued)*

23. Will the actuator withstand shock loads?

Shock loads should be eliminated or reduced as much as possible, but if they cannot be avoided, the actuator model selected should be rated at twice the required static load. For severe shock load applications, using the 1800 and 9000 Series, the load bearings should be replaced with heat-treated steel thrust rings which will in- crease the lifting torque approximately 100 percent. These rings are available as a special from Duff-Norton.

24. Is the actuator self - locking?

The 2800 and 9800 Series ball screw units, the 2555 1/4-ton, the 2625 1/2-ton, the 2501 one- ton units and -in some cases -the 1802 & 9002 two-ton unit, the 9005 five-ton unit, the 9010 ten-ton unit and the 9015 15-ton unit are not self locking; the 24:1 and 25:1 ratios are self -locking in most cases. Units considered not self -locking will require a brake or other holding device (see page 13). If vibration conditions exist, see question 25.

25. Can the actuator unit be used where vibration is present?

Yes, but vibration can cause the lifting screw to creep or inch down under load. For applications involving slight vibration, select the higher of the worm gear ratios. Should considerable vibration be present, use a drive motor equipped with a magnetic brake which will prevent the actuator model from self -lowering.

26. Will the actuator unit drift after the motor is switched off?

Yes, unless a brake of sufficient capacity is used to prevent it. The amount of drift will depend upon the load on the actuator unit and the inertia of the rotor in the motor. Due to different construction, the ball screw actuator unit must be considered separately; see page 13. The machine screw worm gear unit (1800 and 9000 Series) requires approximately one-half as much torque to lower the load as it does to raise the load.

For the machine screw actuator unit with no load, the amount of drift will depend upon the size and speed of the motor. For example, a 1750 RPM motor directly connected to an actuator unit (without a load) will give on the average 2"-3" drift; a 500 RPM gear motor will give about 1/9 as much drift. Note that the drift varies as the square of the velocity (RPM). The drift of the actuator unit screw can be controlled by using a magnetic brake on the motor.

27. Is the torque of a rotating screw actuator unit the same as a standard unit?

The lifting torque, as well as the efficiency and side thrust ratings, are the same for a rotating screw unit. It is understood, however, that the same pitch and screw diameter are used in each actuator unit, as well as the same worm gear ratio. This comment also applies to the inverted actuator unit and those with threaded or clevis-style ends.

28. Is the worm gear actuator unit suitable for high temperature operation?

The actuator is normally suitable for operation at ambient temperatures of up to 200°F using standard greases and seals. Operation above 200°F will require special lubricants. For temperatures above 300°F the life of even special lubricants is limited in direct pro- portion to increase in temperature and duration of exposure to such temperatures. At 400°F and above, the oil in the grease will vaporize and grease will carbonize and solidify. Applications of this type should be avoided. For temperatures above 250°F advise Duff - Norton of full particulars of the duration of such temperatures. In some cases, it may be necessary to furnish unlubricated units, then the customer will supply the lubricant of his own choice. We suggest that a lubricant manufacturer be consulted for type of grease and lubrication schedule. As a general rule, the actuator unit should be shielded to keep ambient temperatures to 200°F or less.

Seals for temperatures above 250°F are very expensive. Instead, we would substitute bronze bushings for seals in these cases. If bellows boots are used, special materials will be required for temperatures above 200°F

28a. Is the actuator unit suitable for low temperature operation?

With the standard lubricant and materials of construction, the actuator is suitable for use at sustained temperatures of O°F. Below 0°F, low temperature lubricant should be used. Also, at temperatures below 0°F, if there is any possibility of shock loading, special materials may be required due to notch sensitivity of the standard materials at lower temperatures. Duff-Norton factory application engineers must be consulted in these instances for a recommendation.

Actuators with standard materials of construction and lubrication may be safely stored at temperatures as low as -65°F.

29. How much backlash is there in the actuator unit?

The 1800/9000, 4800/9400 and 2800/9800 Series units must be considered separately, as the normal backlash will vary due to different constructions.

For the 1800/9000: In this unit there is a normal backlash of .005" to .008" in the lifting screw thread, plus .002" to .003" backlash in the load bearings. Therefore, the total backlash is .007" to .011". This backlash is due not only to normal manufacturing tolerances, but to the fact that we must have some clearances to prevent binding and galling when the actuator unit is under load. Usually, the backlash is not a problem unless the load on the actuator unit changes between compression and tension. If a problem does exist, then the 4800 and 9400 Series with the anti-backlash feature should be considered.

4800 and 9400 Series: This unit can be adjusted for screw thread and bearing clearances to a minimum of .0005". Some clearances must be maintained to keep torque requirements within reason. As the inside thread of the worm gear and the anti-backlash nut wears, adjustment can be maintained by tightening down on the shell cap. Setscrews located in the top of the shell cap are to be respotted each time an adjustment is made.

The additional nut used in the anti-backlash actuator unit is a built-in wear indicator. The clearance between the two nuts is designed to be 50 percent of the thread thickness. When all this adjustment is used, it indicates the point where the worm gear and the anti-backlash nut set is to be replaced. See the illustration of this feature on page 62.

2800 and 9800 Series -This unit cannot be adjusted. It will have a normal backlash of .002" to .013" between the ball nut and the ball track; .002" to .003" backlash in the load bearings. Total backlash will be .004" to .016". As in the 1800 and 9000 Series, this backlash will not be detrimental unless the load changes between compression and tension, or tension and compression.

30. How does the "Anti-Backlash" feature operate?

The worm gear and the anti-backlash nut are pinned together with guide pins. The threads in the anti-backlash nut work in opposition to the worm gear on the threads of the lifting screw.

Adjustment is made by threading in the shell cap of the actuator unit, which forces the anti-backlash nut threads into closer contact, reducing clearance and thus reducing backlash. (See page 62,)

31. What lead error is present in the lifting screw threads?

1800 and 9000, 2500, 2555, 2625 or 4800 and 9400 Series lift screws have .002" to .010" per foot lead error. It is cumulative and not detrimental to the operation of the actuator model.

2800 and 9800 Series -This is a heat treated rolled ball track with a lead error of plus or minus .009" per foot cumulative.

Frequently Asked Questions *(continued)*

32. How do you compute the raise per minute with a given worm shaft speed?

When the worm shaft speed is known, the distance the load can be raised per minute can be determined with this formula:

$$\text{Raise per minute} = \frac{\text{RPM of Worm Shaft}}{\text{Turns of worm for 1" raise}}$$

or Travel per Worm Turn (mm) x RPM of Worm Shaft

(Worm turns for 1" raise are shown in actuator specifications on pages 31, 50, 58, 67, 85, and 94.)

33. How do you calculate the RPM of worm shaft necessary to achieve a given rate of raise?

If the application calls for a certain raise per minute, the worm shaft speed which will give the rate of raise can be calculated as follows (or see tables on page 106). Worm shaft RPM = Desired Rate of Raise (in / min) x Worm Turns for 1" Raise

For metric actuators:

$$\text{RPM} = \frac{\text{Desired Rate of Raise (mm / min)}}{\text{Travel per worm Turn (mm)}}$$

34. How do you compute permissible eccentric loads?

Eccentric load is computed by dividing the permissible bending moment (in tables on pages 136 thru 138) by the distance from the centerline of the lifting screw to the centerline of the load.

35. How is the Duff - Norton rotary limit switch mounted on an actuator unit?

It is suggested that the actuator unit be purchased with the limit switch factory mounted. The rotary limit switch can be field mounted by following the instructions found in this book under “Rotary Limit Switch.” In most cases, the switch is mounted to the worm using the worm flange retainer bolts. This switch cannot be directly mounted on 1 / 4- to 1-ton actuator models.

36. How is the maximum raise determined when using the limit switch?

Maximum raise is determined by the ratio of the switch used and the turns for one inch raise of the actuator unit. The limit switch ratios available are 10:1, 20:1 and 40:1. Refer to the charts on pages 125, 126, 127, or on the inside cover of the limit switch, and use the following formula.

$$\text{Max. Raise of Actuator Unit (inches)} = \frac{\text{Max. Input Revolutions of Limit Switch}}{\text{Turns of Actuator Unit Worm for 1" Raise}}$$

37. How is the rotary limit switch adjusted for position stop?

The Duff -Norton rotary limit switch is infinitesimally adjustable by moving the adjustable nuts of the worm-driven screw.

38. Can a multiple actuator unit arrangement be set up to visually indicate position of the lifting screw at any given point?

Yes, in several ways. However, it is suggested you consult the Duff -Norton Company for recommendations based on your particular application.

How To Select The Right Actuator

To properly select an actuator, the following must be established:

1. Total load
2. Load per actuator, if more than one is required
3. Desired lifting speed
4. Travel
5. Load -tension or compression? both?
6. Ambient temperatures (See questions 28 and 28a)

With the information above, calculate the following:

1. Torque -Torque is proportional to the load. See torque requirements table for Machine Screw or Ball Screw Actuator on pages 31, 50, 59, 62, 67, 85, and 94.
2. Input RPM -Turns of worm per I" travel x desired lifting speed or see RPM table on page 106 and 107. INPUT RPM SHOULD NOT EXCEED 1800 RPMS.
3. hp Per Actuator = $\frac{\text{RPM X Torque Per Actuator}}{63{,}000}$

DO NOT EXCEED MAX. hp PER ACTUATOR AS GIVEN IN SPECIFICATION CHART ON PAGE 31, 50, 59, 62, 67, 85, and 94.

If the max. hp recommendation is exceeded, you can reduce the lifting speed, use a larger actuator, possibly consider a ball screw actuator or change the ratio.

4. If the load is in compression, then check the screw column strength chart and instructions on pages 140 and 141.

NOTE: It may be necessary to select a larger actuator if the max. recommended screw length has been exceeded, regardless of load

To Select The Motor

Lifting torques are provided in the specification tables for machine screw jacks on page 23 and for ball screw jacks on page 50. For loads other than full capacity, torque is directly proportional to the load.

1. Use the following formula to determine the hp per actuator: $hp = \frac{\text{Lifting Torque x RPM of Worm}}{63{,}000}$
2. The number of actuators required is determined by total load and actuator capacity.
3. Arrangement efficiency is as follows:

Two actuators	95%	Four	85%
Three	90%	Six and eight	80%

4. The efficiency of each gear box is 90%. The formula for motor or arrangement hp is:

$$\text{Arrangement hp} = \frac{\text{hp per actuator x No. of actuators}}{\text{Arrangement efficiency x efficiency of gear boxes}}$$

To Select The Brake

Because of the high efficiency of the ball screw actuator, a brake is always required. Some machine screw models are also self -lowering, so a brake should be used. Brakes are also recommended to control drift for all models. See questions 24, 25 and 26 on page 20.

5. To calculate brake size: Obtain the value for C from the tabulation for the motor hp and RPM (below). In the specification chart on pages 31, 58, 62, 67 and 94, you'll find worm turns per 1" raise and the hold back torque. Select the desirable drift of the actuator unit in inches of drift after the motor is turned off. Allow as much drift as possible in order to hold the brake size to a minimum. If a gear reduction is used in the drive, then the "reducer ratio" is equal to the gear ratio of the reducer. Substitute these values in the equation below, then solve for brake torque required by motor.

$$\text{Motor Brake Torque in lb. ft.} = \frac{C}{\text{Turns of Worm for 1” Raise x Drift x Reducer Ratio}} + \frac{\text{Hold Back Torque x No. of Actuators}}{\text{Reducer Ratio}}$$

Tabulation of "C" Factors for Motor Brake Equation

Motor hp	900 rpm	1200 rpm	1800 rpm	Motor hp	900 rpm	1200 rpm	1800 rpm
1/2	4.45	5.1	6.1	7 1/2	87.5	65	108
3/4	6.15	7.89	9.2	10	102	126	146
1	16.1	9.18	17.8	15	233	268	273
1 1/2	20.4	11.3	21.6	20	308	306	315
2	21.8	29.5	25.6	25	344	548	596
3	38.9	38.0	66.5	30	530	611	676
5	48	48.3	87.4	40	595	940	931

How To Select The Right Actuator

Typical Design Problem

Two Model 9810 Ball Screw actuator units, standard ratio, were selected to raise a total load of 12 tons at a lifting speed of approximately 36 in. per min.

To obtain this lifting speed, it is determined to use an 1800 RPM motor and a 3: 1 gear reducer.

1. The hp per actuator = $\frac{\text{Starting Torque x RPM of Worm}}{63{,}000}$

Since the load per actuator is only 60% of full

$\frac{12 \text{ tons}}{2 \text{ actuators}}$ = 6 tons per actuator on a 10-ton actuator = 60%

The starting torque is 60% of that shown in the specification table (350 in.-lb. x .60 = 210 in.-lb) The RPM turns of worm per 1" raise x 36 in. of raise per minute = 16.88 turns of worm per 1" raise x 36 in. of raise per minute = 600 RPM

$$\text{hp per actuator} \quad \frac{210 \text{ in-lbs x } 600 \text{ rpm}}{63{,}000} = 2.0 \text{ hp}$$

2. The arrangement efficiency for a two-actuator arrangement is 95%.
3. In this case, there are no gear boxes used, just a gear reducer, so neglect this factor.

$$\text{The arrangement hp} = \frac{2.0 \text{ x } 2}{.95 \text{ x } .9 \text{ Reducer Efficiency}}$$

hp = 4.68

Use a 5 hp motor

4. Motor size was calculated in above to be 5 hp.

A. From the tabulation of "C" factors (See chart, page 23).
C = 87.4 for a 5 hp, 1800 RPM motor.

In order to stop within 3 / 8" of drift, it is necessary to determine brake size required:

B. The hold-back torque for 10 tons is 11 Lb.-ft. (from Specification Chart, page 67). For 6 tons, it will be:

$\frac{6 \text{ x } 11}{10}$ = .6.60 lb. ft.

Therefore, use the closest standard brake size for 6.8 lb. ft.

C. Substitute in the Motor Brake Torque Equation:

$$\text{Motor Brake Torque} = \frac{87.4}{16.9 \text{ x } .375 \text{ x } 3} + \frac{6.60 \text{ X } 2}{3} = 6.8 \text{ lb. ft.}$$

If additional assistance is required, complete the application analysis form found at the front of this catalog and fax to Duff-Norton at 704-588-1994, or contact your local Duff -Norton representative.

Order Checklist

To ensure you receive the required equipment, please use the following checklist before finalizing your order.

- ☐ Quantity
- ☐ Stroke
- ☐ Capacity
- ☐ Type unit ordered (1800,2800, 9000-9800, etc.)
- ☐ Type screw end (top plate, threaded end, etc.)
- ☐ Submit print if special end configuration is desired.
- ☐ Ratio
- ☐ Whether upright, inverted screw, translating screw or rotating screw
- ☐ Keyed screw (not standard; must be specified)
- ☐ Boot
- ☐ Anti-backlash feature (machine screw actuator models only)
- ☐ Worm extension -right-hand or left-hand or both (double extension is standard)
- ☐ Limit switch and position (state voltage-available as standard with 250 V, 480 V, or 600 V. Also state whether switch is to be mounted on right or left extension of worm shaft.)
- ☐ Transducer
- ☐ Visual position indicator
- ☐ Numeric control ratio
- ☐ Call out other special requirements in detail, or submit print with order

Model Numbering System

Duff -Norton Mechanical Actuators Example:

LNTM -1802 -6 -1R
(a) (b) (c) (d)

(a) Basic Model
(b) Series No.
(c) Travel of Unit (inches)
(d) Suffix

Basic Model Prefixes (a)

CM - Clevis end on machine screw actuator models. Clevis is called out as a separate item on ball screw actuator units.

CCM - Actuator unit with double clevis mounting arrangement.

DM - Inverted rotating screw actuator unit.

F - C-Face Adapter included.

KM - Keyed lifting screw with top plate on machine screw actuator models. Ball screw track cannot be interrupted with cut keyway, as this would permit loss of recirculating balls.

L - Limit Switch used with extended mounting.

M - On machine screw actuator models, indicates top plate. On ball screw actuator models, indicates standard threaded end. When preceding 2700 (9700) or 2900 (9900) Series, indicates MAXI -P AC TM electromechanical actuator.

N - Numeric Control Ratio, when used after L or alone.

PM - Plain end, with no machining on end of lifting screw on machine screw actuator unit.

SM - Stainless Steel

TM - Threaded end on machine screw actuator unit. Threaded end is standard on ball screw actuator models.

UM - Upright rotating screw actuator unit.

Capacity and Series Designations (b)

1800 & 9000 - Covers standard machine screw actuator models from 2 tons to 150 tons. The fourth digit changes to indicate capacity in tons with the upright unit shown as actual capacity number (1802 -9005, etc.), the inverted by lowering one number (1801 -9004, etc.), and the rotating screw raised one number (1803 -9006, etc.) except the 100 -ton which is outlined below.

Examples: 25 -ton capacity and 100 -ton capacity.

9025 -25 -ton standard with upright lifting screw.

9024 -25 -ton standard with inverted lifting screw.

9026 -25 -ton standard with rotating upright or inverted lifting screw. Direction of screw is indicated by UM or DM.

1899 & 9099 -100 -ton standard with upright lifting screw.

1898 & 9098 -100 -ton standard with inverted lifting screw.

1897 & 9097 -100 -ton standard with rotating upright or inverted lifting screw. Direction of screw is indicated by UM or DM.

2000 & 10000 - Designates deviation from standard in 1800 & 9000 Series. Fourth numeral changes, same as in standard 1800 and 9000 Series.

2250 - Indicates standard 250 -ton capacity with upright lifting screw.

2249 - Standard 250 -ton with inverted lifting screw.

2251 -Standard 250 -ton with rotating upright or inverted lifting screw. Direction of screw is indicated by UM or DM.

2501 -Standard one -ton capacity with upright lifting screw.

2500 -Standard one -ton capacity with inverted lifting screw.

2502 - Standard one -ton capacity with rotating upright or inverted lifting screw. Direction of screw is indicated by UM or DM.

3501 - Indicates deviation from standard in one -ton series. Fourth numeral changes, same as in standard 2501 Series.

2555 - Standard 500 -lb. capacity Miniature actuator unit with upright lifting screw.

2554 - Standard 500 -lb. capacity Miniature actuator unit with inverted lifting screw.

2556 - Standard 500 -lb. capacity Miniature actuator unit with upright or inverted rotating screw. Direction of screw is indicated by UM or DM.

3055 - Indicates deviation from standard in 500 -lb. Miniature Series. Fourth numeral changes, same as for standard 2555 Series.

2625 - Standard 1,000 -lb. Miniature actuator unit with upright lifting screw.

2624 - Standard 1,000 -lb. Miniature actuator unit with inverted lifting screw.

2626 - Standard 1,000 -lb. Miniature actuator unit with upright or inverted rotating screw. Direction of screw is indicated by UM or DM.

3625 - Indicates deviation from standard in 1,000 -lb. Miniature Series. Fourth numeral changes, same as for standard 2625 Series.

3555 - Micro -miniature actuator unit with upright lifting screw.

3554 - Micro -miniature actuator unit with inverted lifting screw.

2800 & 9800 - Covers standard ball screw actuator models from 2 tons through 50 tons. The fourth digit changes to indicate capacity in tons with the upright unit shown as actual capacity number (2802 -9805, etc.), the inverted by lowering one number (2801 -9804, etc.), and the rotating screw raised one number (2803 -9806, etc.).

2802 - Standard upright translating screw ball screw actuator unit.

2801 - Standard inverted translating screw ball screw actuator unit.

2803 - Standard rotating upright or inverted screw ball screw actuator unit. Direction of screw indicated by UM or DM.

28021 -28011 -28031, etc. - First four digits same as for 2800 Series. The fifth digit indicates 1" lead on ball track. Available in 2, 5 and 10 -ton only.

28003 - Standard three -ton upright translating screw ball screw actuator unit.

28002 - Standard three -ton inverted translating screw ball screw actuator unit.

28004 - Standard three -ton rotating upright or inverted screw ball screw actuator unit. Direction of screw indicated by UM or DM.

3800 - Indicates deviation from standard in 2800 Series actuator models. Different types carry same fourth and fifth digit designators.

28631 - Standard 1,000 -lb. capacity Miniature actuator unit with upright translating ball screw.

28630 - Standard 1,000 -lb. capacity Miniature actuator unit with inverted translating ball screw.

28632 - Standard 1,000 -lb. capacity Miniature actuator unit with upright or inverted rotating ball screw. Direction of screw indicated by UM or DM.

4501 - Anti -Backlash one -ton capacity machine screw actuator unit with standard upright translating lifting screw.

4500 - Anti -Backlash one -ton capacity machine screw actuator unit with standard inverted translating lifting screw.

4555 - Anti -Backlash 500 -lb. capacity Miniature actuator unit with standard upright translating lifting screw.

4554 - Anti -Backlash 500 -lb. capacity Miniature actuator unit with standard inverted translating lifting screw.

4625 - Anti -Backlash 1,000 -lb. capacity Miniature actuator unit with upright translating lifting screw.

4624 - Anti -Backlash 1,000 -lb. capacity Miniature actuator unit with inverted translating lifting screw.

5625 - lndicates deviation from standard on 1,000 -lb. capacity Miniature actuator unit with upright translating lifting screw and anti -backlash feature.

5624 - Indicates deviation from standard on 1,000 -lb. capacity Miniature actuator unit with inverted translating lifting screw and anti -backlash feature.

4800 & 9400 - Standard machine screw actuator unit with anti -backlash feature. Capacities from 2 tons through 150 tons. The fourth digit changes to indicate capacity in tons with the upright unit showing actual capacity number in tons (4802 - 9405, etc.), the inverted by lowering one number (4801 -9404, etc.), except the 100 -ton which is outlined below.

9425 - As above with upright translating lifting screw. 9424 - As above with inverted translating lifting screw.

4899 & 9499 - 100 -ton capacity anti -backlash machine screw actuator unit with upright translating lifting screw.

4898 & 9498 - 100 -ton capacity anti -backlash machine screw actuator unit with inverted translating lifting screw.

5501 - Indicates deviation from standard on one -ton anti - backlash machine screw actuator unit with upright translating screw.

5500 - Indicates deviation from standard on one -ton anti - backlash machine screw actuator unit with inverted translating screw.

5800 & 10400 - Indicates deviation from standard on 4800 and 9400 Series anti -backlash machine screw actuator unit. Fourth digit changes same as on 4800 and 9400 Series.

7001 – Standard 2 ton inverted translating machine screw actuator with reverse base mounting.

7002 – Standard 2 ton upright translating machine screw actuator with reverse base mounting.

7003 – Standard 2 ton rotating machine screw actuator with reverse base mounting.

7401 – Standard 2 ton inverted translating machine screw actuator with anti-backlash feature and reverse base mounting.

7402 – Standard 2 ton upright translating machine screw actuator with anti-backlash feature and reverse base mounting.

7510 – Standard 2,000 lb inverted translating High Duty Cycle actuator.

7511 – Standard 2,000 lb upright translating High Duty Cycle actuator.

7512 – Standard 2,000 lb rotating High Duty Cycle actuator.

7514 – Standard 5,200 lb inverted translating High Duty Cycle actuator.

7515 – Standard 5,200 lb upright translating High Duty Cycle actuator.

7516 – Standard 5,200 lb rotating High Duty Cycle actuator.

7521 – Standard 13,000 lb inverted translating High Duty Cycle actuator.

7522 – Standard 13,000 lb upright translating High Duty Cycle actuator.

7523 – Standard 13,000 lb rotating High Duty Cycle actuator.

7801 – Standard 2 ton inverted translating ball screw actuator with reverse base mounting.

7802 – Standard 2 ton upright translating ball screw actuator with reverse base mounting.

7803 – Standard 2 ton rotating ball screw actuator with reverse base mounting.

78011 - Standard 2 ton inverted translating ball screw actuator with 1” lead ball screw and reverse base mounting.

78021 - Standard 2 ton upright translating ball screw actuator with 1” lead ball screw and reverse base mounting.

78031 - Standard 2 ton rotating ball screw actuator with 1” lead ball screw and reverse base mounting.

8001 - Special 2 ton inverted translating machine screw actuator with reverse base mounting.

8002 - Special 2 ton upright translating machine screw actuator with reverse base mounting.

8003 - Special 2 ton rotating machine screw actuator with reverse base mounting.

8401 - Special 2 ton inverted translating machine screw actuator with anti-backlash feature and reverse base mounting.

8402 - Special 2 ton upright translating machine screw actuator with anti-backlash feature and reverse base mounting.

8510 - Special 2,000 lb inverted translating High Duty Cycle actuator.

8511 - Special 2,000 lb upright translating High Duty Cycle actuator.

8512 - Special 2,000 lb rotating High Duty Cycle actuator.

8514 - Special 5,200 lb inverted translating High Duty Cycle actuator.

8515 - Special 5,200 lb upright translating High Duty Cycle actuator.

8516 - Special 5,200 lb rotating High Duty Cycle actuator.

8521 - Special 13,000 lb inverted translating High Duty Cycle actuator.

8522 - Special 13,000 lb upright translating High Duty Cycle actuator.

8523 - Special 13,000 lb rotating High Duty Cycle actuator.

8801 - Special 2 ton inverted translating ball screw actuator with reverse base mounting.

8802 - Special 2 ton upright translating ball screw actuator with reverse base mounting.

8803 - Special 2 ton rotating ball screw actuator with reverse base mounting.

Motorized Actuator Models - Capacity and Series Designation

9704 - Standard 5000 lb. capacity machine screw MAXI -P AC TM electromechanical actuator with inverted translating screw.

9705 - Standard 5000 lb. capacity machine screw MAXI - PACTM electromechanical actuator with upright translating screw.

9706 - Standard 5000 lb. capacity machine screw MAXI - PAC TM electromechanical actuator with upright or inverted rotating screw; direction indicated by UM or DM.

9709 - Standard 9200 lb. capacity machine screw MAXI - PAC TM electromechanical actuator with inverted translating screw.

9710 - Standard 9200 lb. capacity machine screw MAXI - PAC TM electromechanical actuator with upright translating screw.

9711 - Standard 9,200 lb. capacity machine screw MAXI - PAC TM electromechanical actuator with upright or inverted rotating screw; direction indicated by UM or DM.

9904 - Standard 10,000 lb. capacity ball screw MAXI -PAC TM electromechanical actuator with inverted translating screw.

9905 - Standard 10,000 lb. capacity ball screw MAXI -PAC TM electromechanical actuator with upright translating screw.

9906 - Standard 10,000 lb. capacity ball screw MAXI -PAC TM electromechanical actuator with upright or inverted rotating screw; direction indicated by UM or DM.

9909 - Standard 14,000 lb. capacity ball screw MAXI -PAC TM electromechanical actuator with inverted translating screw.

9910 - Standard 14,000 lb. capacity ball screw MAXI -PAC TM electromechanical actuator with upright translating screw.

9911 - Standard 14,000 lb. capacity ball screw MAXI -PAC TM electromechanical actuator with upright or inverted rotating screw; direction indicated by UM or DM.

99041 - Standard 5,000 lb. capacity ball screw MAXI -PAC TM electromechanical actuator with inverted translating screw having 1" lead on ball track.

99051 - Standard 5,000 lb. capacity ball screw MAXI -PAC TM electromechanical actuator with upright translating screw having 1" lead on ball track.

99061 - Standard 5,000 lb. capacity ball screw MAXI -PAC TM electromechanical actuator with upright or inverted rotating screw having 1" lead on ball track; direction indicated by UM or DM.

99091 - Standard 5,600 lb. capacity ball screw MAXI -PAC TM electromechanical actuator with inverted translating screw having 1" lead on ball track.

99101 - Standard 5,600 lb. capacity ball screw MAXI -PAC TM electromechanical actuator with upright translating screw having 1" lead on ball track.

99111 - Standard 5,600 lb. capacity ball screw MAXI -PAC TM electromechanical actuator with upright or inverted rotating screw having 1" lead on ball track; direction indicated by UM or DM.

Third Space Numerals (c)

The characters appearing in this space are to indicate raise in inches on -all standard units, but not on specials. This space on specials helps to identify to our Engineering Department the actual actuator model produced. The numerals do not indicate raise or type of modification performed on special orders.

Suffix (d)

B - Indicates boot required to protect lifting screw.

L - Single -end worm shaft extension on left -hand side only.

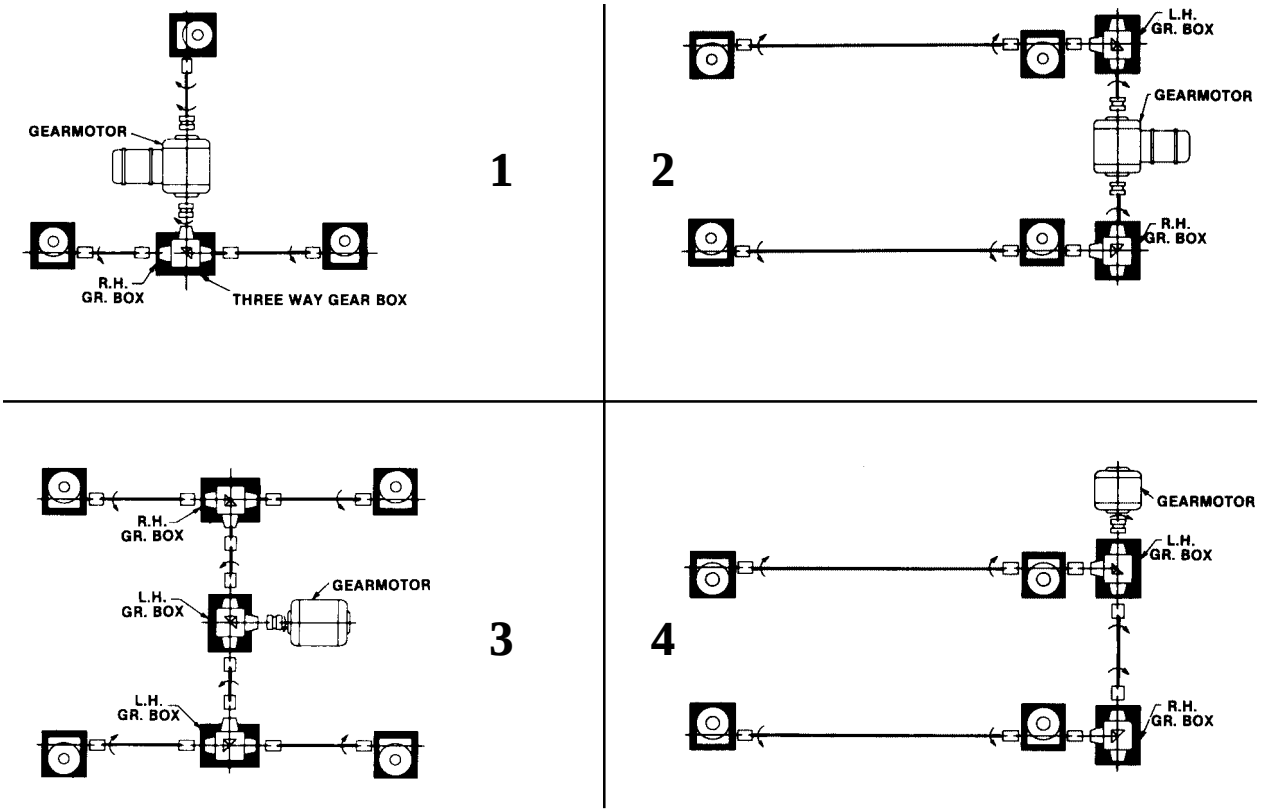
R - Single -end worm shaft extension on right -hand side only.

1 - Alternate ratio required 1 X -Supplied without dust guard, but with guide bushing.

X - Supplied without dust guard, but with guide bushing.

C - Nema 56 frame C -Face motor mount MAXI -PAC™.

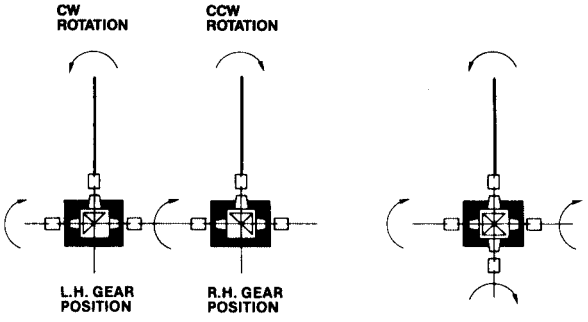
Typical Arrangements



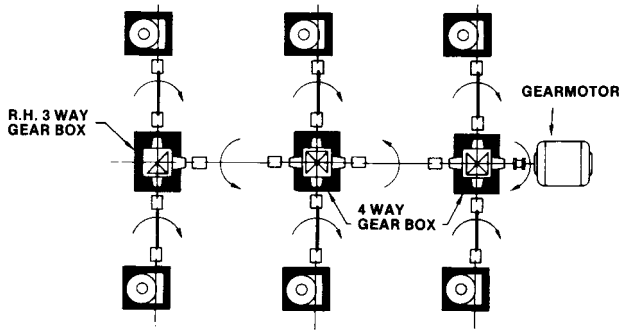
Shaft Rotation for Mitre Gear Boxes

The direction of rotation of a connecting shaft can a readily be controlled by the selection of either a right- or left - hand mitre gear box. The sketch below shows how either a C.C.W or a C.W. rotation is obtained. Both gear boxes are identical except for the position of the mitre gear on the drive shaft. This is merely a question of assembly choice. The second sketch shows a typical arrangement of four actuators, two gear boxes (one R.H. and one L.H) and a gear motor drive. This is the most commonly used actuator arrangement, and this sketch illustrates how easy it is to obtain reverse rotation of a connecting shaft. In the lower right of this page is an arrangement showing use of 3-way and 4-way gear boxes in combination. Note that the No. 1 and the No.2 4-way gear boxes are switched end-for-end to make the opposite rotation of the stub shafts work for you.

Shaft Rotation



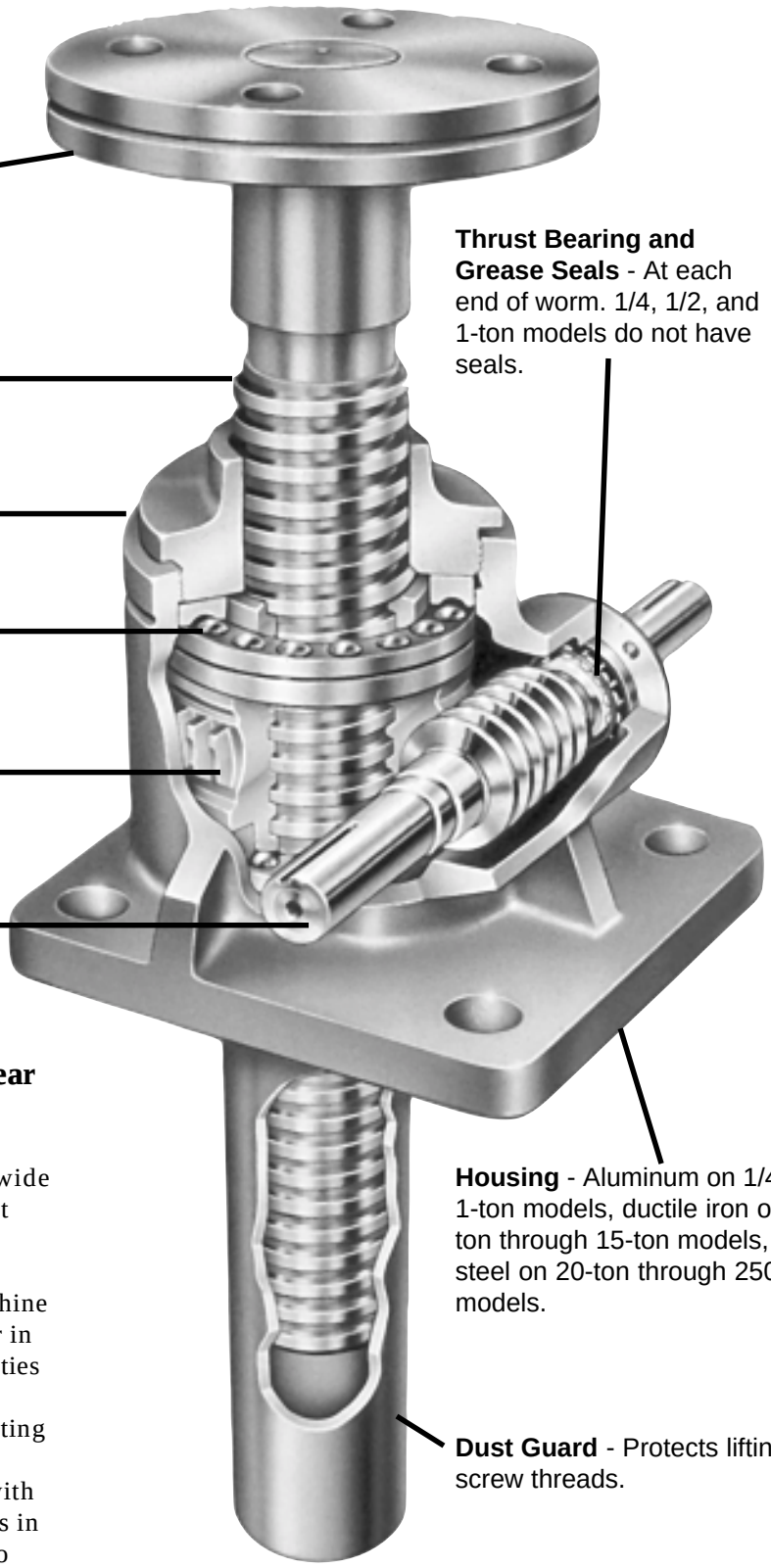
4 Way Gear Box Arrangement



Machine Screw Actuator Models

Advantages:

- Positive, mechanical positioning
- Uniform lifting speed
- Multiple arrangements
- Anti-backlash feature (optional)



Top Plate - Must be bolted to lifting member to prevent rotation except when screw is keyed.

Lifting Screw - Available with threaded end or clevis end instead of top plate.

Shell Cap - Locked into place by set screws.

Load Bearings - Bearings, top and bottom to take loads in either direction.

Worm Gear - Aluminum bronze. Accurately hobbed for greater gear contact.

Worm - Available with double or single shaft extension.

Thrust Bearing and Grease Seals - At each end of worm. 1/4, 1/2, and 1-ton models do not have seals.

Housing - Aluminum on 1/4 to 1-ton models, ductile iron on 2-ton through 15-ton models, cast steel on 20-ton through 250-ton models.

Dust Guard - Protects lifting screw threads.

Capacities from 1/4 Ton to 250 Tons Worm Gear Ratios from 5:1 to 50:1

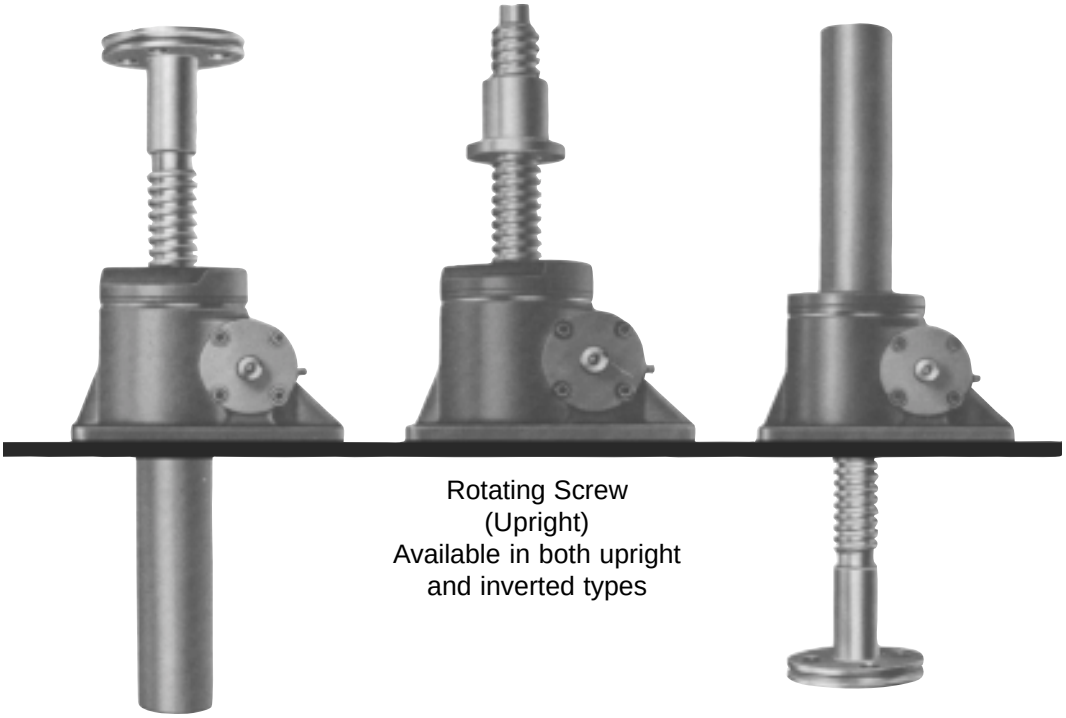
Because the Duff -Norton machine screw mechanical actuator is produced in many standard models with a wide range of capacities, there is a standard model for almost any requirement. Models can be furnished to 250 tons capacity.

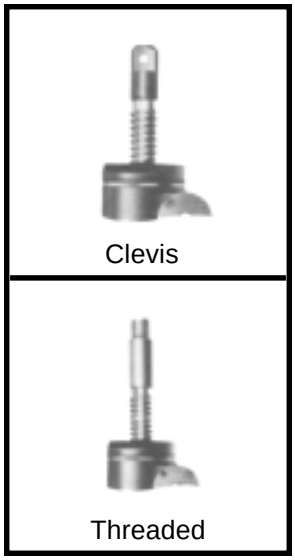
Operated manually or by means of gear motors, machine screw actuator models can be used singly, in tandem or in multiple arrangements (see page 28). Since most capacities have a uniform lifting speed, added economy can be realized in raising unevenly distributed loads by operating the different capacities in union.

Most Duff -Norton machine screw actuator models with higher ratios are self -locking and will hold heavy loads in position indefinitely without creep. They can be used to push, pull, apply pressure and as linear actuators. They are furnished with standard raises in increments of 1 inch. Depending upon size and type of load, models are available with raises up to 20 feet.

More Than 200 Standard Combinations

- Precise Positioning -Can be controlled accurately for positioning within thousandths of an inch.
- Self Locking -Will normally hold loads in position without creeping when using the higher ratio units, as long as the actuator unit is not subject to vibration.
- Uniform Lifting Speed -Since many models have the same gear ratios, various capacities can be used in the same application to lift unevenly distributed loads with uniform speed.
- Quick, Sure Operation -Designed and built to be positive acting, for accurate response to motive power.
- Anti-Backlash Option -Reduces vertical backlash between the screw and the worm gear nut to a practical minimum for smooth, precise operation and minimum wear.





With such a wide range of standard machine screw actuator configurations, Duff-Norton gives your design flexibility and economy. Examples of these standard options include upright or inverted screws with threaded or top plate screw end, as well as upright and inverted screws with top plate, keyed lifting screw, limit switches, C-face motor flanges and position indicators.

Duff-Norton machine screw actuators are available in standard models to meet almost any requirement. Capacities cover a wide range, from 1/4 to 250 tons.

Operated manually or with air, hydraulic or electric motors, machine screw actuators can be used individually, in tandem or in multiple arrangements. Since most capacities have similar gear ratios, you can realize added economy by using different capacities in unison to raise unevenly distributed loads.

Most higher ratio Duff-Norton machine screw actuators are self-locking and will hold heavy loads indefinitely without creeping. However, if self-locking is absolutely necessary, a motor brake or other restraining device should be considered.

They can be used to push, pull and apply pressure and position precisely. Raises, measured in increments of 1 inch, are available up to 20 feet.

ATTACHMENTS

NEMA C-face flanges, motors, gear boxes, reducers and couplings are available for single actuator drive or multiple actuator arrangements. Position control components include limit switches, potentiometers, digital encoders and meters with LED display.

Model No.		2555	2625	2501	1802, 7002 &9002	9005	9010	9015	9020	9025	9035	1850 & 9050	9075	9099	18150	2250
	Inverted	2554	2624	2500	1801, 7001 &9001	9004	9009	9014	9019	9024	9034	1849 & 9049	9074	9098	18149	2249
Capacity, Tons		1/4	1/2	1	2	5	10	15	20	25	35	50	75	100	150	250
Lifting Screw Diameter (inches)		1/2 .250 Pitch Acme	5/8 .125 Pitch Acme	3/4 .200 Pitch Acme	1 .250 Pitch Acme	1 1/2 .375 Pitch Acme	2 .500 Pitch Acme	2 1/4 .500 Pitch Acme	2 1/2 .500 Pitch Acme	3 .666 Pitch Acme	3 3/4 .666 Pitch Acme	4 1/2 .666 Pitch Square	5 .666 Pitch Square	6 .750 Pitch Square	7 1.000 Pitch Square	9 1.000 Pitch Square
Worm Gear Ratios	Std. Ratio	5:1	5:1	5:1	6:1	6:1	8:1	8:1	8:1	10 2/3:1	10 2/3:1	10 2/3:1	10 2/3:1	12:1	12:1	50:1
	Optional	---	---	20:1	24:1	24:1	24:1	24:1	24:1	32:1	32:1	32:1	32:1	36:1	36:1	---
Turns of Worm for 1" Raise	Std. Ratio	20	40	25	24	16	16	16	16	16	16	16	16	16	12	50
	Optional	---	---	100	96	64	48	48	48	48	48	48	48	48	36	---
No Load Torque (In-Lbs)	Std. Ratio	2	2	5	5	10	20	20	30	40	50	100	150	200	250	200
	Optional	---	---	5	5	10	20	20	30	40	50	100	150	200	250	---
	Optional	---	---	---	5	---	---	---	---	---	---	---	---	---	---	---
Maximum HP per Actuator	Std. Ratio	1/3	1/3	1/2	2	4	5	5	5	8	8	15	15	25	25	35
	Optional	---	---	1/4	1/2	3/4	1 1/2	1 1/2	1 1/2	2 1/2	2 1/2	6	6	11	11	---
Torque at Full Load*(In. -Lbs)	Std. Ratio	13	21	55	120	450	750	1,430	2,050	2,700	4,000	7,500	12,000	16,000	28,100	20,000
	Optional	---	---	25	50	185	400	820	1,170	1,200	2,400	4,200	6,600	8,600	15,500	---
Efficiency Rating (%)	Std. Ratio	33.0	20.0	24.5	23.2	22.1	23.7	20.2	18.8	18.7	15.8	13.8	12.4	13.0	14.1	8.0
	Optional	---	---	14.0	13.3	12.1	15.1	12.9	12.0	10.5	8.9	8.3	7.5	8.0	8.6	---
Weight With Base Raise of 6" (Lbs)		2.33	2.33	5	17	35	52	66	93	160	240	410	650	1,200	1,350	2,700
Weight for Each Additional 1" Raise (Lbs.)		0.1	0.1	.27	.33	.85	1.4	1.5	2.6	2.5	3.7	5.5	6.5	9.0	12.6	23.0

* For loads from 25% to 100% of actuator capacity, torque requirements are approximately proportional to the load.

All actuator units can be supplied with standard raises up to 24 inches. Special raises up to 20 feet are available upon request. Standard inverted keyed models do not have a cover pipe (except for the l-ton and 75-ton models). Closed height dimensions may increase for actuators supplied with bellows boots. See page 112.

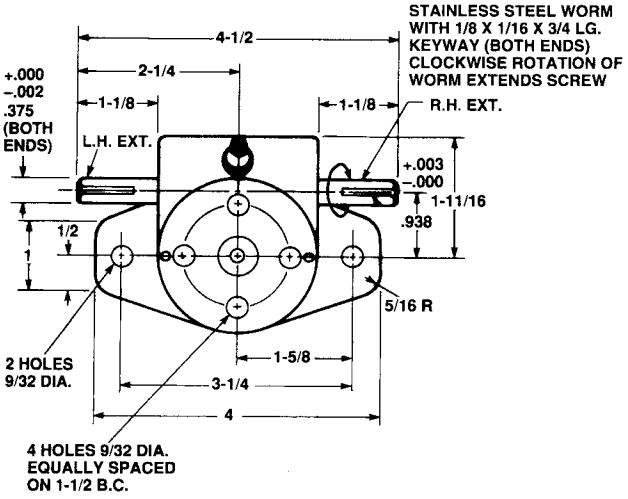
Numeric Controls:

1 to 25 Ton Actuators with Decimal Ratio at No Extra Cost

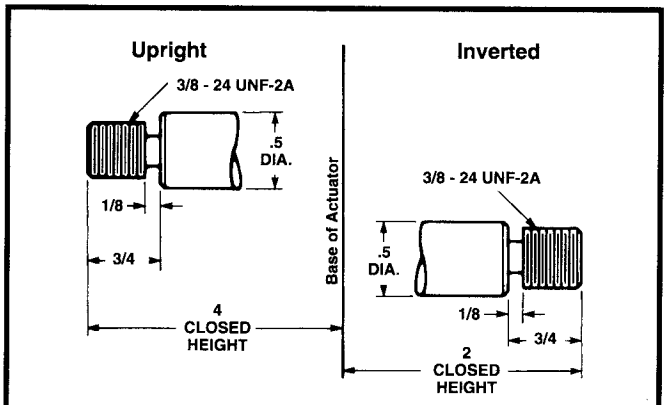
Numeric Control Ratios - 100 Turns = 1" of Travel								
Model No.	Upright	2501	1802, 7002 & 9002	9005	9010	9015	9020	9025
	Inverted	2500	1801, 7001 & 9001	9004	9009	9014	9019	9024
Capacity, Tons		1	2	5	10	15	20	25
Lifting Screw Diamater (inches)		3/4 .200 Pitch Acme	1 .250 Pitch Acme	1 1/2 .250 Pitch Acme	2 .250 Pitch Acme	2 1/4 .250 Pitch Acme	2 1/2 .250 Pitch Acme	3 .320 Pitch Acme
Worm Gear Ratios		20:1	25:1	25:1	25:1	25:1	25:1	32:1
Turns of Worm for 1" Raise		100	100	100	100	100	100	100
No Load Torque (In. - Lbs.)		5	5	10	20	20	30	40
Torque at Full Load(In. - Lbs.)		24	48	175	370	640	925	1500
Actuator Efficiency Rating (%)		13.3	13.2	9.1	8.6	7.5	6.9	5.3
Maximum HP per Actuator		1/4	1/2	3/4	1 1/2	1 1/2	1 1/2	2 1/2

* All other data for these models same as shown in table at top of page.

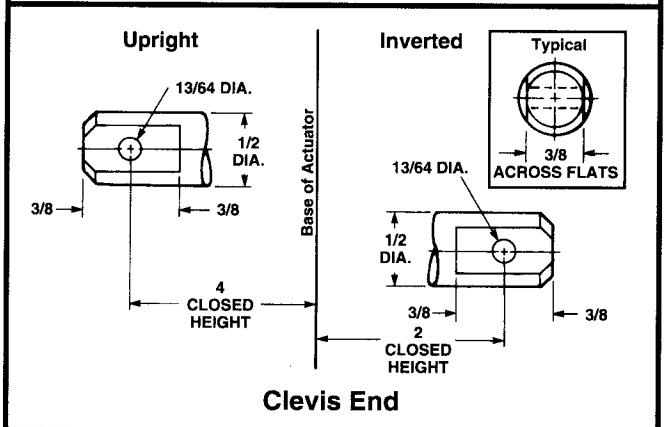
Machine Screw Actuators, 500 Pounds



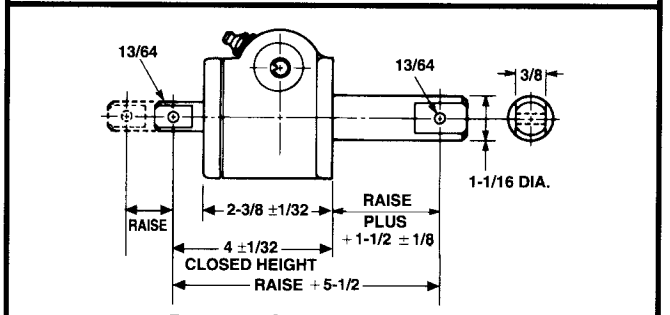
1/2" Diameter x .250 Lead Lifting Screws



Threaded End

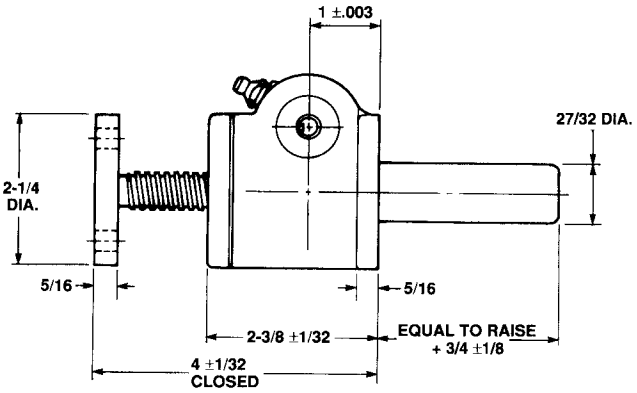


Clevis End

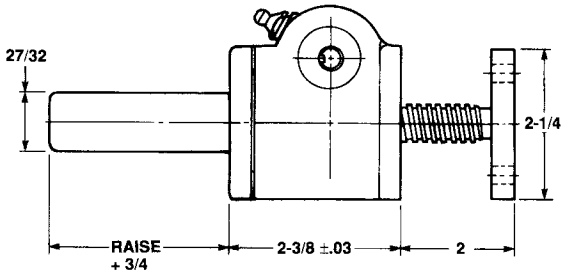


Double Clevis: CCM-2555

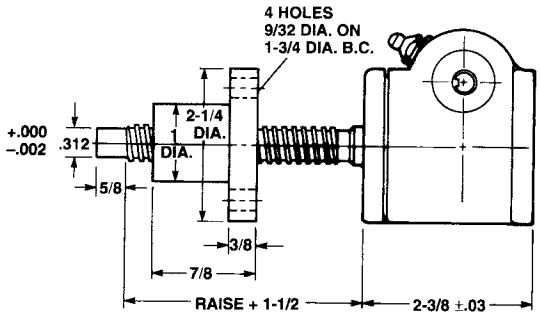
Maximum Allowable Raise in Compression 7" —Rating 500 Lbs.



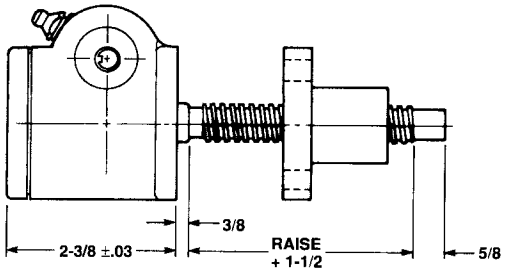
Upright: M-2555



Inverted: M-2554



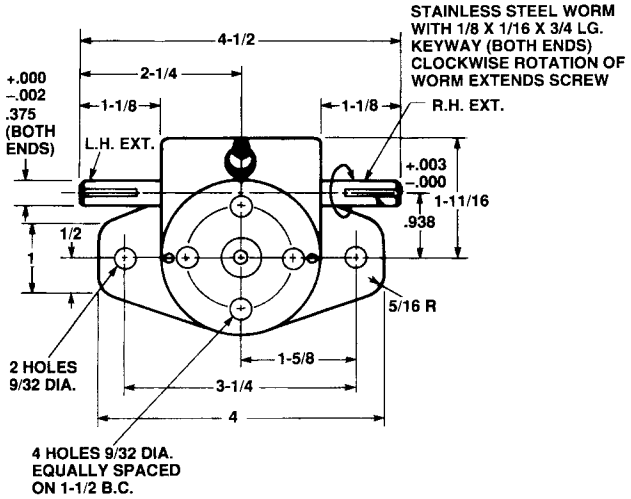
Upright Rotating: UM-2556



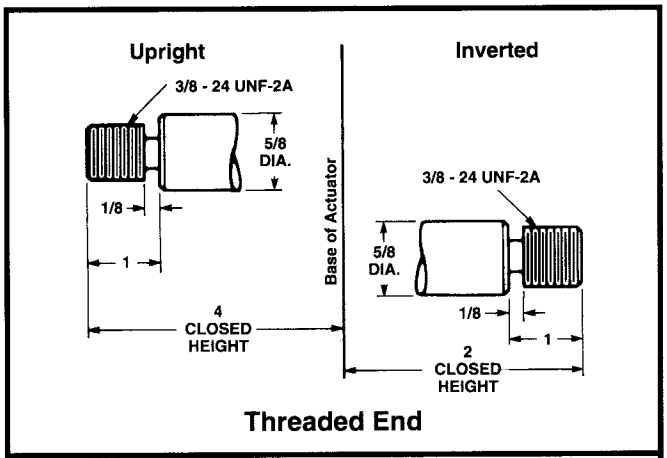
Inverted Rotating: DM-2556

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice. When the lifting screw is keyed, the holes in the top plate will not necessarily be in the position shown.

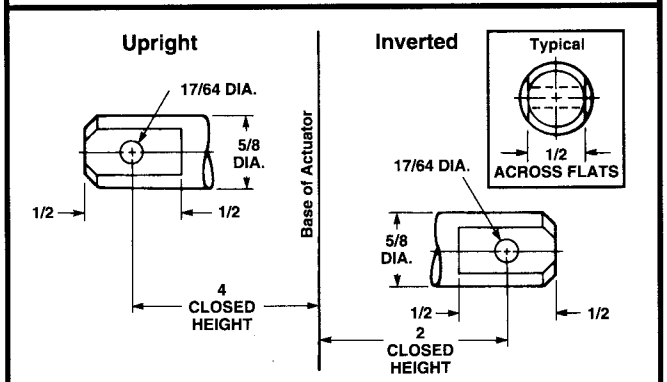
Machine Screw Actuators, 1000 Pounds



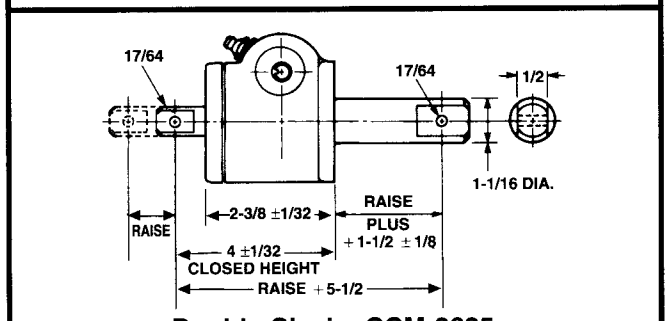
5/8" Diameter x .125 Lead Lifting Screws



Threaded End

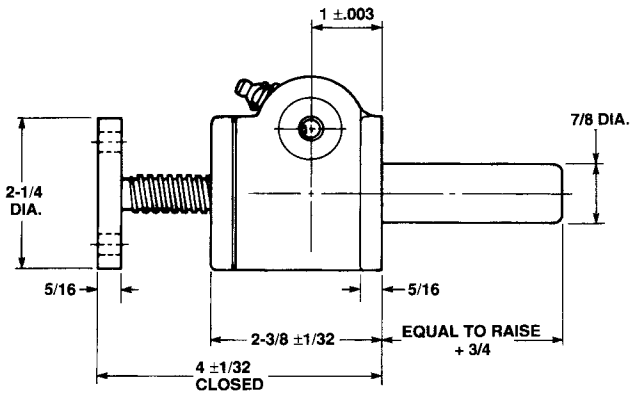


Clevis End

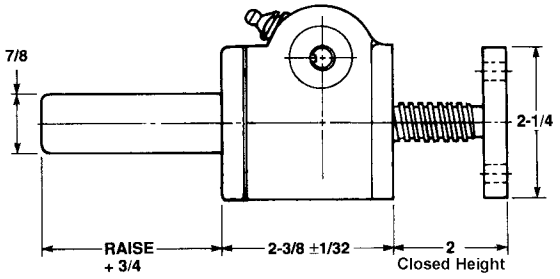


Double Clevis: CCM-2625

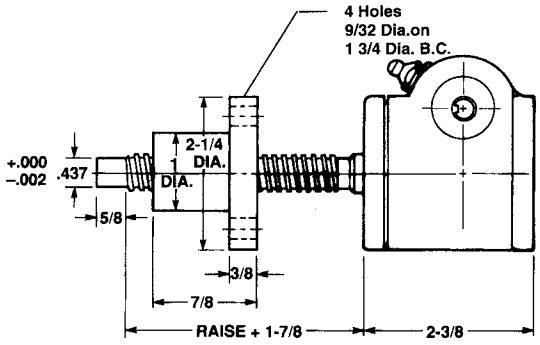
Maximum Allowable Raise in Compression 9 " —Rating 1000 Lbs.



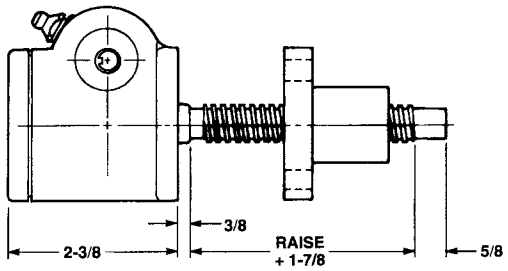
Upright: M-2625



Inverted: M-2624



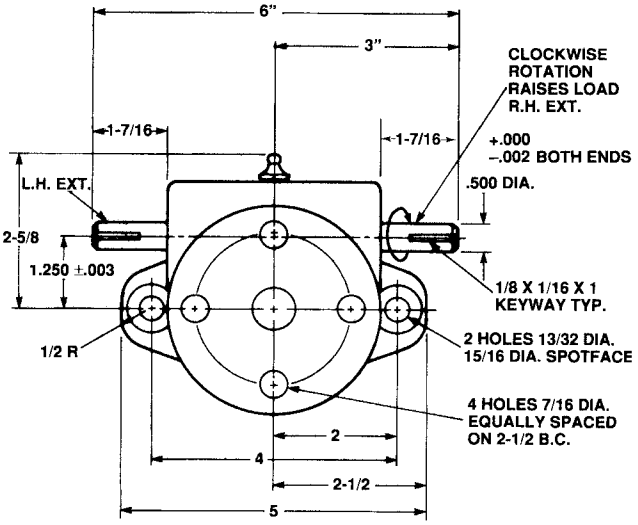
Upright Rotating: UM-2626



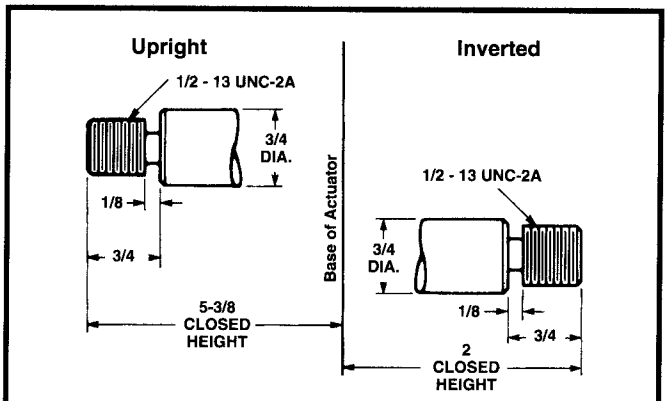
Inverted Rotating: DM-2626

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice. When the lifting screw is keyed, the holes in the top plate will not necessarily be in the position shown.

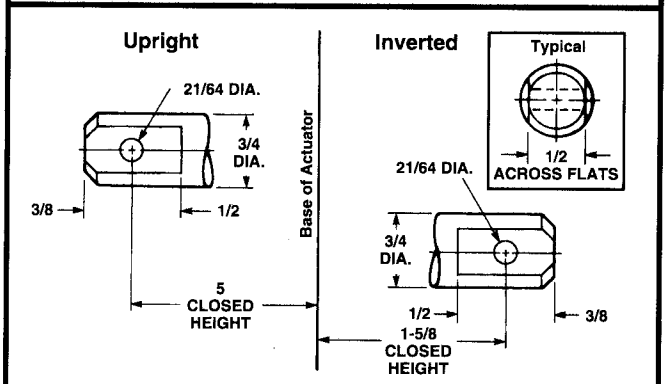
Machine Screw Actuators, 1 Ton



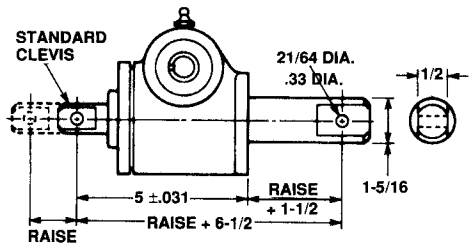
3/4" Diameter x .200 Lead Lifting Screws



Threaded End

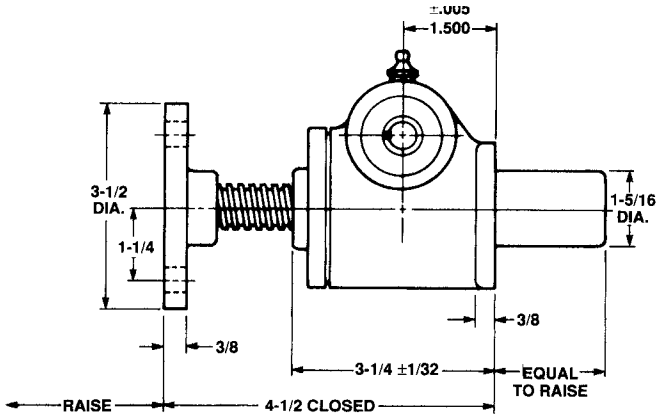


Clevis End

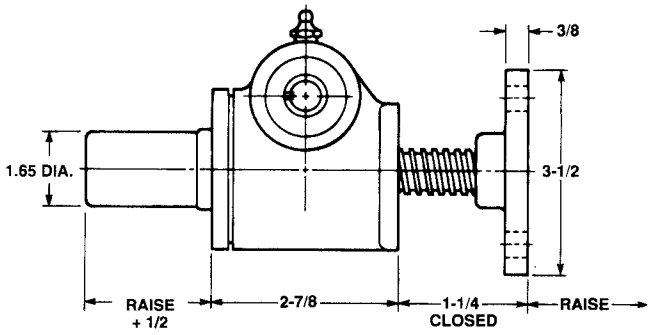


Double Clevis: CCM-2501

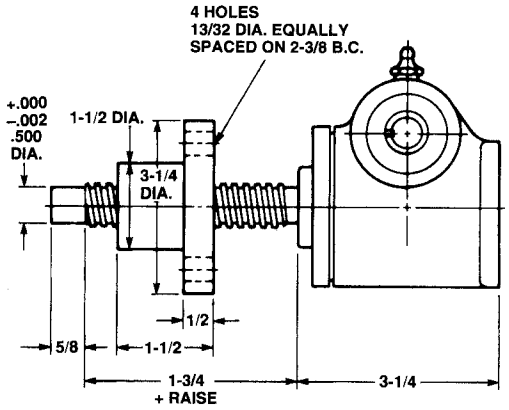
Maximum Allowable Raise in Compression 10" —Rating 1500 Lbs.
Maximum Raise at Rated Load in Compression 8"



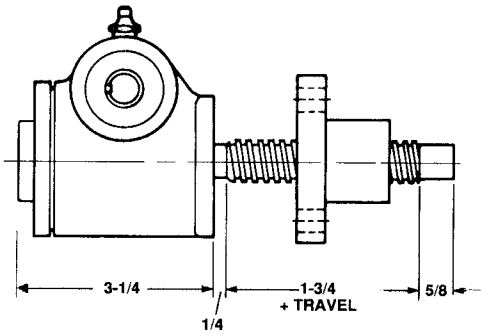
Upright: M-2501



Inverted: M-2500



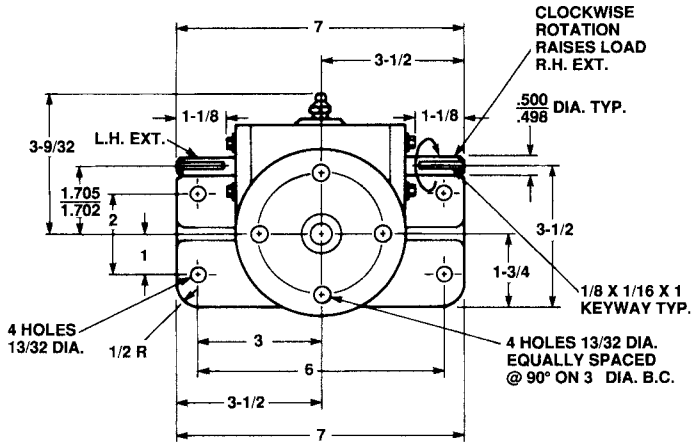
Upright Rotating: UM-2502



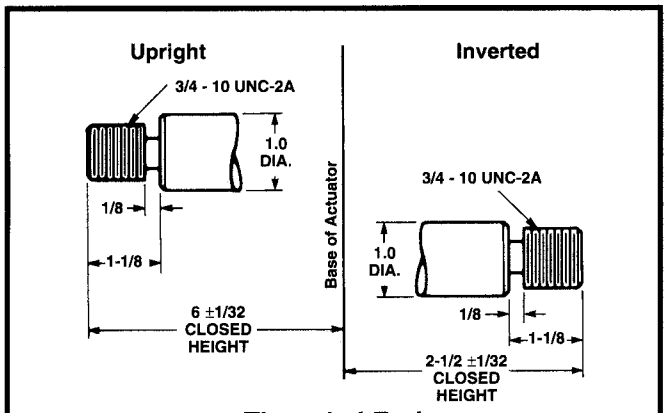
Inverted Rotating: DM-2502

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice. When the lifting screw is keyed, the holes in the top plate will not necessarily be in the position shown.

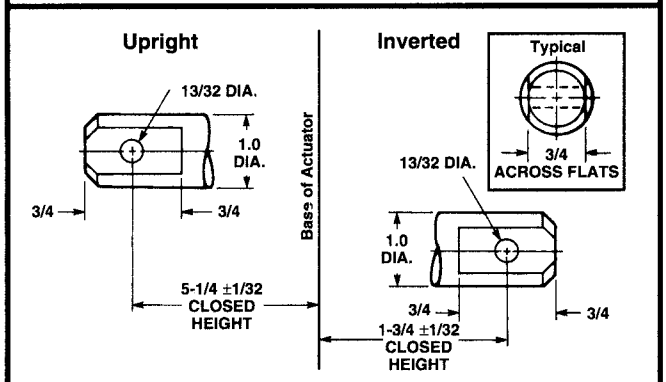
Machine Screw Actuators, 2 Ton, 1800 Series



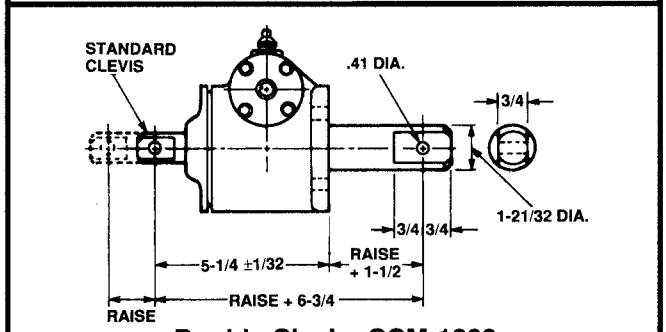
1" Diameter x .250 Lead Lifting Screws



Threaded End

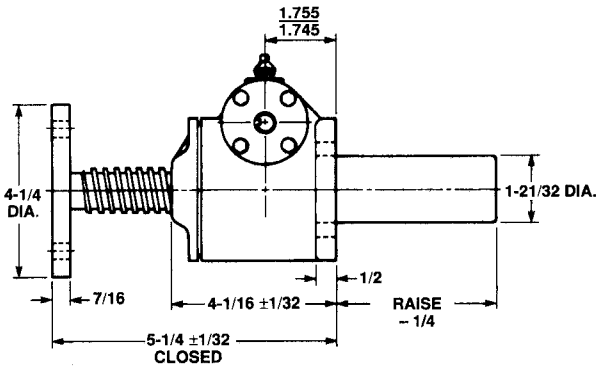


Clevis End

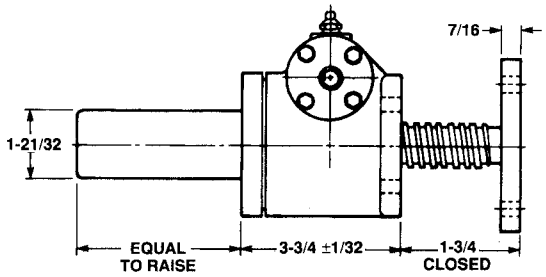


Double Clevis: CCM-1802

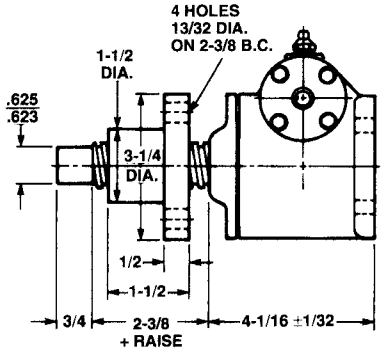
Maximum Allowable Raise in Compression 14" —Rating 3000 Lbs.
Maximum Raise at Rated Load in Compression 12"



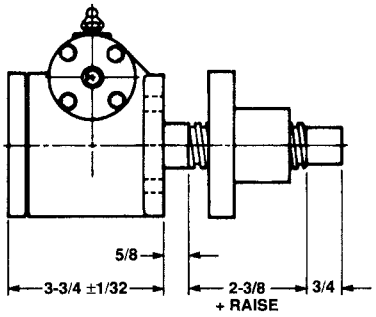
Upright: M-1802



Inverted: M-1801



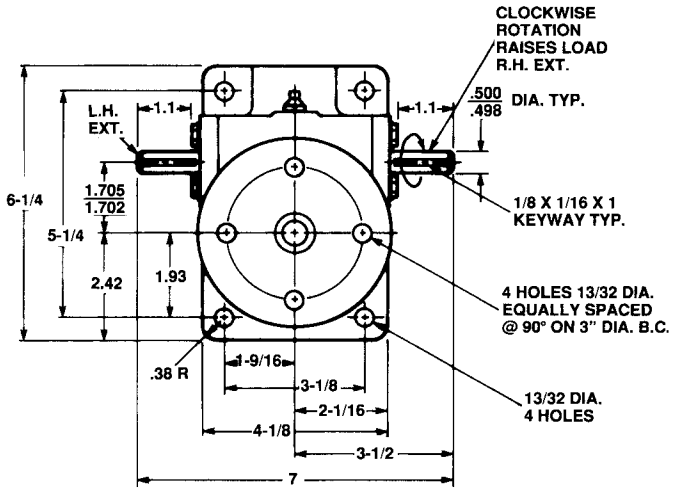
Upright Rotating: UM-1803



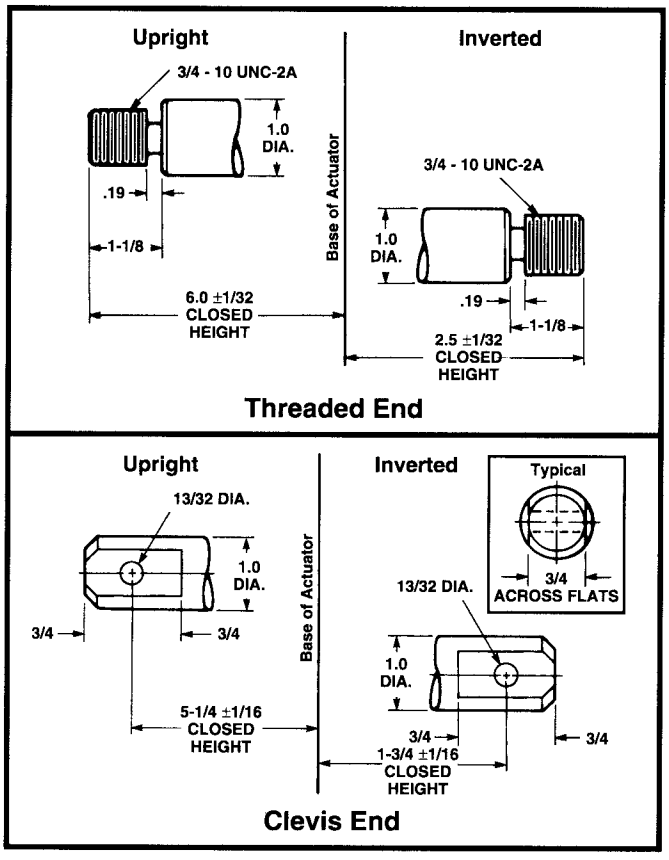
Inverted Rotating: DM-1803

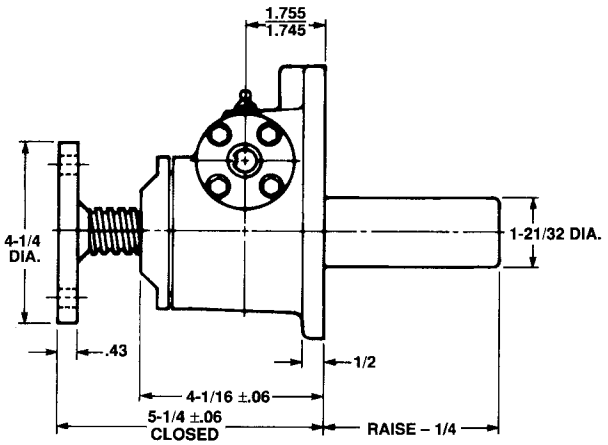
Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice. When the lifting screw is keyed, the holes in the top plate will not necessarily be in the position shown.

Machine Screw Actuators, 2 Ton, 9000 Series

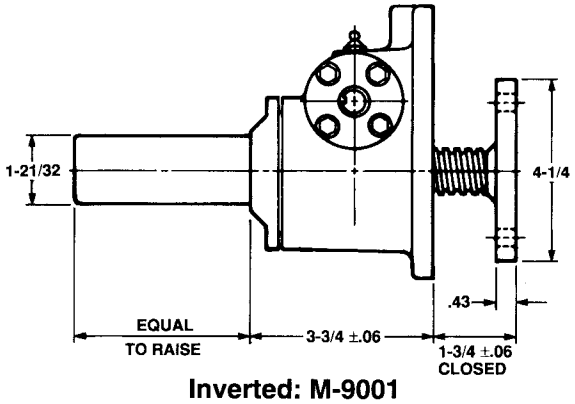


1" Diameter x .250 Lead Lifting Screws

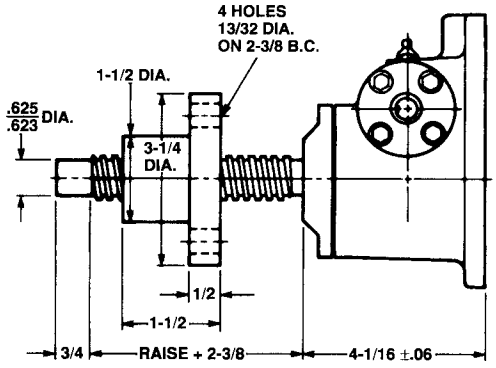




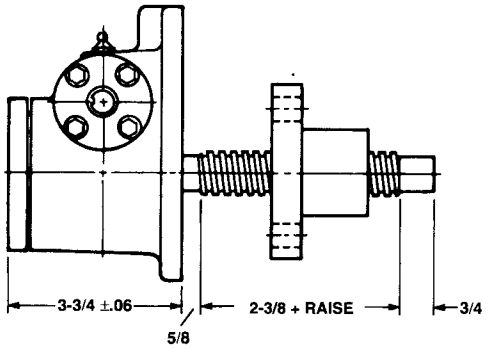
Upright: M-9002



Inverted: M-9001



Upright Rotating: UM-9003

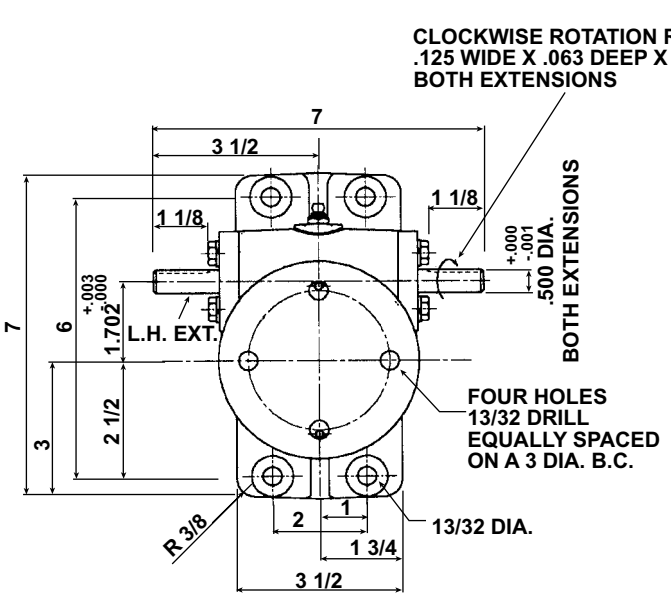


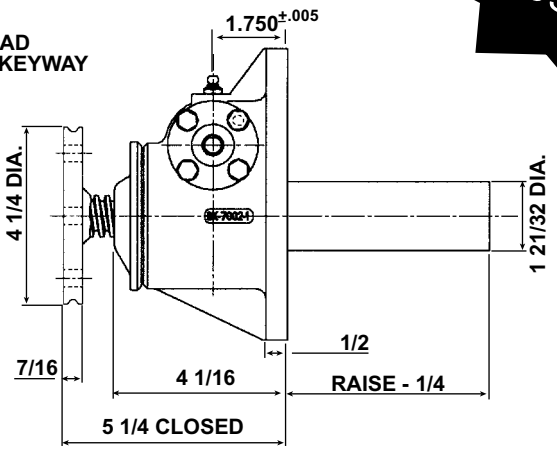
Inverted Rotating: DM-9003

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice. When the lifting screw is keyed, the holes in the top plate will not necessarily be in the position shown.

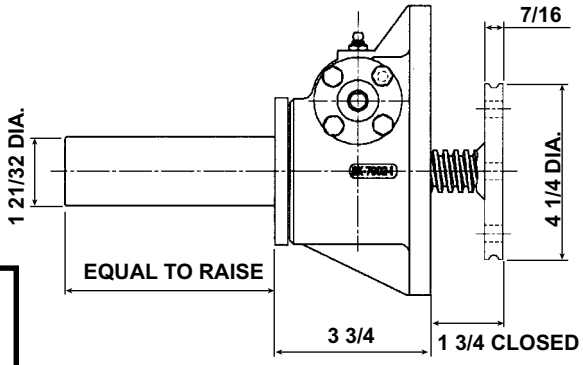
Machine Screw Actuators, 2 Ton, 7000 Series

New Design!



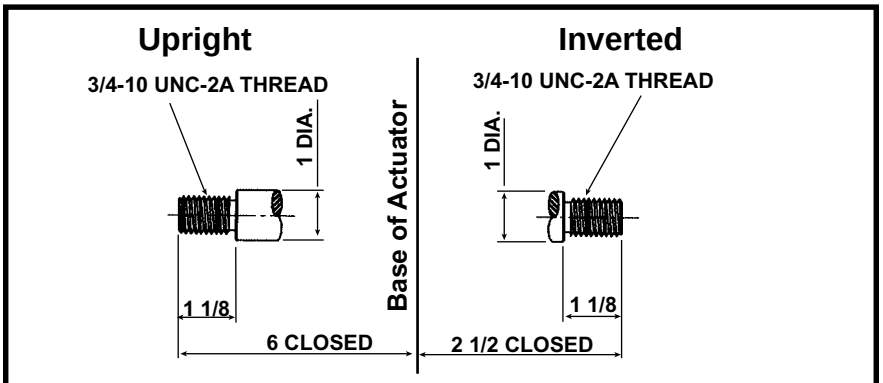


Upright: M-7002

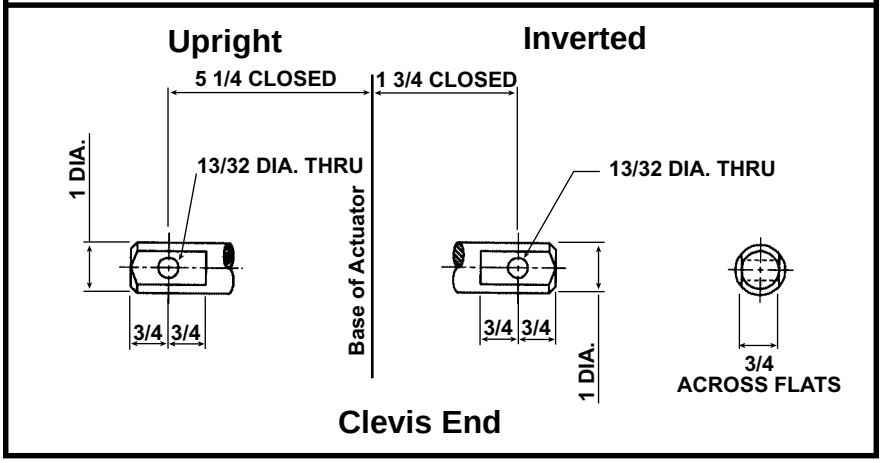


Inverted: M-7001

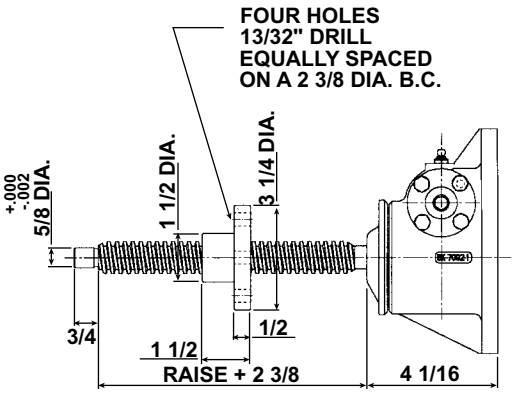
1" Diameter x .250 Lead Lifting Screw



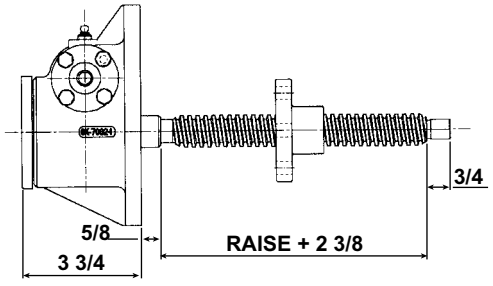
Threaded End



Clevis End



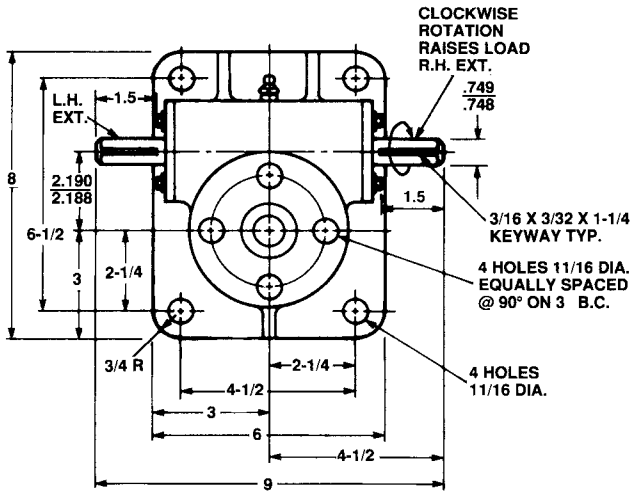
Uprght Rotating: UM-7003



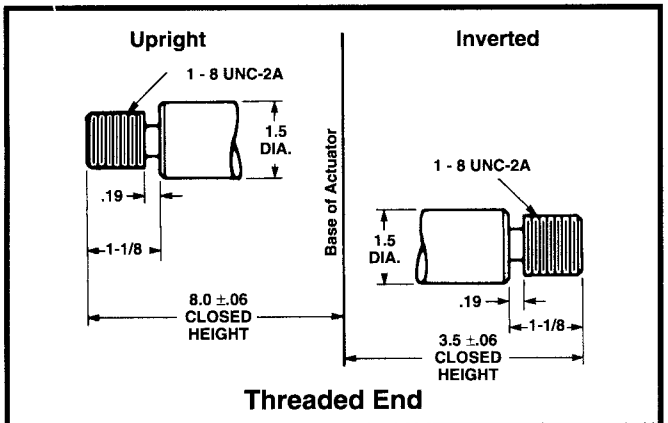
Inverted Rotating: DM-7003

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice. When the lifting screw is keyed, the holes in the top plate will not necessarily be in the position shown.

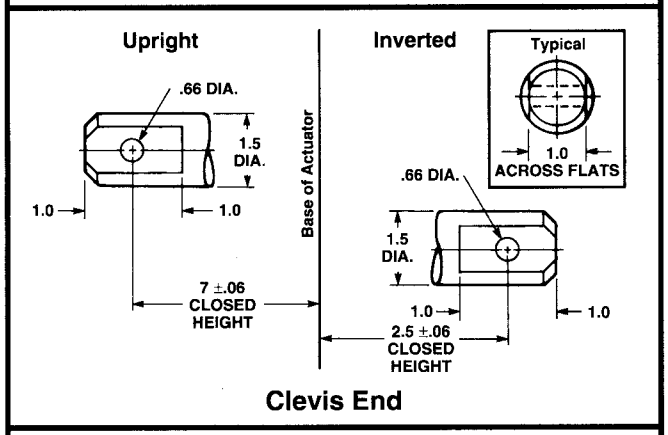
Machine Screw Actuators, 5 Ton



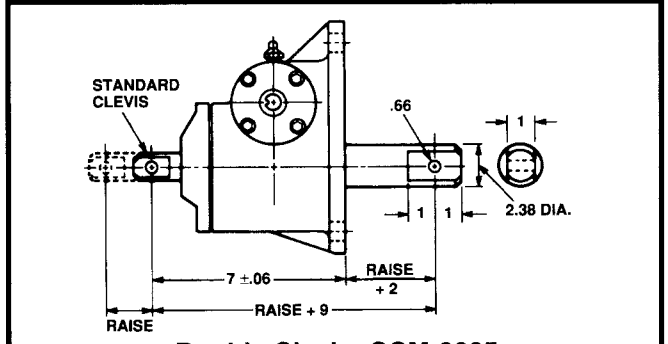
1 1/2" Diameter x .375 Lead Lifting Screws



Threaded End

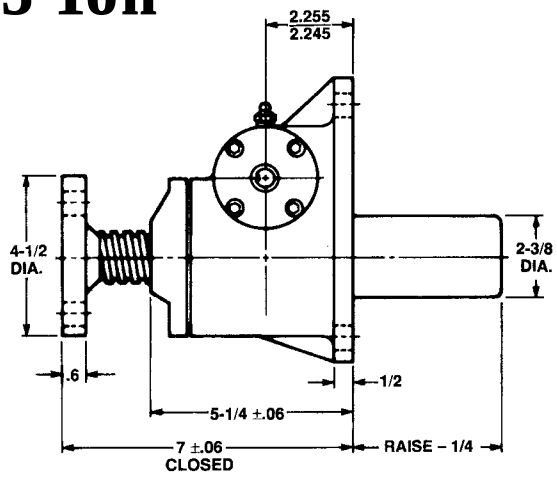


Clevis End

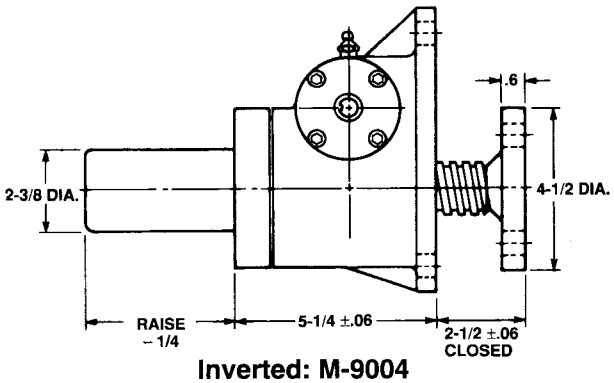


Double Clevis: CCM-9005

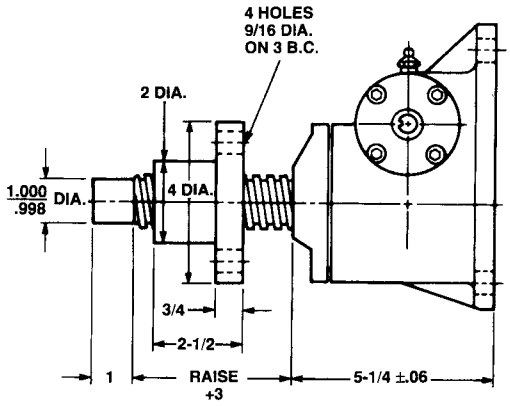
Maximum Allowable Raise in Compression 22" —Rating 6500 Lbs.
Maximum Raise at Rated Load in Compression 17"



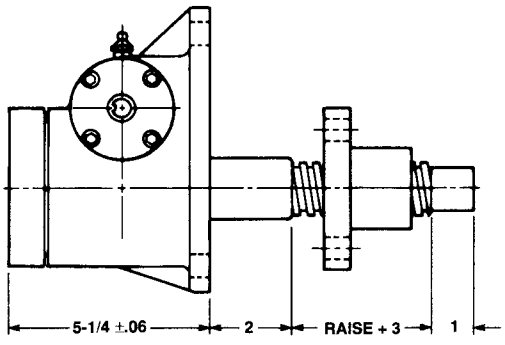
Upright: M-9005



Inverted: M-9004



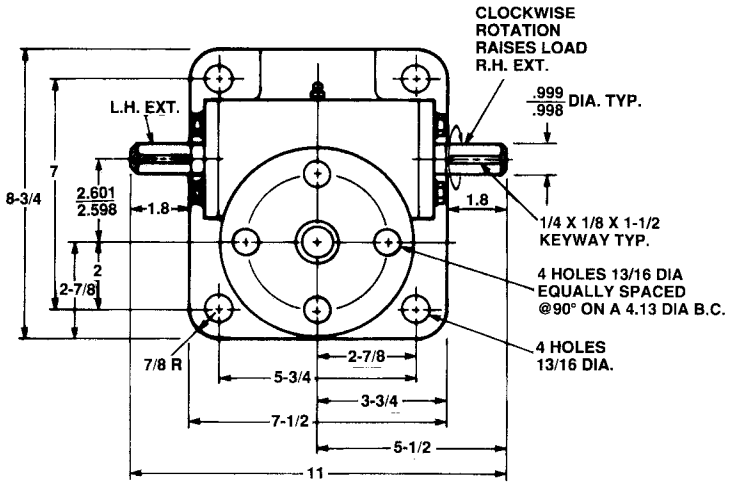
Upright Rotating: UM-9006



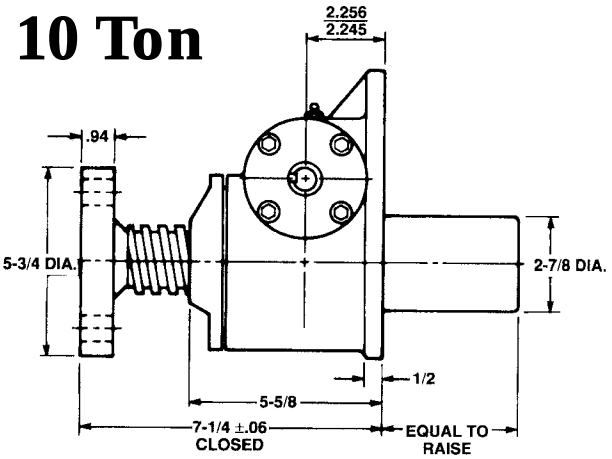
Inverted Rotating: DM-9006

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice. When the lifting screw is keyed, the holes in the top plate will not necessarily be in the position shown.

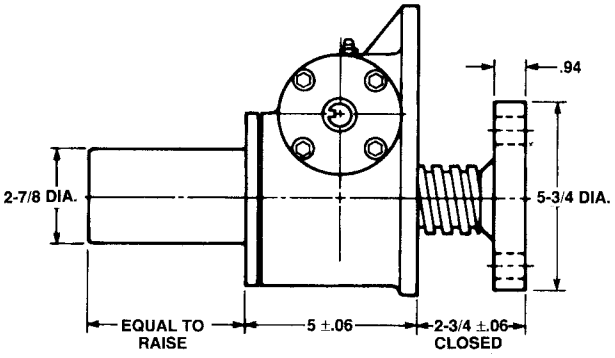
Machine Screw Actuators, 10 Ton



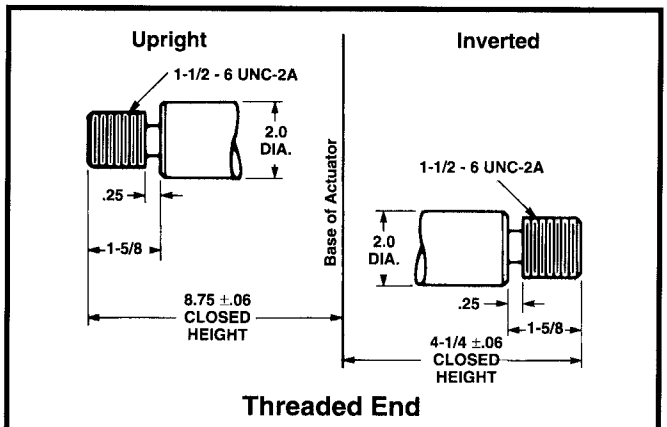
2" Diameter x .500 Lead Lifting Screws



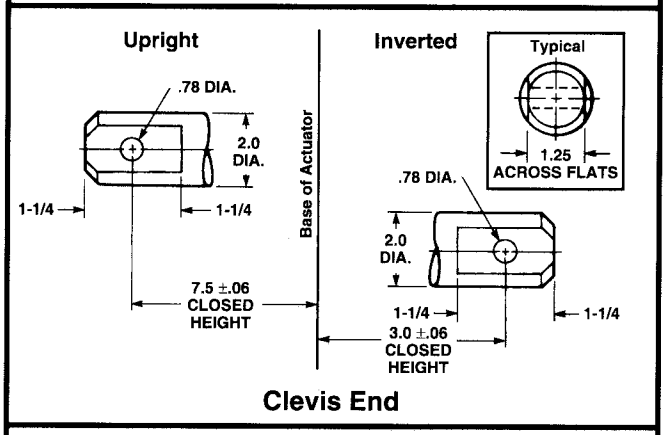
Upright: M-9010



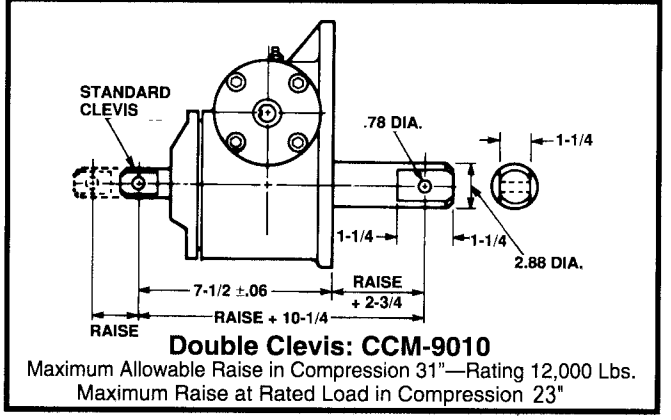
Inverted: M-9009



Threaded End

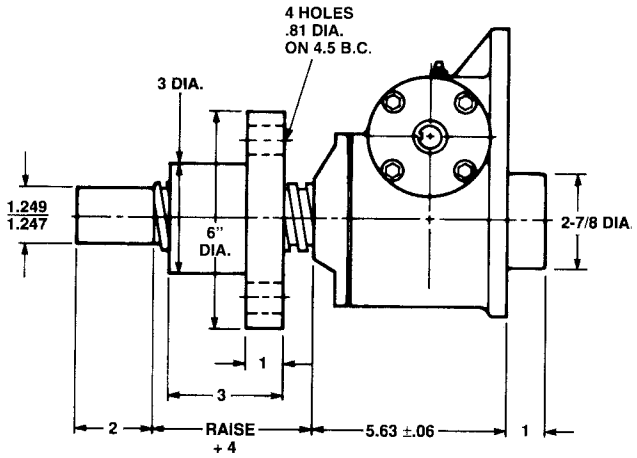


Clevis End

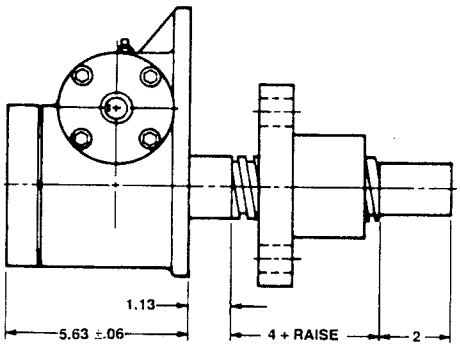


Double Clevis: CCM-9010

Maximum Allowable Raise in Compression 31"—Rating 12,000 Lbs.
Maximum Raise at Rated Load in Compression 23"



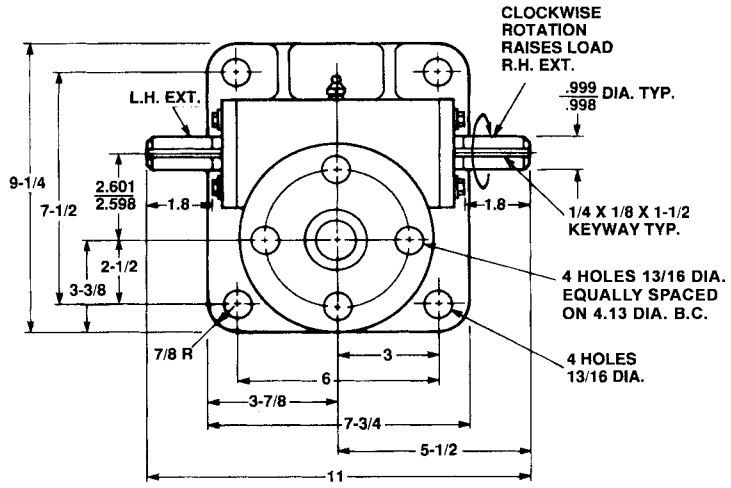
Upright Rotating: UM-9011



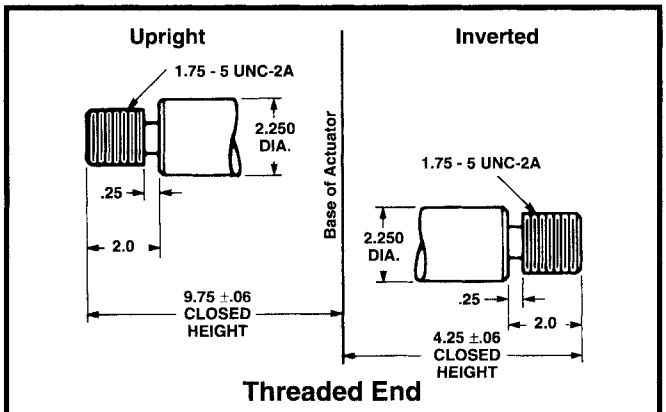
Inverted Rotating: DM-9011

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice. When the lifting screw is keyed, the holes in the top plate will not necessarily be in the position shown.

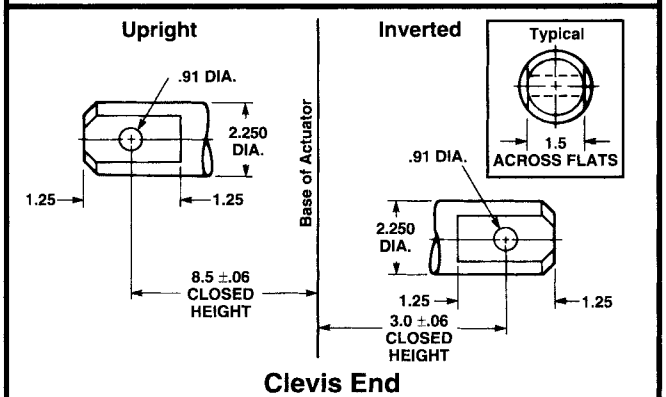
Machine Screw Actuators, 15 Ton



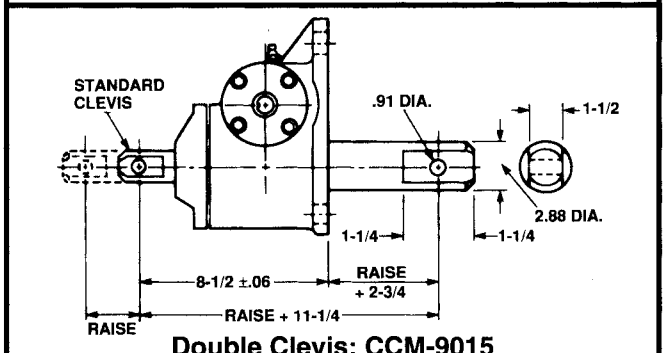
2¼" Diameter x .500 Lead Lifting Screws



Threaded End

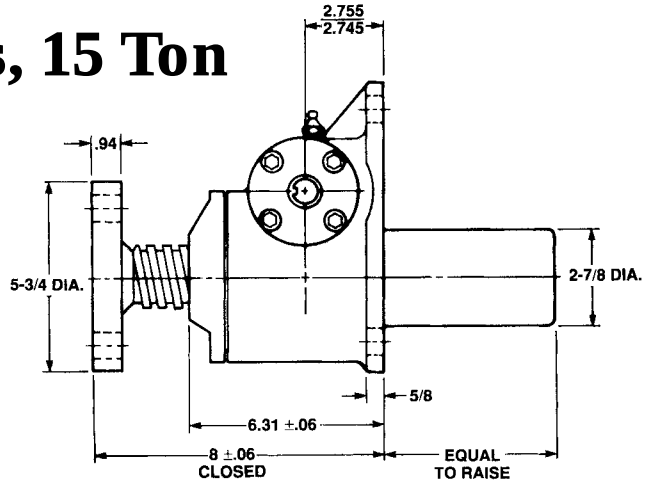


Clevis End

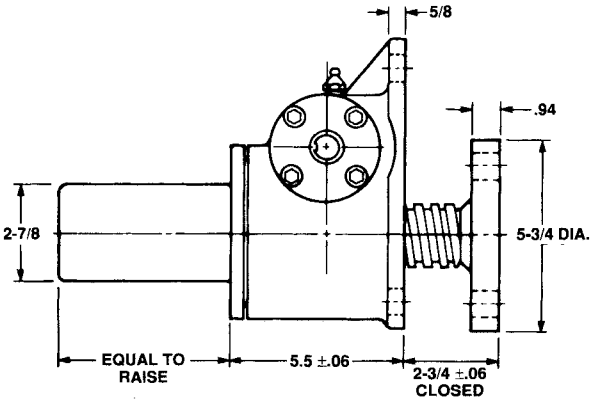


Double Clevis: CCM-9015

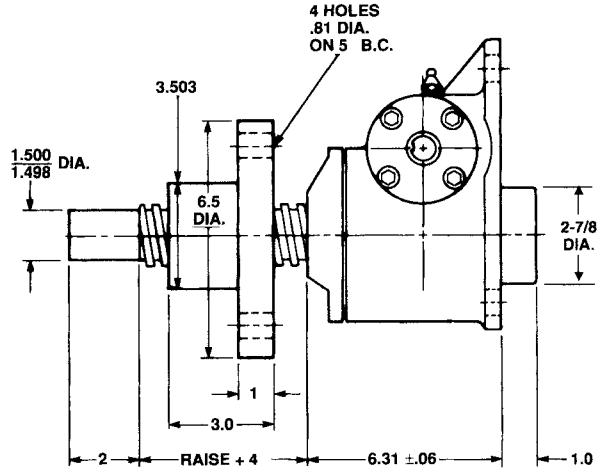
Maximum Allowable Raise in Compression 37 " —Rating 16,000 Lbs.
Maximum Raise at Rated Load in Compression 26"



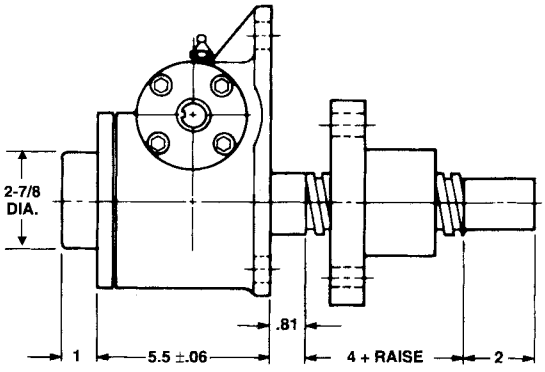
Upright: M-9015



Inverted: M-9014



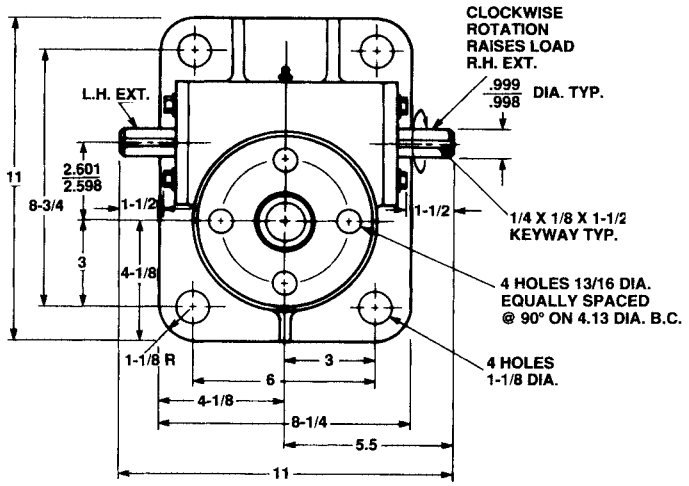
Upright Rotating: UM-9016



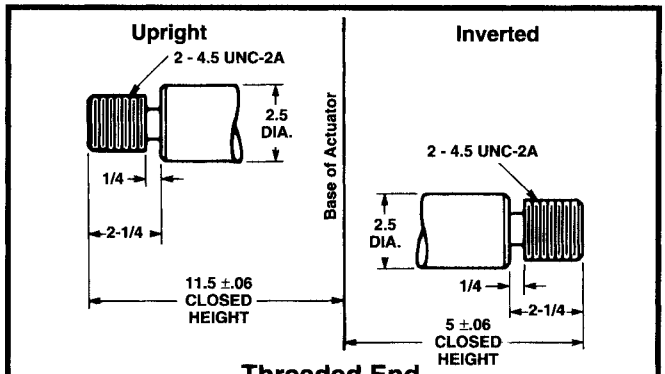
Inverted Rotating: DM-9016

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice. When the lifting screw is keyed, the holes in the top plate will not necessarily be in the position shown.

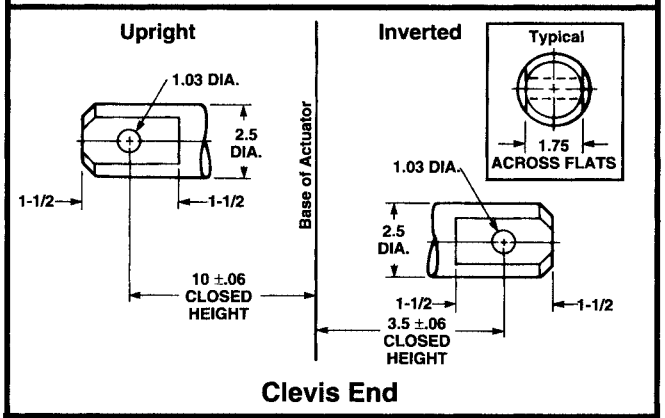
Machine Screw Actuators, 20 Ton



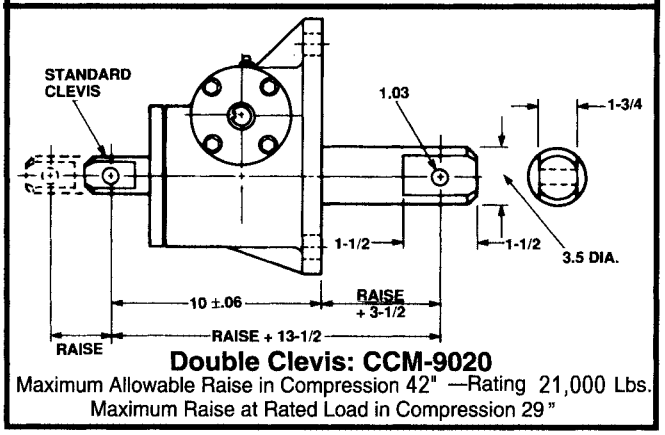
2 1/2" Diameter x .500 Lead Lifting Screws



Threaded End

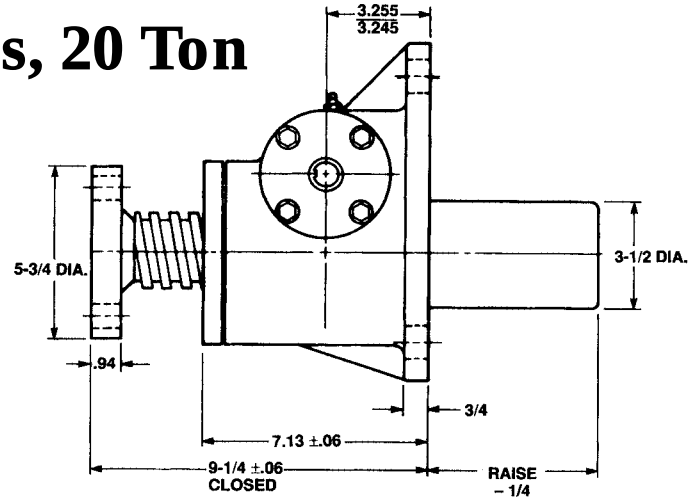


Clevis End

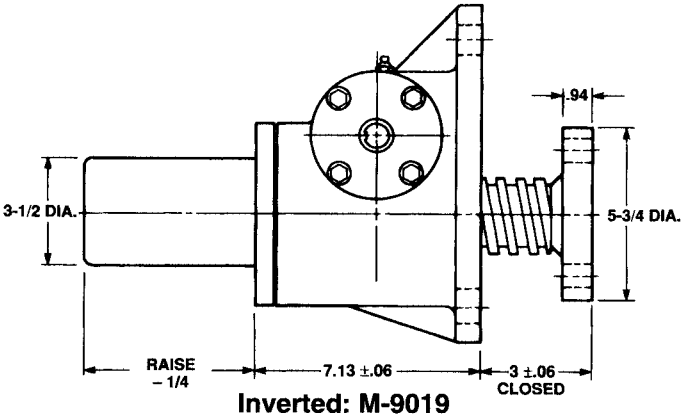


Double Clevis: CCM-9020

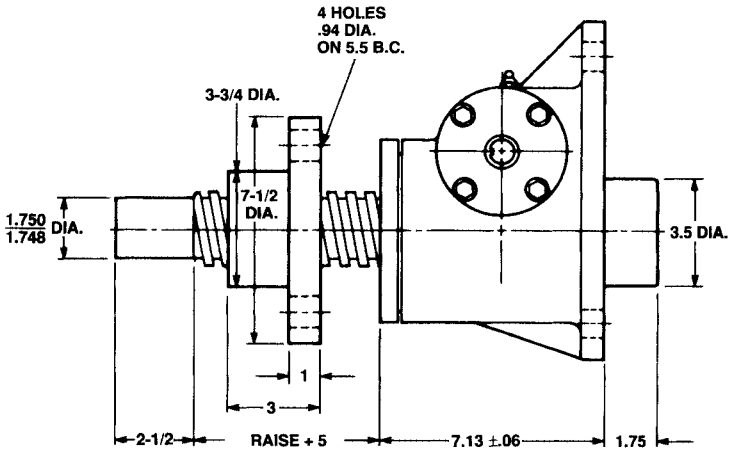
Maximum Allowable Raise in Compression 42" —Rating 21,000 Lbs.
Maximum Raise at Rated Load in Compression 29"



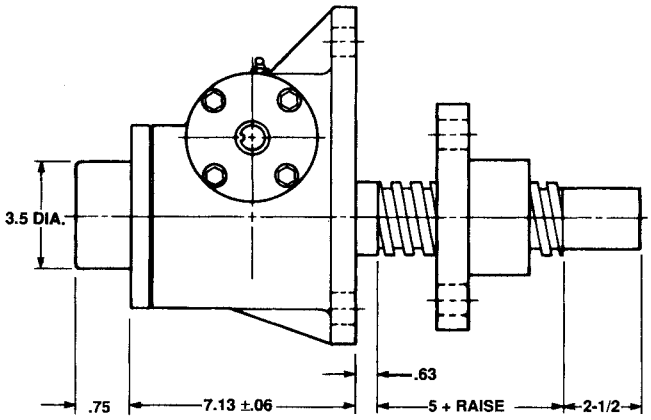
Upright: M-9020



Inverted: M-9019



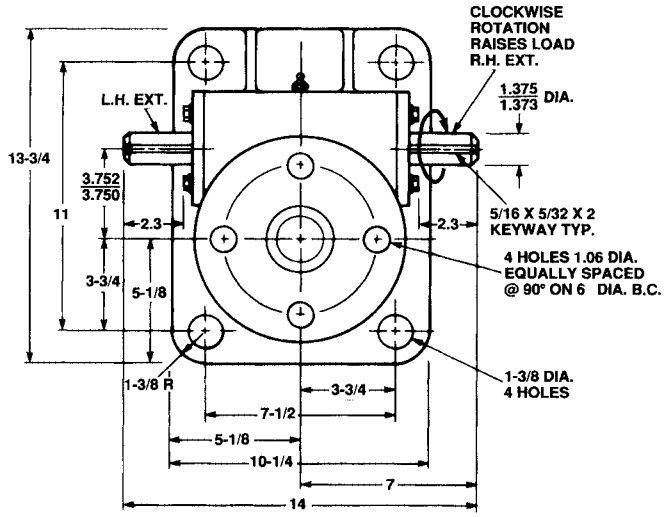
Upright Rotating: AUM-9021



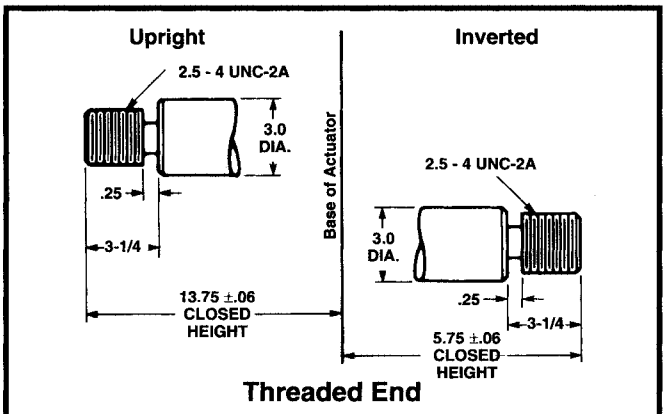
Inverted Rotating: ADM-9021

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice. When the lifting screw is keyed, the holes in the top plate will not necessarily be in the position shown.

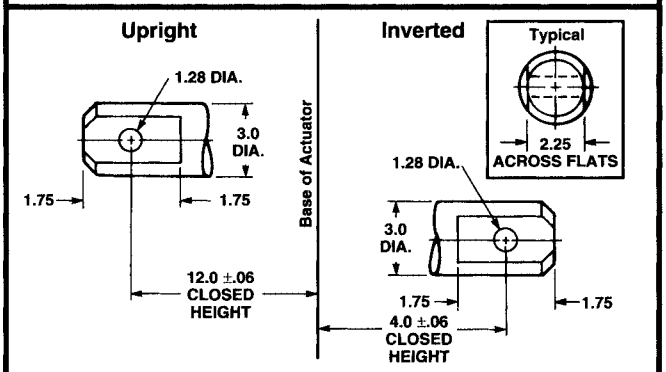
Machine Screw Actuators, 25 Ton



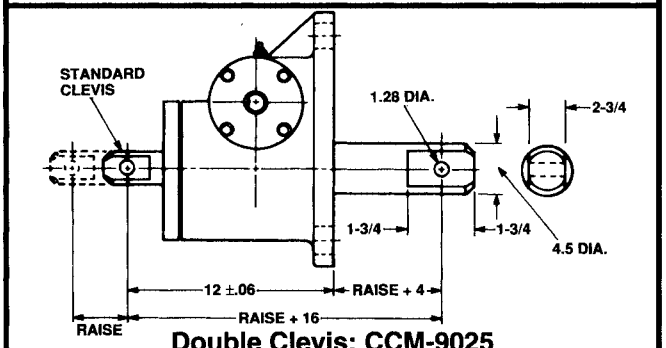
3" Diameter x .666 Lead Lifting Screws



Threaded End

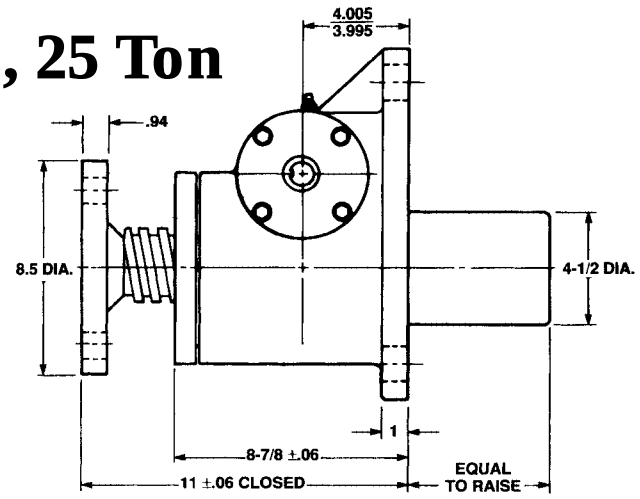


Clevis End

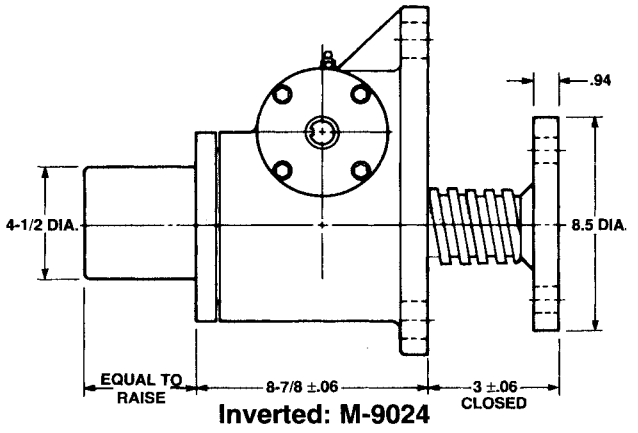


Double Clevis: CCM-9025

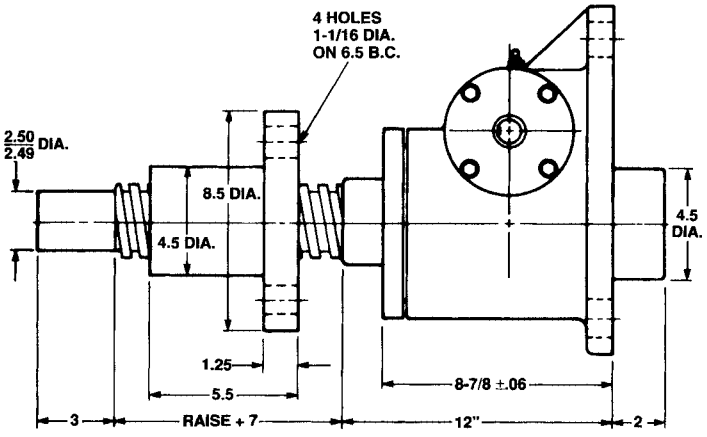
Maximum Allowable Raise in Compression 56"—Rating 37,000 Lbs.
Maximum Raise at Rated Load in Compression 47"



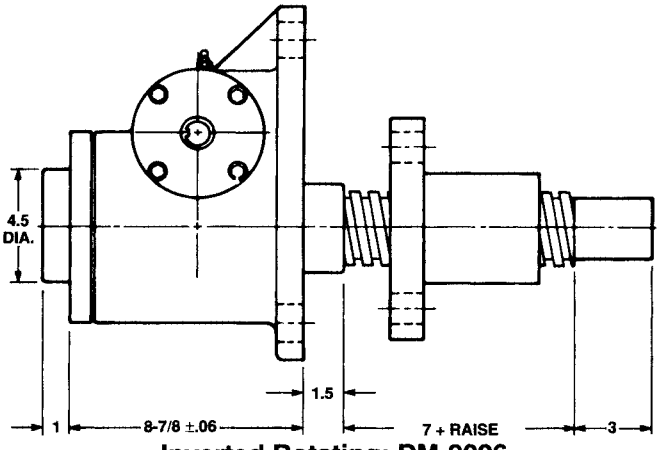
Upright: M-9025



Inverted: M-9024



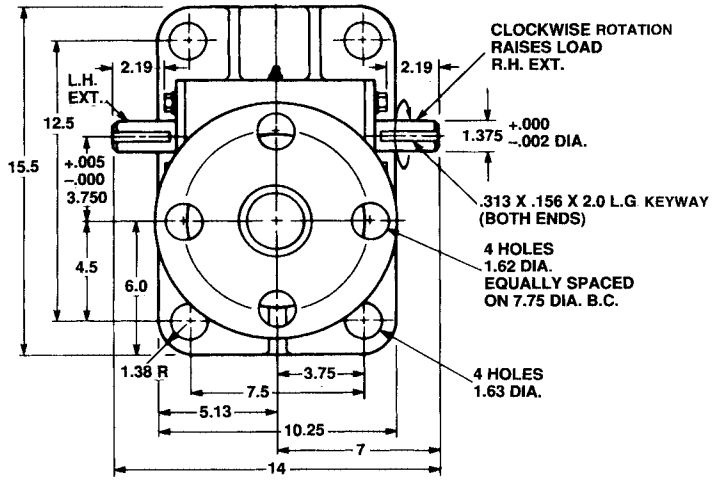
Upright Rotating: UM-9026



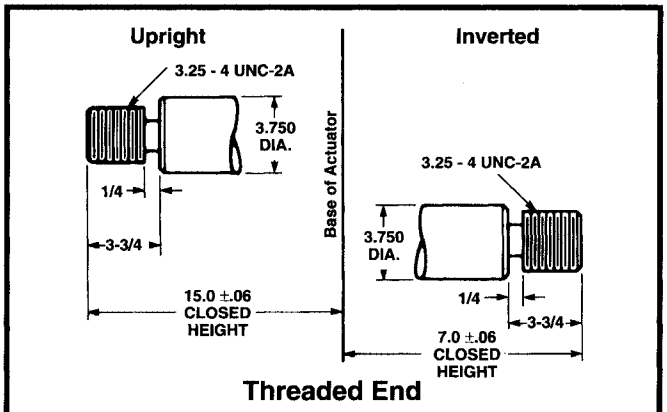
Inverted Rotating: DM-9026

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice. When the lifting screw is keyed, the holes in the top plate will not necessarily be in the position shown.

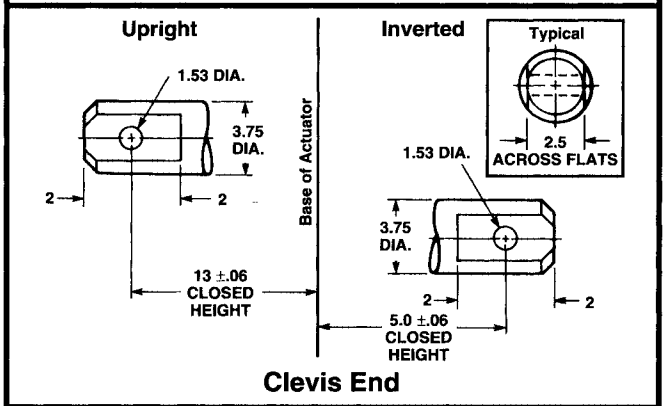
Machine Screw Actuators, 35 Ton



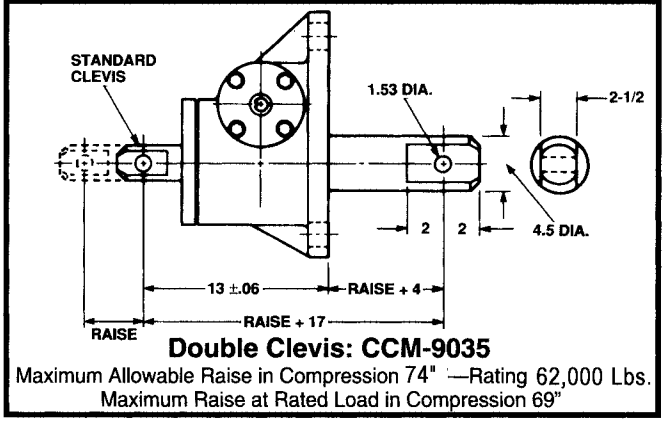
3 3/4" Diameter x .666 Lead Lifting Screws



Threaded End

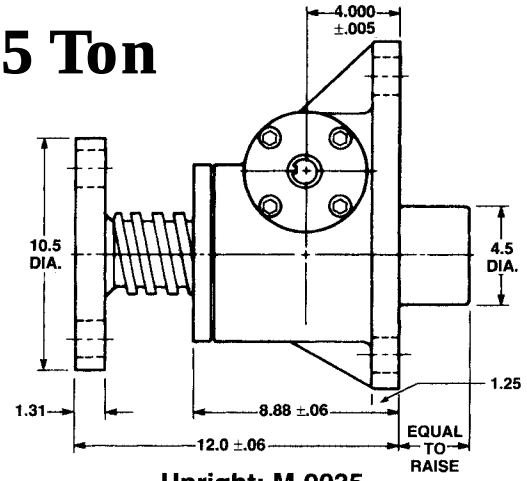


Clevis End

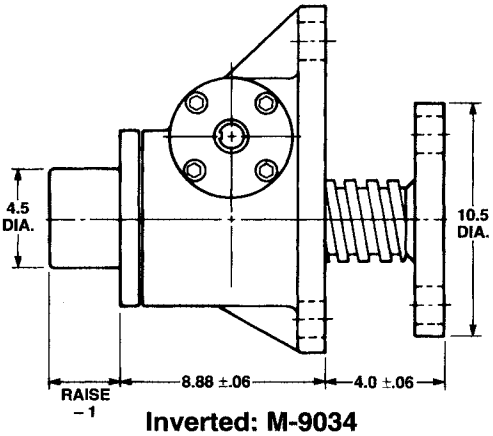


Double Clevis: CCM-9035

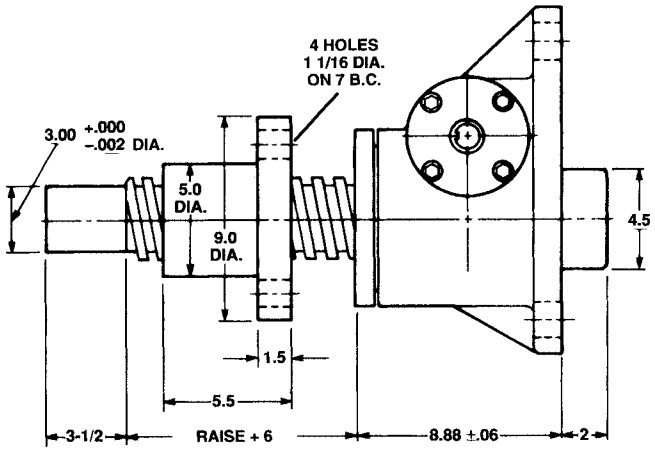
Maximum Allowable Raise in Compression 74" —Rating 62,000 Lbs.
Maximum Raise at Rated Load in Compression 69"



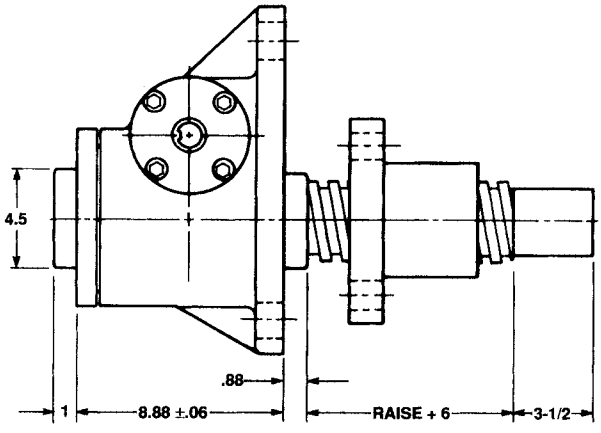
Upright: M-9035



Inverted: M-9034



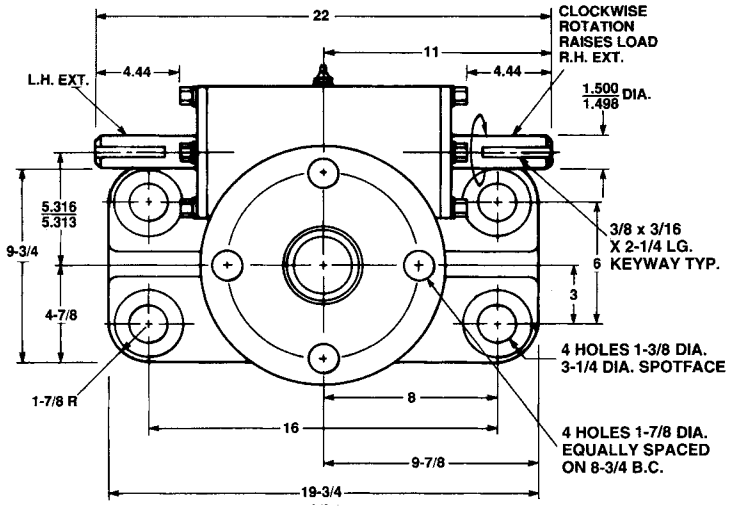
Upright Rotating: UM-9036



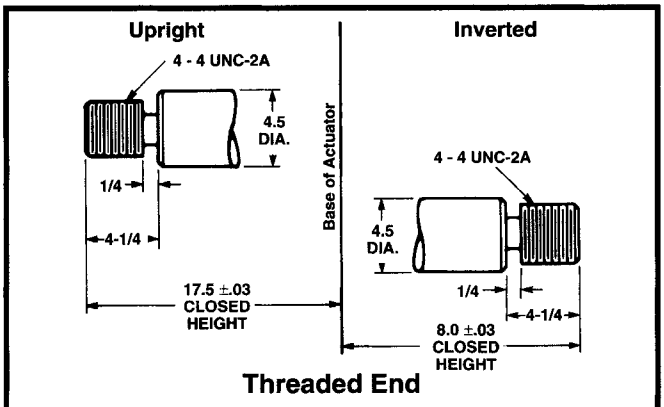
Inverted Rotating: DM-9036

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice. When the lifting screw is keyed, the holes in the top plate will not necessarily be in the position shown.

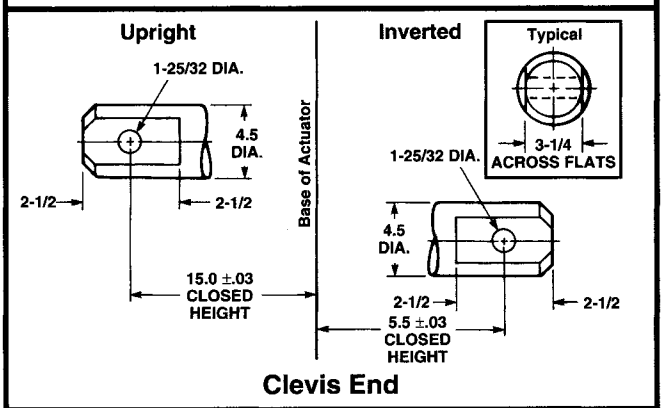
Machine Screw Actuators, 50 Ton



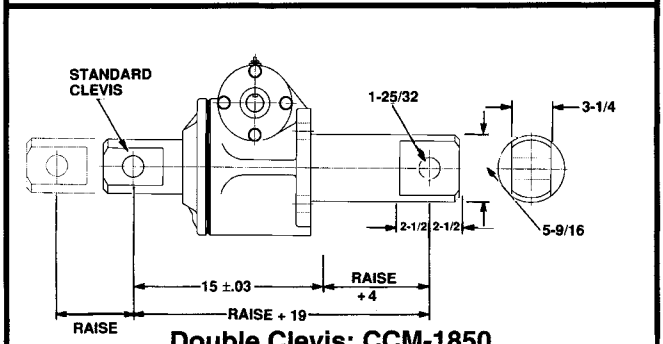
4 1/2" Diameter x .666 Lead Lifting Screws LH Thread



Threaded End

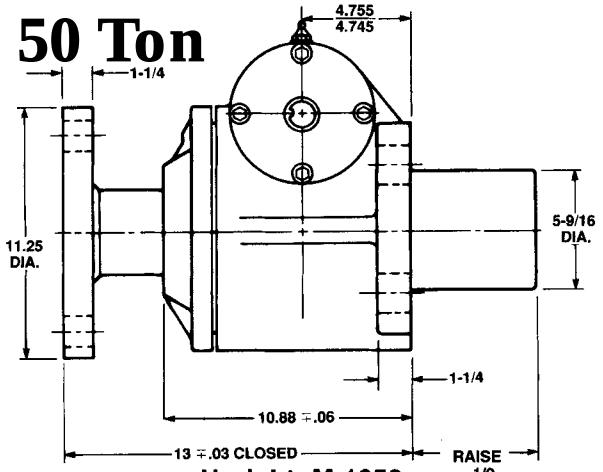


Clevis End

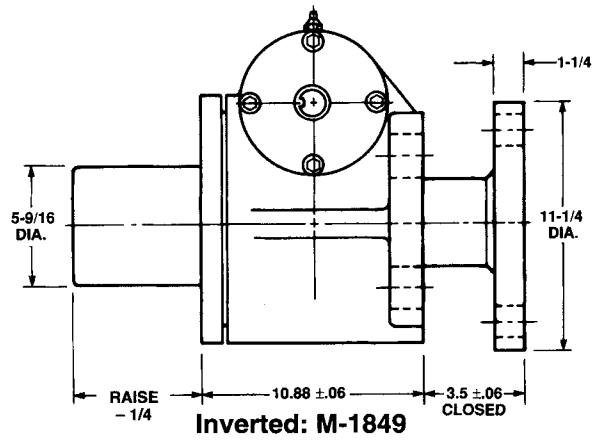


Double Clevis: CCM-1850

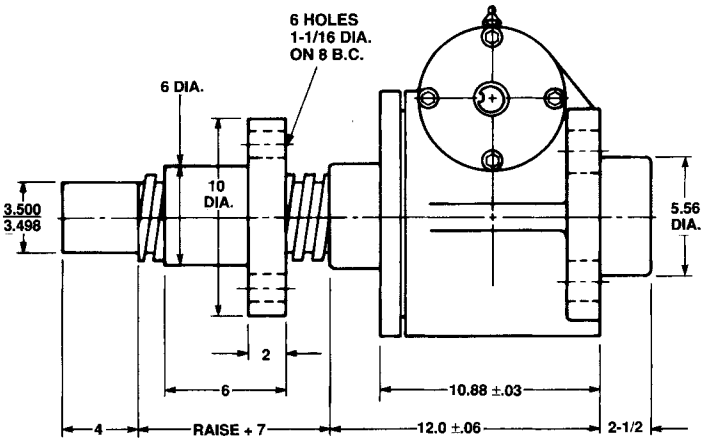
Maximum Allowable Raise in Compression 93" —Rating 94,000 Lbs.
Maximum Raise at Rated Load in Compression 90".



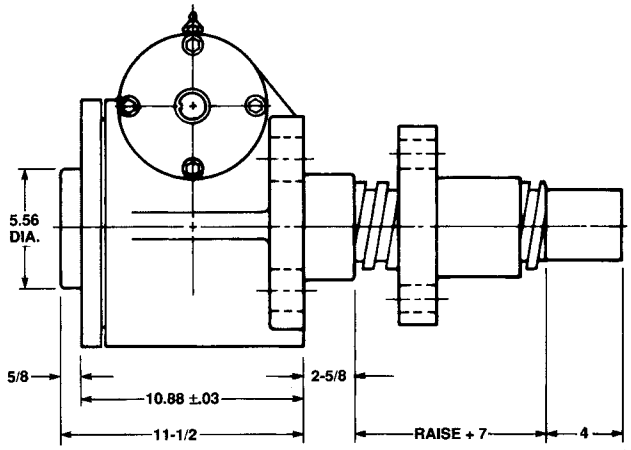
Upright: M-1850



Inverted: M-1849



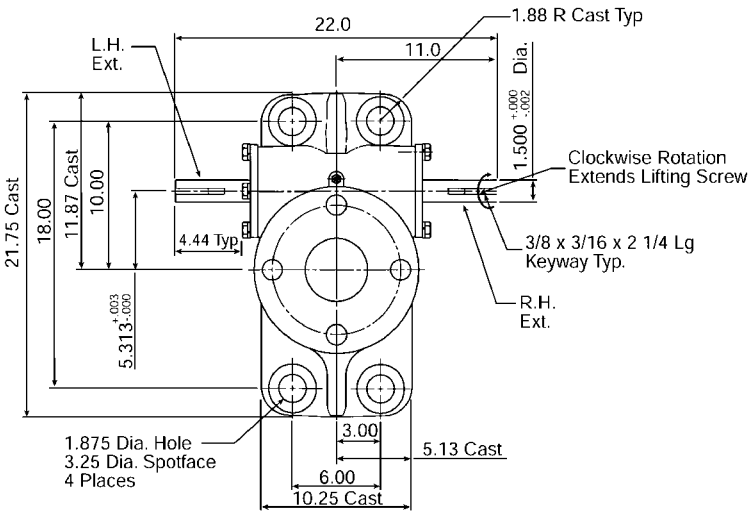
Upright Rotating: UM-1851



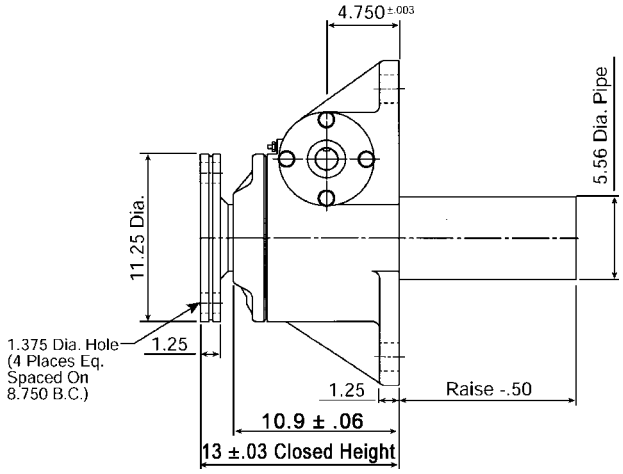
Inverted Rotating: DM-1851

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice. When the lifting screw is keyed, the holes in the top plate will not necessarily be in the position shown.

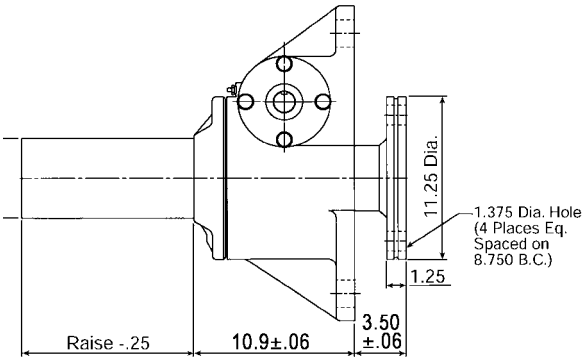
Machine Screw Actuators, 50 Ton Reverse Base



4½ Diameter x .6666 Lead Lifting Screw

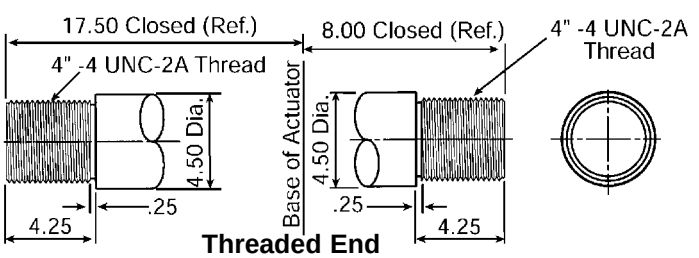


Upright: M-9050



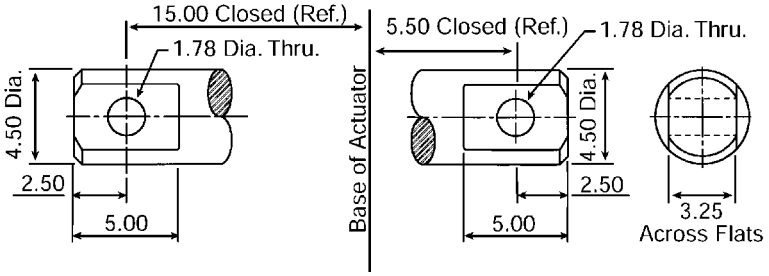
Inverted: M-9049

Upright **Inverted**

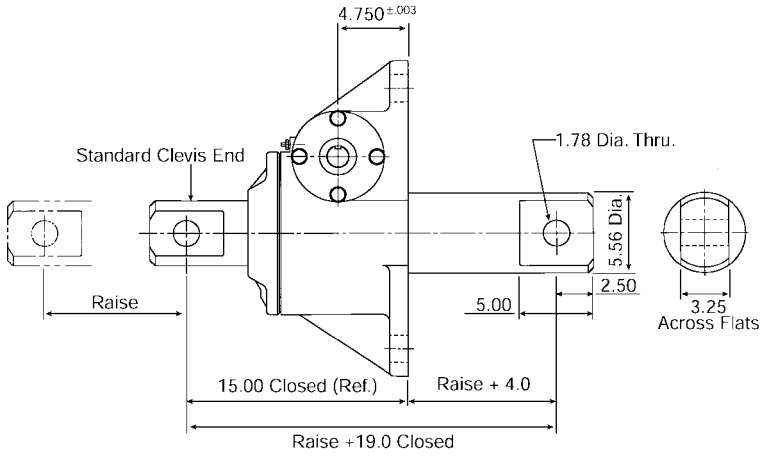


Threaded End

Upright **Inverted**

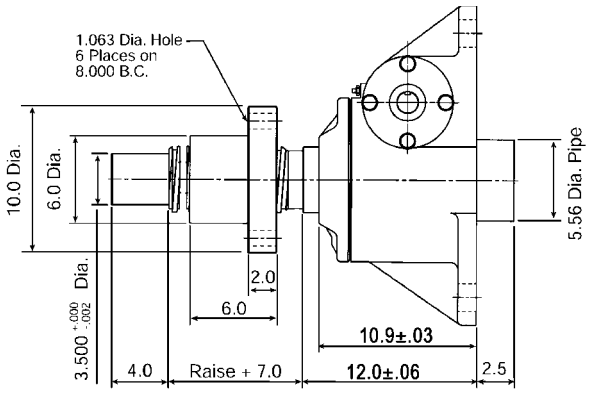


Clevis End

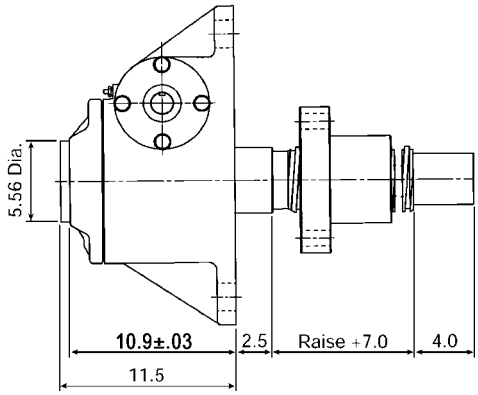


Double Clevis: CCM-9050

Maximum Allowable Raise in Compression 93" — Rating 94,000 lbs.
Maximum Raise at rated load in compression is 90"



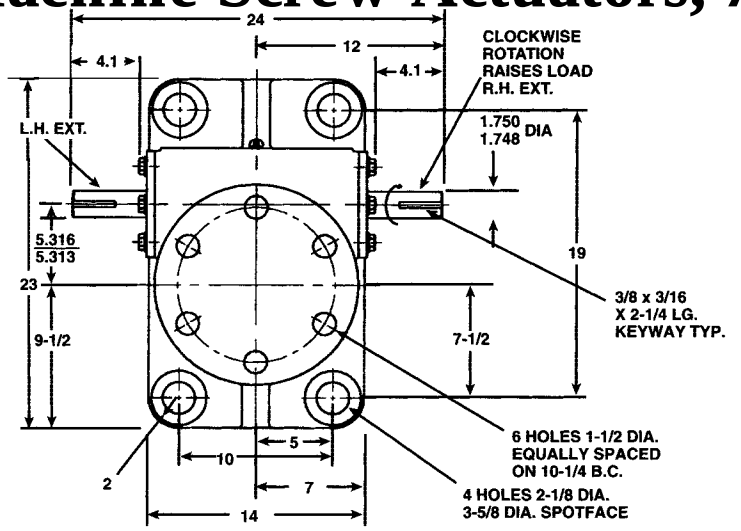
Upright Rotating: UM-9051



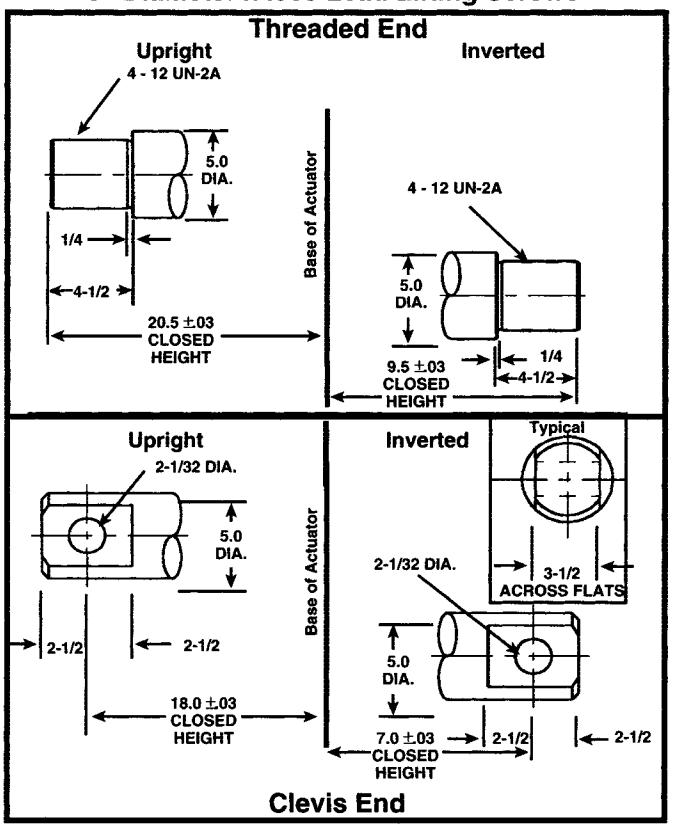
Inverted Rotating: DM-9051

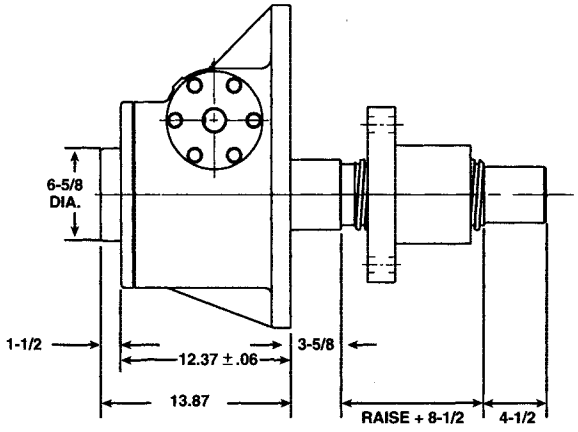
Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice. When the lifting screw is keyed, the holes in the top plate will not necessarily be in the position shown.

Machine Screw Actuators, 75 Ton

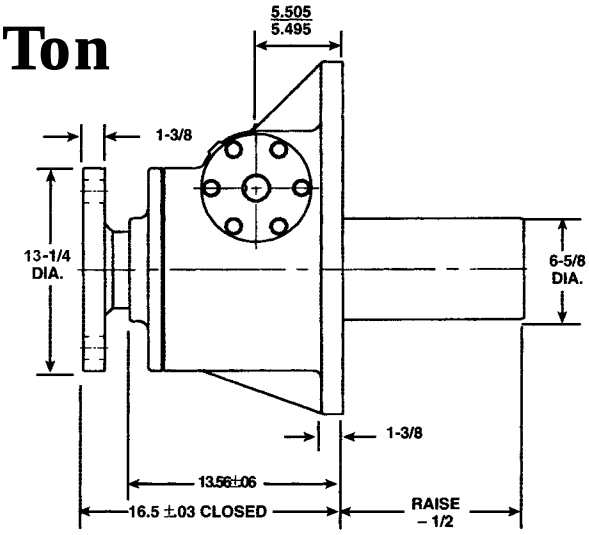


5" Diameter x .666 Lead Lifting Screws

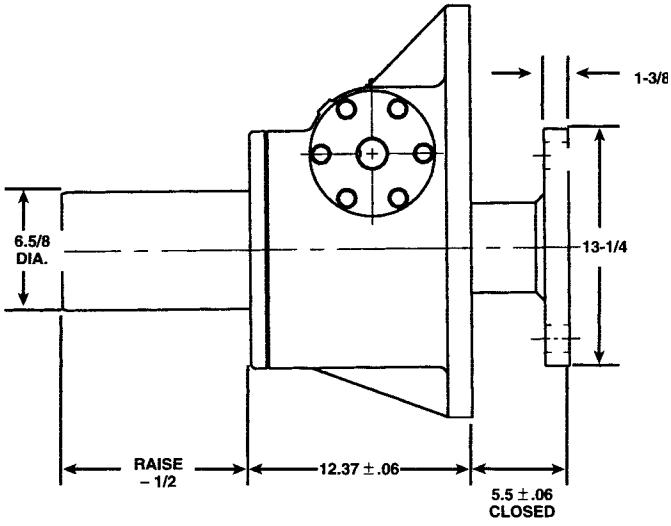




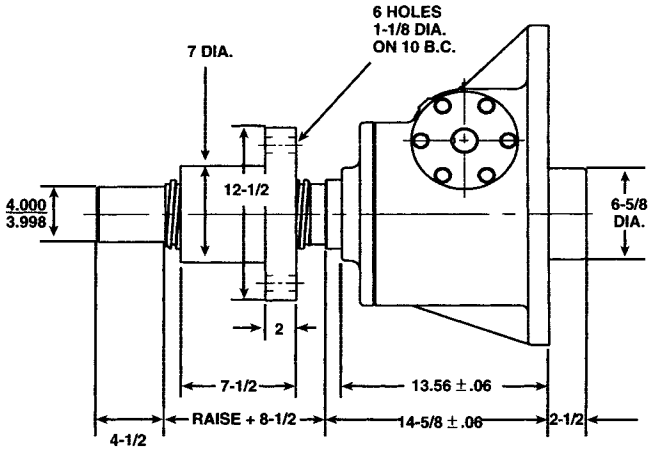
Inverted Rotating: DM-9076



Upright: M-9075



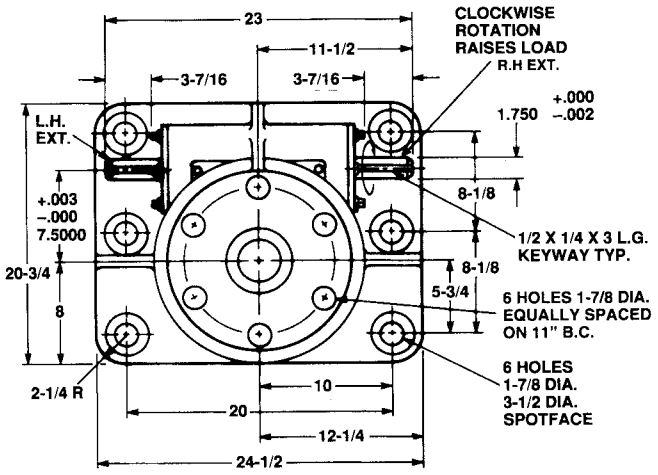
Inverted: M-9074



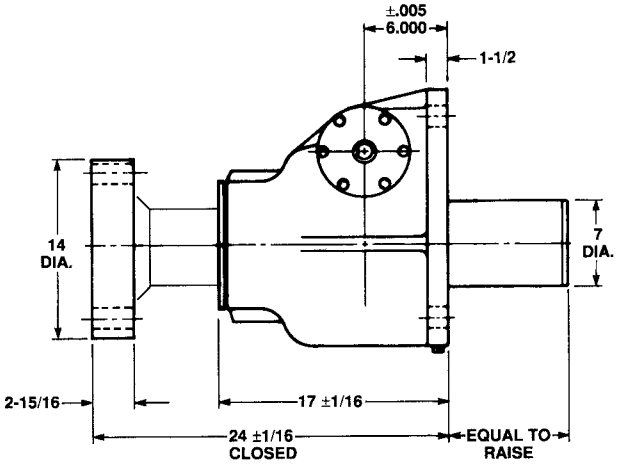
Upright Rotating: UM-9076

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice. When the lifting screw is keyed, the holes in the top plate will not necessarily be in the position shown.

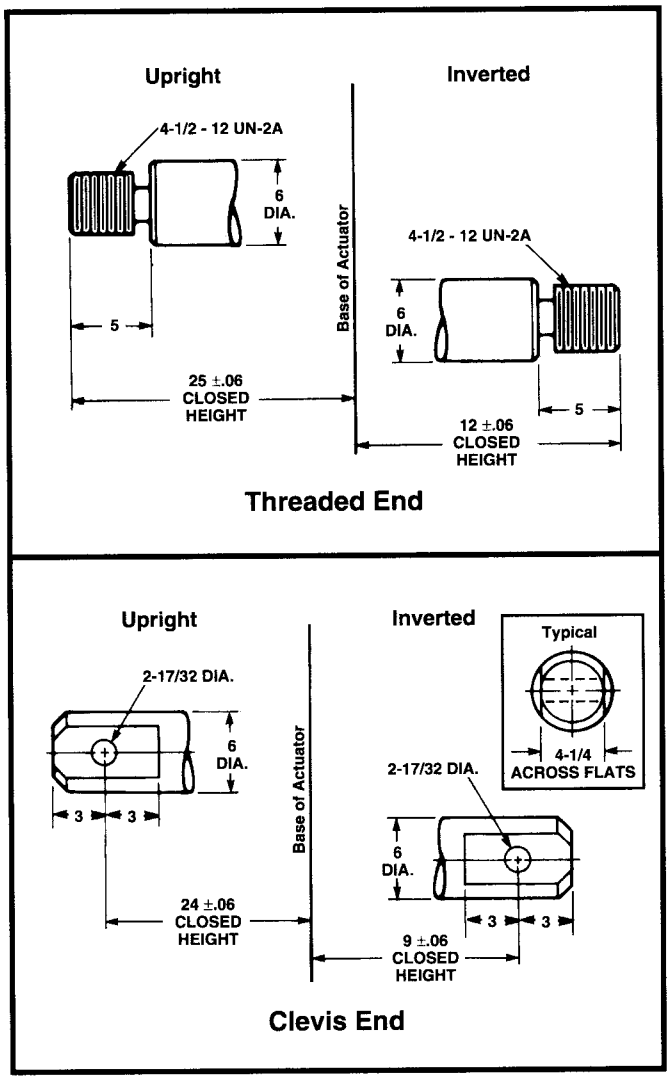
Machine Screw Actuators, 100 Ton

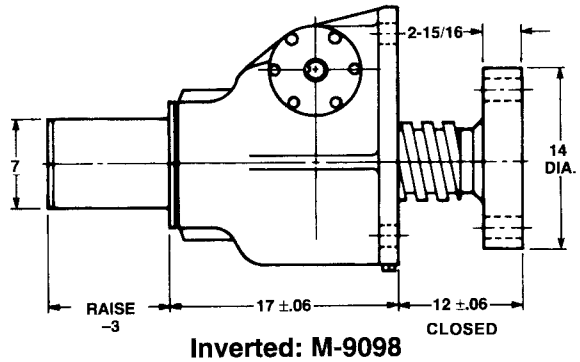


6" Diameter x .750 Lead Lifting Screws

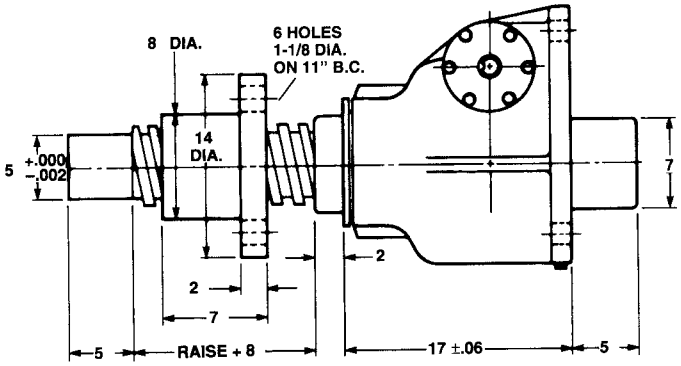


Upright: M-9099

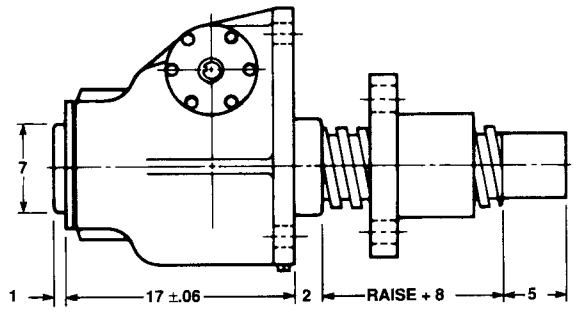




Inverted: M-9098



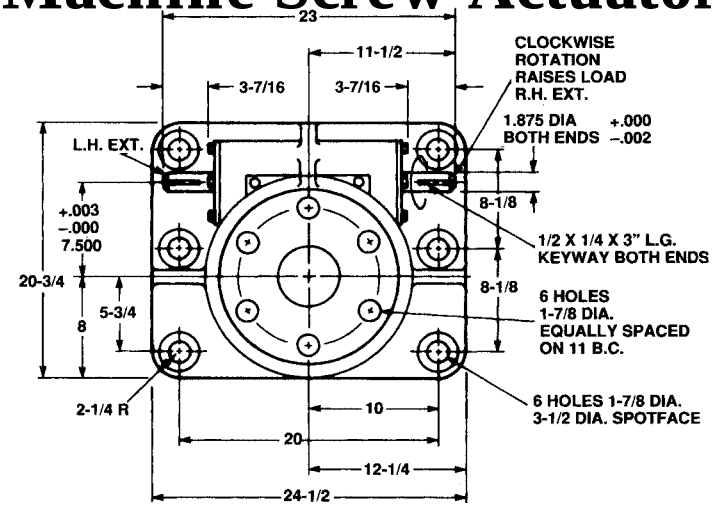
Upright Rotating: UM-9097



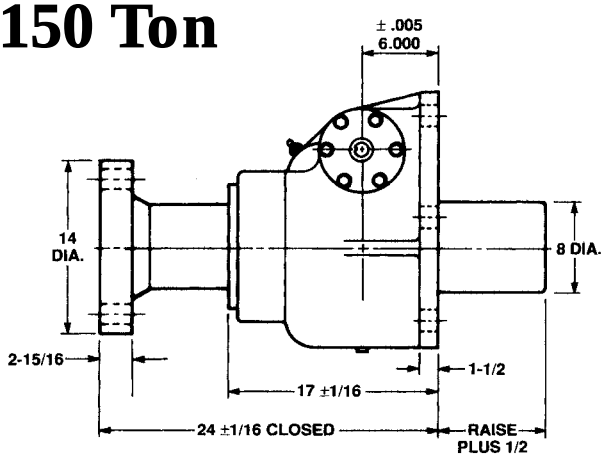
Inverted Rotating: DM-9097

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice. When the lifting screw is keyed, the holes in the top plate will not necessarily be in the position shown.

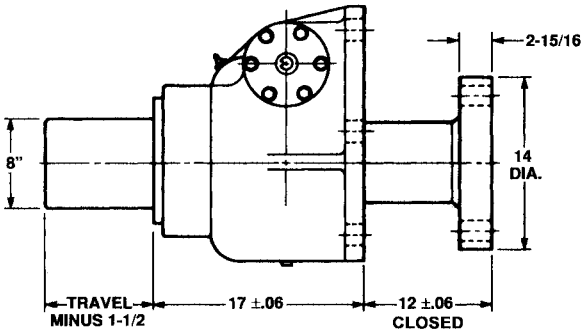
Machine Screw Actuators, 150 Ton



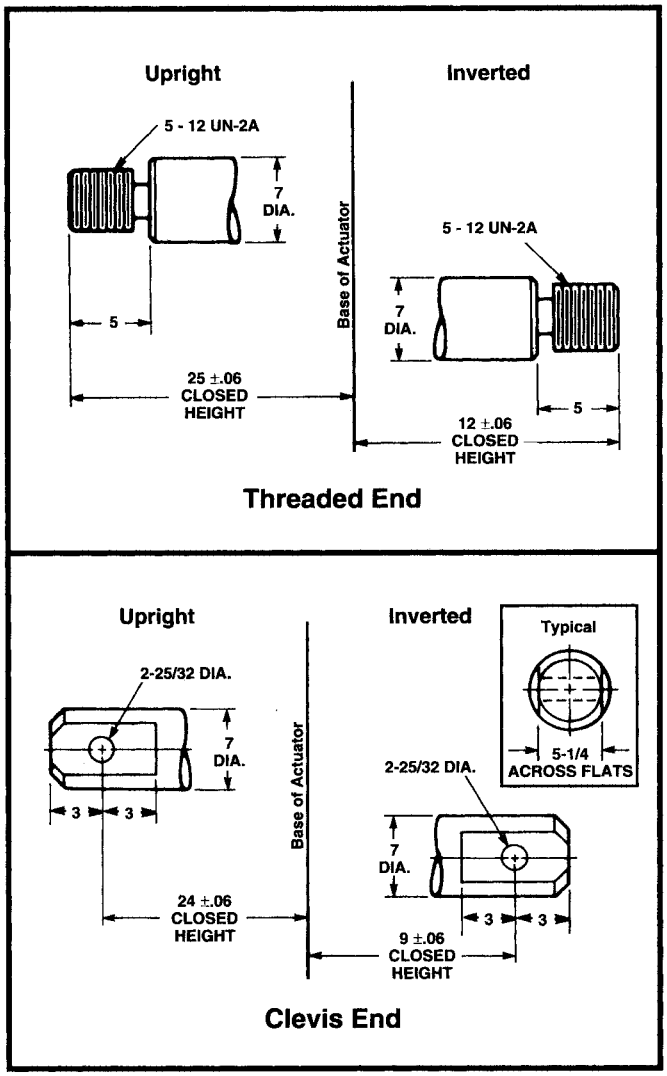
7" Diameter x 1" Lead Lifting Screws

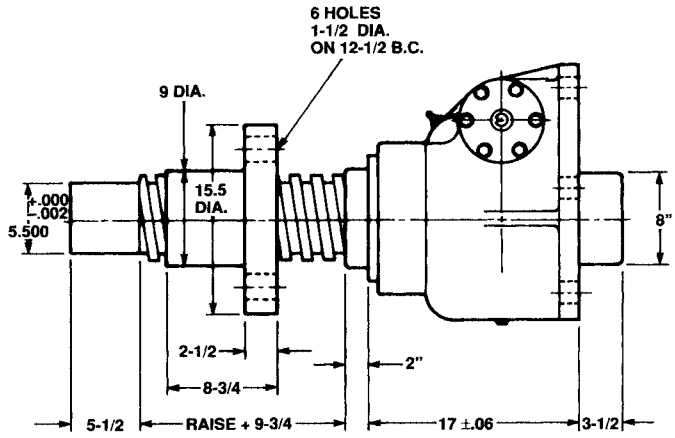


Upright: M-18150

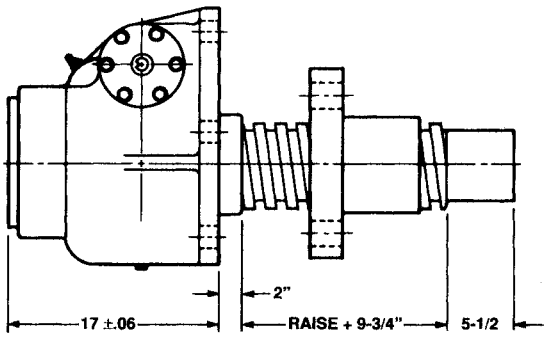


Inverted: M-18149





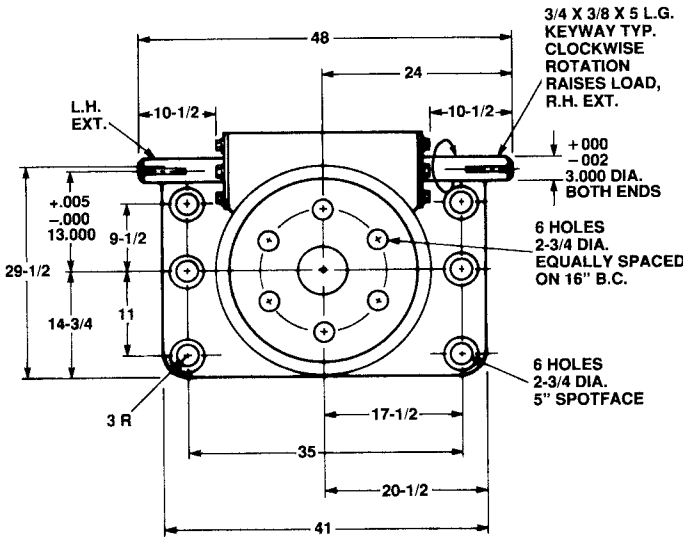
Upright Rotating: UM-18151



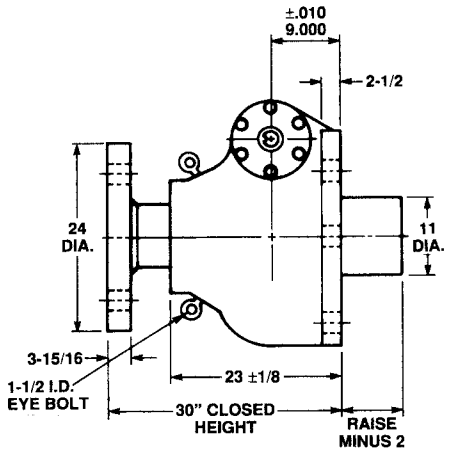
Inverted Rotating: DM-18151

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice. When the lifting screw is keyed, the holes in the top plate will not necessarily be in the position shown.

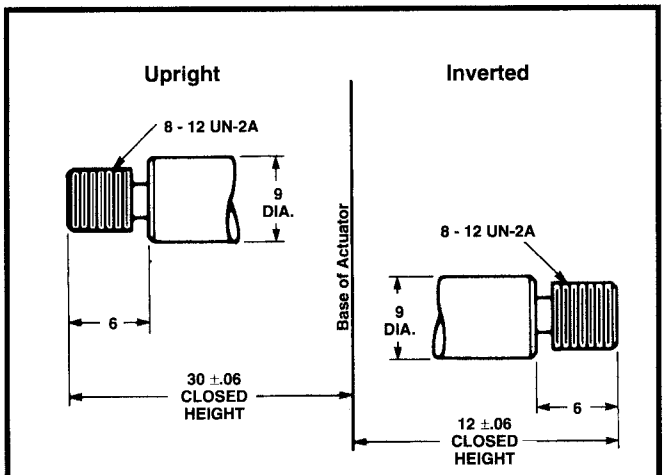
Machine Screw Actuators, 250 Ton



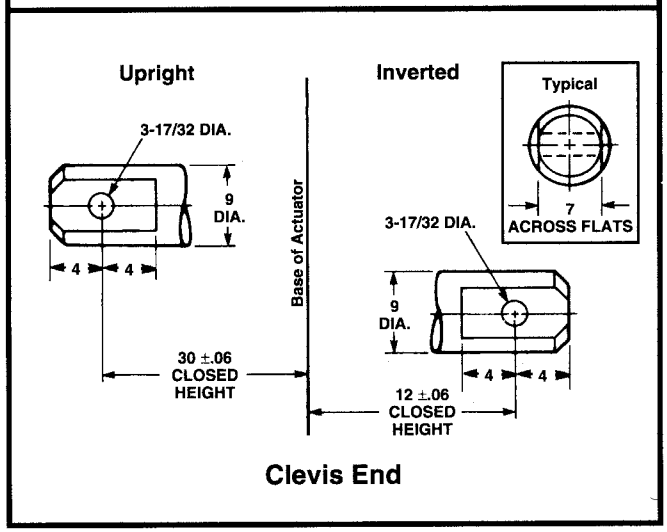
9" Diameter x 1" Lead Lifting Screws



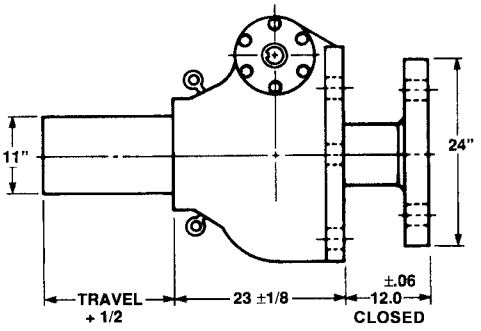
Upright: M-2250



Threaded End



Clevis End



Inverted: M-2249

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice. When the lifting screw is keyed, the holes in the top plate will not necessarily be in the position shown.

Metric Actuators

Duff-Norton Metric Actuators are manufactured to the same high quality standards and include all of the same features and benefits as the standard line of actuators while incorporating the following features:

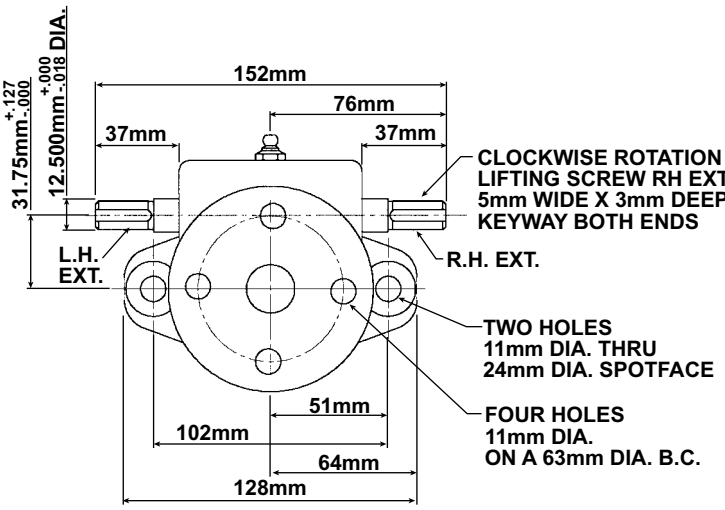
- Metric Bearings
- Metric shaft and keyway sizes per ISO recommended standards
- Metric screw diameters with trapezoidal threads (machine screw actuators)
- All metric fasteners on machine screw units
- Metric bolt centers
- Other sizes and models available, contact Duff-Norton for more information

Metric Machine Screw Actuator Units

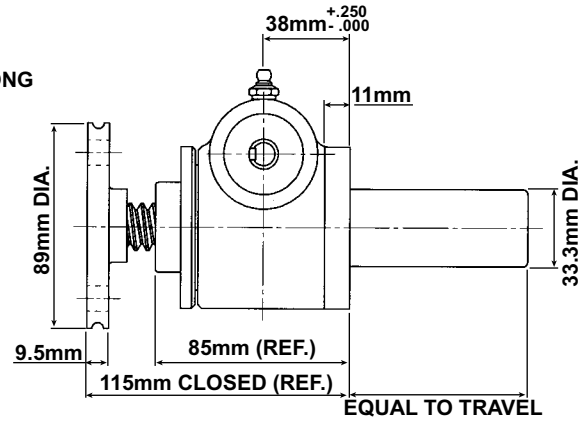
Model No.	Upright	MET2625	MET2501	MET9002	MET9005	MET9010	MET9015	MET9020
	Inverted	MET2624	MET2500	MET9001	MET9004	MET9009	MET9014	MET9019
Capacity kN		5	10	19	49	98	147	196
Lifting Screw	Diameter (mm)	16	20	26	38	52	58	65
	Lead (mm)	3	5	6	9	12	12	12
	Type	Metric Trapezoidal	Metric Trapezoidal	Metric Trapezoidal	Metric Trapezoidal	Metric Trapezoidal	Metric Trapezoidal	Metric Trapezoidal
Worm Gear Ratios	Std. Ratio	5:1	5:1	5:1	6:1	8:1	8:1	8:1
	Optional	-	20.00	24.00	24.00	24.00	24.00	24.00
Travel per worm turn (mm)	Std. Ratio	0.60	1.00	1.00	1.50	1.50	1.50	1.50
	Optional	-	0.25	0.25	0.38	0.50	0.50	0.50
Maximum Input Power (kW)	Std. Ratio	0.25	0.37	1.49	2.98	3.73	3.73	3.73
	Optional	-	0.19	0.37	0.56	1.12	1.12	1.12
Worm Torque at No Load* (N-M)	Std. Ratio	0.23	0.56	0.56	1.13	2.26	2.26	3.39
	Optional	-	0.56	0.56	1.13	2.26	2.26	3.39
Worm Torque at Full Load*(N-M)	Std. Ratio	2.77	7.41	15.07	55.71	114.87	185.55	270.18
	Optional	-	3.64	7.09	26.55	62.01	99.51	144.94
Efficiency Rating (%)	Std. Ratio	16.90	21.10	20.70	21.00	20.40	18.90	17.30
	Optional	-	10.70	11.00	11.00	12.60	11.80	10.80
Weight with Raise of 150mm (kg)		1.04	2.27	7.71	15.88	23.59	29.94	42.18
Weight for Each 25mm Raise (kg)		0.04	0.13	0.13	0.40	0.63	0.67	1.16
For Engineering Drawings See Page		Contact Duff-Norton	51	52	53	54	55	56

* -For loads from 25% to 100% of actuator capacity, torque requirements are approximately proportional to the load.
Raises, measured in increments of 25 mm, are available up to 6.1 meters, depending on lifting screw diameter and available bar stock length.
Except for 20 kN units, standard inverted keyed models do not have a cover pipe.

Machine Screw Actuators, 10kN

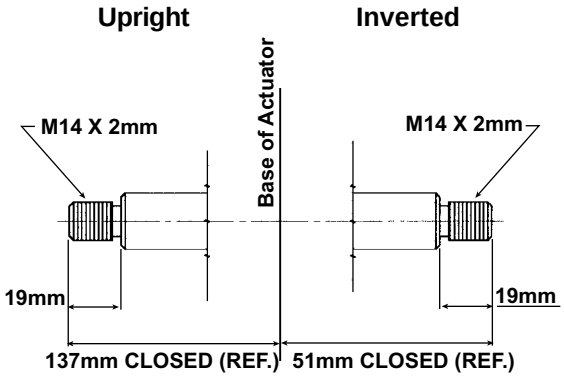


Top View: MET-2501

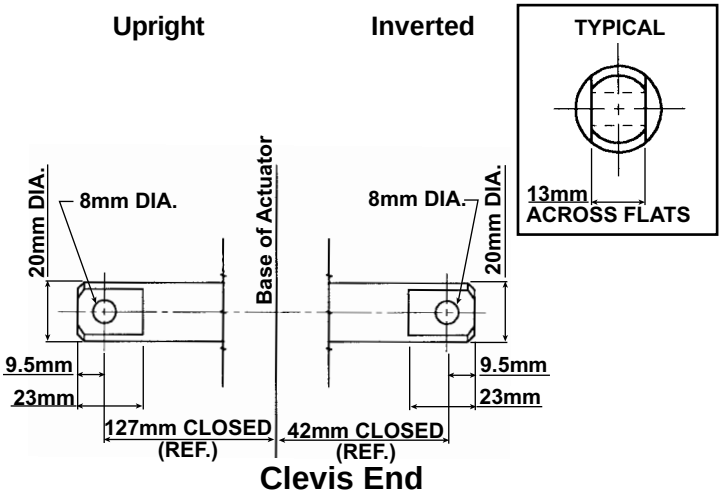


Upright: MET-2501

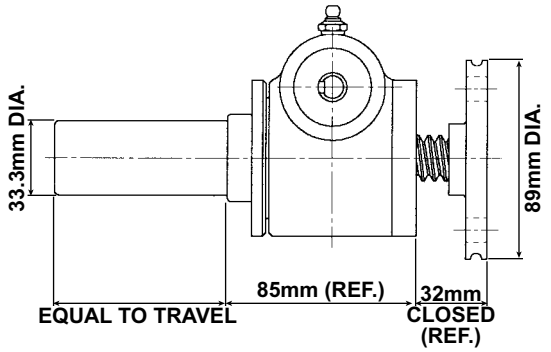
20mm O.D. 5mm Pitch Lifting Screws
(Other Available Screw Ends)



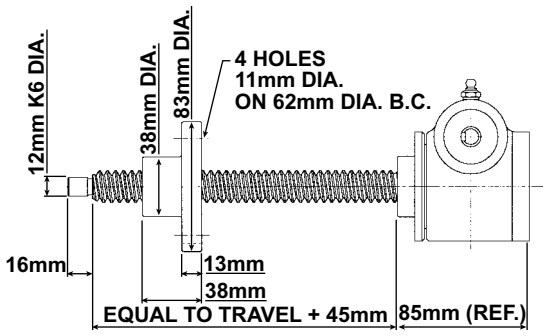
Threaded End



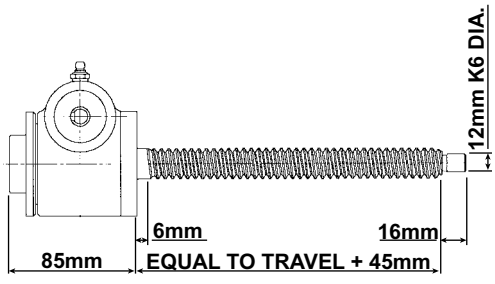
Clevis End



Inverted: MET-2500

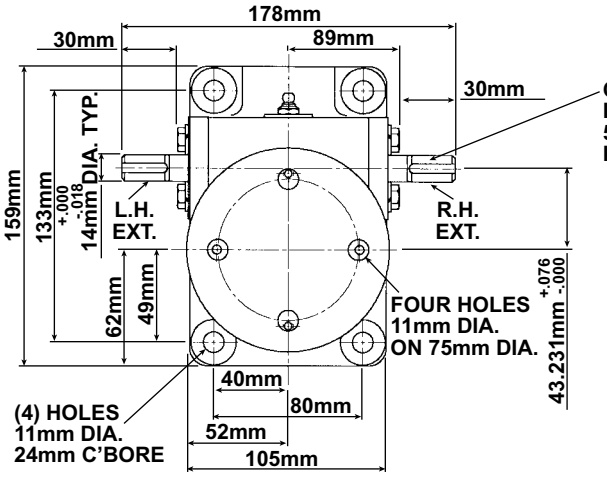


Upright Rotating: MET-UM-2502

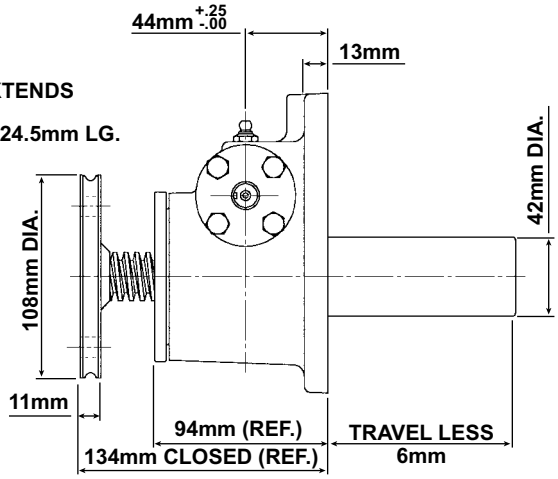


Inverted Rotating: MET-DM-2502

Machine Screw Actuators, 19kN

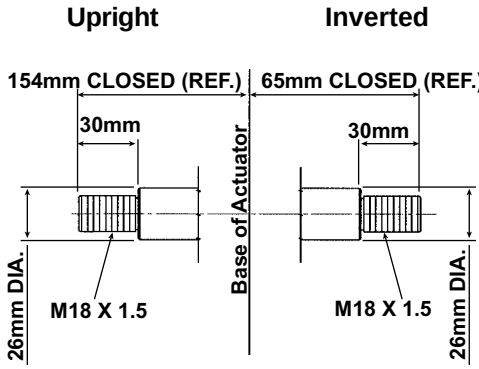


Top View: MET-9002

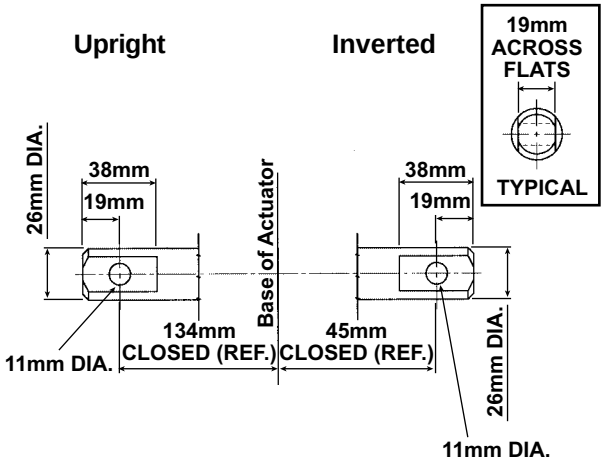


Upright: MET-9002

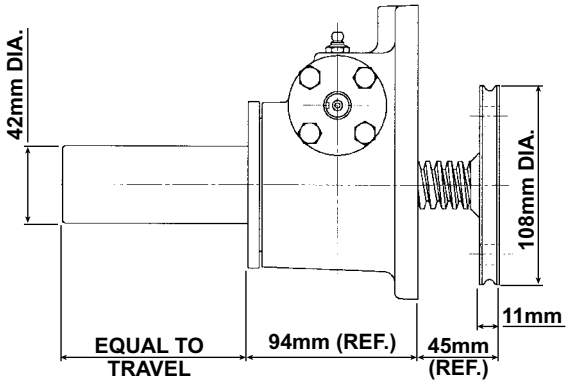
26mm O.D. 6mm Pitch Lifting Screws (Other Available Screw Ends)



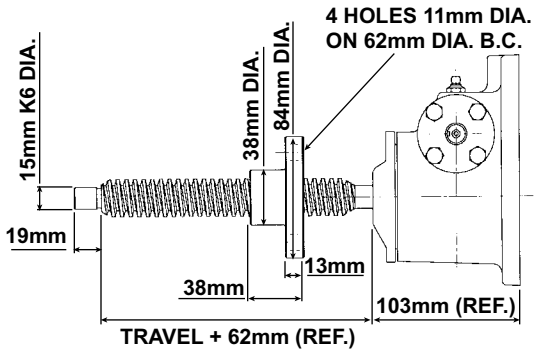
Threaded End



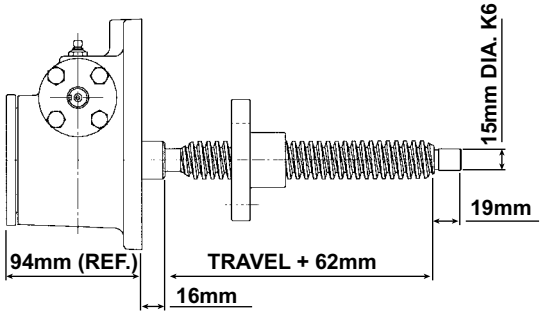
Clevis End



Inverted: MET-9001

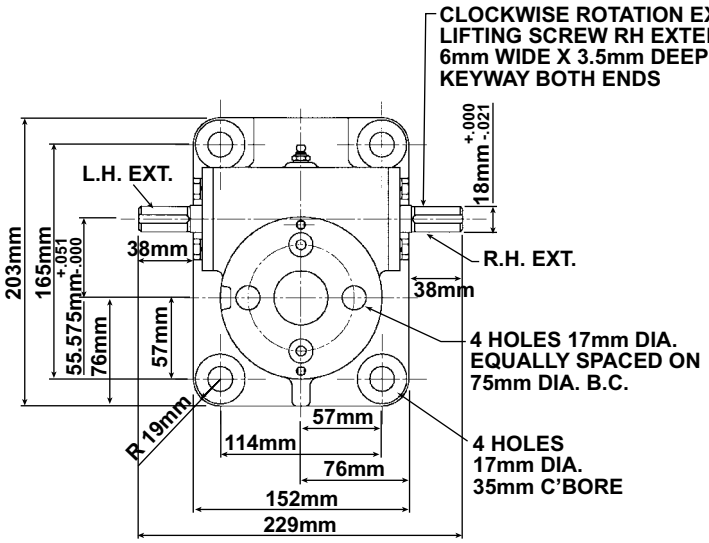


Upright Rotating: MET-UM-9003

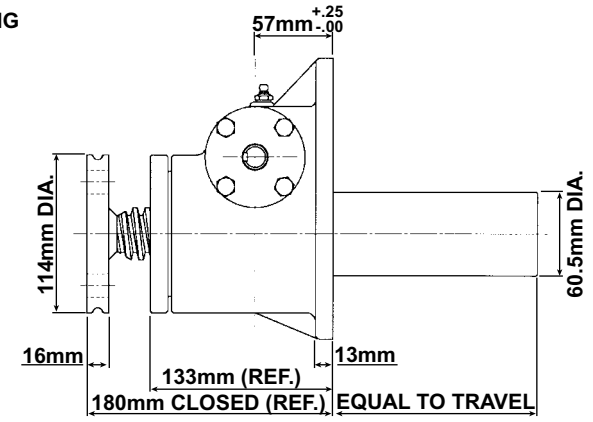


Inverted Rotating: MET-DM-9003

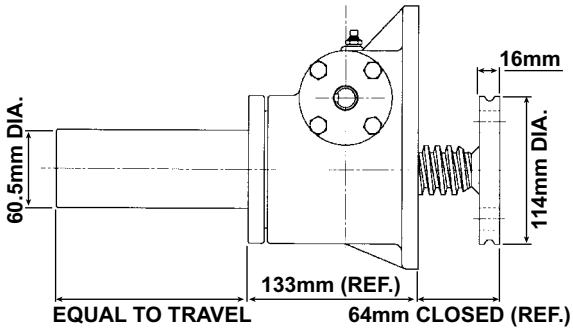
Machine Screw Actuators, 49kN



Top View: MET-9005



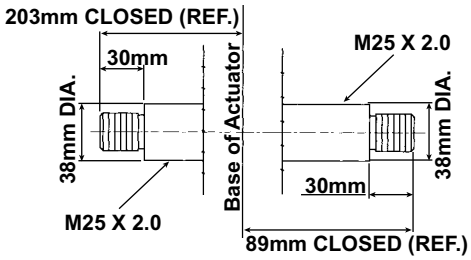
Upright: MET-9005



Inverted: MET-9004

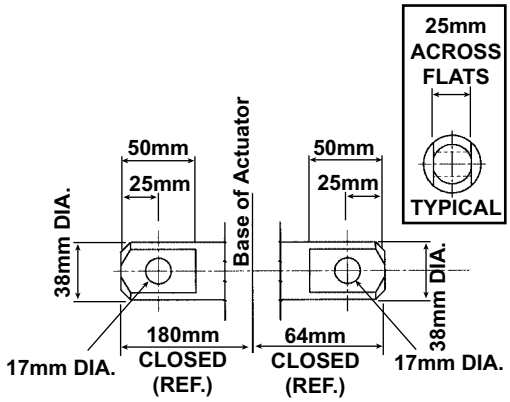
38mm O.D. x 9mm Pitch Lifting Screws (Other Available Screw Ends)

Threaded End

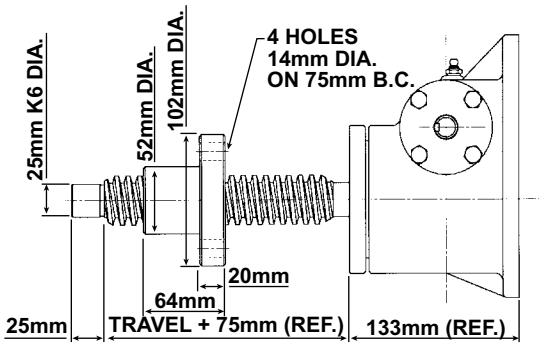


Upright **Inverted**

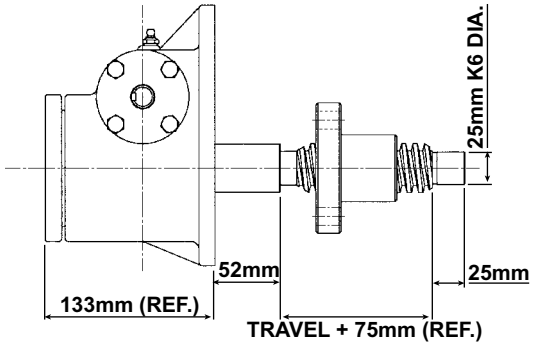
Clevis End



Upright **Inverted**

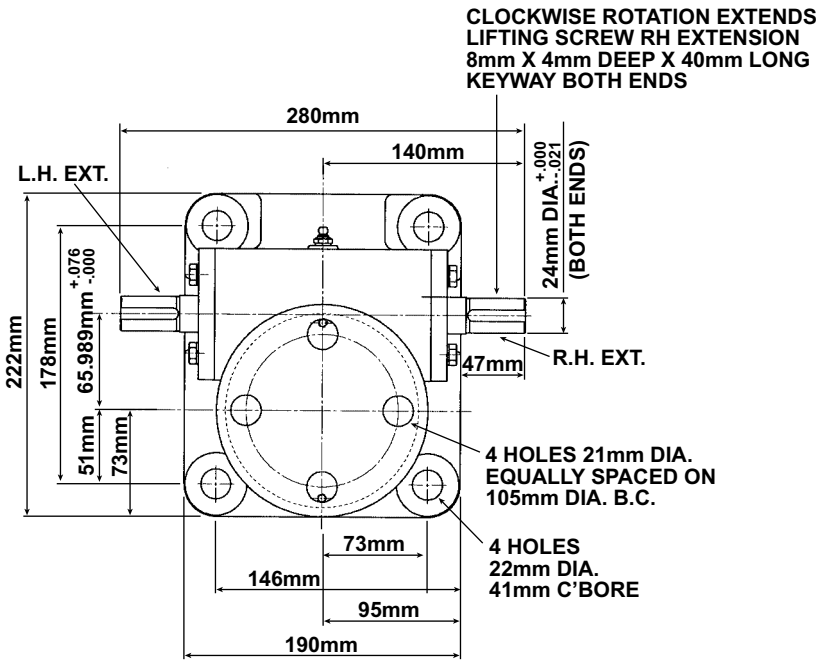


Upright Rotating: MET-UM-9006

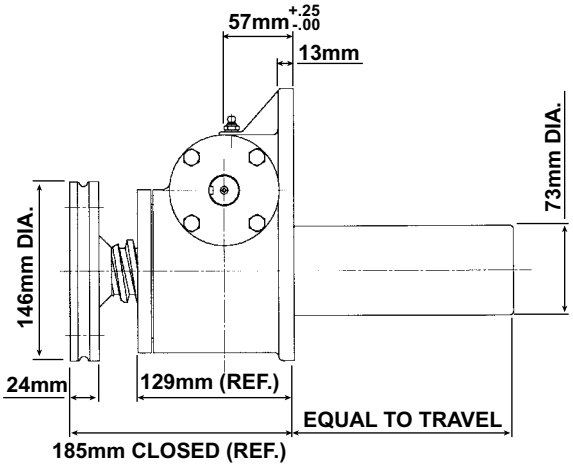


Inverted Rotating: MET-DM-9006

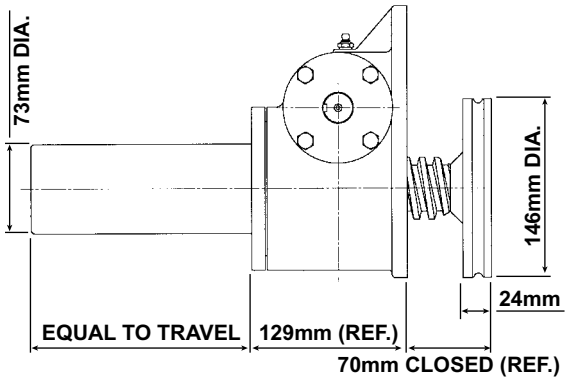
Machine Screw Actuators, 98kN



Top View: MET-9010



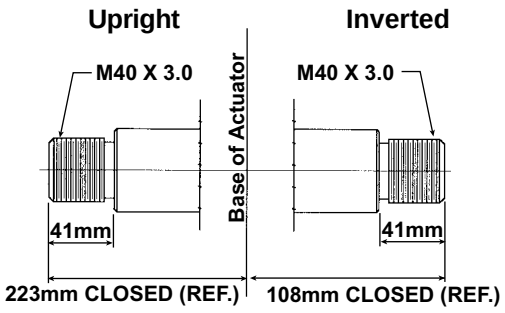
Upright: MET-9010



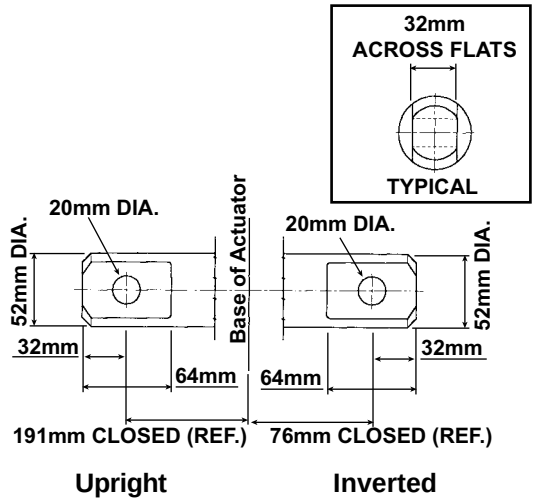
Inverted: MET-9009

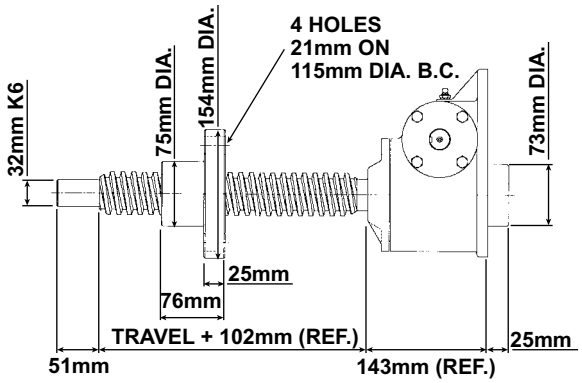
52mm O.D. x 12mm Pitch Lifting Screws (Other Available Screw Ends)

Threaded End

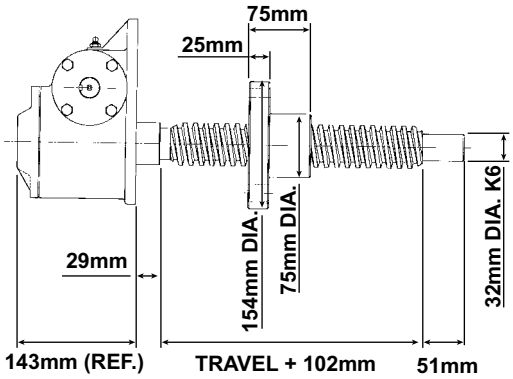


Clevis End



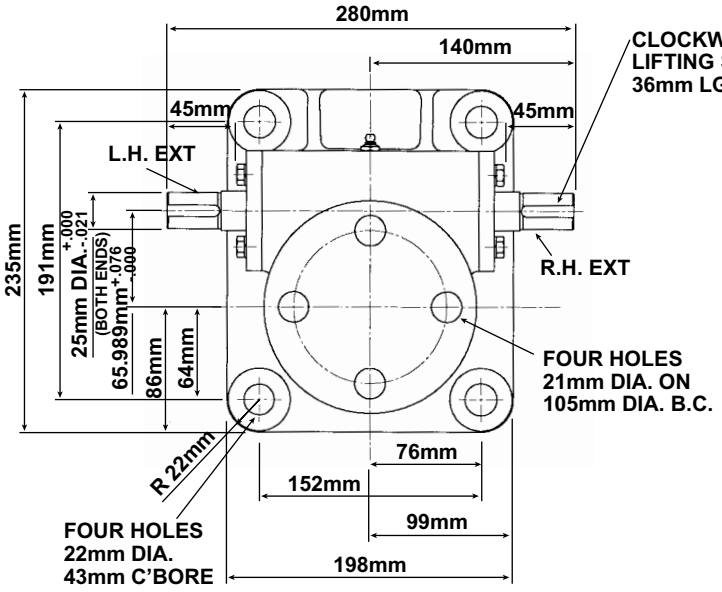


Upright Rotating: MET-UM-9011

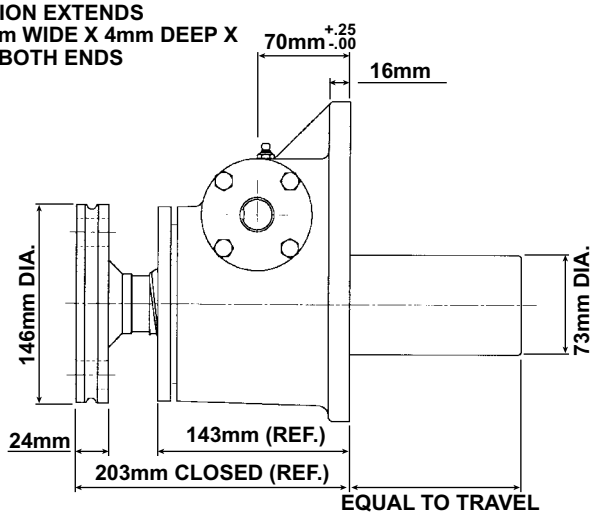


Inverted Rotating: MET-DM-9011

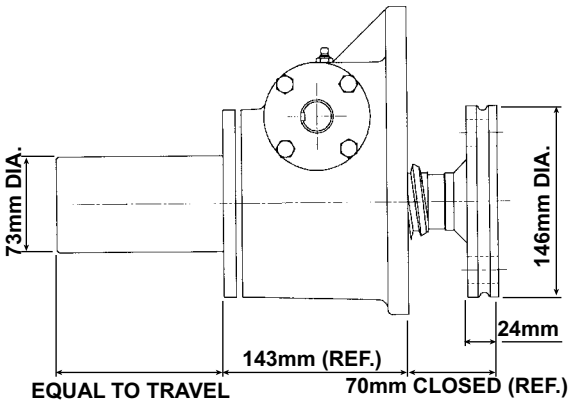
Machine Screw Actuators, 147kN



Top View: MET-9015



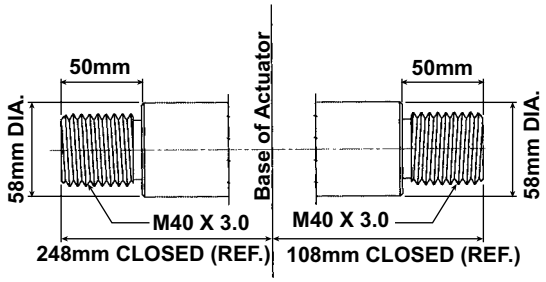
Upright: MET-9015



Inverted: MET-9014

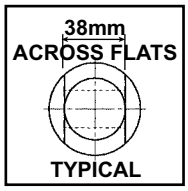
58mm O.D. x 12mm Pitch Lifting Screws
(Other Available Screw Ends)

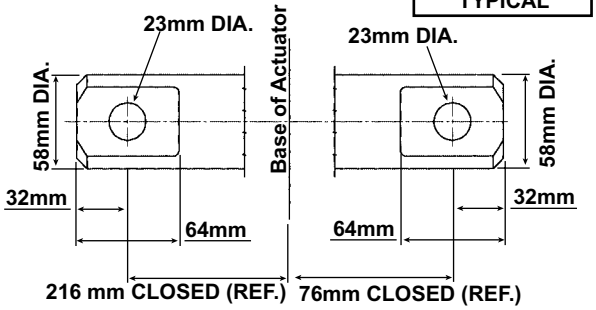
Threaded End



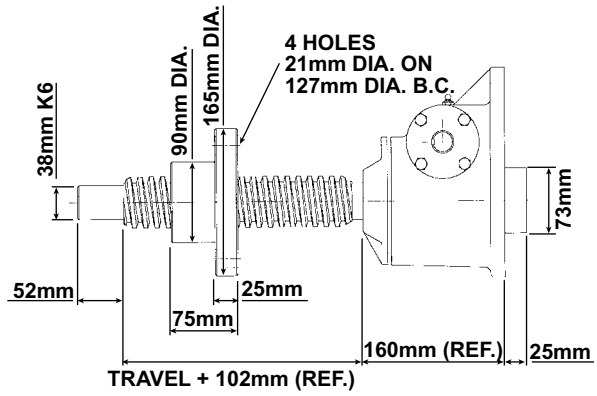
Upright **Inverted**

Clevis End

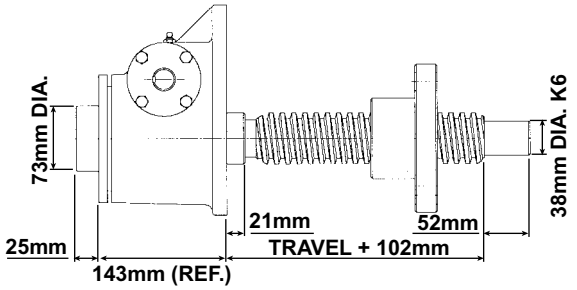




Upright **Inverted**

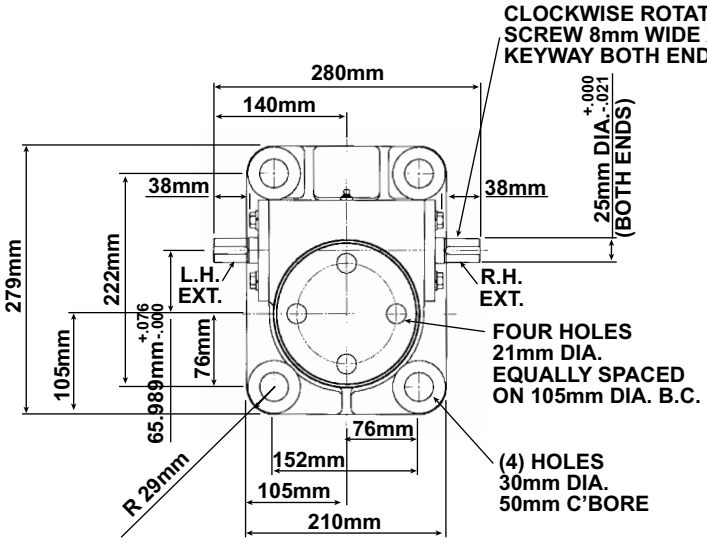


Upright Rotating: MET-UM-9016

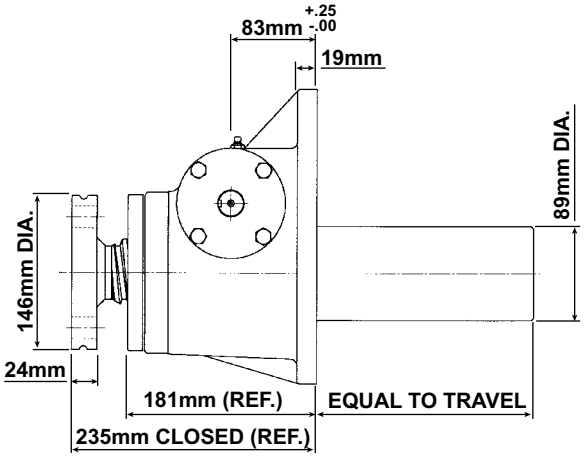


Inverted Rotating: MET-DM-9016

Machine Screw Actuators, 196kN



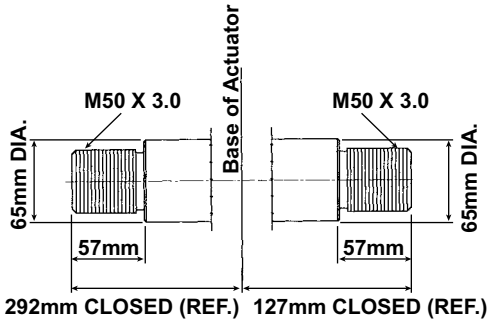
Top View: MET-9020



Upright: MET-9020

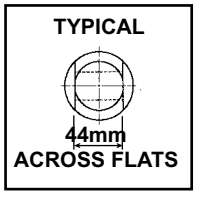
65mm O.D. x 12mm Pitch Lifting Screws (Other Available Screw Ends)

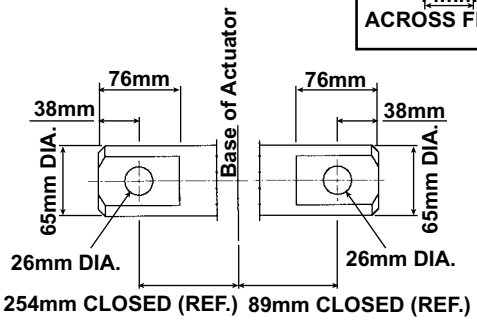
Threaded End



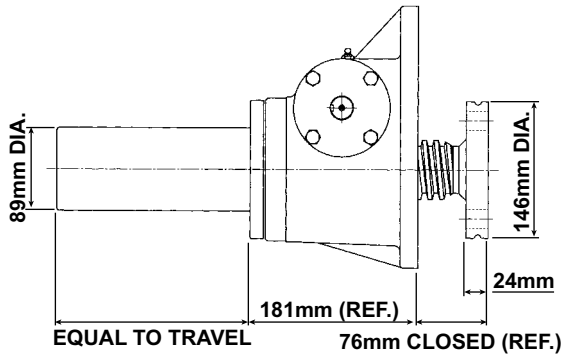
Upright **Inverted**

Clevis End

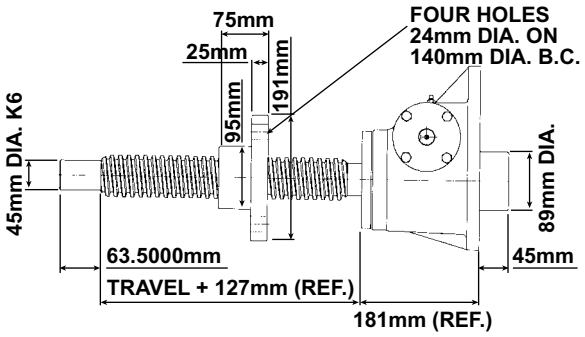




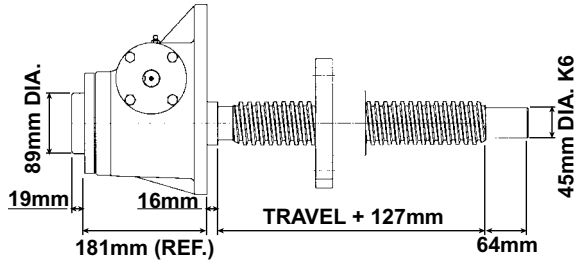
Upright **Inverted**



Inverted: MET-9019



Upright Rotating: MET-UM-9021



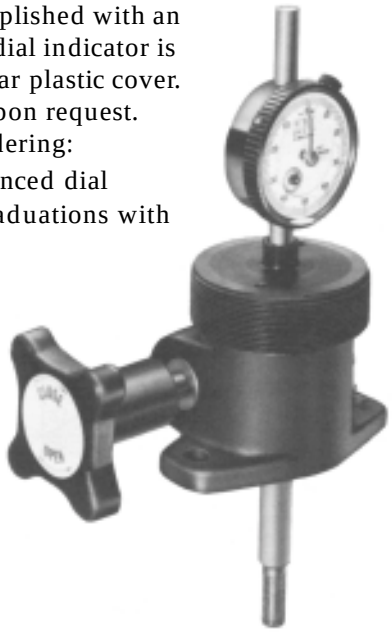
Inverted Rotating: MET-DM-9021

Micro-Miniature Actuator

Manual operation is accomplished with an easy-to-use hand knob. The dial indicator is protected by a removable clear plastic cover.

Dial indicators available upon request. Indicate preference when ordering:

- **Part No. SK-3554-46** -Balanced dial reading 0-50-0 in. .001" graduations with revolution counter.
- **Part No. SK-3554-8**3 - Continuous dial reading 0-100 in .001" graduations with revolution counter. (Type of dial must be specified as above when ordering actuator.)



- Actuates up to 1,000 pounds.
- Allows for extremely fine adjustment
- Corrosion-resistant.
- Equipped with anti-backlash nuts to minimize vertical backlash between the screw and worm gear nut.
- Also available in stainless steel. Standard model has anodized aluminum shell cap and housing with stainless steel worm and lifting screws. Also available with sealed 316 stainless steel shell cap, housing, worm and lifting screw.

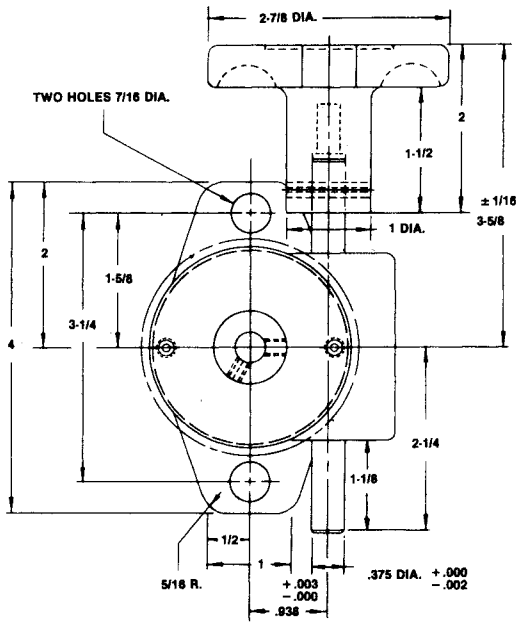
Note: The load bearings and worm bearings inside stainless steel actuators are not stainless steel.

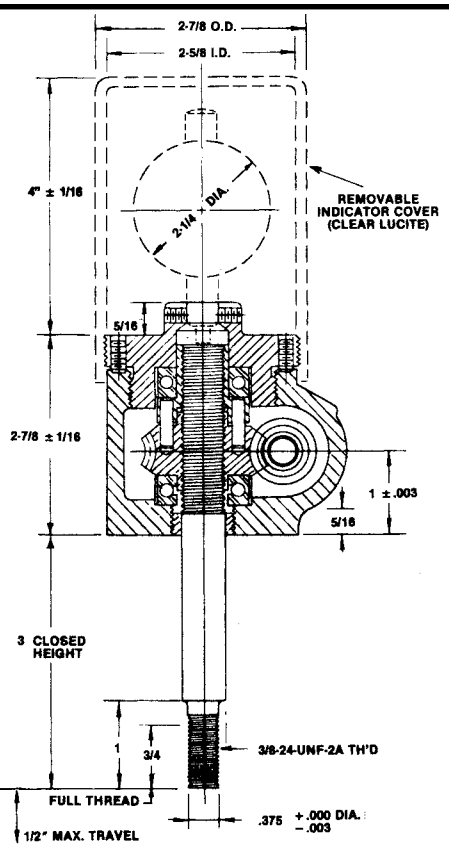
Patent Nos. 3,220,277 and 3,323,777

Micro-Miniature Actuator Specifications

Model No.	Rated Capacity	Screw Dia.	Turns of Worm for 1/2" Raise	No Load Torque	Lifting Torque at Full Load	Worm Gear Ratio	Weight	Shell Cap and Housing
M-3554-30	500 lbs.	.500	500	2 In.-Lbs.	12 In.-Lbs.	20:1	2 lbs.	Aluminum
M-3554-27	1000 lbs.	.625	500	2 In.-Lbs.	18 In.-Lbs.	20:1	2 lbs.	Aluminum
M-3554-136	1000 lbs.	.625	500	2 In.-Lbs.	18 In.-Lbs.	20:1	3 lbs.	Stainless Steel

Specifications





Dimensions are subject to change without notice.

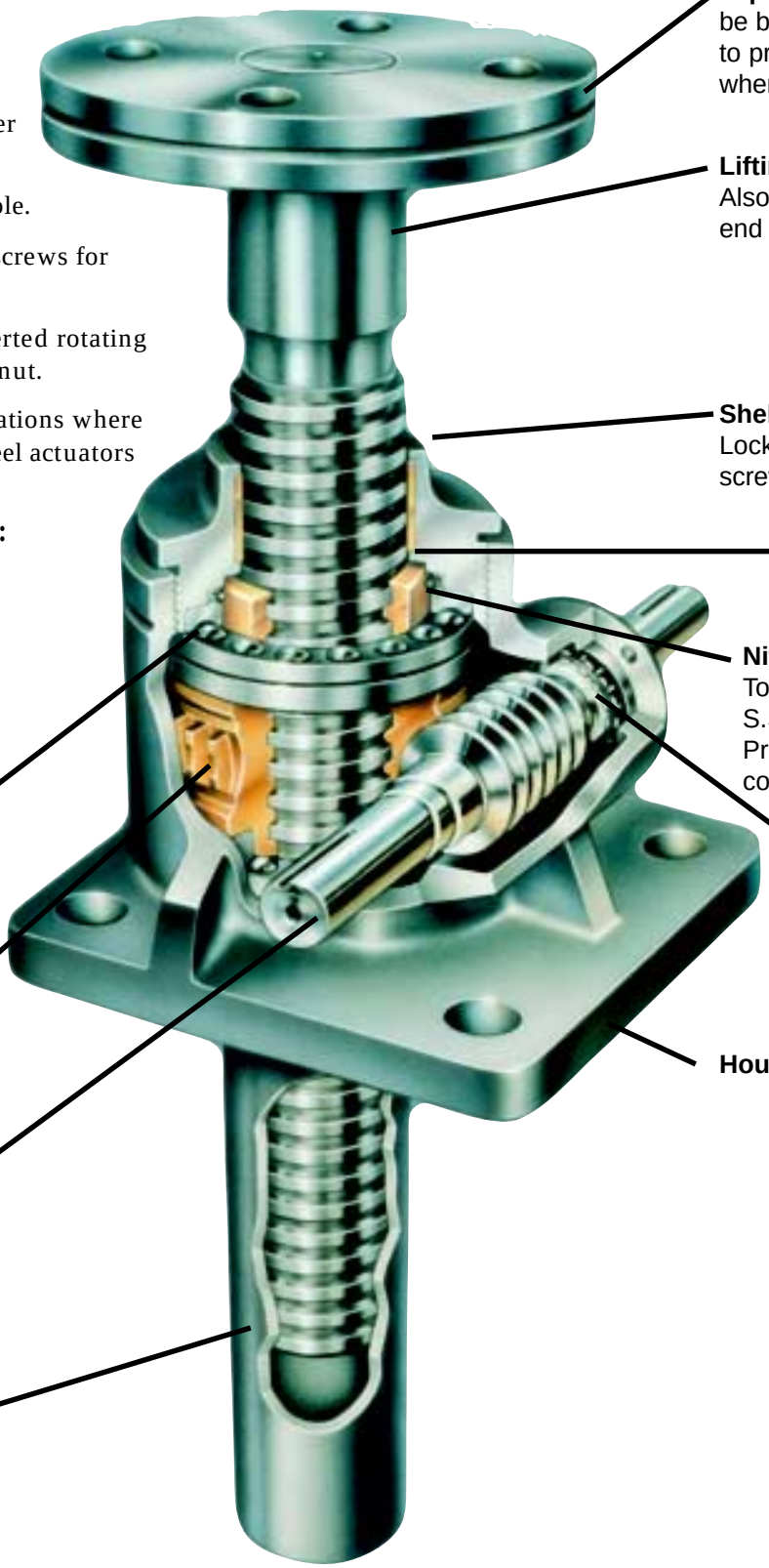
Stainless Steel Machine Screw Actuator Models

Advantages:

- Capacity from 2 tons through 100 tons.
- Worm gear ratios from 6:1 to 36:1.
- Corrosion resistant.
- Stainless steel hardware
- Sealed gear cavity keeps water and other contaminants out.
- Anti-backlash models available.
- Available with keyed lifting screws for translating screw models.
- Available in upright and inverted rotating screw models with traveling nut.
- Can be retrofitted into applications where Duff-Norton non-stainless steel actuators have been previously used.

Optional Special Features:

- Closed heights
- Lifting screw ends
- Worm shaft extensions
- Lifting screw thread pitches
- Materials
- With stop nuts
- With boots



Top Plate -316 S.S. Must be bolted to lifted member to prevent rotation, except when keyed.

Lifting Screw -316 S.S. Also available as threaded end or clevis end.

Shell Cap -316 S.S. Locked into place by set screws.

Guide Bushing - Bronze

Nitrile Rubber Seals - Top and bottom with 316 S.S. case and spring. Protects gearcase from contamination.

Worm Bearings and Seals - Both ends of worm. 316 S.S. case and spring.

Housing -316 S.S.

Carbon Steel Load Bearings - Top and bottom to take full load in either direction.

Worm Gear - Aluminum Bronze. Accurately hobbed for greater gear contact.

Worm -316 S.S. standard. (17 -4 Ph available as special) single piece construction

Dust Guard - 316S.S. Protects lifting screw threads.

Stainless Steel Actuator Specifications

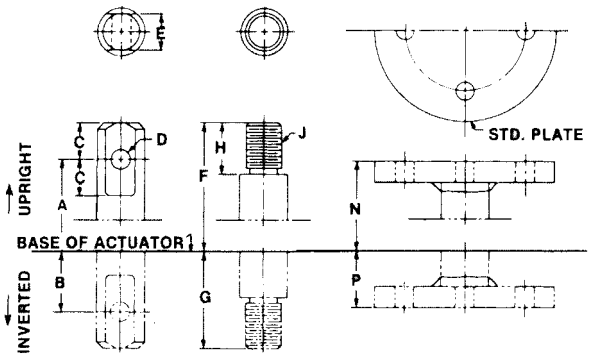
Stainless Steel Machine Screw Actuator Units

Model No.	Upright	SM-1802	SM-9005	SM 9010	SM-9015	SM-9020	SM-9025	SM-9035	SM-1850	SM-9099
	Inverted	SM-1801	SM-9004	SM-9009	SM-9014	SM-9019	SM-9024	SM-9034	SM-1849	SM-9098
Capacity, Ton*	Sustaining	2	5	10	15	20	25	35	50	100
	Operating	.66	1.66	3.33	5.00	6.66	8.33	11.66	16.66	33.33
Lifting Screw Diameter (Inches)		1 .250 Pitch Acme	1 1/2 .375 Pitch Acme	2 .500 Pitch Acme	2 1/4 .500 Pitch Acme	2 1/2 .500 Pitch Acme	3 .666 Ptich Acme	3 3/4 .666 Pitch Acme	4 1/2 .666 Pitch Square	6 .750 Pitch Square
Worm Gear Ratios	Std. Ratio	6:1	6:1	8:1	8:1	8:1	10 2/3:1	10 2/3:1	10 2/3:1	12:1
	Optional	24:1	24:1	24:1	24:1	24:1	32:1	32:1	32:1	36:1
Turns of Worm for 1" Raise	Std. Ratio	24	16	16	16	16	16	16	16	16
	Optional	96	64	48	48	48	48	48	48	48
Maximum H.P. Per Actuator	Std. Ratio	2	4	5	5	5	8	8	15	25
	Optional	1/2	3/4	1 1/2	1 1/2	1 1/2	2 1/2	2 1/2	6	11
Torque at Operating Load*(In. - Lbs)	Std. Ratio	40	150	250	475	685	665	1335	2500	5335
	Optional	17	60	135	275	390	400	800	1400	2865
Efficiency Rating (%)	Std. Ratio	23.2	22.1	23.7	20.2	18.8	18.7	15.6	13.8	13.0
	Optional	13.3	12.1	15.1	12.9	12.0	10.5	8.9	8.3	8.0
Weight with Base Raise of 6' (Lbs)		19	37	55	70	96	168	250	420	1260
Torque at No Load (In-Lbs)		5	10	20	20	30	40	50	100	200

For loads from 25% to 100% of actuator capacity, torque requirements are approximately proportional to the load.
* Actuator has been derated for 316 S.S. worm. For full load rating use 17 -4 PH worm.

Stainless Steel Actuators:

Standard Screw End Dimensions

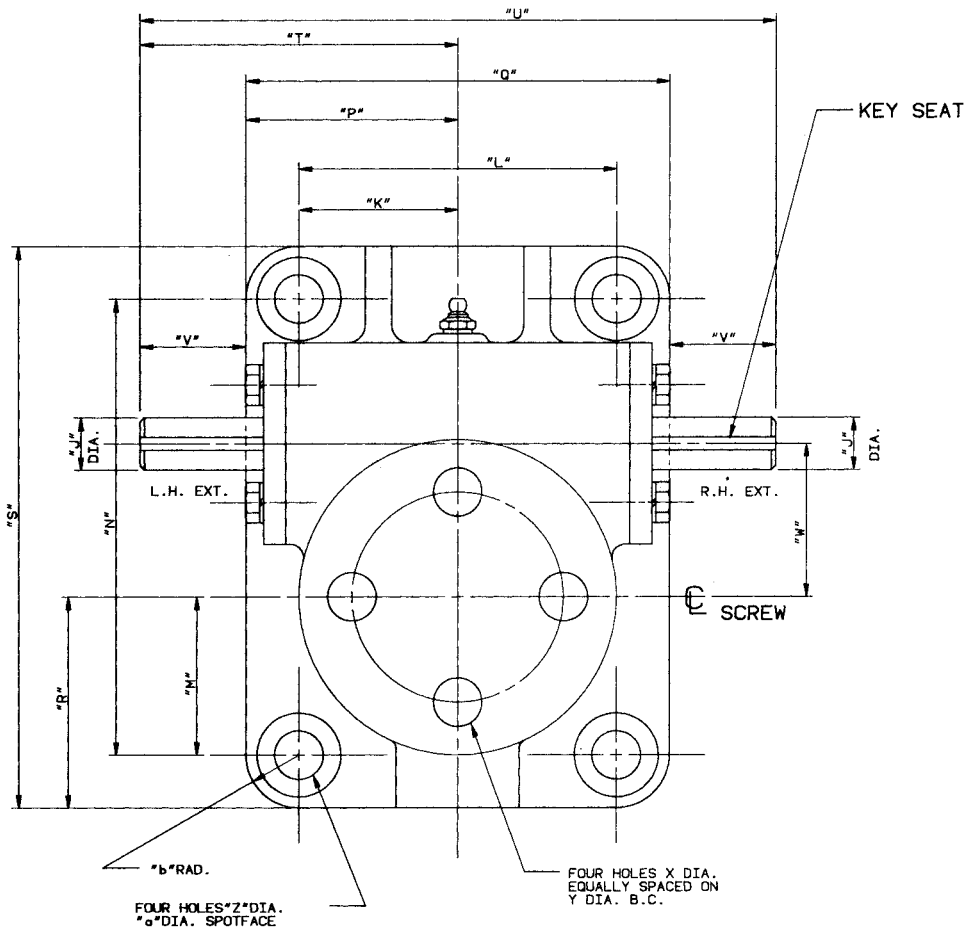


Standard Stainless Steel Actuators Screw End Dimensions

Model No.	A**	B**	C	D	E	F**	G**	H	J	N**	P**
SM-1802	5 1/4"	1 3/4"	3/4"	13/32 "	3/4"	6.0	2 1/2"	1 1/8"	3/4"-10-UNC-2A	5.25	1 3/4"
SM-9005	7"	2 1/2"	1"	21/32"	1"	8.0	3 1/2"	1 1/8"	1"-8-UNC-2A	7.5	2 1/2"
SM-9010	7 1/2"	3"	1 1/4"	25/32"	1 1/4"	9.25	4 1/4"	1 5/8"	1 1/2"-6-UNC-2A	7.75	2 3/4"
SM-9015	8 1/2"	3"	1 1/4"	29/32"	1 1/2"	10.25	4 1/4"	2"	1 3/4"-5-UNC-2A	8.5	2 3/4"
SM-9020	10"	3 1/2"	1 1/2"	1 1/32"	1 3/4"	12.5	5"	2 1/4"	2"-4 1/2-UNC-2A	10.25	3"
SM-9025	12"	4"	1 3/4"	1 9/32"	2 1/4"	14.5	5 3/4"	3 1/4"	2 1/2"-4-UNC-2A	11.75	3"
SM-9035	13"	5""	2"	1 17/32"	2 1/2"	15.5	7"	3 3/4"	3 1/4"-4-UNC-2A	12.5	4"
SM-1850	15"	5 1/2"	2 1/2"	1 21/32"	3 1/4"	18.0	8"	4 1/4"	4"-4-UNC-2A	13.5	3 1/2"
SM-9099	24"	9"	3"	2 17/32"	4 1/4"	25.0	12"	5"	4 1/2"-12-UNC-2A	24.0	12"

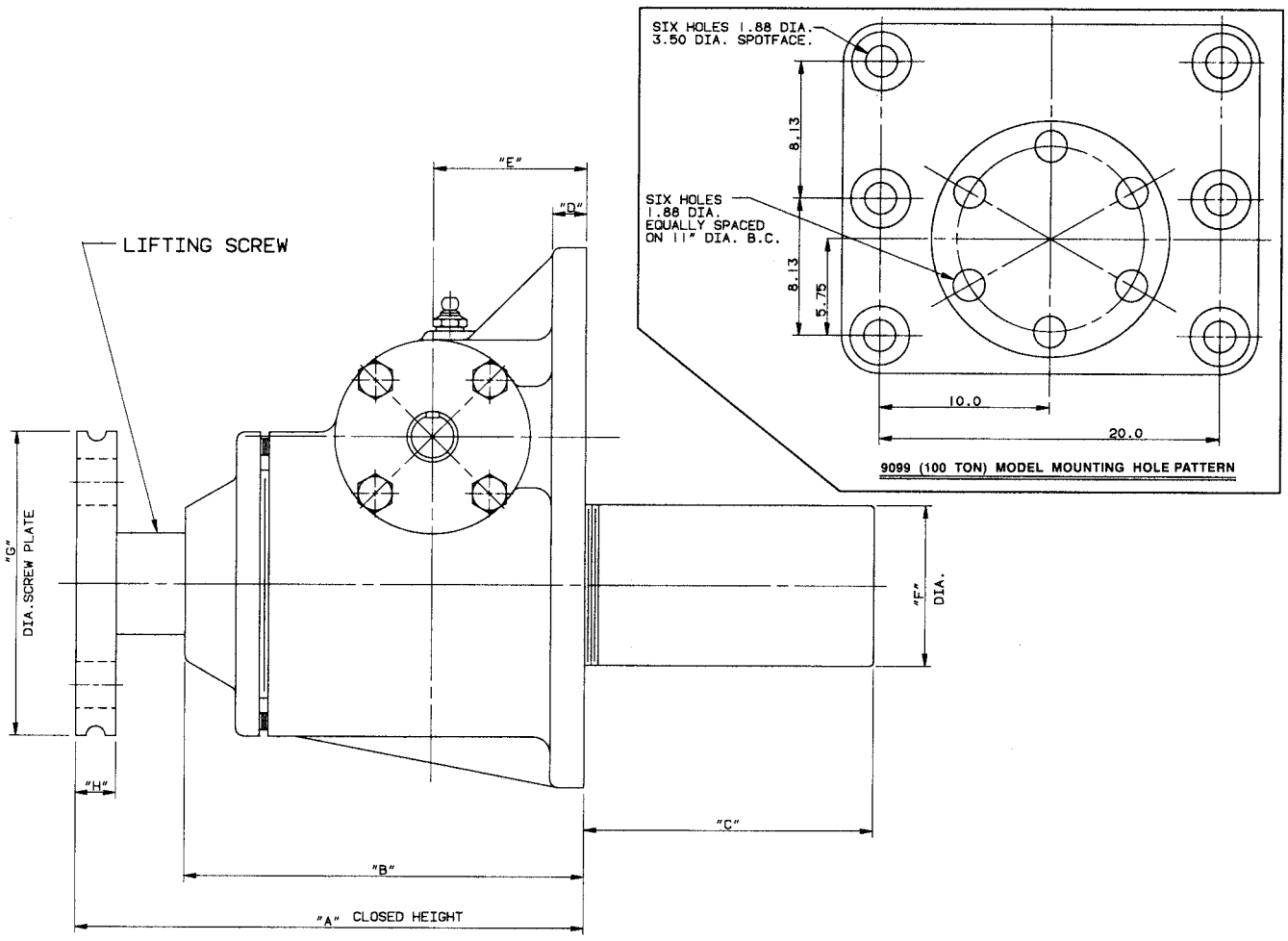
**Closed dimensions may increase for actuator units supplied with bellows boots. Consult Duff-Norton Company.
Note: Lifting screws listed above are not keyed. Must be held to prevent rotation.
Keyed lifting screws and keyed anti-backlash models also available. Consult Duff-Norton.

Stainless Steel Machine Screw Actuators:
2 to 100 Tons



Model Number	Capacity Tons Sustaining	Capacity Tons Operating	A	B	C	D	E (+/-.005)	F	G	H	J (+.000/-.002)	K	L	M	N	P	Q	R	S
SM-1802	2	.67	5.50	4.56	Travel	.50	1.750	1.66	4.25	.50	.500	3.00	6.00	1.00	2.00	3.50	7.00	1.75	3.5
SM-9002	2	.67	5.50	4.56	Travel	.50	1.750	1.66	4.25	.50	.500	1.56	3.13	1.93	5.25	2.06	4.13	2.42	6.25
SM-9005	5	1.66	7.50	5.88	Travel +3/8	.50	2.250	2.38	4.50	.60	.749	2.25	4.50	2.25	6.50	3.00	6.00	3.00	8.00
SM-9010	10	3.33	7.75	6.00	Travel +1/4	.50	2.250	2.88	5.75	.94	1.000	2.88	5.75	2.00	7.00	3.75	7.50	2.88	8.75
SM-9015	15	5.00	8.00	6.31	Travel +1/2	.63	2.750	2.88	5.75	.94	1.000	3.00	6.00	2.50	7.50	3.88	7.75	3.38	9.25
SM-9020	20	6.66	10.25	8.00	Travel -1/4	.75	3.250	3.50	5.75	.94	1.000	3.00	6.00	3.00	8.75	4.13	8.25	4.13	11.00
SM-9025	25	8.33	11.75	9.75	Travel +1/4	1.00	4.000	4.50	8.50	.94	1.375	3.75	7.50	3.75	11.00	5.13	10.25	5.13	13.75
SM-9035	35	11.66	12.50	9.56	Travel +1/4	1.25	4.000	4.50	10.50	1.31	1.375	3.75	7.50	4.50	12.50	5.13	10.25	6.00	15.50
SM-1850	50	16.66	13.50	11.38	Travel	1.25	4.750	5.63	11.25	1.25	1.500	8.00	16.00	3.00	6.00	9.88	19.75	4.88	9.75
SM-9099	100	33.33	24.00	18.50	Travel +1/2	1.50	6.000	7.00	14.00	2.94	1.750	10.00	20.00	5.75	16.26	12.25	24.50	8.00	20.75

Dimensions are subject to change without notice.



Model No.	T	U	V	W	X	Y	Z	a	b	Keyseat	Lifting Screw	Actuator Ratio		Turns of Worm for 1" Travel	
												St'd.	Opt.	St'd	Opt.
SM-1802	3.50	7.00	1.12	1.702 +.003/-.000	.41	3.00	.41	.75	.5	.125 x .060 x 1.00 LG.	1.00 Dia. Acme-.250 Pitch	6:1	24:1	24	96
SM-9002	3.50	7.00	1.12	1.702 +.003/-.000	.41	3.00	.41	.88	.38	.125 x .060 x 1.00 LG.	1.00 Dia. Acme-.250 Pitch	6:1	24:1	24	96
SM-9005	4.50	9.00	1.50	2.188 +.002/-.000	.69	3.00	.69	1.19	.75	.188 x .094 x 1.25 LG.	1.50 Dia. Mod. Acme-.375 Pitch	6:1	24:1	16	64
SM-9010	5.50	11.00	1.80	2.598 +.003/-.000	.81	4.13	.81	1.31	.88	.250 x .125 x 1.50 LG.	2.00 Dia. Acme-.500 Pitch	8:1	24:1	16	48
SM-9015	5.50	11.00	1.80	2.598 +.003/-.000	.81	4.13	.81	1.38	.88	.250 x .125 x .150 LG.	2.25 Dia. Acme-.500 Pitch	8:1	24:1	16	48
SM-9020	5.50	11.00	1.50	2.598 +.003/-.000	.81	4.13	1.12	1.75	1.13	.250 x .125 x 1.50 LG.	2.50 Dia. Acme-.500 Pitch	8:1	24:1	16	48
SM-9025	7.00	14.00	2.30	3.750 +.006/-.000	1.06	6.00	1.38	2.13	1.38	.313 x .156 x 2.00 LG.	3.00 Dia. Stub Acme-.6666 Pitch	10 2/3:1	32:1	16	48
SM-9035	7.00	14.00	2.10	3.750 +.006/-.000	1.62	7.75	1.62	2.63	1.38	.313 x .156 x 2.00 LG.	3.75 Dia. Stub Acme-.6666 Pitch	10 2/3:1	32:1	16	48
SM-1850	11.00	22.00	4.40	5.313 +.003/-.000	1.38	8.75	1.88	3.25	1.88	.375 x .188 x 2.25 LG.	4.50 Dia. Mod. Sq.-.6666 Pitch L.H.	10 2/3:1	32:1	16	48
SM-1899	11.50	23.00	3.40	7.500 +.003/-.000	1.88	11.0	1.88	3.50	2.25	.500 x .250 x 3.00 LG.	6.00 Dia. Mod. Sq.-.750 Pitch	12:1	36:1	16	48

Dimensions are subject to change without notice.

Anti-Backlash Actuator

How Anti-Backlash Feature Works

When the screw (1) is under a compression load, the bottom of its thread surfaces are supported by the top thread surfaces of the worm gear (2) at point (A). The anti-backlash nut (3), being pinned to the worm gear and floating on these pins and being adjusted downward by the shell cap, forces its bottom thread surfaces against the upper thread surfaces of the lifting screw at point (B). Thus, backlash between the worm gear threads and the lifting screw threads is reduced to a regulated minimum.

When wear occurs in the worm gear threads and on the load carrying surfaces of the lifting screw thread, the load carrying thickness of the worm gear thread will be reduced. This wear will create a gap at point (B) and provide backlash equal to the wear on the threads.

Under a compression load, the lifting screw will no longer be in contact with the lower thread surface of the anti-backlash nut. Under this condition, backlash will be present when a tension load is applied.

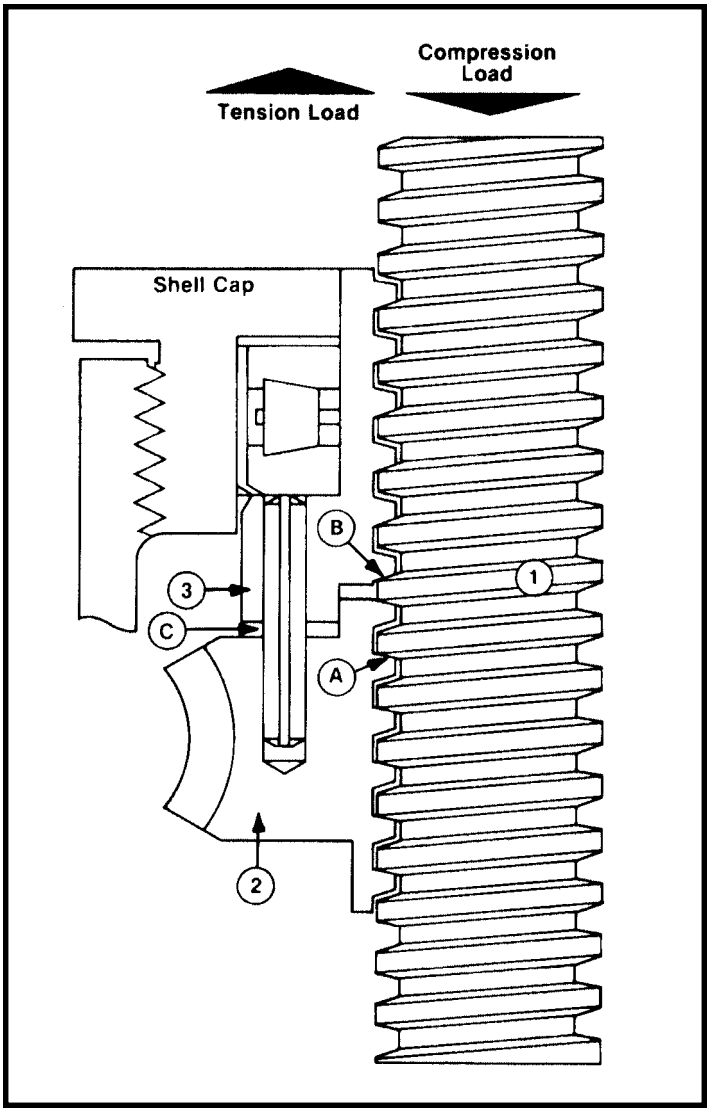
The anti-backlash feature can be maintained simply by adjusting the shell cap until the desired amount of backlash is achieved.

To avoid binding and excessive wear, do not adjust lifting screw backlash to less than .0005".

This will reduce the calculated separation (C) between the anti-backlash nut and the worm gear and will reduce the backlash between the worm gear threads and the lifting screw to the desired minimum value.

When separation (C) has been reduced to zero, wear has taken place. Replace the worn gear and backlash nut set at this point. This feature acts as a built in safety device.

Note: Use anti-backlash as a safety device or to provide wear indication for critical applications. Keyed anti-backlash models may require key adaptor, which projects below jack base. Consult Duff-Norton for dimensions.



*Patent No. 3,323,777

4800 & 9400 Series with Anti-Backlash Feature

For applications where a reversal of loading from tension to compression is encountered, 1800 and 9000 Series actuator models in a wide range of capacities are available equipped with anti-backlash nuts. These are designated as 4800 and 9400 Series.

The anti-backlash nuts reduce the vertical backlash between the screw and the worm gear nut to a practical minimum for smoother, more precise operation and minimum wear. They also act as a safety device, providing a dual-nut load carrying unit, when worm gear becomes worn.

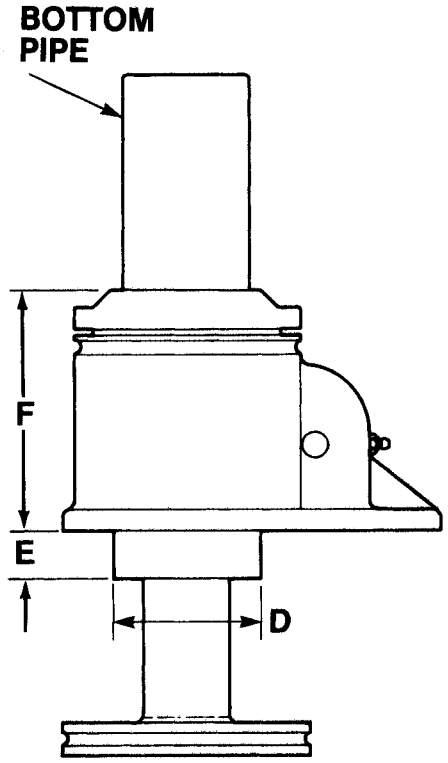
Torques, actuator efficiency ratings, weights and in some instances closed heights of 4800 and 9400 Series differ from those of 1800 and 9000 Series. See table below. All actuator units can be supplied with standard raises up to 24 inches. Consult factory for special raises up to 20 ft. For compression loads refer to page 112.

Anti-Backlash Machine Screw Actuators

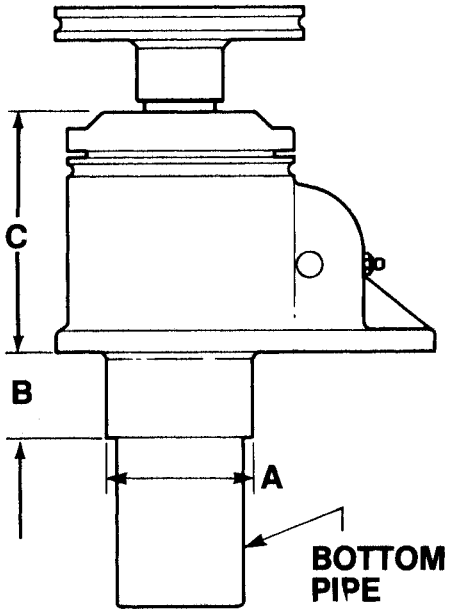
Model No.		4555	4625	4501	4802, 7802 & 9402	9405	9410	9415	9420	9425	9435	4850 & 9450	9499	48150
Capacity, Tons		1/4	1/2	1	2	5	10	15	20	25	35	50	100	150
Torque at Full Load* (In.-Lbs)	Std. Ratio	15	23	60	135	500	1045	1573	2255	2970	4400	8250	17,600	30,900
	Optional	---	---	27	55	205	540	905	1290	1320	2640	4620	9460	17,050
Torque at No Load (In.-Lbs)		2.2	2.2	5.5	5.5	11	22	22	33	44	55	110	220	275
Efficiency Rating (%)	Std. Ratio	27.7	16.8	21.2	19.6	19.9	19.8	18.0	17.6	13.4	13.7	12.4	11.7	12.7
	Optional	---	---	11.7	11.9	10.9	12.6	11.0	10.8	8.3	7.7	7.3	7.2	7.7
Closed Height, Inches		4	4	5	5 1/4	7	7 1/4	8	9 1/2	12	13	14	26 1/2	26 1/2
Weight with Base Raise of 6" (Lbs.)		2.5	2.5	6	18	37	550	70	101	197	250	440	1395	1475

Key Adaptor Dimensions for Anti-Backlash Actuators

Keyed Anti-Backlash Inverted



Keyed Anti-Backlash Upright



Key Adaptor Dimensions For Anti-Backlash Machine Screw Actuators

Actuator Capacity, Tons	Upright A Dia.	Upright B	Upright C	Inverted D	Inverted E	Inverted F
1/2	1.66	.38	2.88	1.25	.81	2.43
1	1.66	.38	3.84	1.5	.75	3.38
2	2.25	1.25	3.88	2.25	.63	3.88
5	2.75	1.75	5.43	2.75	.88	5.38
10	3.38	2.0	5.75	3.38	1.13	5.75
15	3.63	2.0	6.13	3.63	1.25	6.13
20	4.0	1.5	7.75	4.0	1.0	7.75
25	5.5	2.25	9.69	5.5	1.25	9.69
35	6.5	2.38	9.44	6.5	1.25	9.44
50	7.0	3.0	11.75	7.0	3.0	11.75

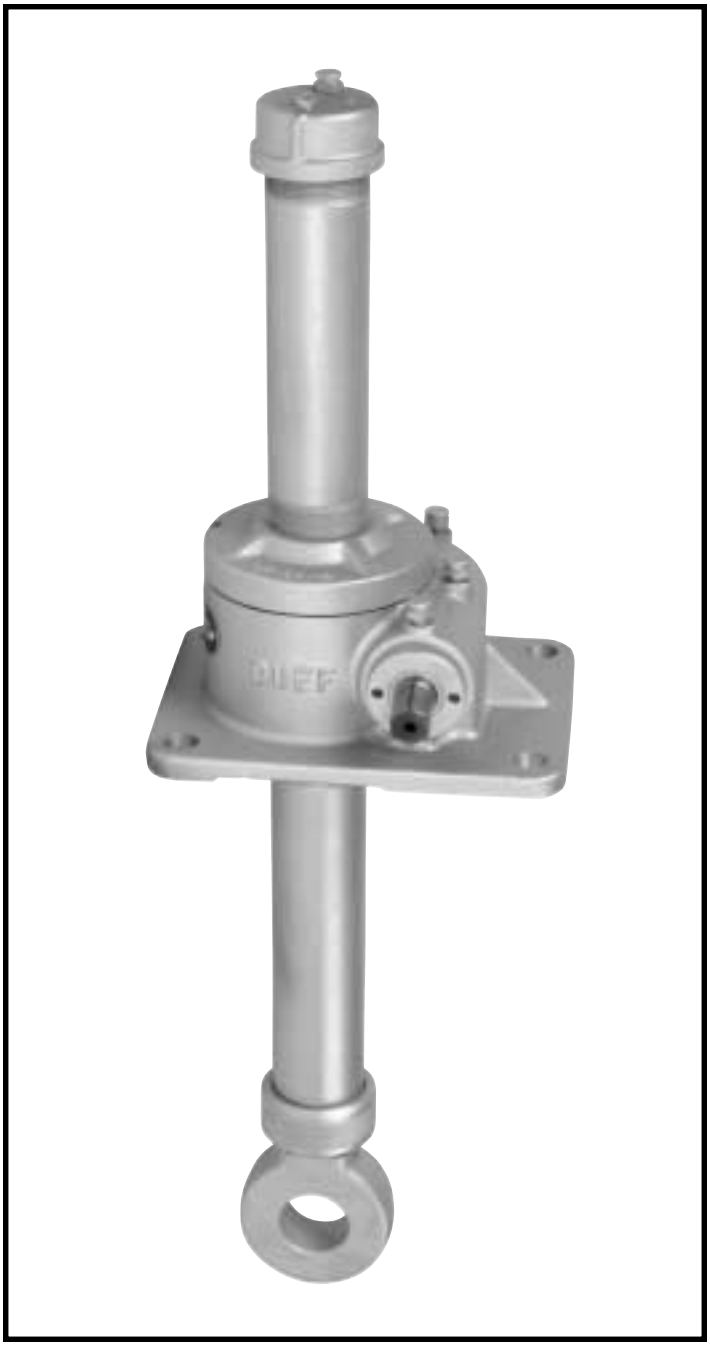
Anode Jack

Duff-Norton was the originator of the anode jack, which was developed in partnership with the Aluminum Industry. Our jacks were used in the first commercial aluminum-making plant in the United States and continue to be used in aluminum plants throughout the world.

The anode jack is a heavy-duty version of our standard Duff-Norton actuator, modified for each user's specific application. The worm gears are made of aluminum bronze and are up to 40% larger than our standard versions. Along with the larger worm gears are larger bearings and heavy-duty seals. Sealing is very important because the alumina dust is very abrasive. Anode jacks use only heat-treated alloy steel worms. Additionally, high temperature grease is used.

These jacks have a large overload capacity to handle the side loading stresses caused by the thermal expansions and contractions of the frames. They are also built to take the compressive overloads caused by occasional high-jacking of the frames and frozen pots.

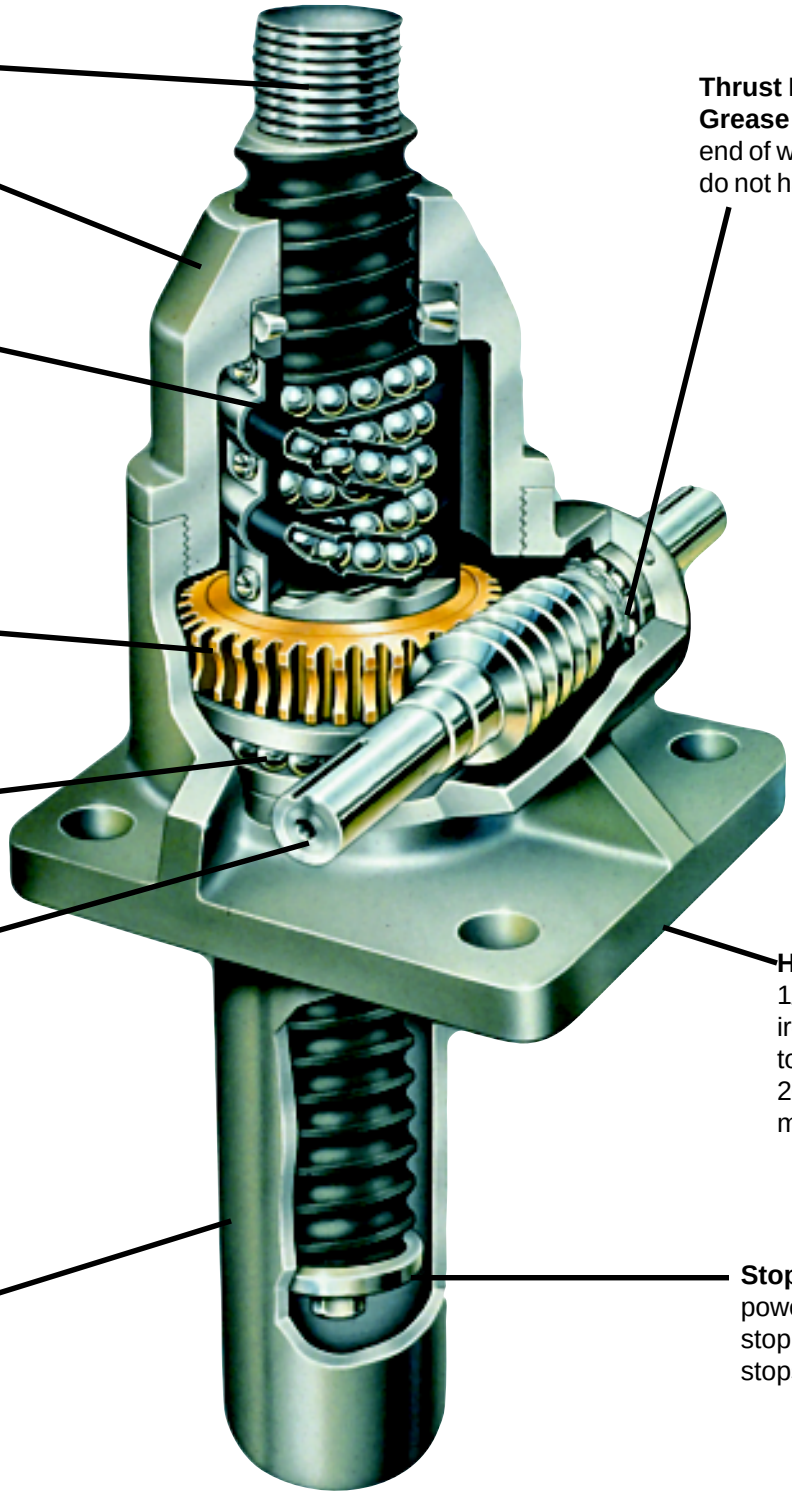
In addition to these jacks, Duff-Norton can also supply anode jacking arrangements, which include the motor, reducer, shafting and couplings for your complete system requirements.



Ball Screw Actuator Models

Advantages:

- Move loads and apply force more efficiently than other mechanical actuators.
- Permit faster operation and longer life under load.
- Require less power by providing positive mechanical action.
- Permit synchronization of multiple units.
- Capacity from 1/2 to 50 tons.
- Handles full load in tension or compression
- 40 models available.



Lifting Screw -Standard with threaded end,

Shell Cap -Adjustable to take end play out of bearings. Locked into place by set screws.

Ball Nut -Equipped with return tubes for continuous recirculation of steel balls. Threaded and secured to worm gear. Should be ordered as set.

Worm Gear -Aluminum bronze. Accurately hobbed for greater gear contact.

Load Bearings -Top and bottom to take loads in either direction.

Worm -Available with double or single shaft extension. Clockwise rotation of this end raises load on all actuator models except 50-ton ball screw actuator units.

Dust Guard - Protects lifting screw threads.

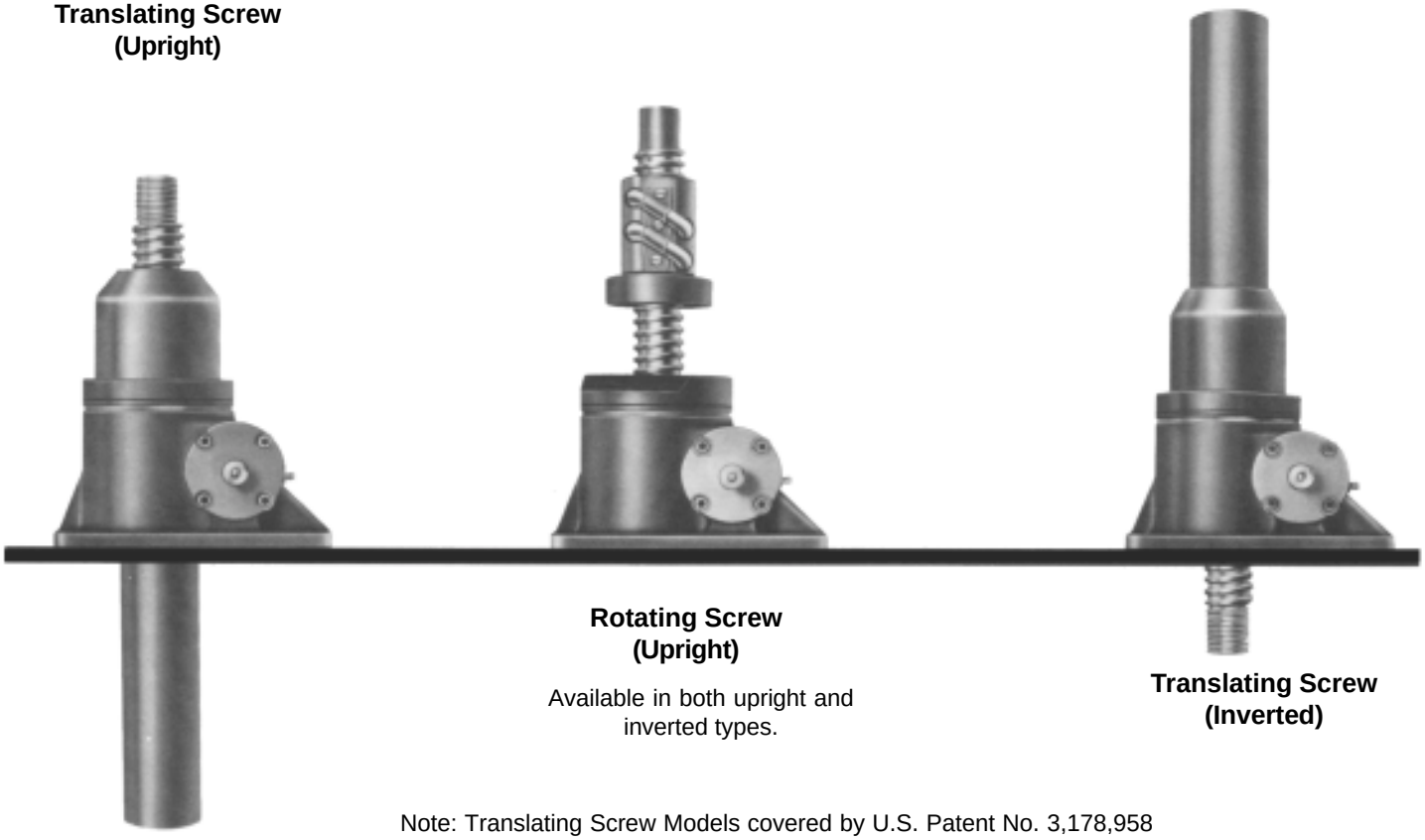
Thrust Bearing and Grease Seals - At each end of worm. 1/2-ton models do not have seals.

Housing -Aluminum on 1/2-ton models, ductile iron on 2-ton through 10-ton models cast steel on 20-ton through 50-ton models.

Stop Disc -This is not a power stop. For positive stop, we suggest external stops be used in structure.

Ball Screw Actuator Models

- **High Speed** -Low friction permits linear motion in some models up to 300 inches per minute at 1800 rpm worm shaft speeds, providing maximum horsepower ratings are not exceeded.
- **Positive Action** -Operates with a high degree of reliability, without the need for costly pumps, hoses or valves.
- **Precise Positioning** -High efficiency means accurate control, even in multiple actuator arrangements.
- **Long Life** -Low friction means longer operating life.
- Low Power Usage -Highly efficient design means less power is needed to achieve a given thrust; power needs are as much as two-thirds that of machine screw actuators, with savings in motors, couplings, reducers, shafting and controls.



Note: Translating Screw Models covered by U.S. Patent No. 3,178,958

Move loads and apply force more efficiently

The Duff-Norton ball screw gives you a single- package, positive-action linear actuator which can be driven by an electric, air or hydraulic motor. A ball-bearing type heat-treated screw and mating nut with rolling contact reduces friction to a bare minimum in converting torque to thrust. Overall operating efficiency is as high as 70% in some models, depending on the ratio of the worm gear set.

Because our ball screw actuator unit has been carefully engineered and pretested, you no longer have to purchase components from different suppliers and design your own system to achieve high levels of efficiency. So you save design, set- up and testing time.

Capacities from 1/2 to 50 tons

Duff-Norton ball screw actuators are available in two types: translating screw and rotating screw, each available with either upright or inverted

screw. In the translating screw type, the ball nut is fixed to a rotating gear within the housing, and the lifting screw moves up and down through the nut. In the rotating screw type, the screw is fixed to the rotating gear, and the ball nut travels up and down the screw.

Both types of ball screw actuators, and their variations, are available in capacities of 1/2, 2, 3, 5, 10, 20, 25 and 50 tons, with some models that raise up to 10 feet. Raises up to 20 feet are available on request. Ball screw actuators may be used individually, in tandem or in multiple arrangements, connected by shafting, couplings and Duff-Norton gear boxes. Special models are also available.

Single end worm shafts with left or right hand extensions are furnished at no extra charge.

2800, 7800 and 9800 Series Specifications

Ball Screw Actuator Units

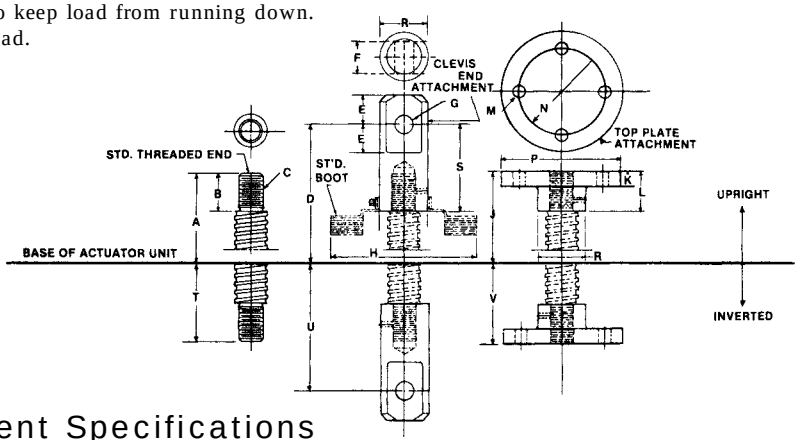
Model No.		28631	2802, 7802 & 9802	28021, 78021 & 98021	28003 & 98003	9805	98051	9810	98101	9820	9825	2860
	Inverted	28630	2801, 7801 & 9801	28011, 78011 & 98011	28002 & 98002	9804	98041	9809	98091	9819	9824	2859
Capacity, Tons		1/2	2	2	3	5	5	10	10	20	25	50
Lifting Screw Diameter (Inches)		5/8	1	1	1 11/64	1 1/2	1 1/2	1 1/2	1 1/2	2 1/4	3	4
		.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
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
	Option #1	20:1	24:1	24:1	24:1	24:1	24:1	24:1	24:1	24:1	32:1	32:1
	Option #2	---	12:1	---	12:1	---	---	---	---	---	---	---
Turns of Worm for 1" Raise	Std. Ratio	25	24	6	14.526	12.667	6	16.888	8	16	16.16	10.66
	Option #1	100	96	24	58.104	50.667	24	50.667	24	48	48.48	32
	Option#2	---	48	---	29.052	---	---	---	---	---	---	---
Maximum H.P. Per Actuator	Std. Ratio	1/3	2	2	2	4	4	5	5	5	8	15
	Option #1	1/6	1/2	1/2	1/2	3/4	3/4	1 1/2	1 1/2	1 1/2	2 1/2	6
	Option#2	---	3/4	---	3/4	---	---	---	---	---	---	---
No Load Torque (In. - Lbs.)	Std. Ratio	0.5	3	10	5	10	20	15	20	40	40	90
	Option#2	---	3	10	5	---	---	---	---	---	---	---
	Option #1	0.5	3	10	5	10	20	15	20	40	40	90
Starting Torque at Full Load (In. - Lbs.)	Std. Ratio	10.5	50	180	110	220	500	350	800	700	925	2,700
	Option #1	5	25	80	50	90	206	175	400	325	475	1,500
	Option#2	---	30	---	68	---	---	---	---	---	---	---
Running Torque at Full Load (In.-Lbs.)	Std. Ratio	9.5	45	160	100	180	410	300	700	650	825	2,200
	Option #1	4.5	20	70	45	80	183	150	290	300	425	1,200
	Option#2	---	25	---	60	---	---	---	---	---	---	---
Efficiency Rating (%)	Std. Ratio	65	59	59	59	70	70	65	65	61	60	55
	Option #1	38	33	33	33	39	39	42	42	44	39	33
	Option #2	---	44	---	44	---	---	---	---	---	---	---
Weight with Base Raise of 6' (Lbs.)		2.75	20	20	21	40	40	50	50	115	235	520
Weight for Each Additional 1" Raise (Lbs.)		0.1	0.3	0.3	0.4	0.9	0.9	0.9	0.9	1.5	2.9	5.0
Hold Back Torque at Rated Load (Lb.-Ft.)	Std. Ratio	1	2	2	7	8	8	11	11	24	24	92
	Option #1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	2	33
	Option#2	---	1	1	2	---	---	---	---	---	---	---

Note: Hold Back Torque is restraining torque at the worm shaft to keep load from running down. Lifting torques are proportional to load, down to 25% of rated load.

Attachments

Standard Duff-Norton ball screw actuators, both upright and inverted screw types, are furnished with threaded ends on screws. However, they are also available with top plates or clevis end attachments.

Bellows boots are recommended to protect screw and nut from dirt and corrosion.



Attachment Specifications

Model no.	A*	B	C	D*	E	F	G	H	J*	K	L	M	N	P	R	S	T*	U*	V*	Top Plate	Clevis End
28631	5"	3/4"	3/8"-24-UNF-2A	6"	1/2"	1/2"	5/16 +.007/-.000	4 1/2"	5"	5/16"	13/16"	9/32"	1 1/2"	2 1/4"	3/4"	1 3/4"	1"	2"	1 1/16"	SK-2800-1-29A	SK-2800-4-29A
2802, 7802 & 9802	7 1/2"	1 1/8"	3/4"-16-UNF-2A	8 5/8"	3/4"	1"	1/2" +.008/-.000	6 5/8"	7 1/2"	7/16"	1 3/16"	13/32"	3"	4 1/4"	1 1/2"	2 1/4"	1 3/8"	2 1/2"	1 7/16"	SK-2800-1-2A	SK-2800-4-2A
28021, 78021 & 98021	7 1/2"	1 1/8"	3/4"-16-UNF-2A	8 5/8"	3/4"	1"	1/2" +.008/-.000	6 5/8"	7 1/2"	7/16"	1 3/16"	13/32"	3"	4 1/4"	1 1/2"	2 1/4"	1 3/8"	2 1/2"	1 7/16"	SK-2800-1-2A	SK-2800-4-2A
28003 & 98003	9 1/4"	1 1/8"	3/4"-16-UNF-2A	10 3/8"	3/4"	1"	1/2" +.008/-.000	6 5/8"	9 5/16"	7/16"	1 3/16"	13/32"	3"	4 1/4"	1 1/2"	2 1/4"	1 3/8"	2 1/2"	1 7/16"	SK-2800-1-2A	SK-2800-4-2A
9805 & 98051	10 3/4"	1 1/8"	1"-14-UNS-2A	12 1/2"	1 1/4"	1 1/4"	3/4" +.010/-.000	7 1/2"	10 3/4"	5/8"	1 1/4"	11/16"	3 1/2"	5"	1 3/4"	2 7/8"	1 3/8"	3 1/8"	1 7/16"	SK-2800-1-5A	SK-2800-4-5A
9810 & 98101	10 3/8"	1 1/8"	1"-14-UNS-2A	12 1/8"	1 1/4"	1 1/2"	1" +.010/-.000	7"	10 3/8"	3/4"	1 3/8"	13/16"	4 1/8"	5 3/4"	**	2 7/8"	1 1/2"	3 1/4"	1 9/16"	SK-2800-1-10A	SK-2800-4-10A
9820	16 1/2"	2 1/4"	1 3/4"-12-UN-2A	19"	1 1/2"	1 3/4"	1 1/4" +.010/-.000	9"	16 1/2"	1"	2 5/16"	13/16"	5"	7"	2 5/8"	4 3/4"	2 3/4"	5 1/4"	2 13/16"	SK-2800-1-20A	SK-2800-4-20A
9825	19 3/4"	2 1/4"	2 1/4"-12-UN-2A	23 1/4	2 1/2"	2 3/4"	1 1/2" +.010/-.000	11"	19 3/4"	1"	2 5/16"	1 1/16"	6"	8 1/2"	3 1/2"	5 3/4"	3 1/8"	6 5/8"	3 3/16"	SK-2800-1-25A	SK-2800-4-25A
2860	25 3/8"	2 3/4"	3 1/4"-12-UN-2A	29 1/8"	2 5/8"	3 3/4"	2" +.012/-.000	12"	25 7/16"	1 3/8"	2 13/16"	1 1/2"	10"	13"	***	6 1/2"	3 5/8"	7 3/8"	3 11/16"	SK-2800-1-60A	SK-2800-4-60A

*Closed dimensions may increase for actuator units supplied with bellows boots.
**For model 9810, R dimension of clevis end attachment is 2"; top plate attachment is 1 3/4".
***For model 2860, R dimension of clevis end attachment is 5"; top plate attachment is 4 1/2".

Note: Lifting screws listed above are not keyed. Must be held to prevent rotation. Top plate and clevis are shipped loose. Must be spot drilled before seating set screws in field installations.

Predict the Life of the Ball Screw and Nut

Predicting screw and nut life lets you forecast necessary replacement, saving time and money. It also permits selection of the most economical screw size.

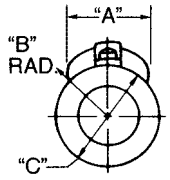
Use caution when installing the ball screw. The life expectancy listed above may be greatly reduced if ball screws are subjected to misalignment, shock loads, side thrust, environmental contamination or lack of lubrication and maintenance.

It is possible to estimate the minimum life of the Duff-Norton ball screw and nut only. Because of the many variable operating conditions, we can not predict the life of the worm and gear set in the 2800 and 9800 Series actuators.

Life Expectancy of Ball Screw and Ball Nut In Total Inches of Travel

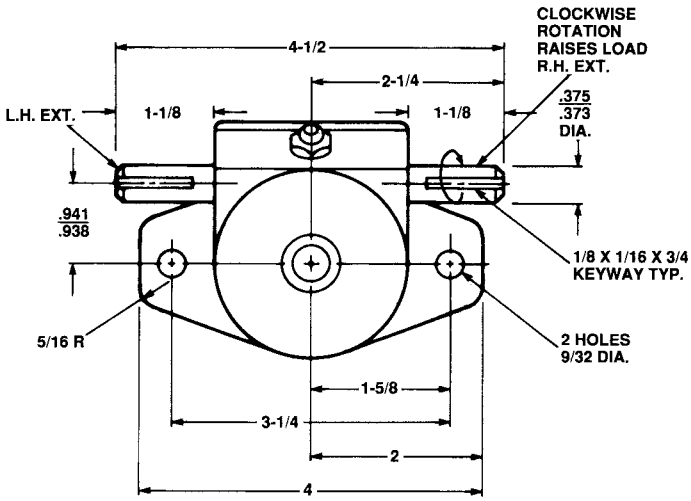
Model No. & Capacity	100% of Full Load	75% of Full Load	50% of Full Load or Less
28631 (1/2 ton)	470,000	1,100,000	3,700,000
2802, 7802 & 9802 (2 ton)	65,000	150,000	520,000
28021, 78021 & 98021 (2 ton)	150,000	360,000	1,200,000
28003 & 98003 (3 ton)	210,000	650,000	2,200,000
*9805 (5 ton)	1,000,000	2,400,000	8,100,000
*98051 (5 ton)	440,000	1,000,000	3,500,000
9810 (10 ton)	130,000	300,000	1,000,000
98101 (10 ton)	50,000	130,000	430,000
9820 (20 ton)	150,000	360,000	1,200,000
9825 (25 ton)	700,000	1,600,000	5,600,000
2860 (50 ton)	630,000	1,500,000	5,000,000

* 5 ton and 10 ton models use the same screw and nut.

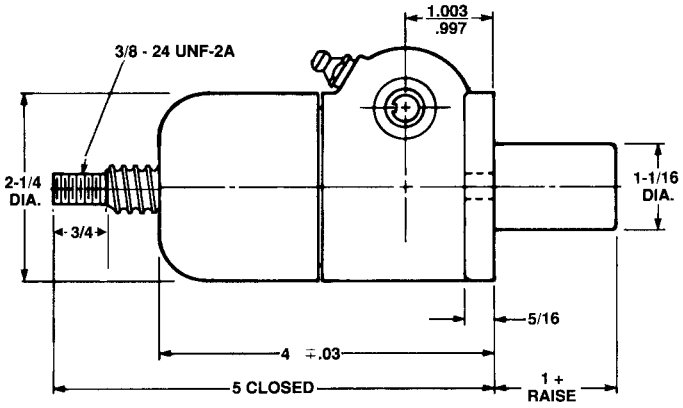


Actuator Capacity	"A"	"B" Radius	"C"
1/2 Ton	.822	.797	1 Sq.
2 Ton .250 Lead	1.104	1.194	1.5 Sq.
2 Ton 1.000 Lead	1.104	1.194	1.5 Sq.
3 Ton	1.587	1.386	2.125 Dia.
5 & 10 Ton .474 Lead	1.981	1.69	2.625 Dia.
5 & 10 Ton 1.000 Lead	1.718	1.72	2.625 Dia.
20 Ton	2.561	2.272	3.375 Dia.
25 Ton	3.349	3.076	4.751 Dia.
50 Ton	4.029	3.756	5.88 Dia.

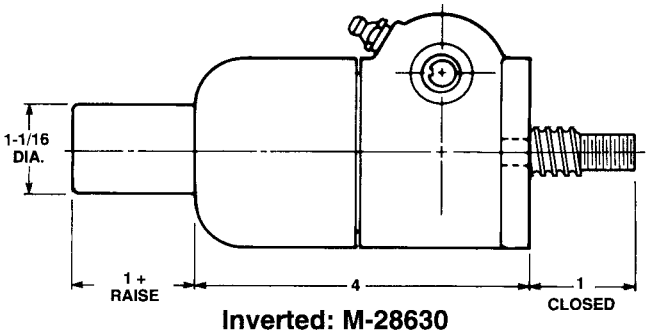
Ball Screw Actuator, 1/2 Ton



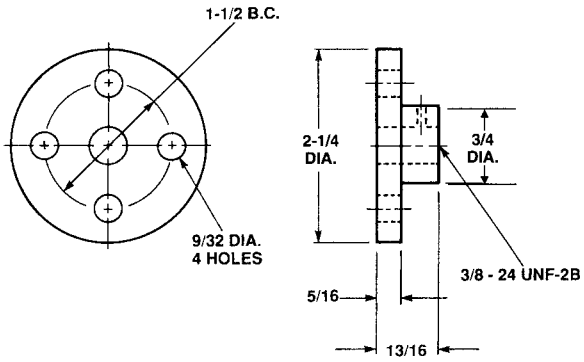
.631" Diameter x .200 Lead Lifting Screws



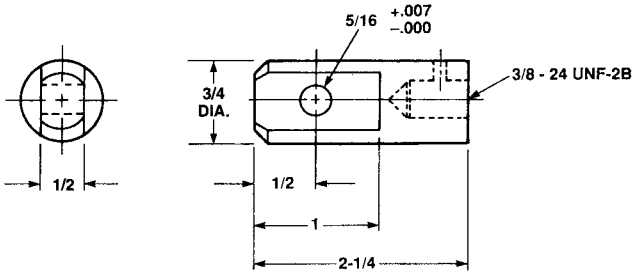
Upright: M-28631



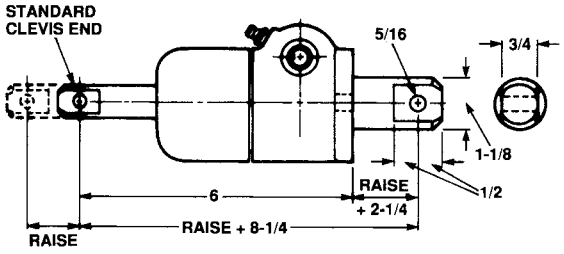
Inverted: M-28630



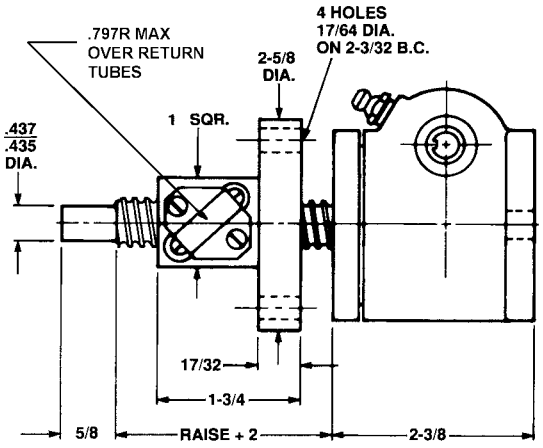
Top Plate (Optional)
SK2800-1-29A



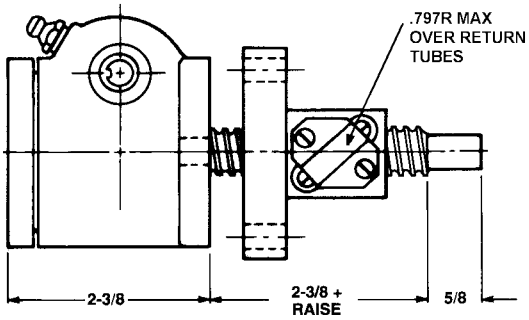
Clevis End (Optional)
SK2800-4-29A



Double Clevis
Maximum Allowable Raise in Compression 8" —Rating 1000 Lbs.



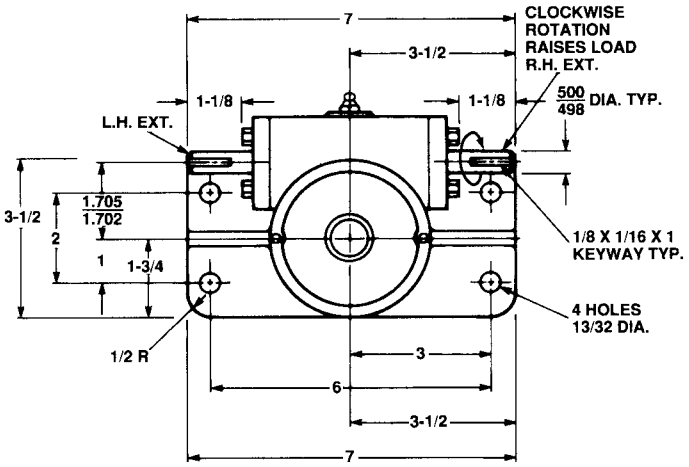
Upright Rotating: UM-28632



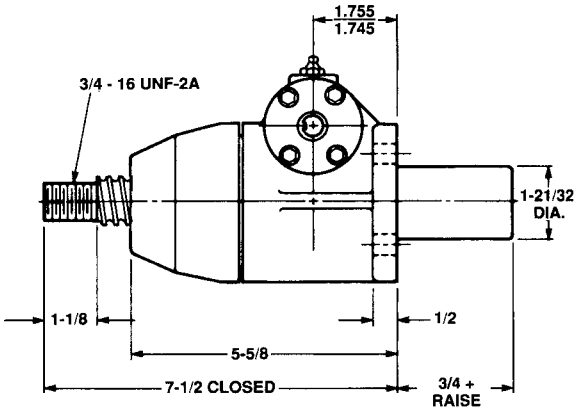
Inverted Rotating: DM-28632

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice.

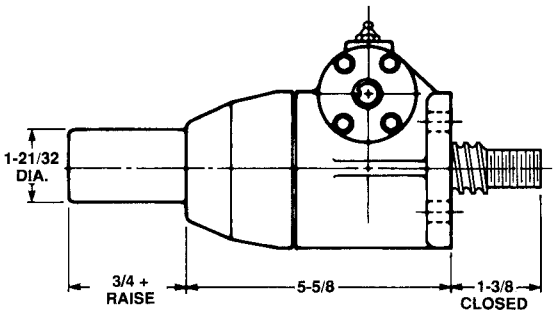
Ball Screw Actuator, 2 Ton, 2800 Series



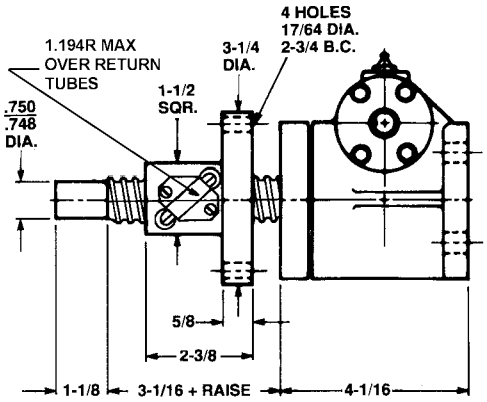
1" Diameter x .250 Lead Lifting Screws



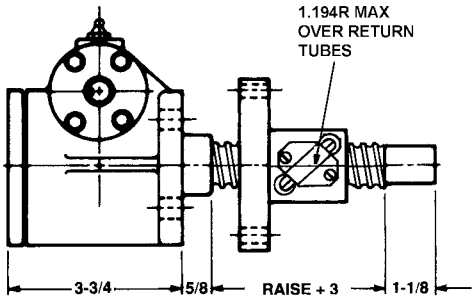
Upright: M-2802



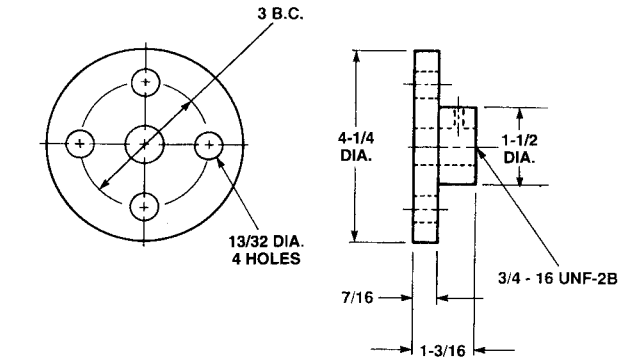
Inverted: M-2801



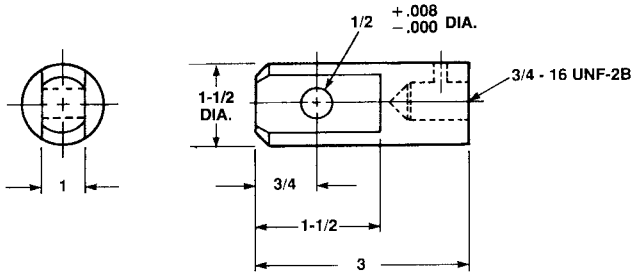
Upright Rotating: KUM-2803



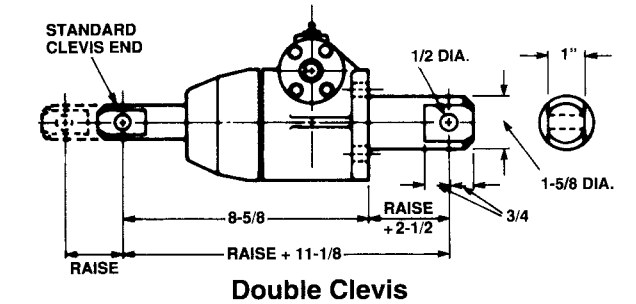
Inverted Rotating: KDM-2803



Top Plate (Optional)
SK2800-1-2A



Clevis End (Optional)
SK2800-4-2A

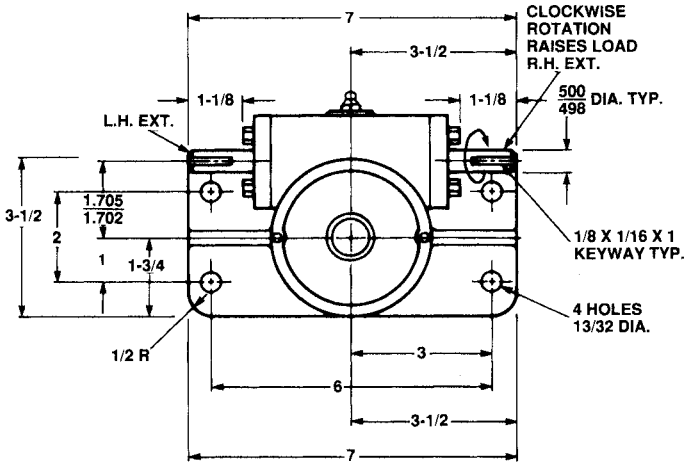


Double Clevis

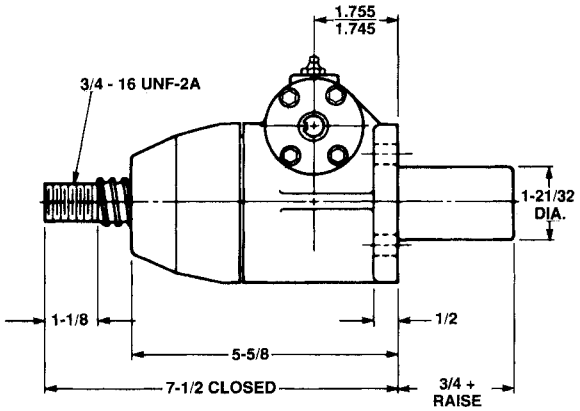
Maximum Allowable Raise in Compression 15"—Rating 3800 Lbs.
Maximum Raise at Rated Load in Compression 14"

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice.

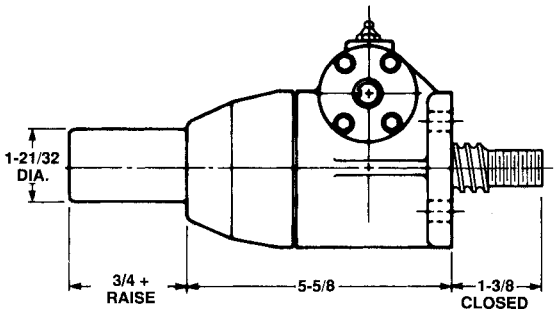
Ball Screw Actuator, 2 Ton - 1” Lead, 2800 Series



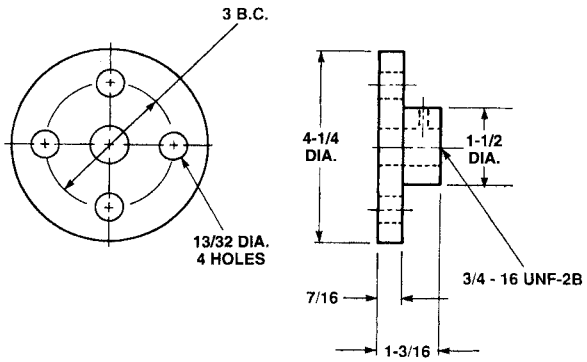
1” Diameter x 1.000 Lead Lifting Screws



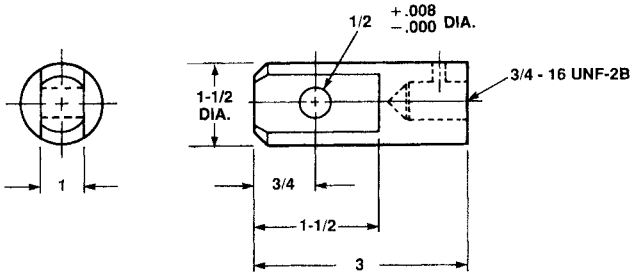
Upright: M-28021



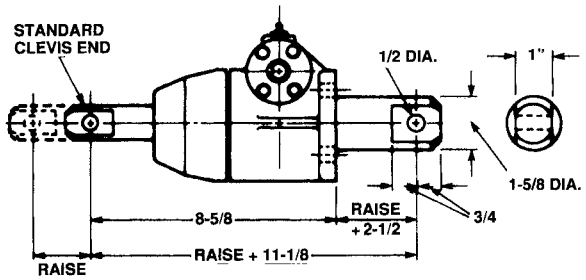
Inverted: M-28011



Top Plate (Optional)
SK2800-1-2A

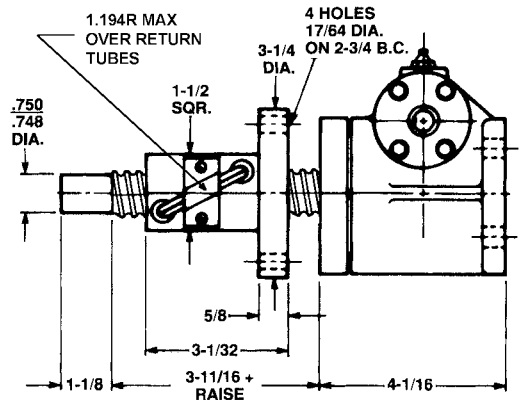


Clevis End (Optional)
SK2800-4-2A

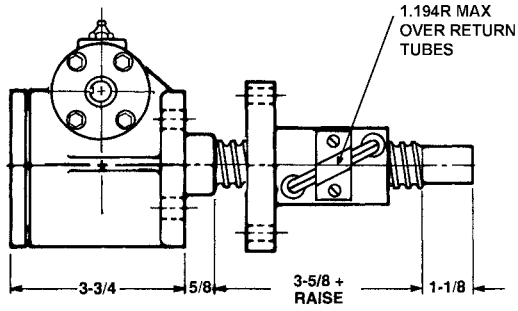


Double Clevis

Maximum Allowable Raise in Compression 15”—Rating 3800 Lbs.
Maximum Raise at Rated Load in Compression 14”



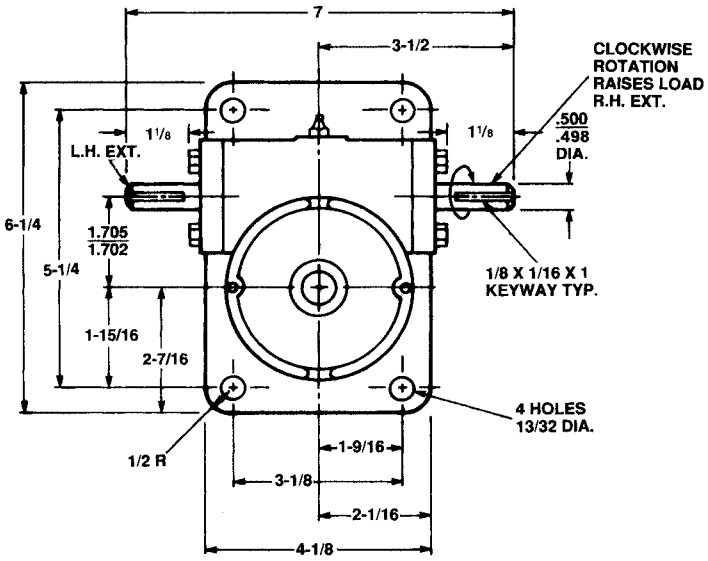
Upright Rotating: KUM-28031



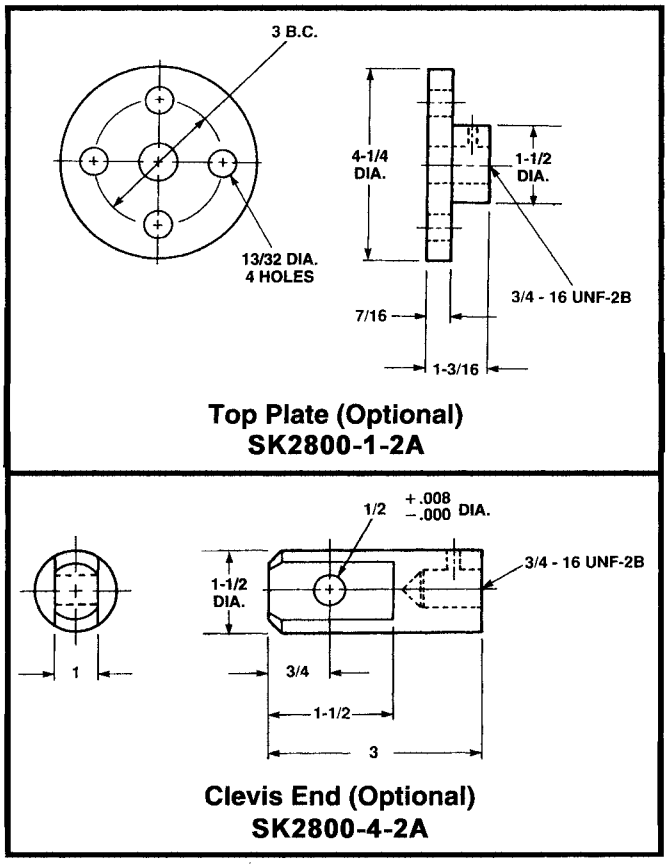
Inverted Rotating: KDM-28031

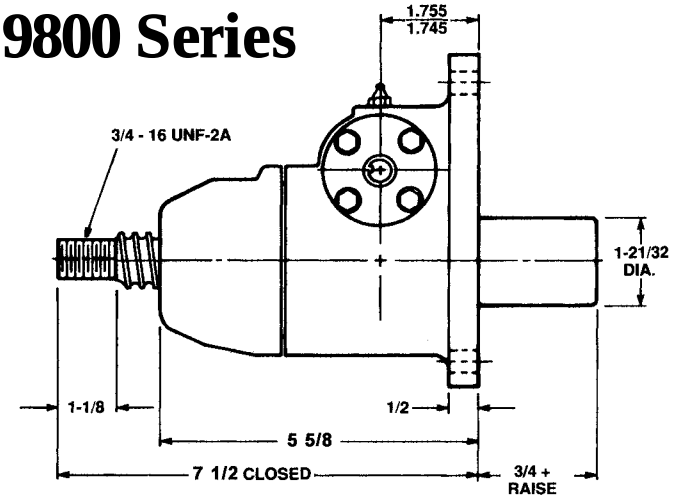
Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice.

Ball Screw Actuator, 2 Ton, 9800 Series

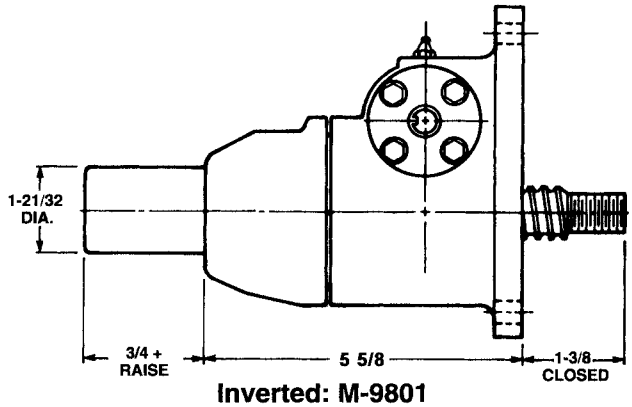


1" Diameter x .250 Lead Lifting Screws

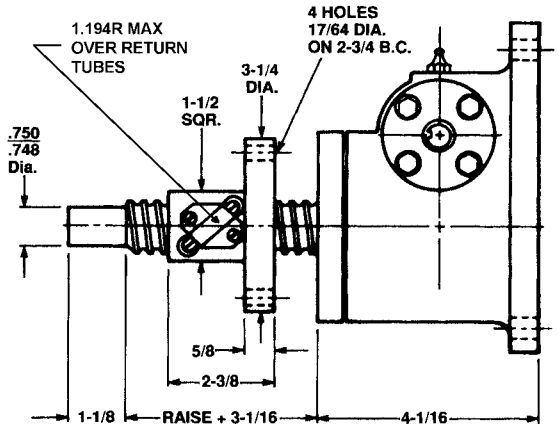




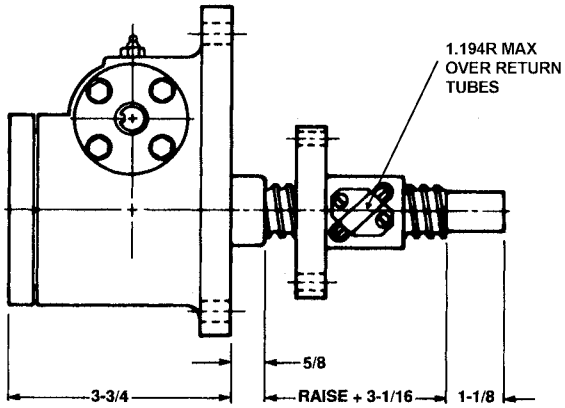
Upright: M-9802



Inverted: M-9801



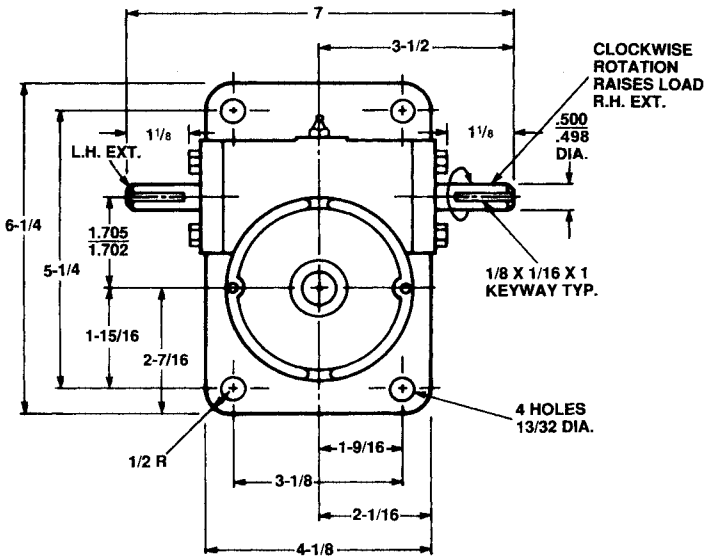
Upright Rotating: UM-9803



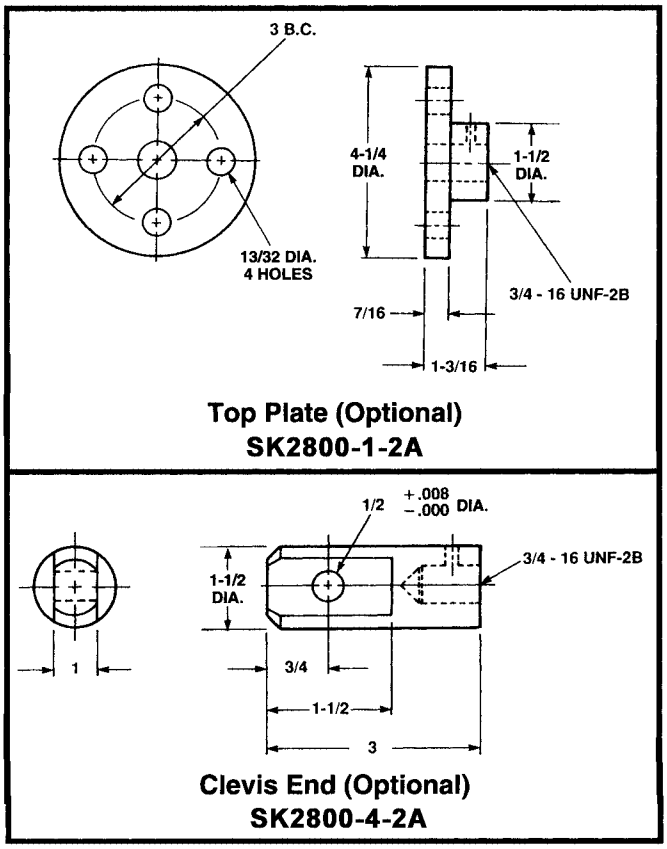
Inverted Rotating: DM-9803

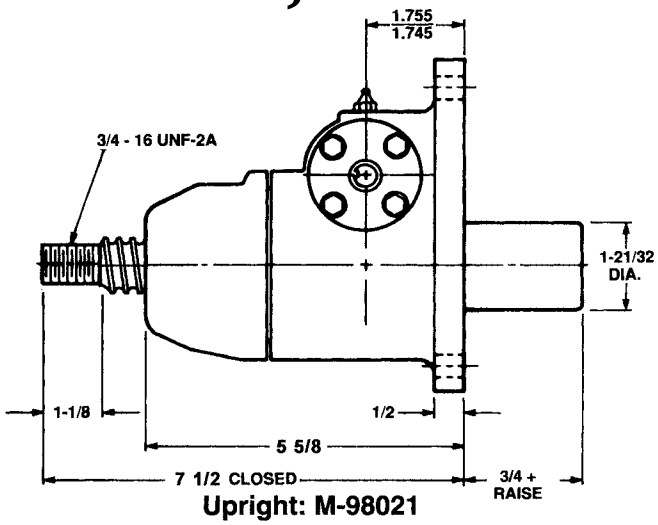
Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice.

Ball Screw Actuator, 2 Ton - 1” Lead, 9800 Series

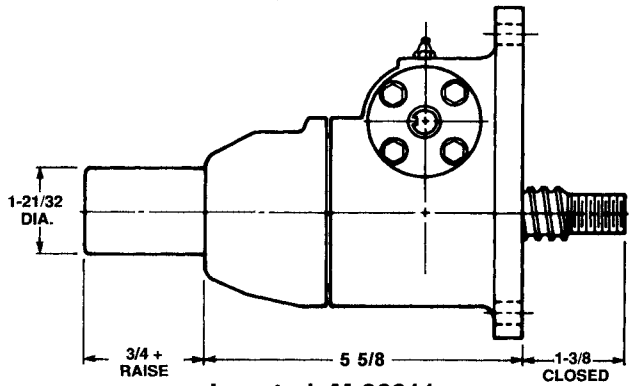


1” Diameter x 1.000 Lead Lifting Screws

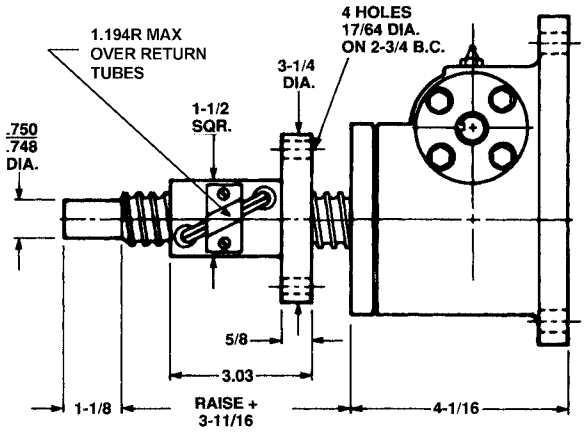




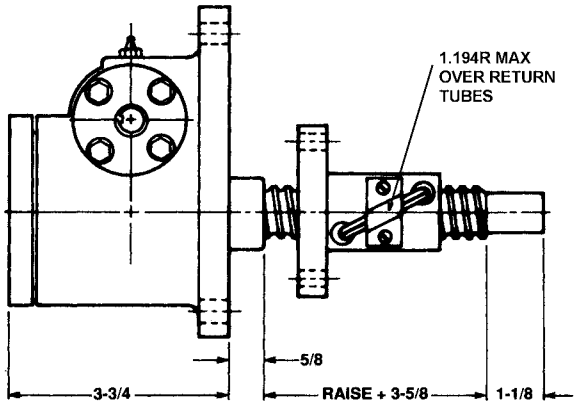
Upright: M-98021



Inverted: M-98011



Upright Rotating: UM-98031

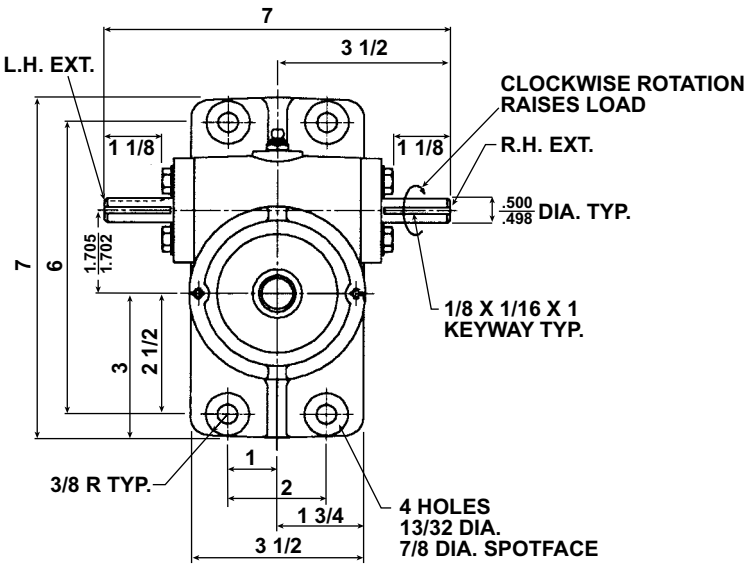


Inverted Rotating: DM-98031

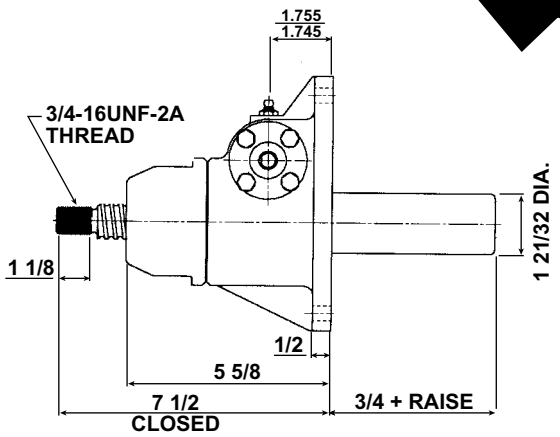
Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice.

Ball Screw Actuator, 2 Ton, 7800 Series

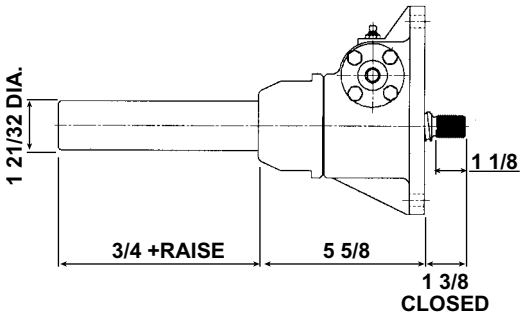
New Design!



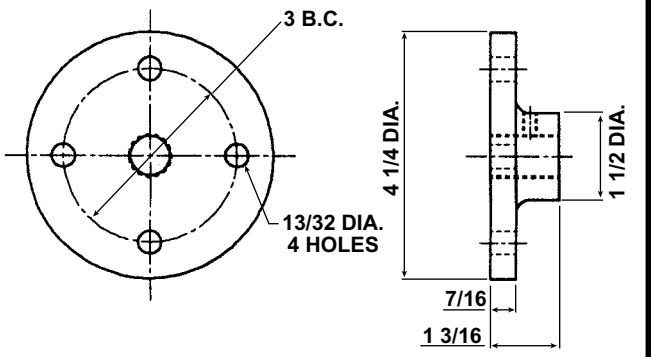
Top View: M-7802



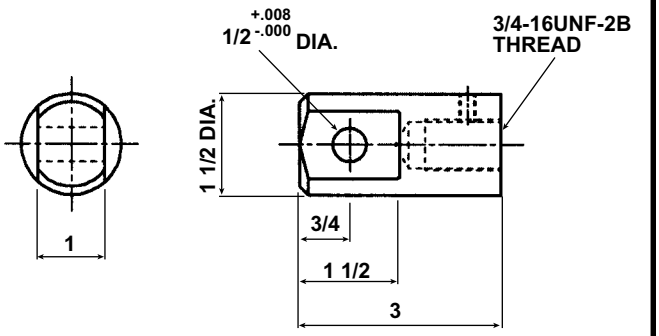
Upright: M-7802



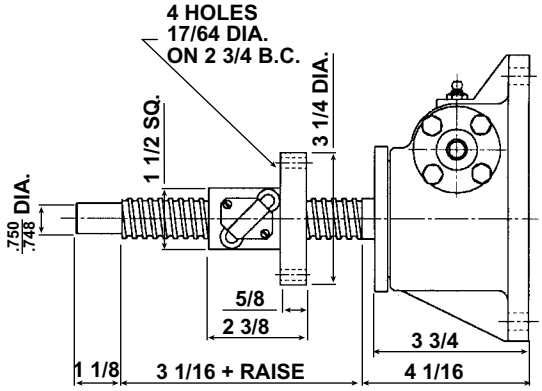
Inverted: M-7801



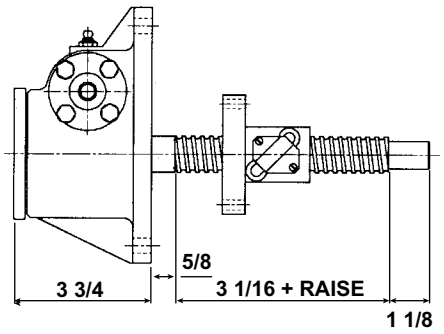
Top Plate (Optional)
SK2800-1-2A



Clevis End (Optional)
SK2800-4-2A



Upright Rotating: UM-7803

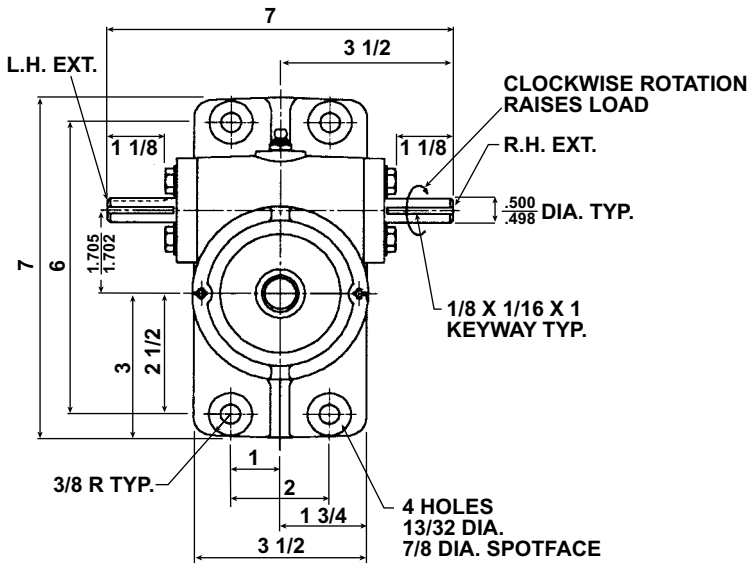


Inverted Rotating: DM-7803

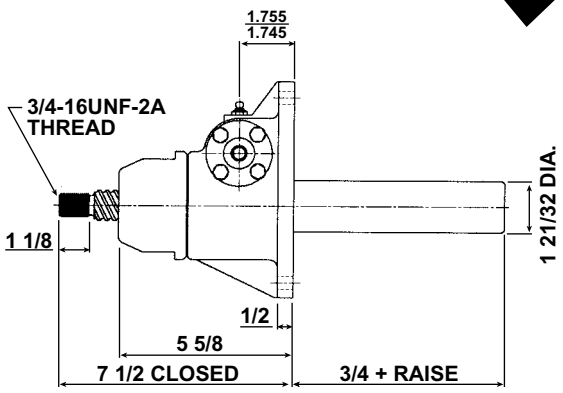
Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice.

Ball Screw Actuator, 2 Ton - 1" Lead, 7800 Series

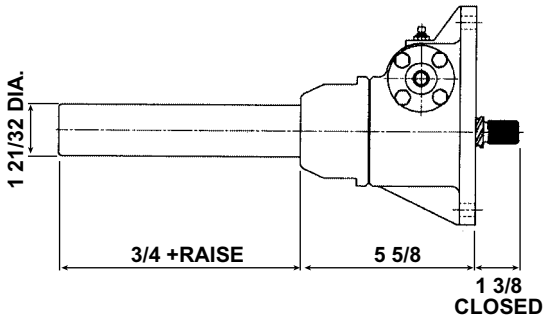
New Design!



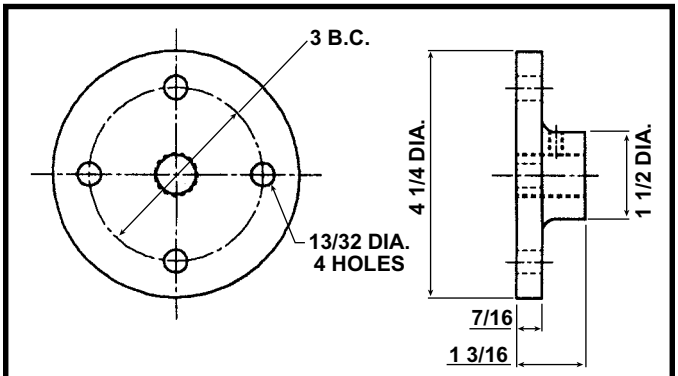
Top View: M-78021



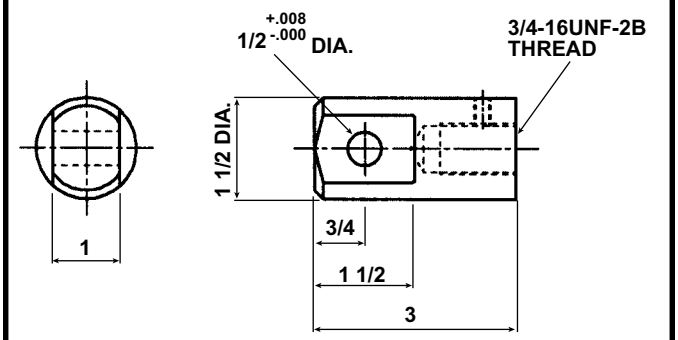
Upright: M-78021



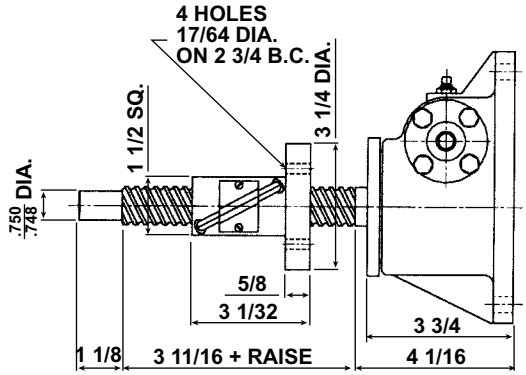
Inverted: M-78011



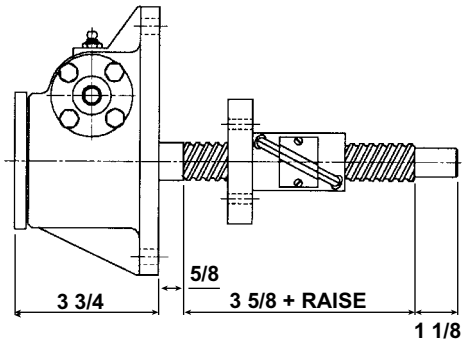
Top Plate (Optional)
SK2800-1-2A



Clevis End (Optional)
SK2800-4-2A



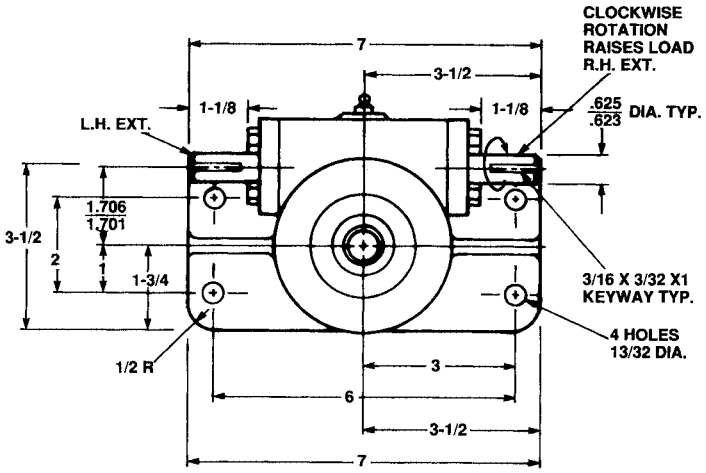
Upright Rotating: UM-78031



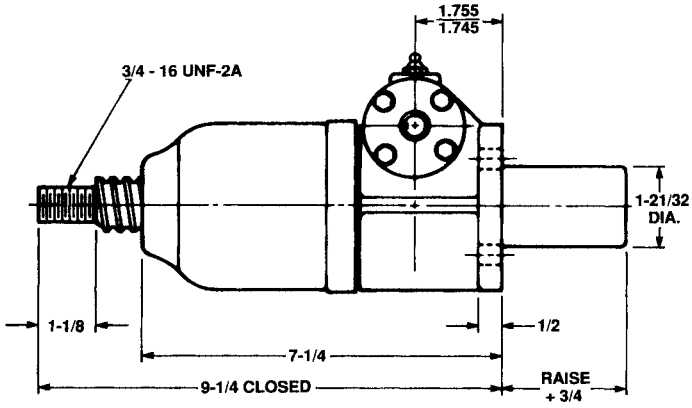
Inverted Rotating: DM-78031

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice.

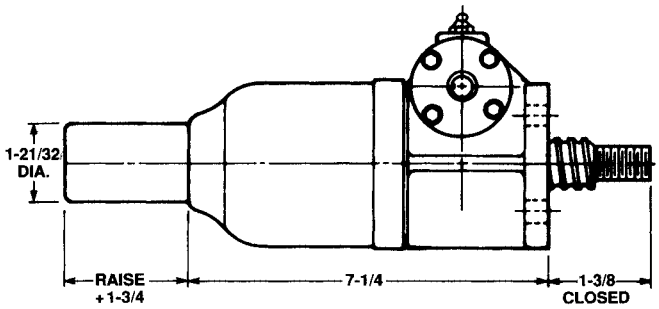
Ball Screw Actuator, 3 Ton



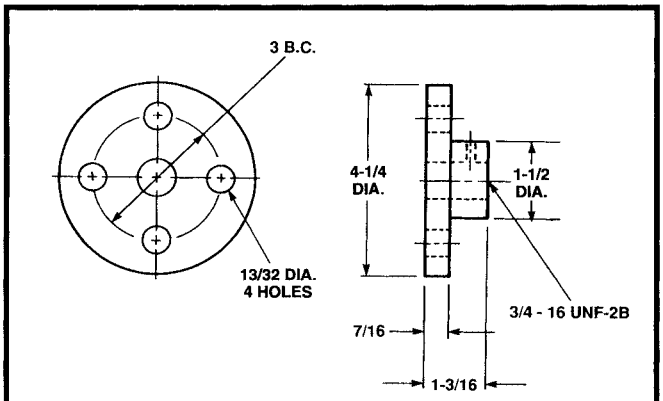
1 11/64" Diameter x .413 Lead Lifting Screws



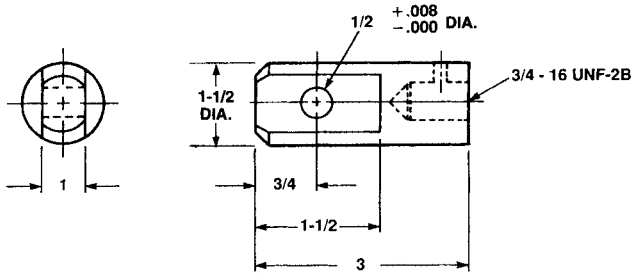
Upright: M-28003



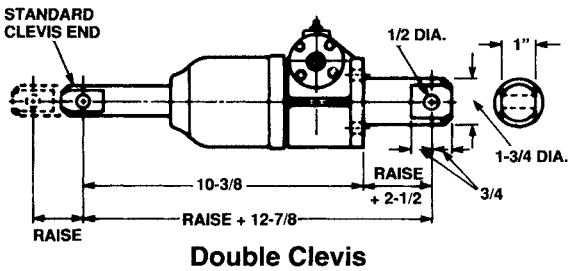
Inverted: M-28002



Top Plate (Optional)
SK2800-1-2A

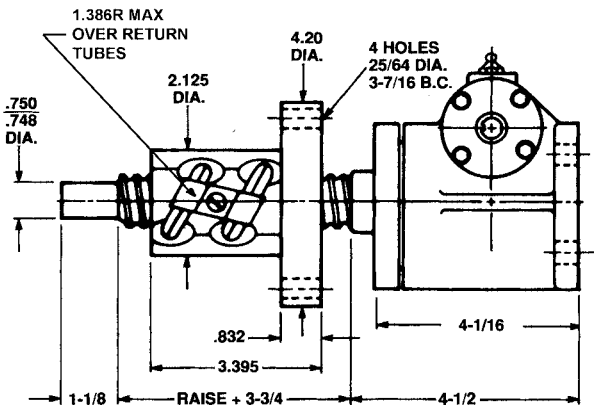


Clevis End (Optional)
SK2800-4-2A

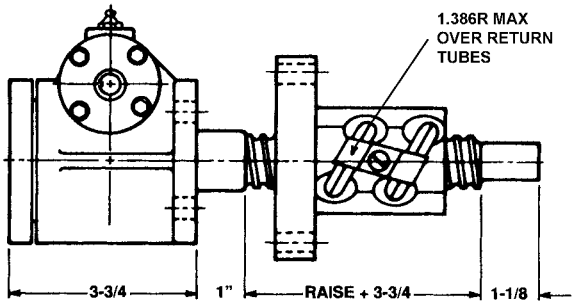


Double Clevis

Maximum Allowable Raise in Compression 15" —Rating 4200 Lbs.
Maximum Raise at Rated Load in Compression 13".



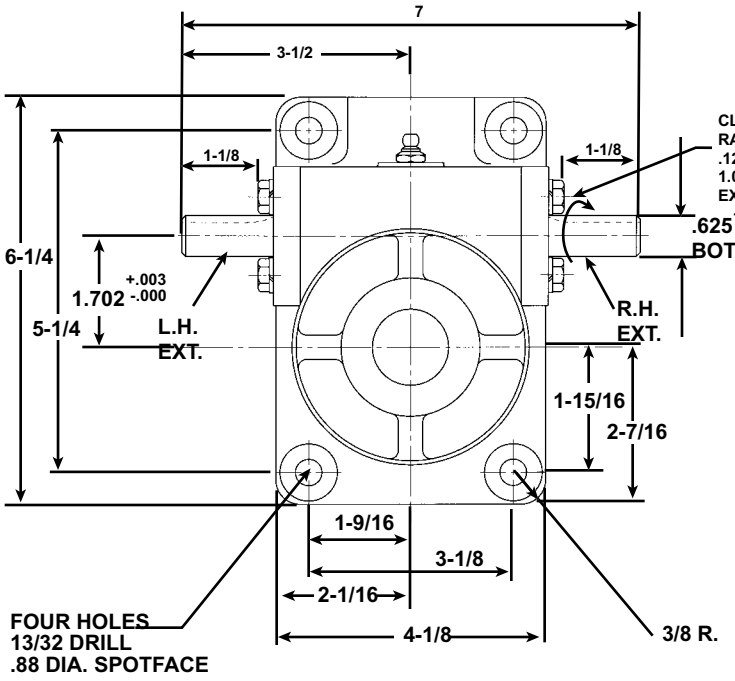
Upright Rotating: KUM-28004



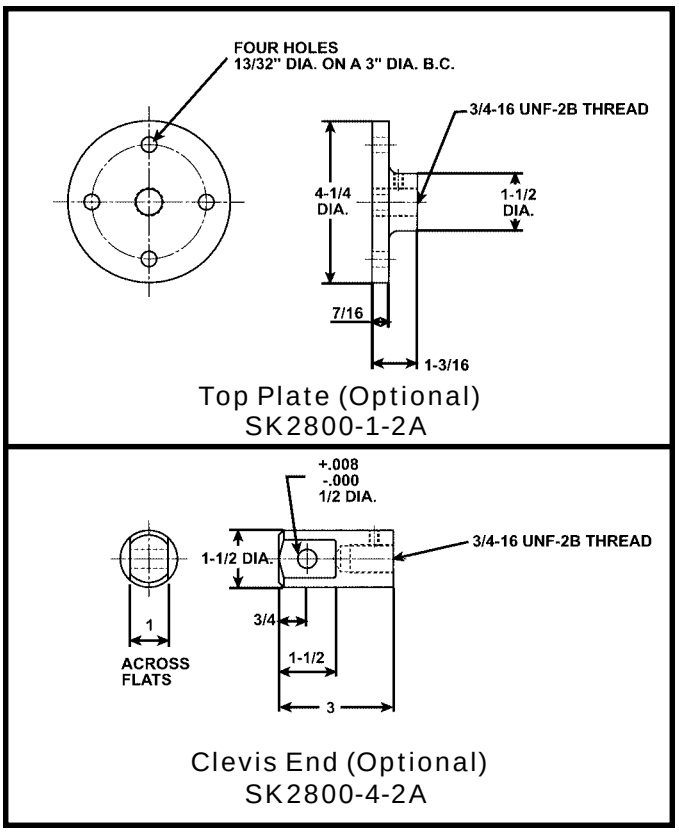
Inverted Rotating: KDM-28004

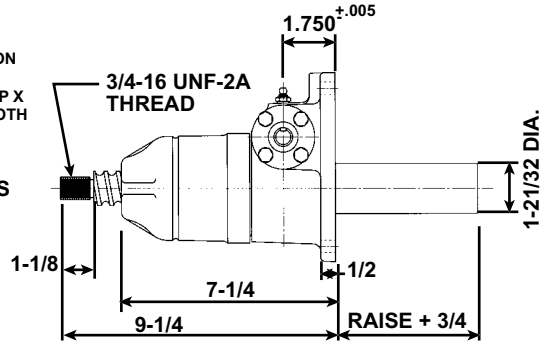
Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice.

Ball Screw Actuator, 3 Ton

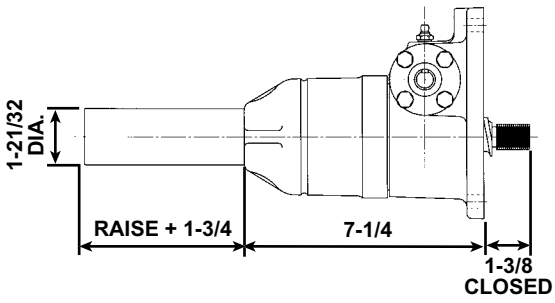


$1^{11}/_{64}$" Diameter x .413 Lead Lifting Screw

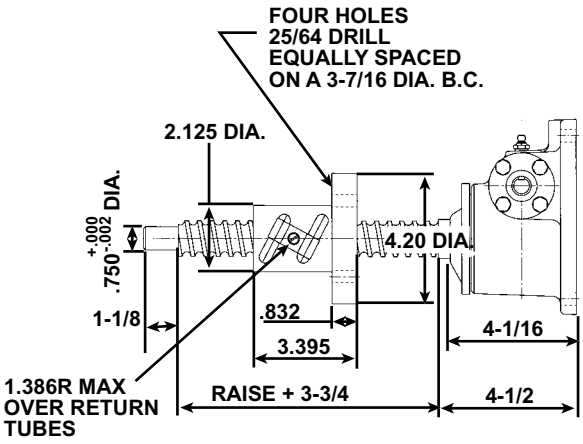




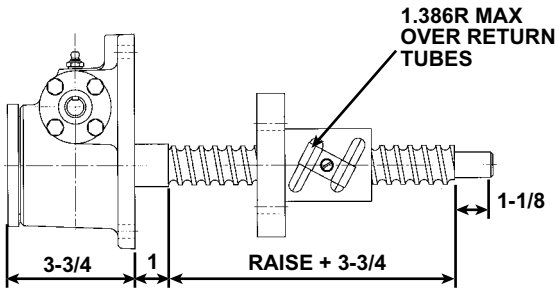
Upright: M-98003



Inverted: M-98002



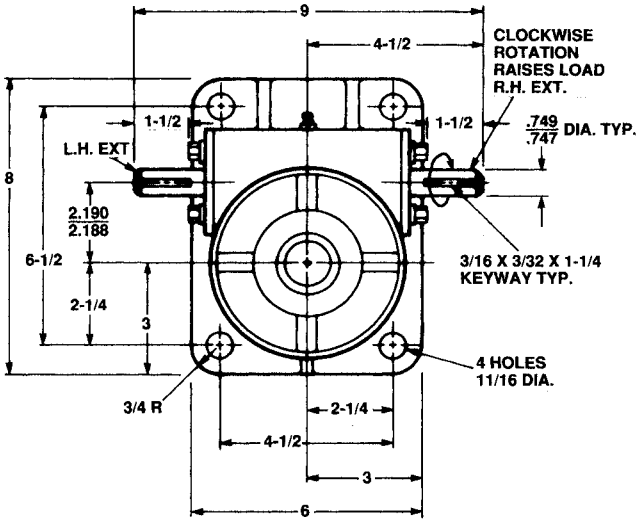
Upright Rotating: UM-98004



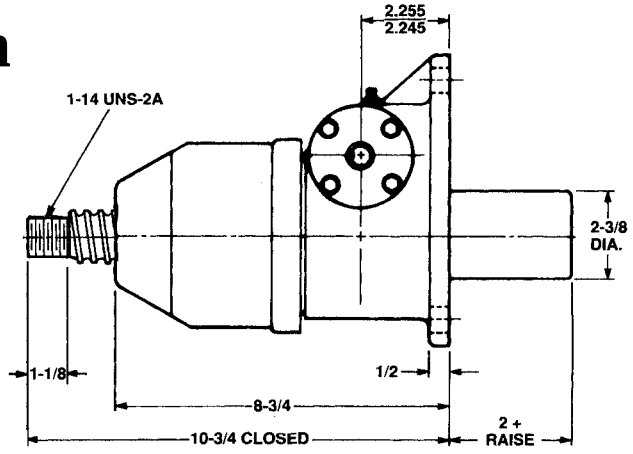
Inverted Rotating: DM-98004

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice.

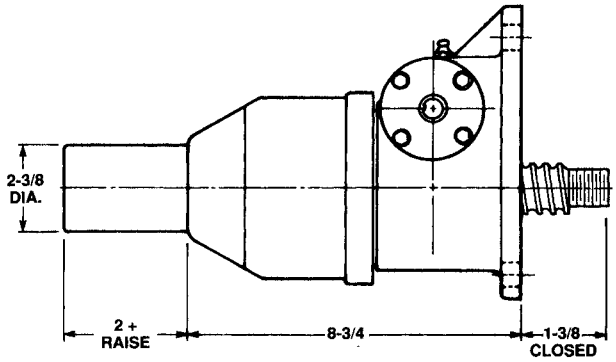
Ball Screw Actuator, 5 Ton



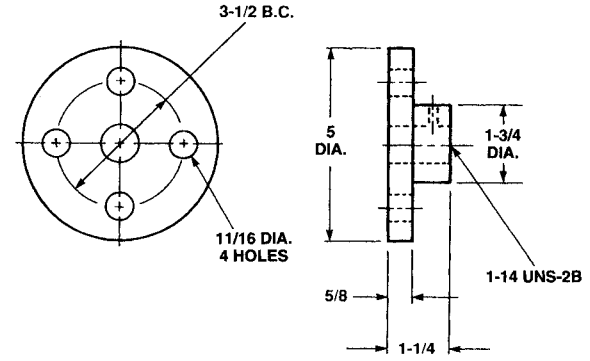
1 1/2" Diameter x .474 Lead Lifting Screws



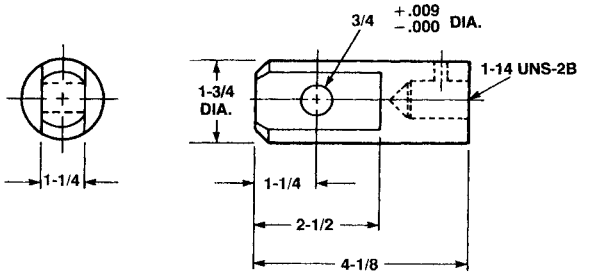
Upright: M-9805



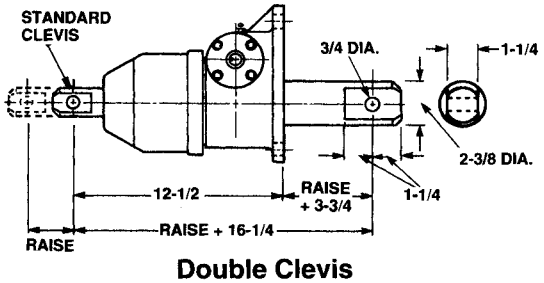
Inverted: M-9804



Top Plate (Optional)
SK2800-1-5A

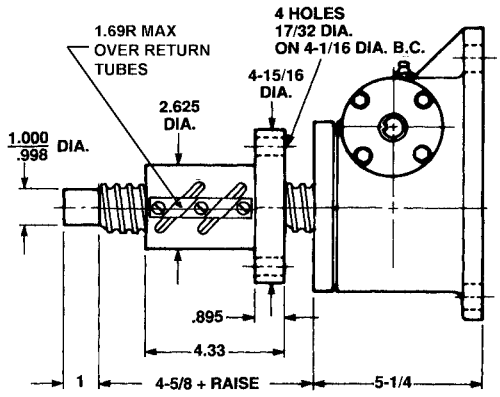


Clevis End (Optional)
SK2800-4-5A

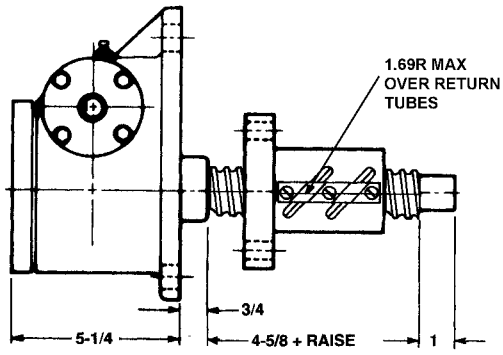


Double Clevis

Maximum Allowable Raise in Compression 20" —Rating 7,300 Lbs.
Maximum Raise at Rated Load in Compression 16".



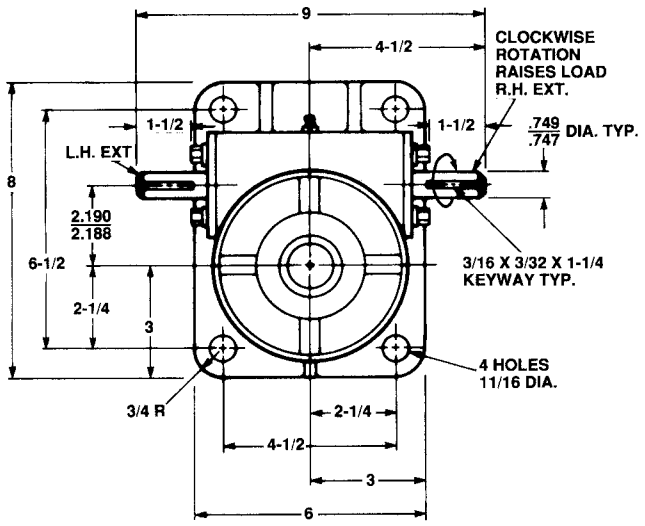
Upright Rotating: UM-9806



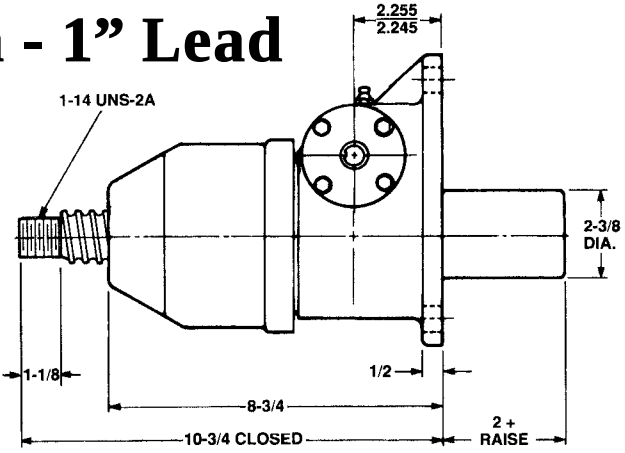
Inverted Rotating: DM-9806

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice.

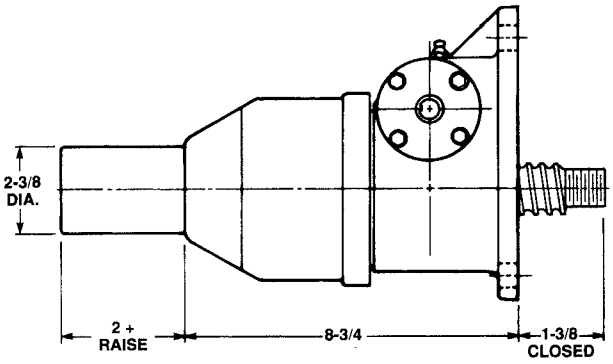
Ball Screw Actuator, 5 Ton - 1” Lead



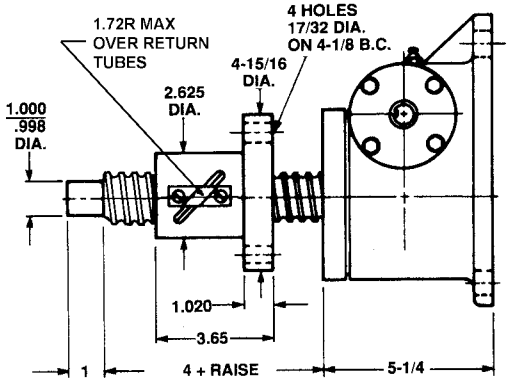
1 1/2” Diameter x 1.000 Lead Lifting Screws



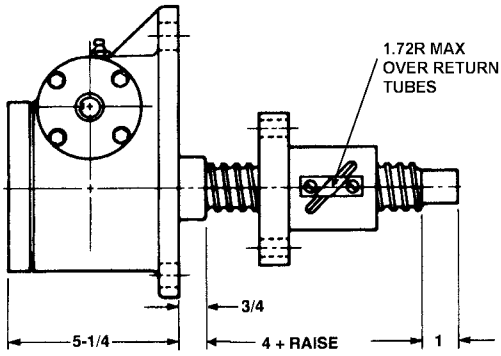
Upright: M-98051



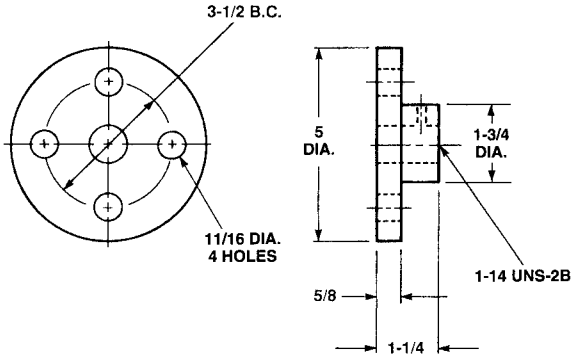
Inverted: M-98041



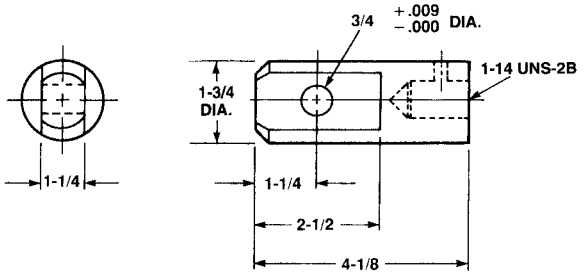
Upright Rotating: UM-98061



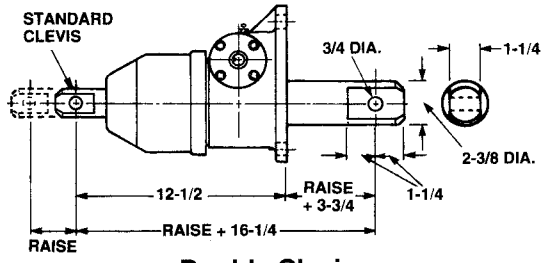
Inverted Rotating: DM-98061



Top Plate (Optional)
SK2800-1-5A



Clevis End (Optional)
SK2800-4-5A

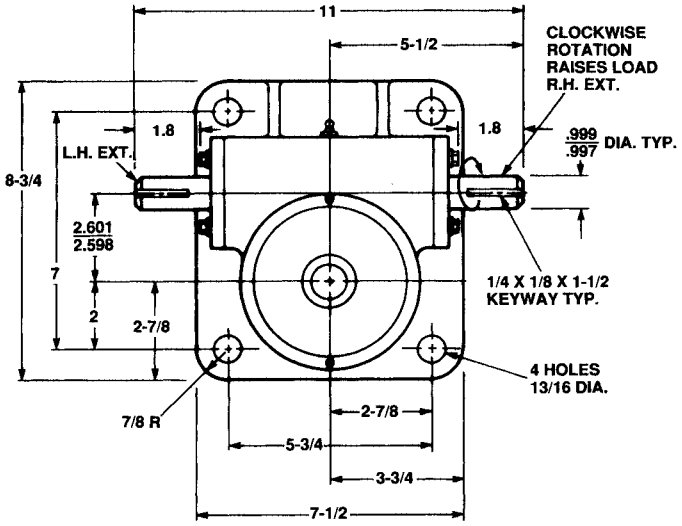


Double Clevis

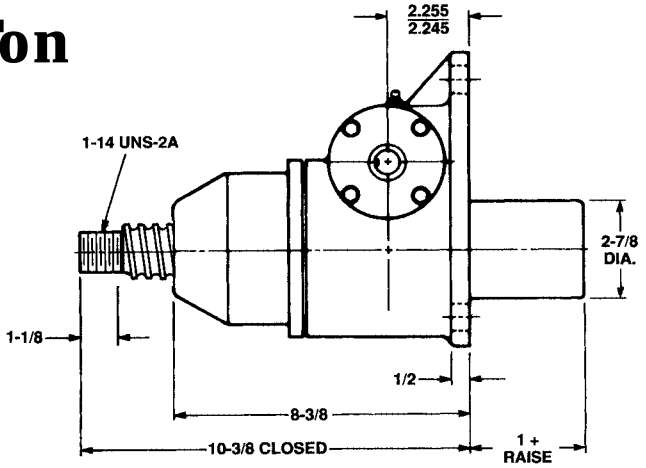
Maximum Allowable Raise in Compression 20”. —Rating 7,300 Lbs.
Maximum Raise at Rated Load in Compression 16”.

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice.

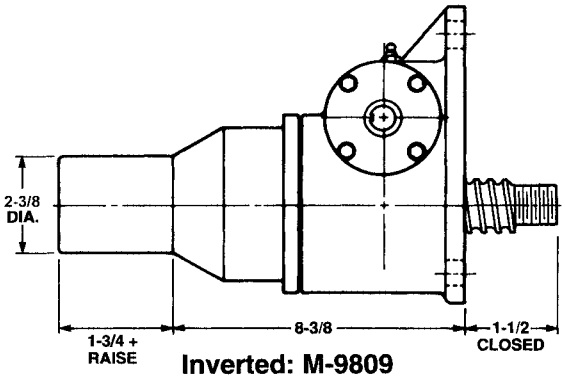
Ball Screw Actuator, 10 Ton



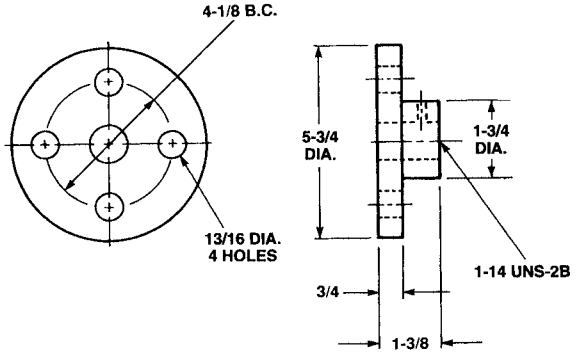
1½" Diameter x .474 Lead Lifting Screws



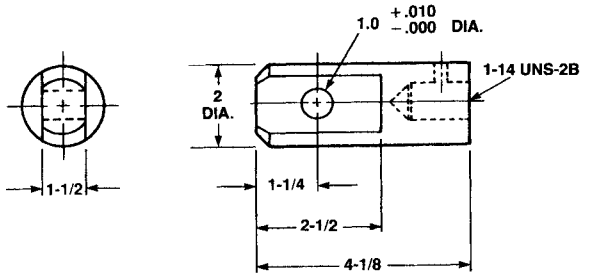
Upright: M-9810



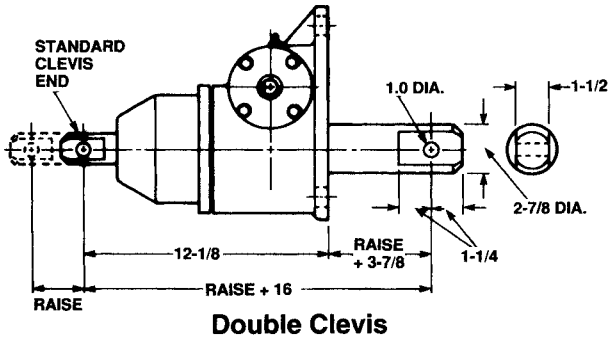
Inverted: M-9809



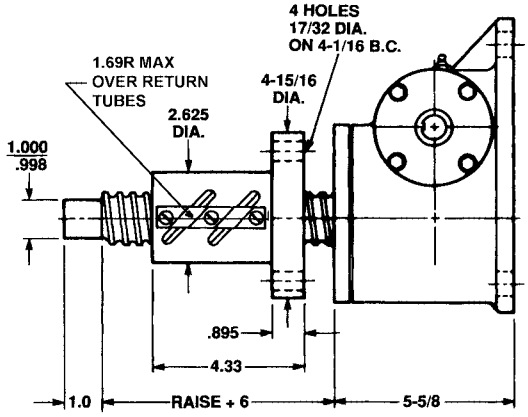
Top Plate (Optional)
SK2800-1-10A



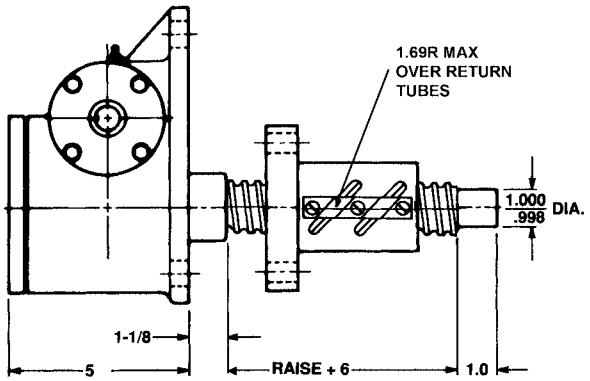
Clevis End (Optional)
SK2800-4-10A



Double Clevis
Maximum Allowable Raise in Compression 20" —Rating 7,300 Lbs.
Maximum Raise at Rated Load in Compression 9".



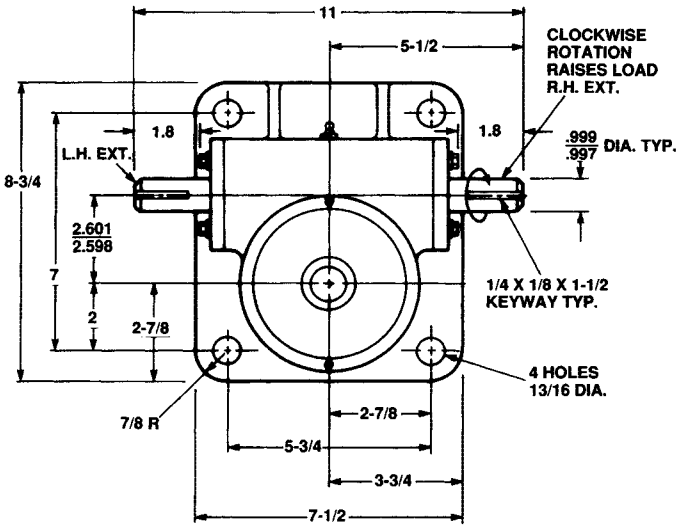
Upright Rotating: UM-9811



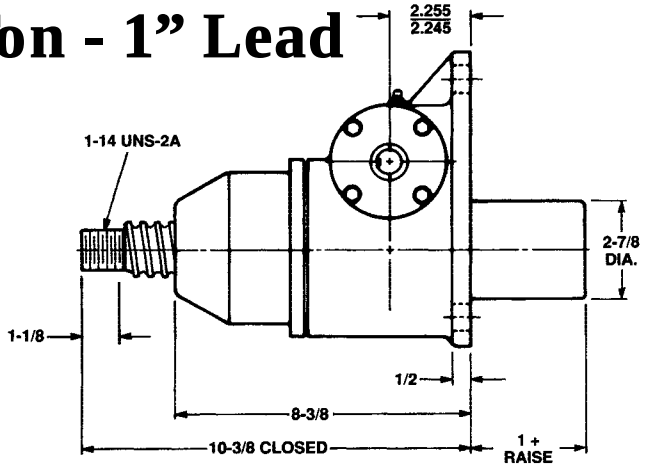
Inverted Rotating: DM-9811

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice.

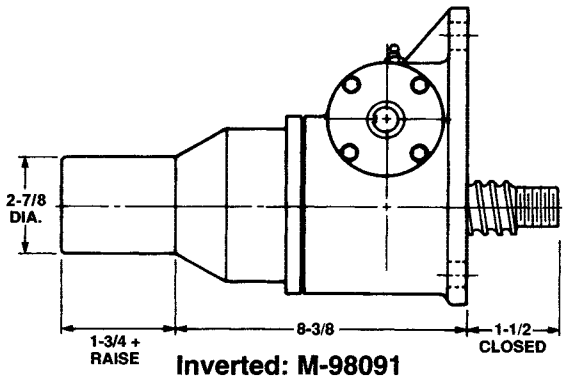
Ball Screw Actuator, 10 Ton - 1” Lead



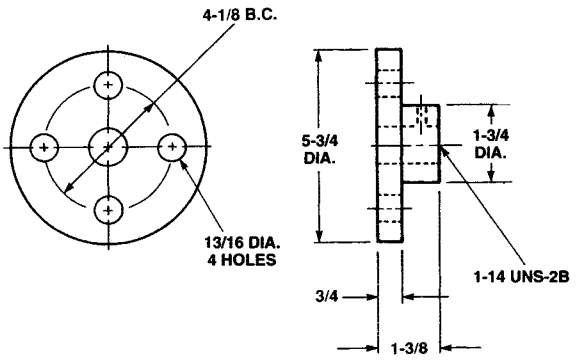
1 1/2” Diameter x 1.000 Lead Lifting Screws



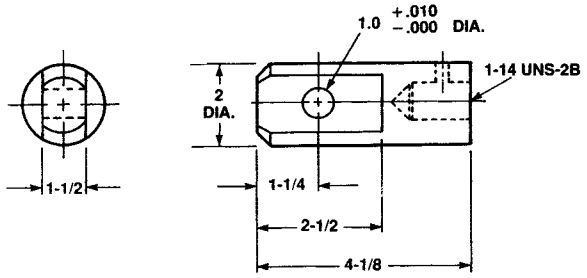
Upright: M-98101



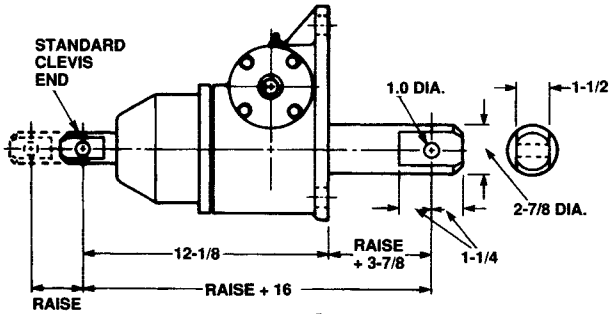
Inverted: M-98091



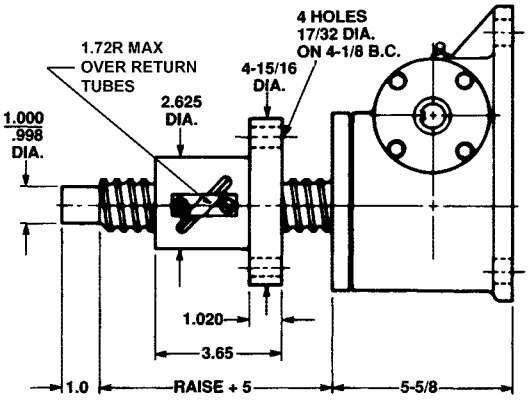
Top Plate (Optional)
SK2800-1-10A



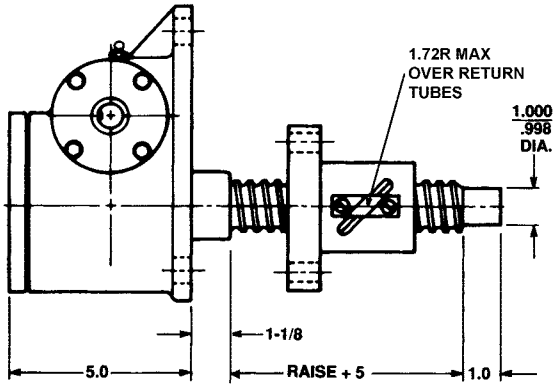
Clevis End (Optional)
SK2800-4-10A



Double Clevis
Maximum Allowable Raise in Compression 20” —Rating 7,300 Lbs.
Maximum Raise at Rated Load in Compression 9”.



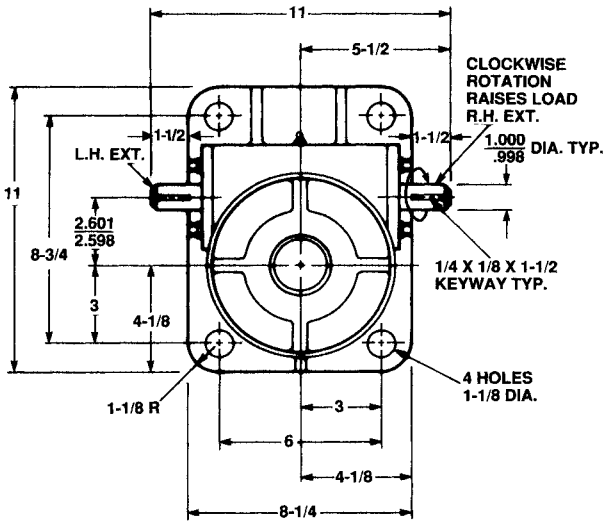
Upright Rotating: UM-98111



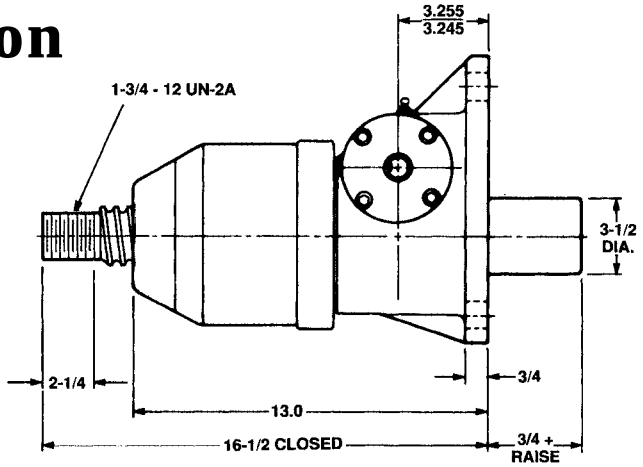
Inverted Rotating: DM-98111

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice.

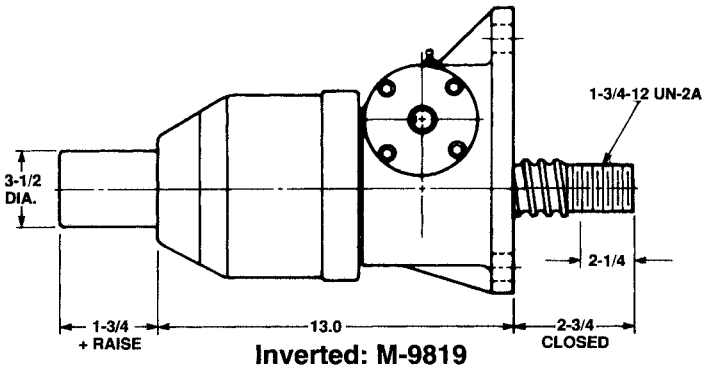
Ball Screw Actuator, 20 Ton



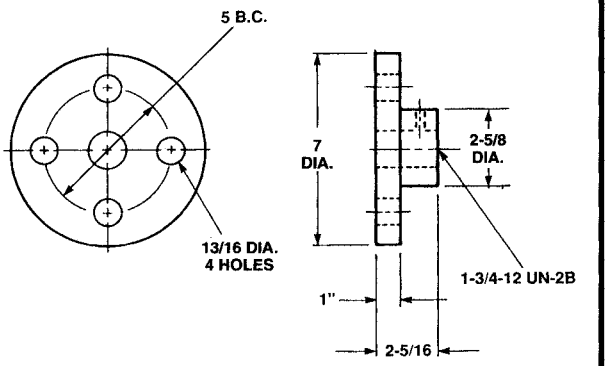
2 1/4" Diameter x .500 Lead Lifting Screws



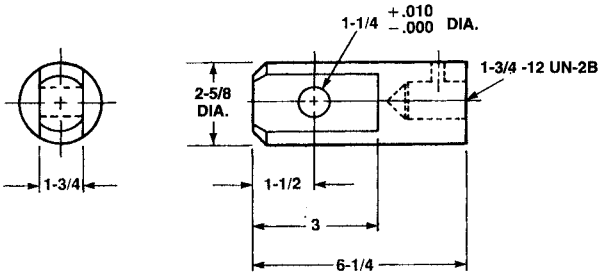
Upright: M-9820



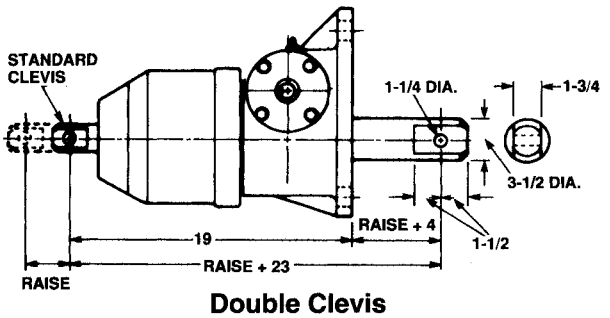
Inverted: M-9819



Top Plate (Optional)
SK2800-1-20A

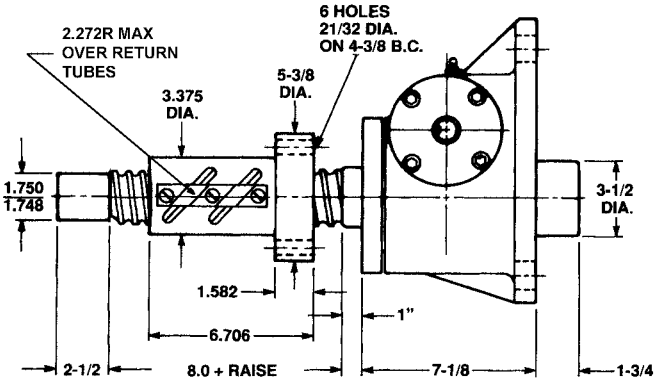


Clevis End (Optional)
SK2800-4-20A

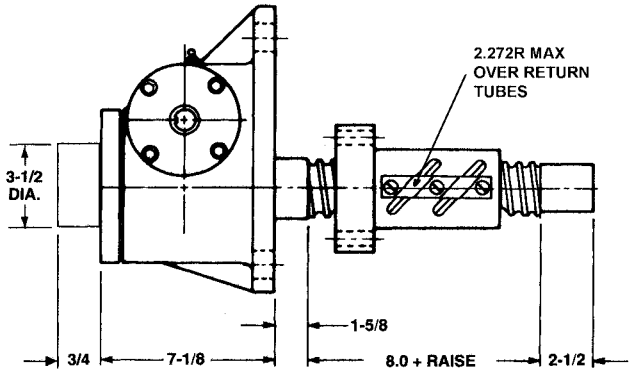


Double Clevis

Maximum Allowable Raise in Compression 35" - Rating 19,000 Lbs.
Maximum Raise at Rated Load in Compression 30".



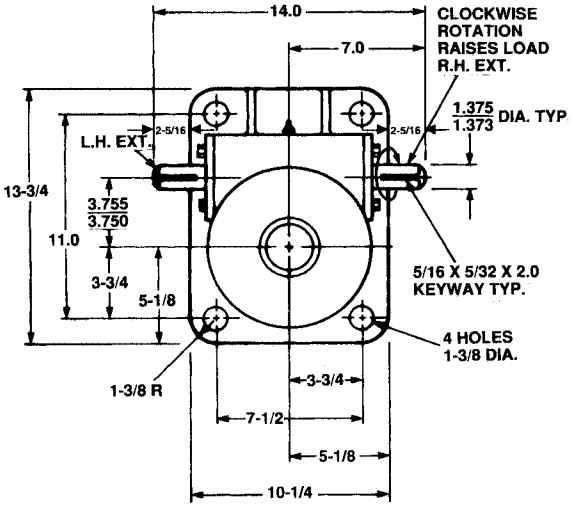
Upright Rotating: AUM-9821



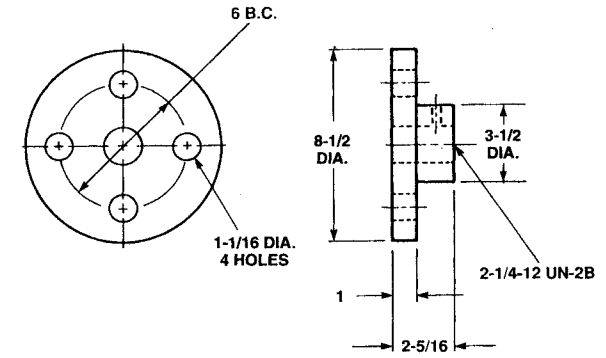
Inverted Rotating: ADM-9821

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice.

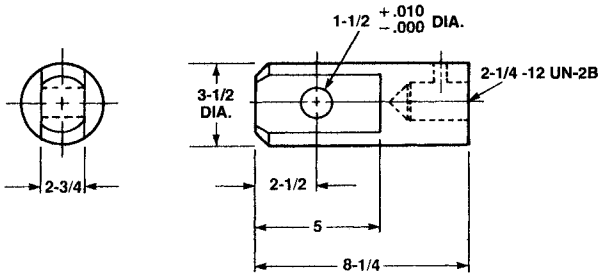
Ball Screw Actuator, 25 Ton



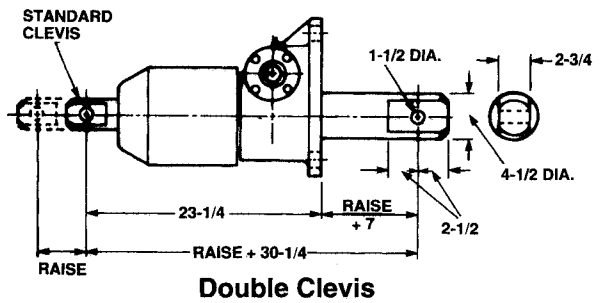
3" Diameter x .660 Lead Lifting Screws



Top Plate (Optional)
SK2800-1-25A

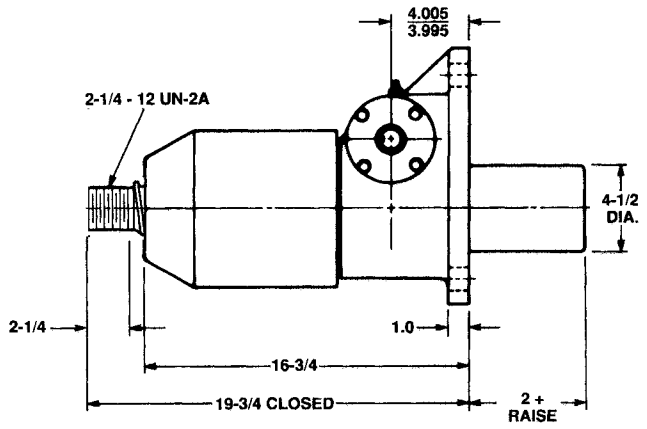


Clevis End (Optional)
SK2800-4-25A

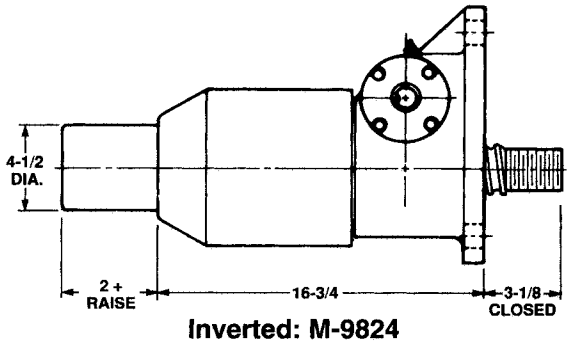


Double Clevis

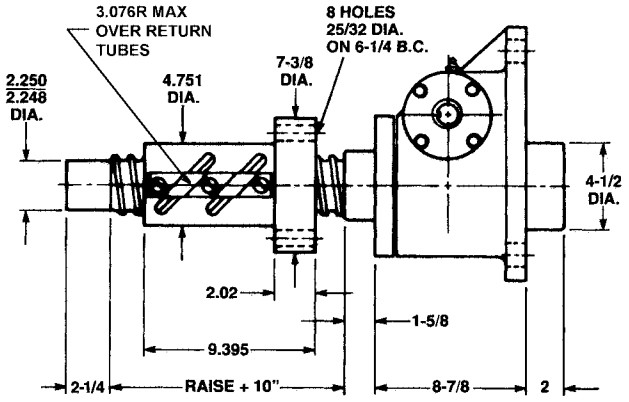
Maximum Allowable Raise in Compression 47"—Rating 35,000 Lbs.
Maximum Raise at Rated Load in Compression 36"



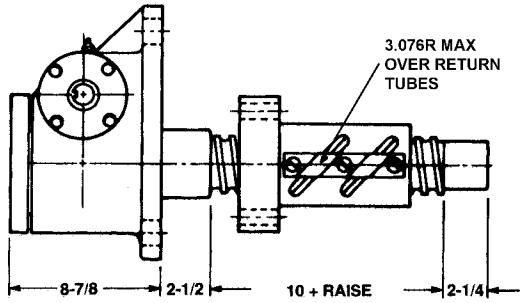
Upright: M-9825



Inverted: M-9824



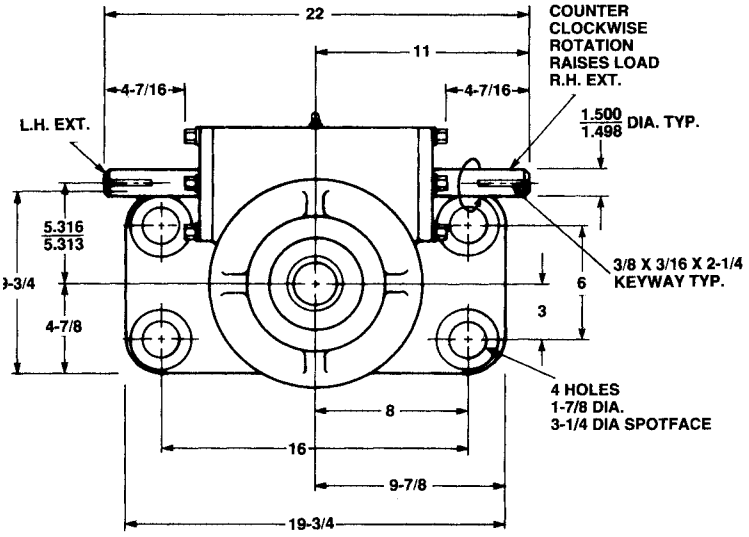
Upright Rotating: UM-9826



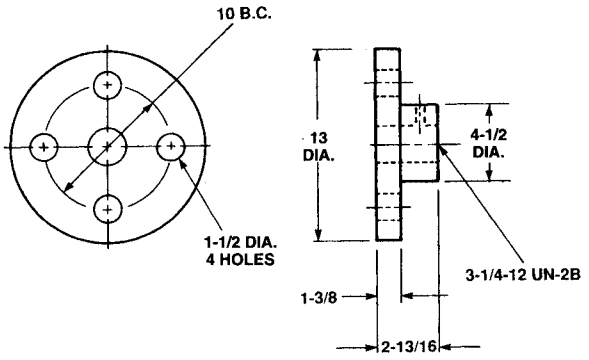
Inverted Rotating: DM-9826

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice.

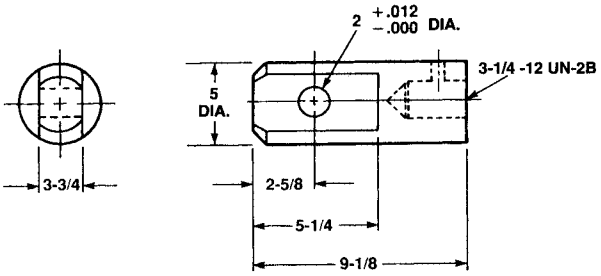
Ball Screw Actuator, 50 Ton



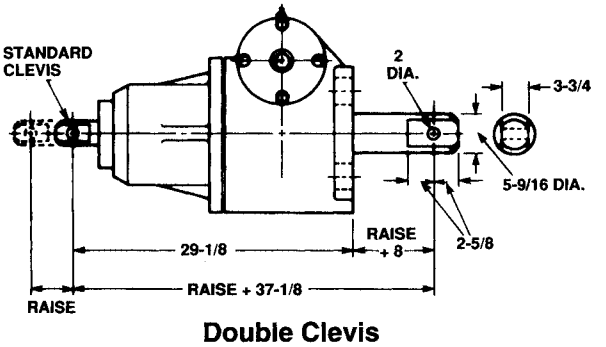
4" Diameter x 1.000 Lead Lifting Screws



Top Plate (Optional)
SK2800-1-50A

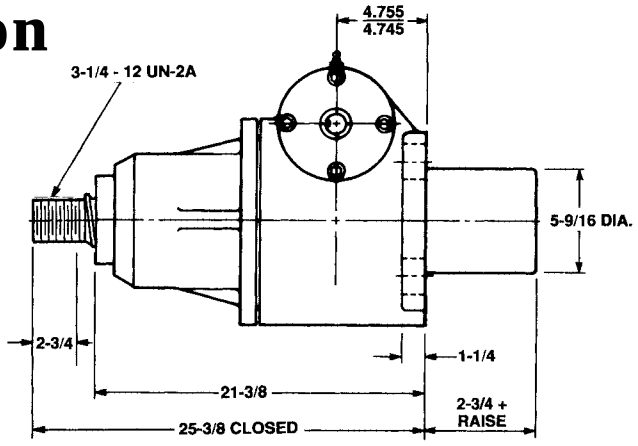


Clevis End (Optional)
SK2800-4-50A

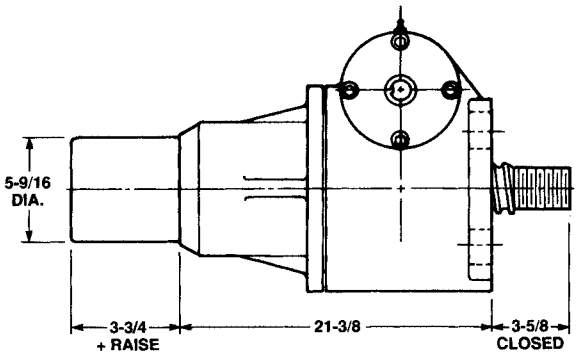


Double Clevis

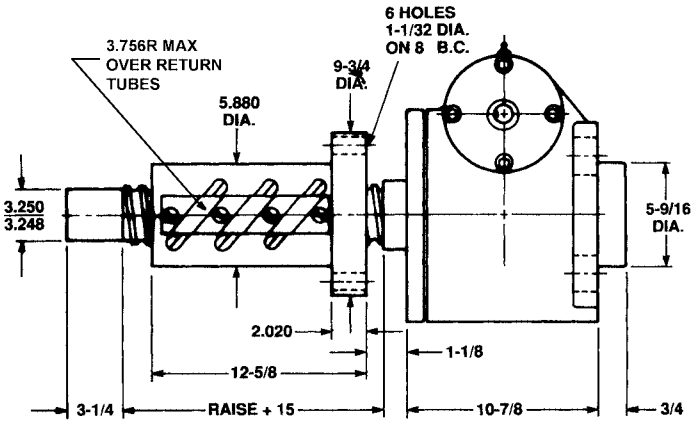
Maximum Allowable Raise in Compression 65" - Rating 62,000 Lbs.
Maximum Raise at Rated Load in Compression 47".



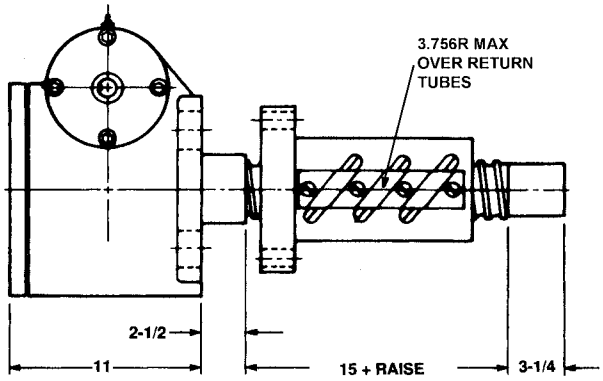
Upright: M-2860



Inverted: M-2859



Upright Rotating: UM-2861



Inverted Rotating: DM-2861

Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 112 through 114. Dimensions are subject to change without notice.

Metric Actuators

Duff-Norton Metric Actuators are manufactured to the same high quality standards and include all of the same features and benefits as the standard line of actuators while incorporating the following features:

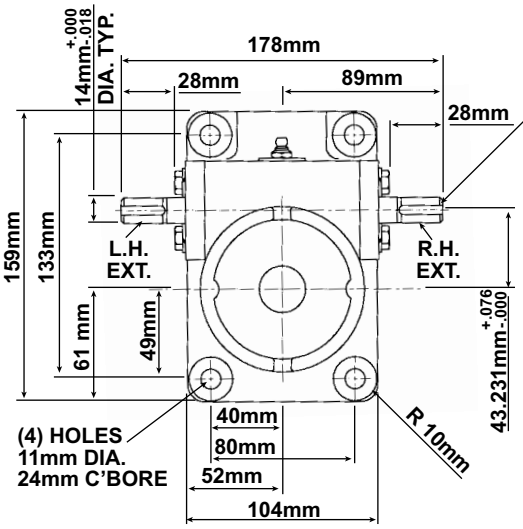
- Metric Bearings
- Metric shaft and keyway sizes per ISO recommended standards
- Metric bolt centers
- Other sizes and models available, contact Duff-Norton for more information

Metric Ball Screw Actuator Units

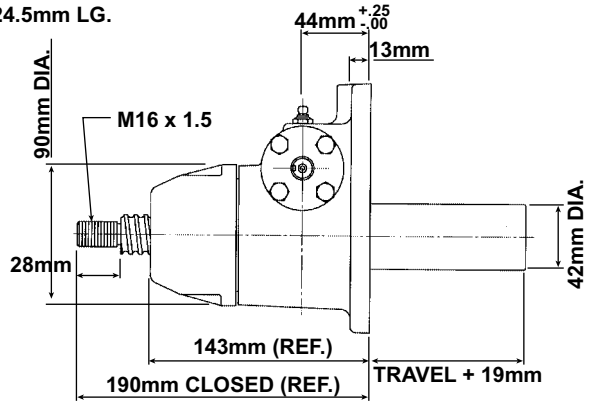
Note: Hold Back Torque is restraining torque at the worm shaft to keep loads from lowering.
Lifting torques are proportional to load down to 25% of rated load.

Model No.	Upright / Inverted	MET28631 / MET28630	MET9802 / MET9801	MET98021 / MET98011	MET28003 / MET28002	MET9805 / MET9804	MET98051 / MET98041	MET9810 / MET9809	MET98101 / MET98091	MET9820 / MET9819
Capacity kN		5	19	19	29	49	49	98	98	196
Lifting Screw	Diameter (mm)	15.9	25.4	25.4	29.8	38.1	38.1	38.1	38.1	57.2
	Lead (mm)	5.08	6.35	25.40	10.49	12.04	25.40	12.04	25.40	12.70
Worm Gear Ratios	Std. Ratio	5:1	6:1	6:1	6:1	6:1	6:1	8:1	8:1	8:1
	Optional	20:1	24:1	24:1	24:1	24:1	24:1	24:1	24:1	24:1
Travel per Worm Turn (mm)	Std. Ratio	1.02	1.06	4.23	1.75	2.01	4.23	1.50	3.18	1.59
	Optional	0.25	0.26	1.06	0.44	0.50	1.06	0.50	1.06	0.53
Maximum Input Power (kW)	Std. Ratio	0.25	1.49	1.49	1.49	2.98	2.98	3.73	3.73	3.73
	Optional	0.12	0.37	0.37	0.37	0.56	0.56	1.12	1.12	1.12
Worm Torque at No Load (N-M)	Std. Ratio	0.06	0.34	1.13	0.56	1.13	2.26	1.69	2.26	4.52
	Optional	0.06	0.34	1.13	0.56	1.13	2.26	1.69	2.26	4.52
Starting Torque at Rated Load (N-M)	Std. Ratio	1.53	6.57	26.01	15.96	31.27	65.82	47.44	98.63	101.12
	Optional	0.73	3.16	12.38	7.52	15.23	31.99	26.05	53.50	55.99
Running Torque at Rated Load (N-M)	Std. Ratio	1.37	5.86	23.20	14.22	27.73	58.36	41.96	87.08	89.57
	Optional	0.60	2.60	10.14	6.13	12.33	25.87	21.42	43.75	46.24
Hold Back Torque at Rated Load (N-M)	Std. Ratio	1.49	2.99	2.99	10.46	11.96	11.96	16.44	16.44	35.87
	Optional	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	2.99
Efficiency Rating (%)	Std. Ratio	63.60	61.70	62.50	63.20	62.00	62.10	61.40	62.50	60.60
	Optional	36.30	34.50	35.50	36.40	34.70	34.90	39.90	41.40	38.90
Weight with Base Raise of 150 mm (kg)		1.27	9.07	9.07	9.53	18.14	18.14	22.68	22.68	52.16
Weight for Each Additional 25 mm Raise (kg)		0.04	0.13	0.13	0.18	0.40	0.40	0.40	0.40	0.67
For Engineering Drawings See Page		Contact Duff-Norton	86	87	Contact Duff-Norton	88	89	90	91	92

Ball Screw Actuators, 19kN

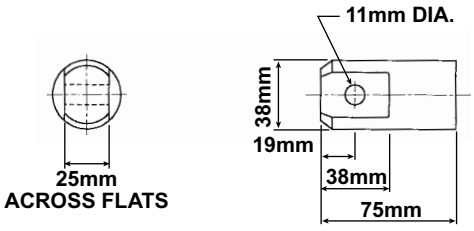


Top View: MET-9802

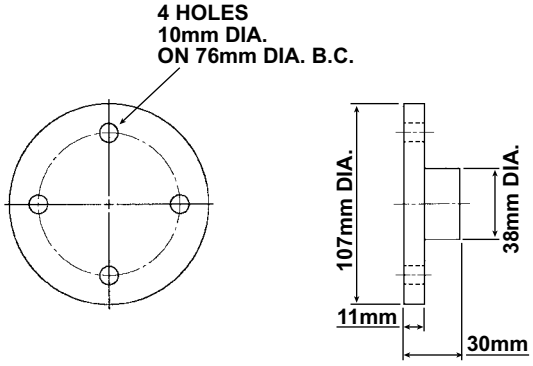


Upright: MET-9802

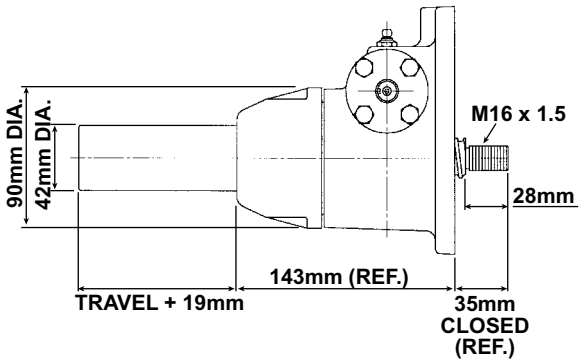
25.4mm O.D. x 6.35mm Pitch Lifting Screws (Other Available Screw End Attachments)



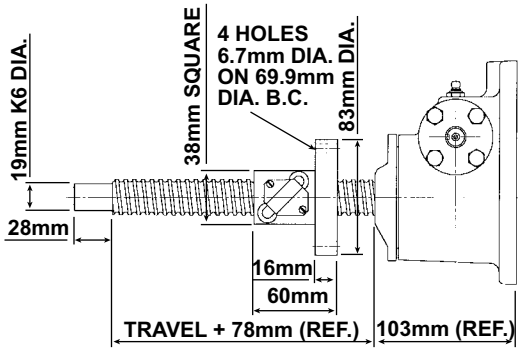
Clevis End Attachment



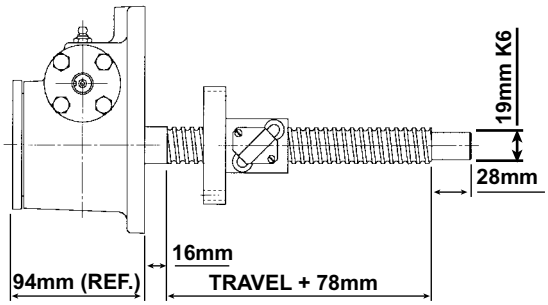
Top Plate Attachment



Inverted: MET-9801

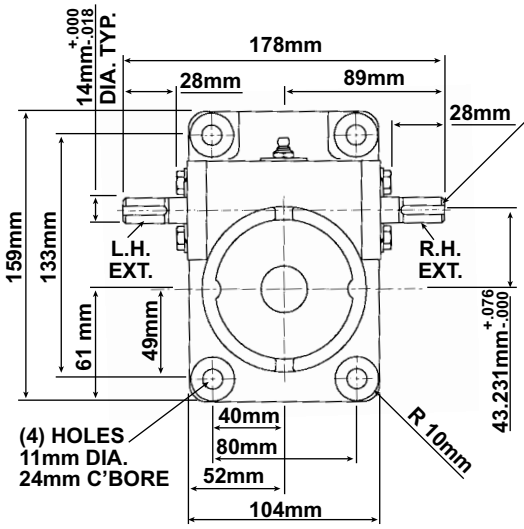


Upright Rotating: MET-UM-9803

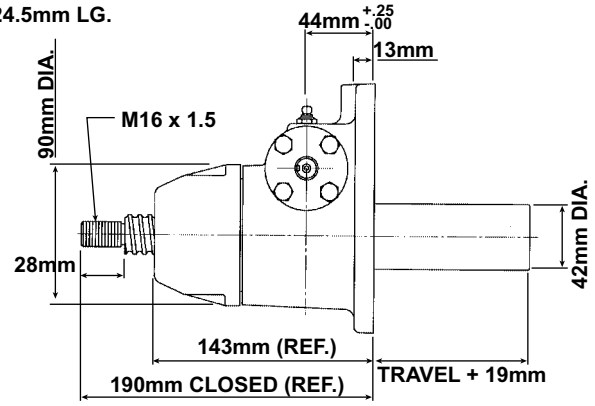


Inverted Rotating: MET-DM-9803

Ball Screw Actuators, 19kN - 1” Lead

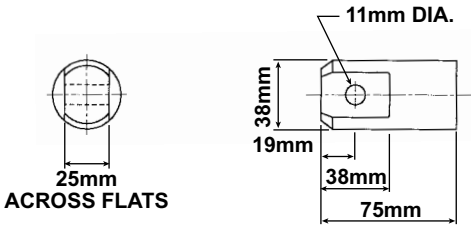


Top View: MET-98021

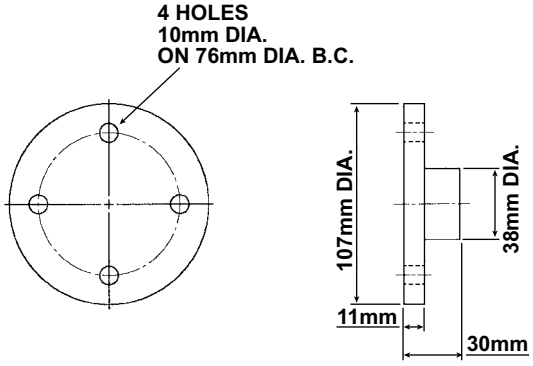


Upright: MET-98021

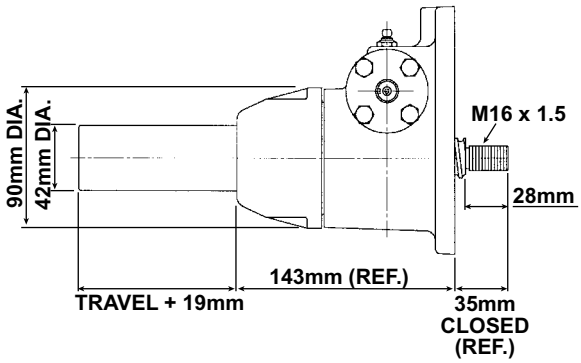
25.4mm O.D. x 25.40mm Pitch Lifting Screws (Other Available Screw End Attachments)



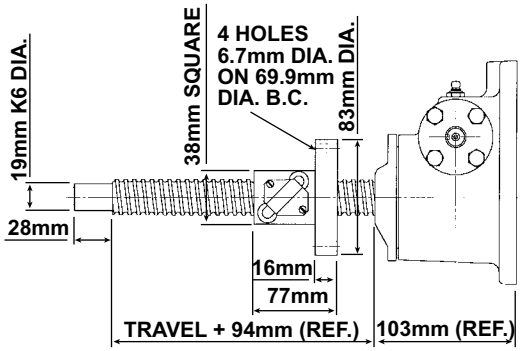
Clevis End Attachment



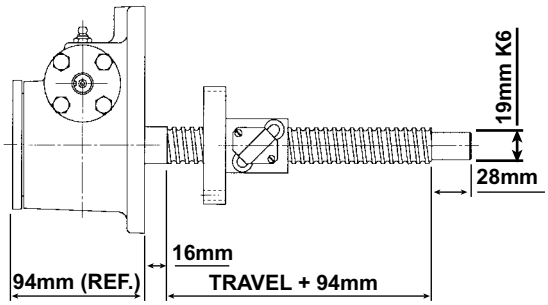
Top Plate Attachment



Inverted: MET-98011

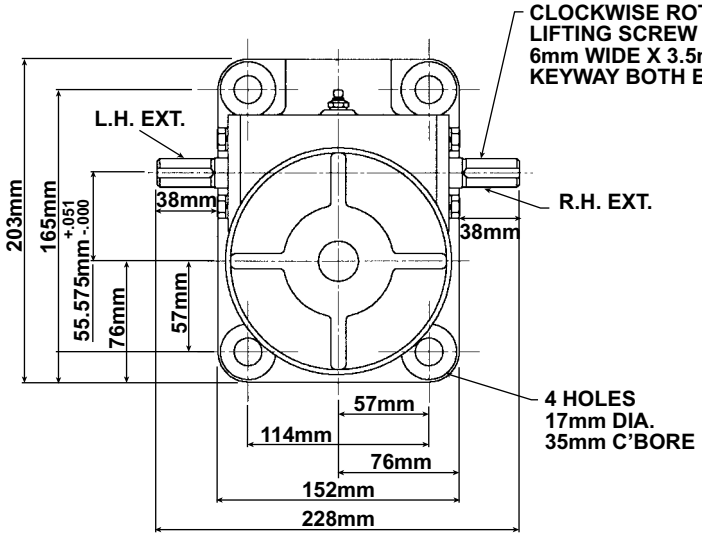


Upright Rotating: MET-UM-98031

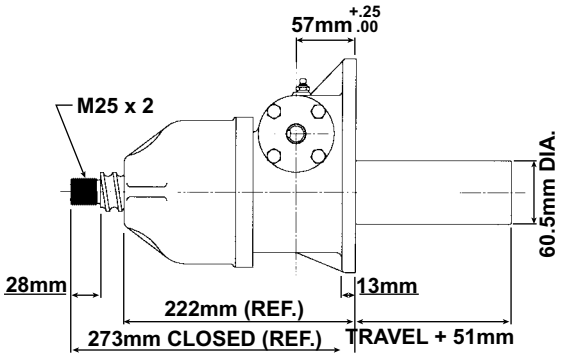


Inverted Rotating: MET-DM-98031

Ball Screw Actuators, 49kN

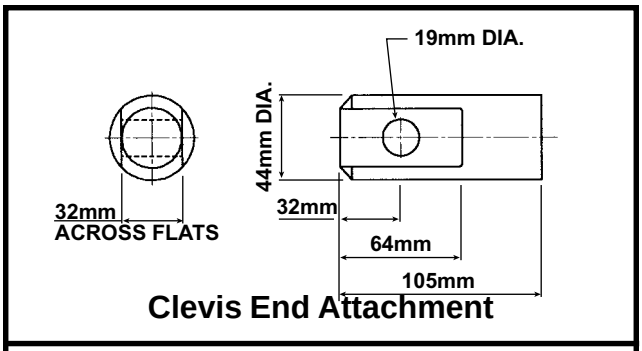


Top View: MET-9805

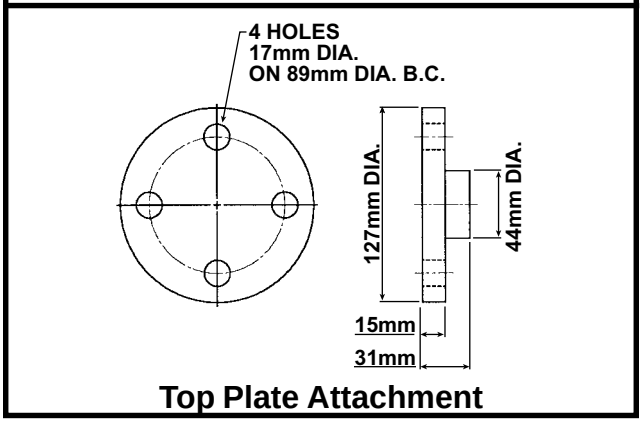


Upright: MET-9805

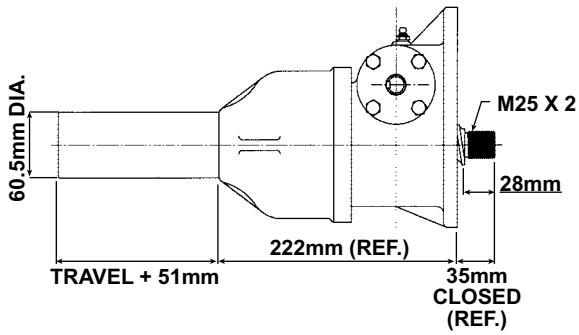
38.1mm O.D. x 12.04mm Pitch Lifting Screws
(Other Available Screw End Attachments)



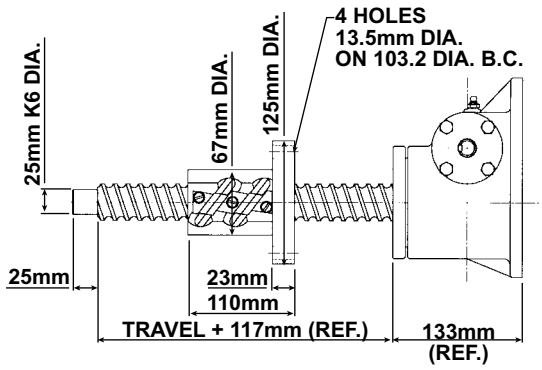
Clevis End Attachment



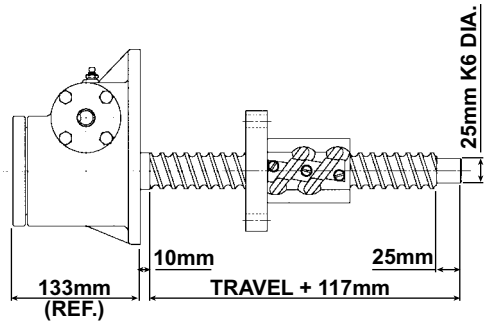
Top Plate Attachment



Inverted: MET-9804

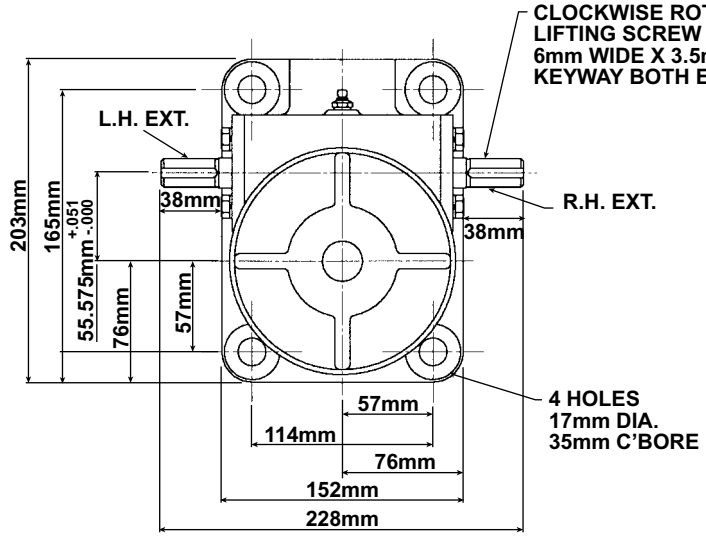


Upright Rotating: MET-UM-9806

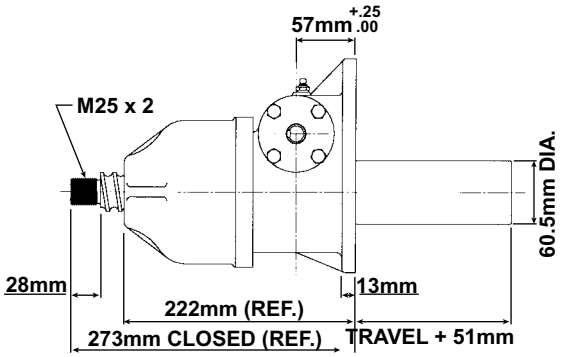


Inverted Rotating: MET-DM-9806

Ball Screw Actuators, 49kN - 1” Lead

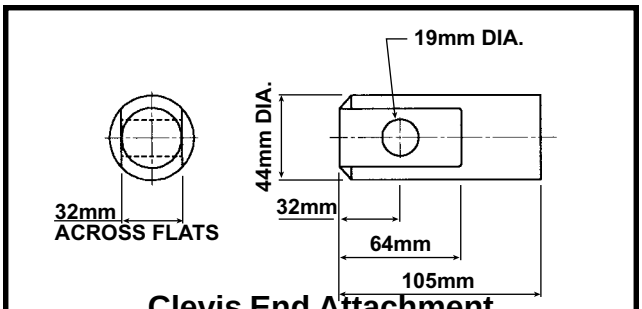


Top View: MET-98051

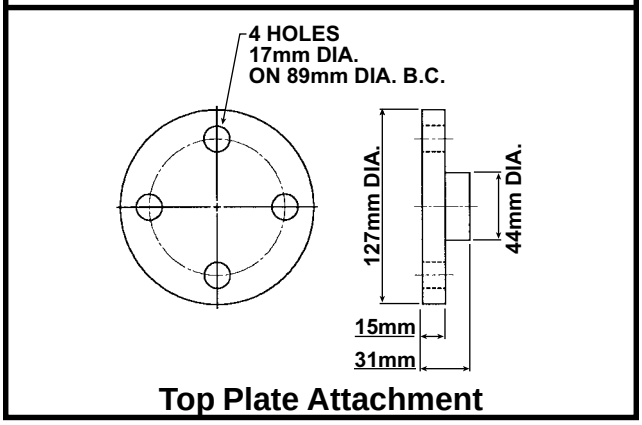


Upright: MET-98051

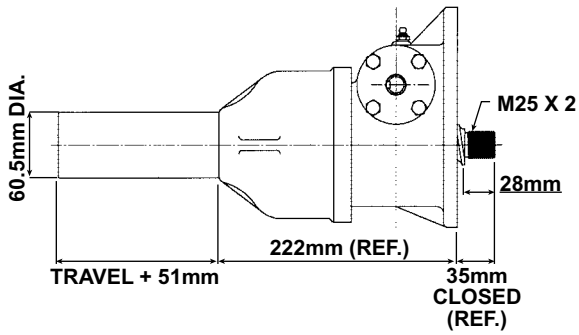
38.1mm O.D. x 25.40mm Pitch Lifting Screws (Other Available Screw End Attachments)



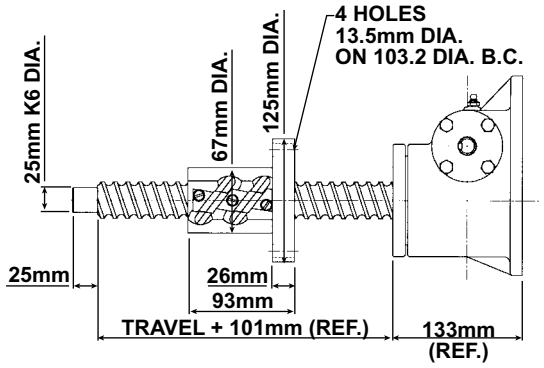
Clevis End Attachment



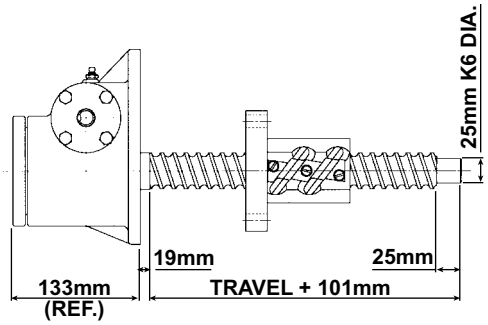
Top Plate Attachment



Inverted: MET-98041

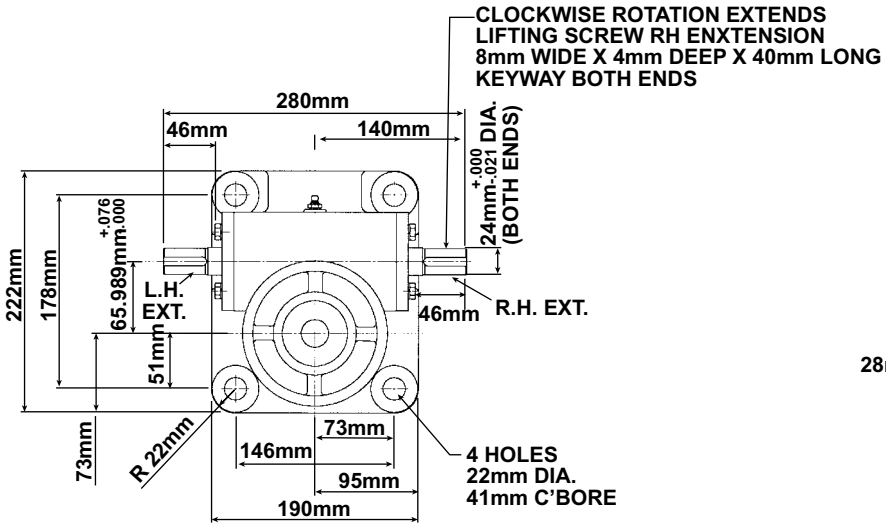


Upright Rotating: MET-UM-98061

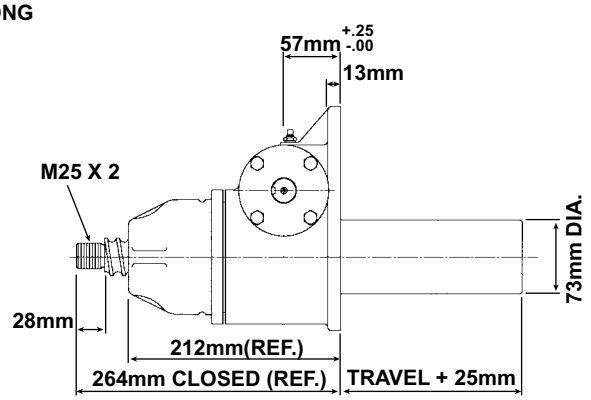


Inverted Rotating: MET-DM-98061

Ball Screw Actuators, 98kN

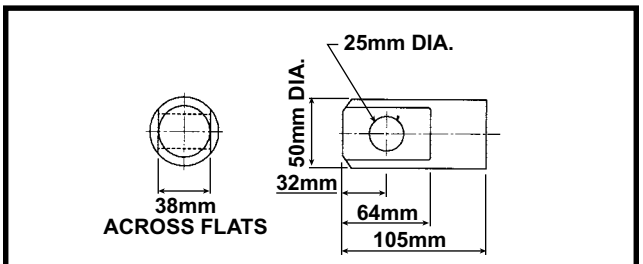


Top View: MET-9810

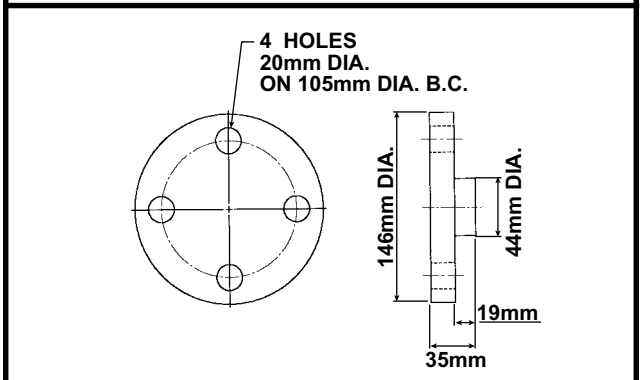


Upright: MET-9810

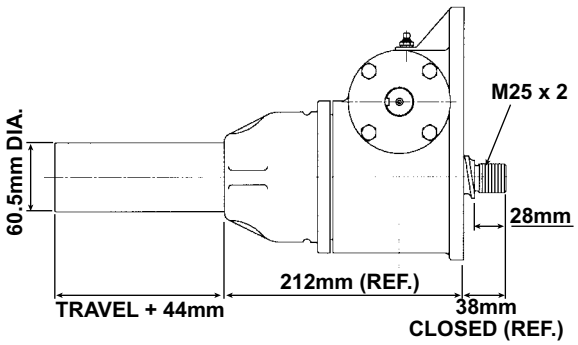
38.1mm O.D. x 12.04mm Pitch Lifting Screws (Other Available Screw End Attachments)



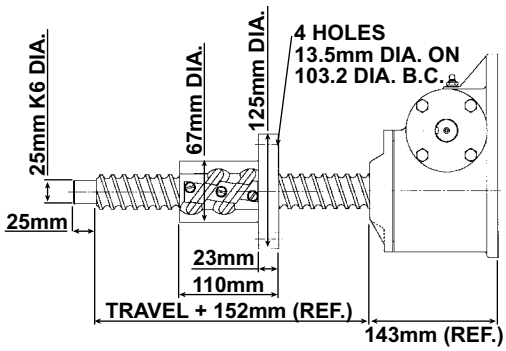
Clevis End Attachment



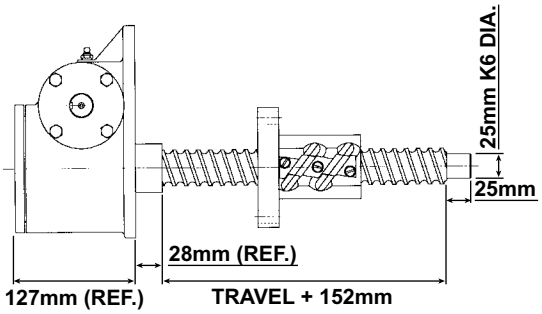
Top Plate Attachment



Inverted: MET-9809

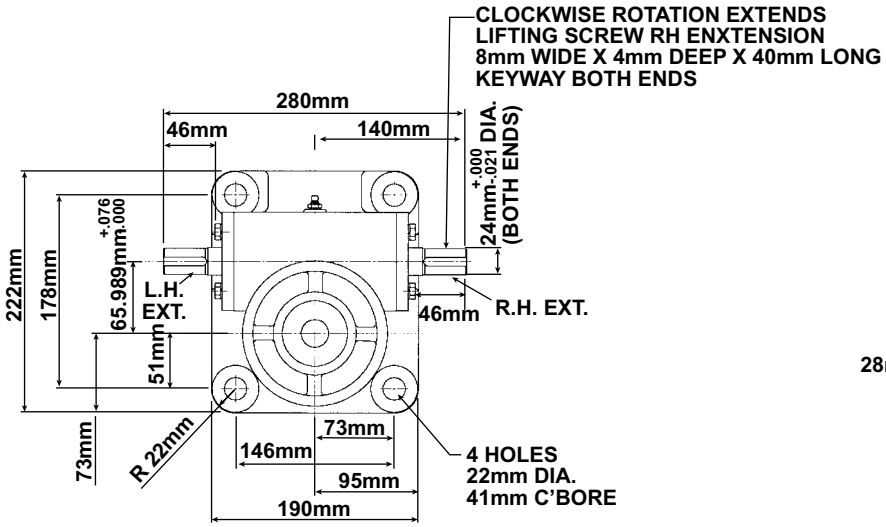


Upright Rotating: MET-UM-9811

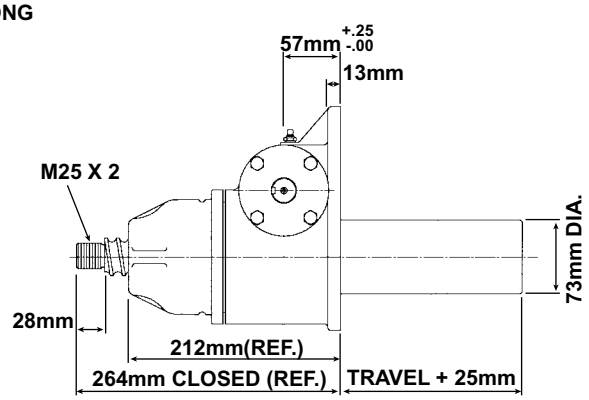


Inverted Rotating: MET-DM-9811

Ball Screw Actuators, 98kN - 1” Lead

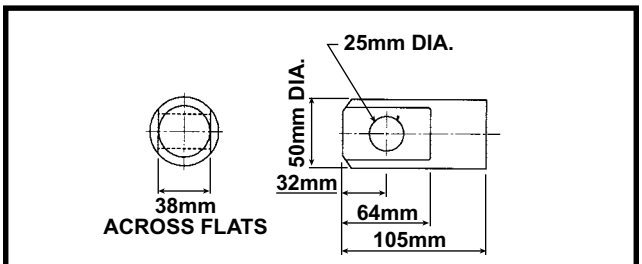


Top View: MET-98101

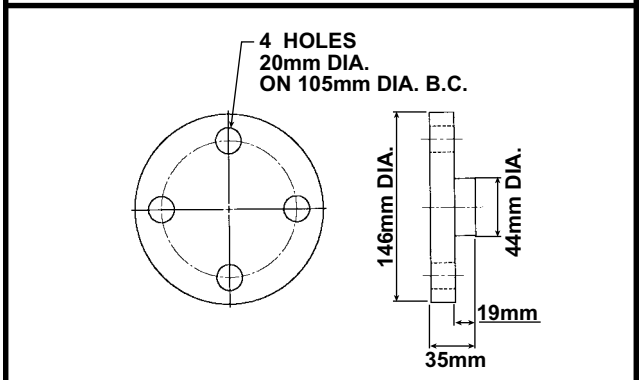


Upright: MET-98101

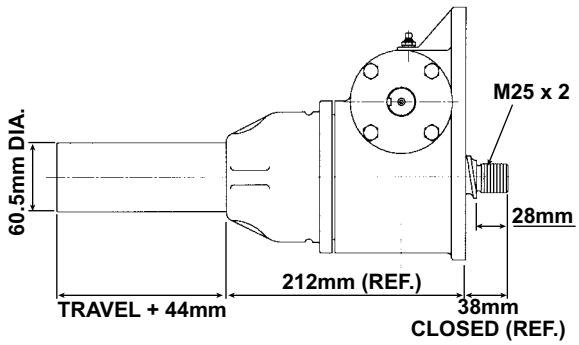
38.1mm O.D. x 25.40mm Pitch Lifting Screws
(Other Available Screw End Attachments)



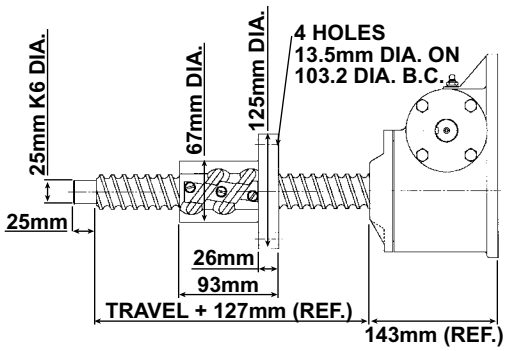
Clevis End Attachment



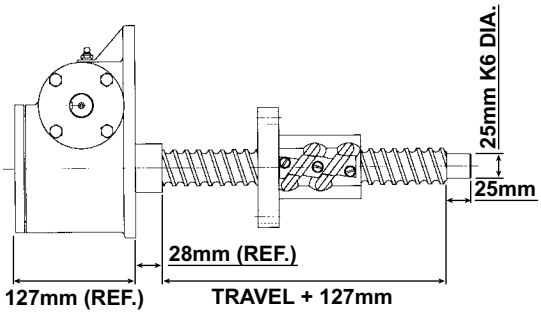
Top Plate Attachment



Inverted: MET-98091

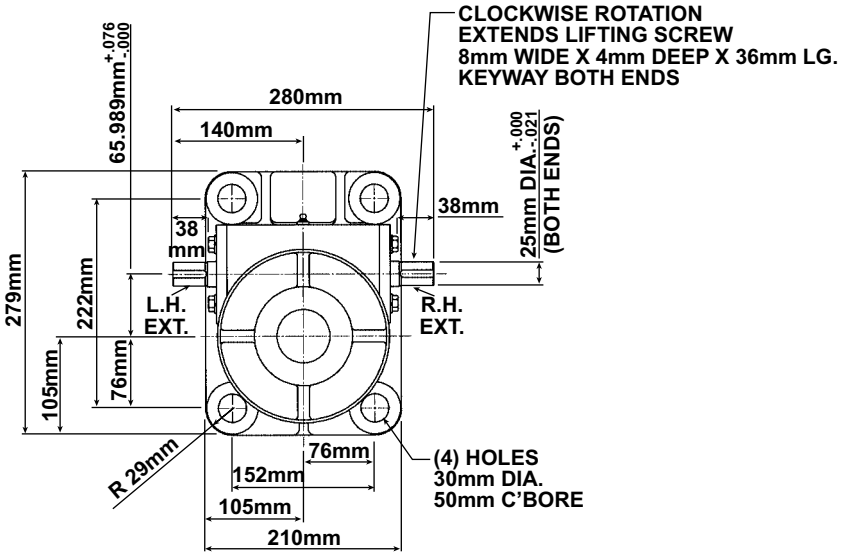


Upright Rotating: MET-UM-98111

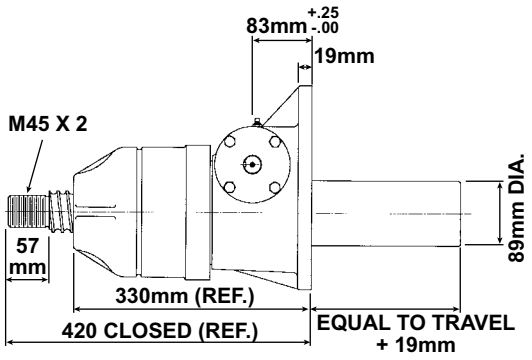


Inverted Rotating: MET-DM-98111

Ball Screw Actuators, 196kN

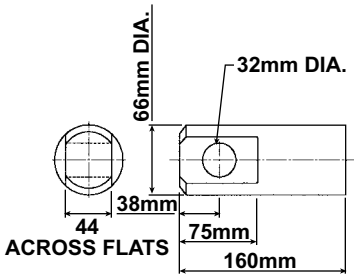


Top View: MET-9820

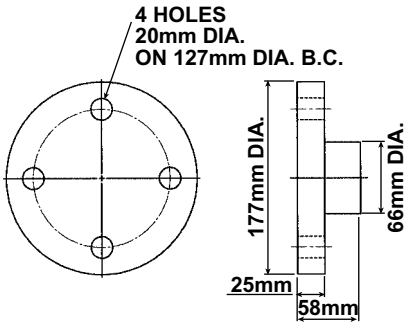


Upright: MET-9820

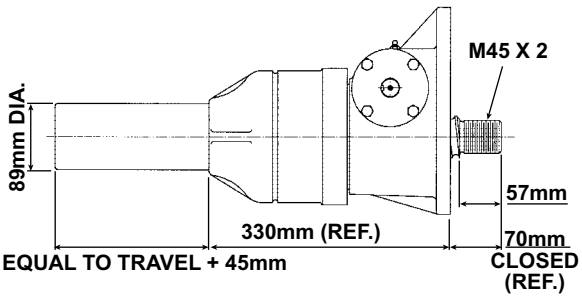
57.2mm O.D. x 12.70mm Pitch Lifting Screws (Other Available Screw End Attachments)



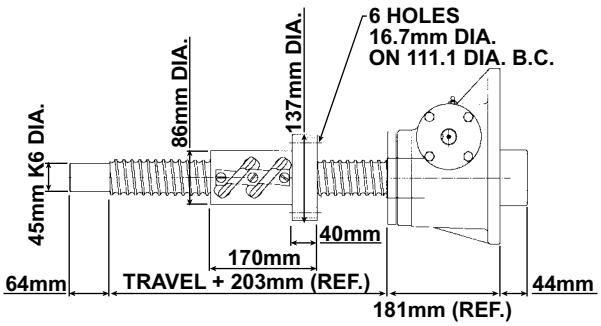
Clevis End Attachment



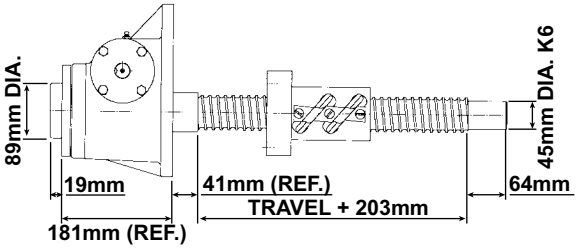
Top Plate Attachment



Inverted: MET-9819



Upright Rotating: MET-UM-9821

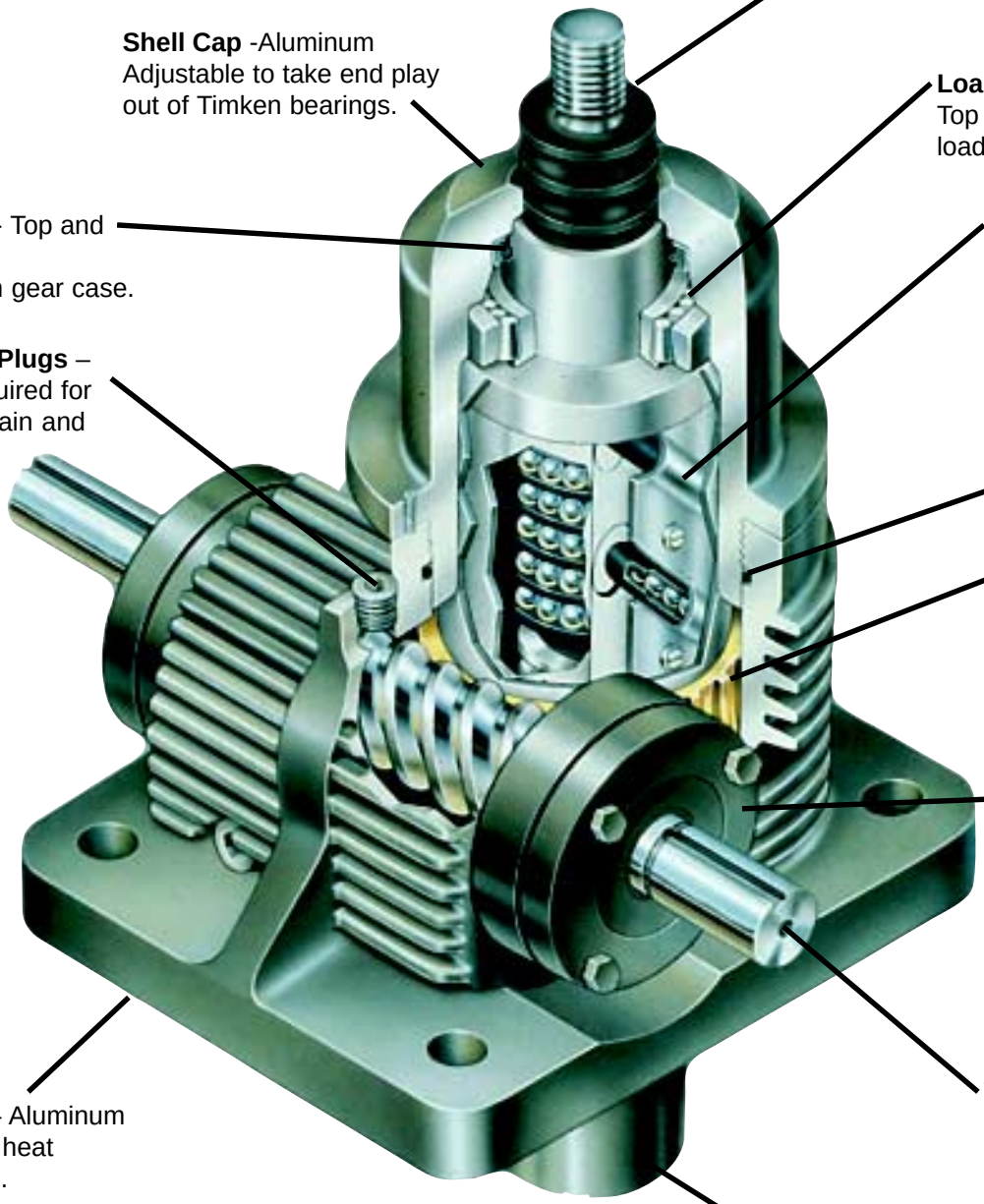


Inverted Rotating: MET-DM-9821

High Duty Cycle Actuator Models

Advantages:

- Predictable life.
- Continuous operation.
- Oil lubricated.
- High mechanical and thermal efficiency
- 12 models available.
- Capacity 3,500 to 27 ,000 pounds
- Available with C-Face motor adaptors



Ball Screw - Threaded end is standard.

Shell Cap -Aluminum Adjustable to take end play out of Timken bearings.

Load Bearings - Top and bottom to take full load in either direction.

Oil Seals - Top and Bottom Seals oil in gear case.

Sealed Ball Nut Assembly - Sealed to prevent gear case oil from leaking out around ball screw.

Pipe Plugs – 3 required for fill, drain and vent.

"0" Ring Seal

Worm Gear - Aluminum bronze.

Worm Bearings and Oil Seals - Each end of worm.

Housing – Aluminum Finned for heat dissipation.

Worm - Single piece construction. Heat treated and ground.

Dust Guard - Protects ball screw threads.

High Duty Cycle Actuator Models

- **12 Models Available.** Upright or inverted translating screw and rotating screw available.
- **Maximum Load Capacities** range from 3500 to 27 ,000 pounds.
- **Rated Load Capacities** (load at which actuator life is 1000 hours) range from 2000 to 13,000 pounds.
- **High Mechanical Efficiency.** The units' mechanical efficiency (as high as 70%) is due to the heat-treated ball bearing screw and mating nut, hardened and ground alloy steel worm, aluminum-bronze worm gear and oil bath lubrication.
- **High Thermal Efficiency.** The high duty cycle actuator units have high thermal efficiency (100% on-time at rated loads and at least 33% on-time at maximum loads)
- **High Speed.** Designed to run at a worm speed of 1750 rpm fully loaded. Higher speeds possible with less than capacity loads. Screw speed is fast as 120 inches per minute.
- **Positive Action.** High reliability; needs no pumps, hoses or valves. Can be synchronized for multiple usage.
- **Less Power Required.** Efficient design needs less power for given thrust; cuts power requirements.
- **Gearing Meets AGMA Standards.** Worm gearing meets AGMA Standards.
- **Sand-cast Aluminum Housing.** Sand-cast aluminum housings for added heat dissipation.
- Available with C-Face Motor Adaptor.

Maximum Allowable Duty Cycle at 1750 RPM Input Speed

Model No.	Max. Capacity	75% Max. Capacity	Rated Capacity
7511	100%	100%	100%
7515	33%	67%	100%
7522	33%	67%	100%

Note: Duty cycles are based on 100°F temperature rise above ambient not to exceed 200°F using Duff-Norton's standard oil.

Duff-Norton 7500 Series high duty cycle actuators are specifically designed for continuous operation within certain load limitations (see Maximum Allowable Duty Cycle chart above). The precision worm gear set operates in an oil bath that improves thermal efficiency.

In addition, the precision drive arrangement permits the accurate prediction of operating life, in terms of millions of inches of travel. This important feature allows optimum maintenance and replacement scheduling, so as to minimize downtime.

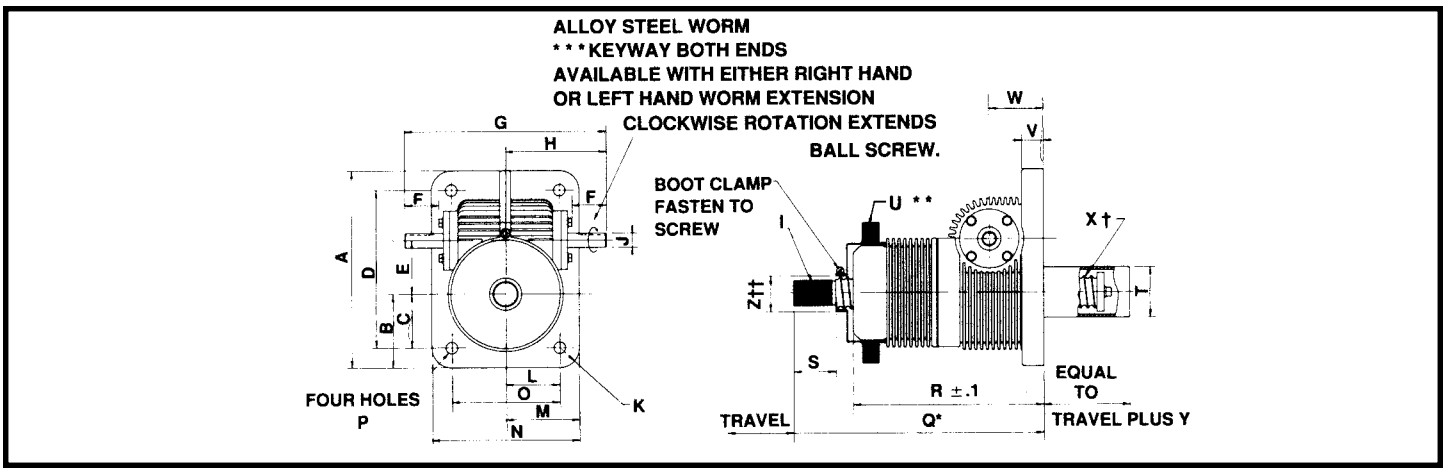
The accompanying Life Expectancy graph is accurate for units installed with good alignment, minimal side loading, and operated in a relatively clean environment.

Specifications

Model No.	7511	7515	7522
Max. Load Cap. (lbs.)	3,500	12,000	27,000
Rated Load Cap. (lbs) (for 1,000 hours life)	2,000	5,200	13,000
Diameter of Lifting Screw (in.)	1.171 .413 Lead	1.5 .474 Lead	2.250 .500 Lead
Closed Height (in.)	10 3/8	11 1/4	16 5/8
Base Size (in.)	5 1/2 x 7.0	7 1/2 x 8 3/4	10 1/4 x 13 3/4
Worm Gear Ratio	6:1	8:1	10 2/3:1
Turns of Worm for 1" Raise	14.5	16.888	21.333
Horsepower per Actuator (Max) at 1750 RPM	2	5	10
No Load Torque (in.-lb.)	5	15	40
Starting Torque at Max. Load (In.-Lbs.)	75	200	420
Running Torque at Max. Load (In.-Lbs)	60	170	350
Actuator Efficiency Rating (Percentage)	70	70	65
Weight with Base Raise of 6" (lbs.)	19	43	95
Weight for Each Additional 1" Raise (lbs.)	.4	.9	1.5
Hold Back Torque* at Max. Load (Lb.-Ft.)	4	9	12

*Note: Hold Back Torque is restraining torque at the worm shaft to keep load from running down.

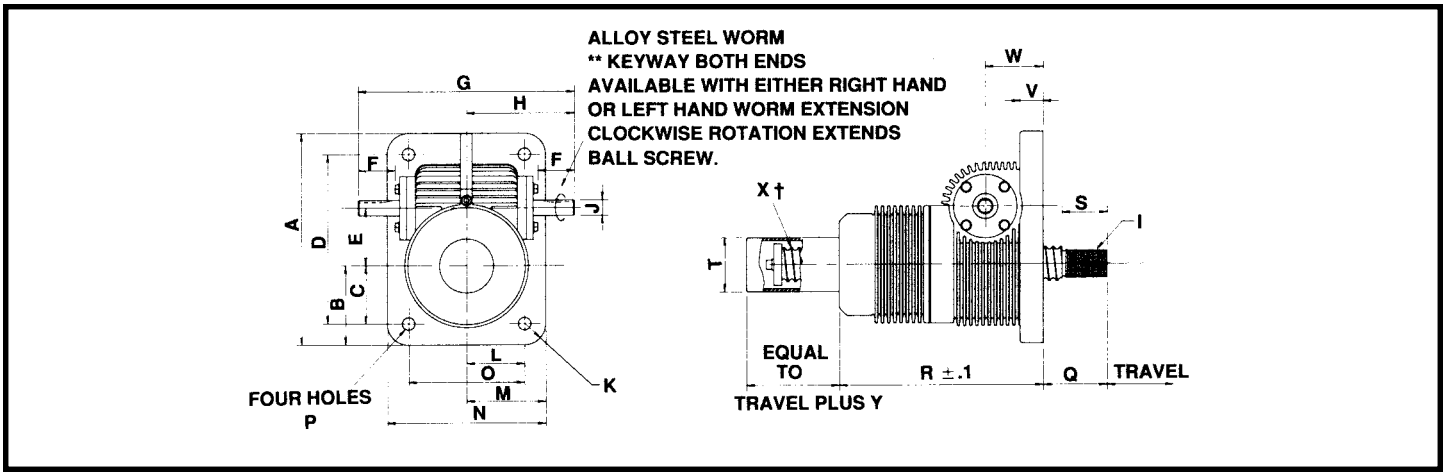
Typical 7500 Series Actuator with Upright Translating Screw



Model No.	Dimensions (inches)																								
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q*	R	S	T	U**	V	W	X†	Y	Z††
7511	7	2 3/4	2.20	6	+/-.001 1.703	1.12	8.6	4.3	3/4 16UNF -2A	+.000 -.002 .500	1/2 R	2 1/4	2 3/4	5 1/2	4 1/2	13/32	+/-.06 10.4	+/-.06 8.4	1 1/8	1 21/32	7 O.D. x 4 I.D.	3/4	+/-.005 2.500	1.171 Dia. .4130 Lead	2	1.5
7515	8 3/4	2 7/8	2	7	+.003 -.000 2.598	1.68	11	5.5	1 14UNS -2A	+.000 -.002 1.000	7/8 R	2 7/8	3 3/4	7 1/2	5 3/4	11/16	+/-.1 11.2	+/-.1 9.2	1 1/8	2 3/8	7 O.D. x 4 3/4 I.D.	1	+/-.005 2.750	1 1/2 Dia. .474 Lead	2	---
7522	13 3/4	5 1/8	3 3/4	11	+.005 -.000 3.750	2.38	14	7.0	1 3/4 12UN -2A	+.000 -.002 1.000	1 3/8 R	3 3/4	5 1/8	10 1/4	7 1/2	13/16	+/-.1 16.6	+/-.1 13.2	2 1/4	3 1/2	9.8 O.D. x 6.8 I.D.	1 1/2	+/-.005 3.750	2 1/4 Dia. .500 Lead	3	---

*Closed height †Dimension includes diameter of ball screw with indicated lead for right-hand single thread. NOTE: When ordering, specify load and duty cycle.
**Bellows boot (optional) ††Hub dia. for boot attachment ***Keyway for Model 7511 is 1/8 x 5/64 x 15/16 LG. Keyway for Models 7515 & 7522 is 1/4 x 1/8 x 11/2.

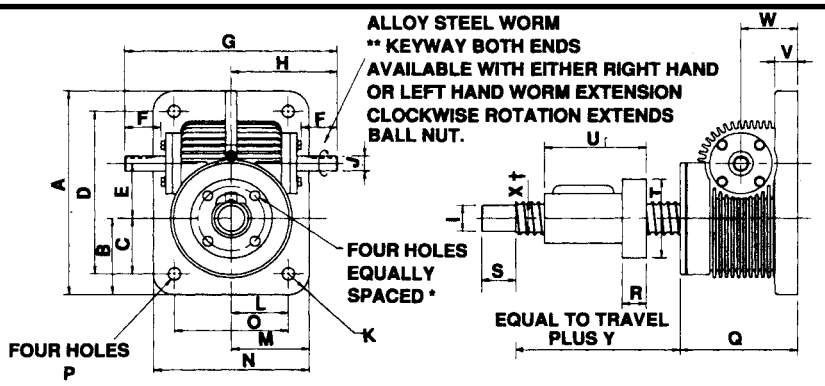
Typical 7500 Series Actuator with Inverted Translating Screw



Model No.	Dimensions (inches)																							
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q*	R	S	T	V	W	X†	Y
7510	7	2 3/4	2.20	6	±.001 1.703	1.12	8.6	4.3	3/4 16UNF -2A	+.000 -.002 .500	1/2 R	2 1/4	2 3/4	5 1/2	4 1/2	13/32	±.06 2.0	±.06 8.4	1 1/8	1 21/32	3/4	±.005 2.500	1.171 Dia. .4130 Lead	2
7514	8 3/4	2 7/8	2	7	+.003 -.000 2.598	1.68	11	5.5	1 14UNS -2A	+.000 -.002 1.000	7/8 R	2 7/8	3 3/4	7 1/2	5 3/4	11/16	±.1 2.0	±.1 9.2	1 1/8	2 3/8	1	±.005 2.750	1 1/2 Dia. .474 Lead	2
7521	13 3/4	5 1/8	3 3/4	11	+.005 -.000 3.750	2.38	14	7.0	1 3/4 12UN -2A	+.000 -.002 1.000	1 3/8 R	3 3/4	5 1/8	10 1/4	7 1/2	13/16	±.1 3.4	±.1 13.2	2 1/4	3 1/2	1 1/2	±.005 3.750	2 1/4 Dia. .500 Lead	3

*Closed height †Dimension includes diameter of ball screw with indicated lead for right-hand single thread. NOTE' When ordering, specify load and duty cycle.
* *Keyway for Model 7510 is 1/8 x 5/64 x 15/16 LG. Keyway for Models 7514 & 7521 is 1/4 x 1/8 x 11/2.

Typical 7500 Series Actuator with Upright Rotating Screw

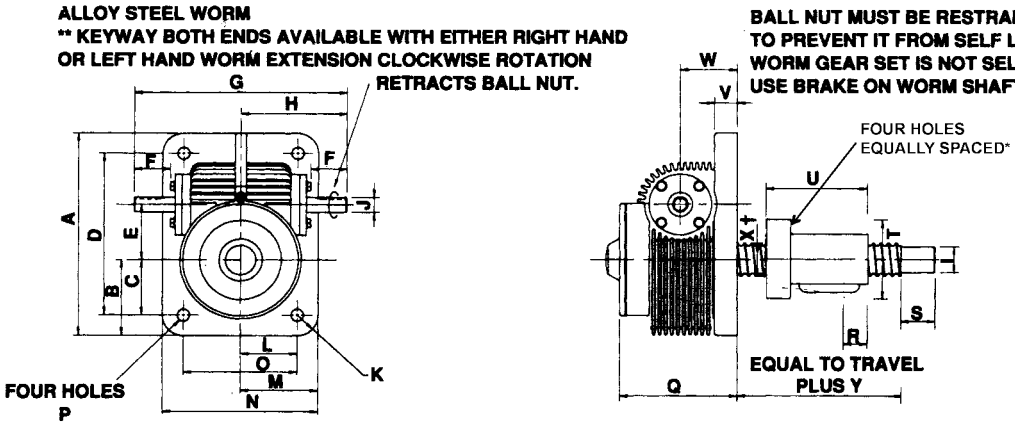


Model No.	Dimensions (inches)																							
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X†	Y
UM-7512	7	2.70	2.20	6	±.001 1.703	1.12	8.6	4.3	+.000 -.002 .750	+.000 -.002 .500	1/2 R	2 1/4	2 3/4	5 1/2	4 1/2	13/32	±.1 5 1/4	.832	1.13	4.250	3.395	3/4	±.005 2.500	1.171 Dia. .4130 Lead	3.75
UM-7516	8 3/4	2 7/8	2.00	7	+.003 -.000 2.589	1 13/16	11	5 1/2	+.000 -.002 1.000	+.000 -.002 1.000	7/8 R	2 7/8	3 3/4	7 1/2	5 3/4	11/16	±.1 5 3/4	.895	1	4.937	4.332	1	±.005 2.750	1 1/2 Dia. .474 Lead	4.75
UM-7523	13 3/4	5.13	3.75	11	+.005 -.000 3.750	2.38	14	7	+.000 -.002 1.750	+.000 -.002 1.000	1 3/8 R	3 3/4	5 1/8	10 1/4	7 1/2	13/16	±.1 7 3/4	±.010 1.582	2 1/4	5.375	±.040 6.706	1 1/2	±.005 3.750	2 1/4 Dia. .500 Lead	8.0

†Dimension includes diameter of ball screw with indicated lead for right-hand single thread
**Keyway for Model UM-7512 is 1/8 x 5/64 x 15/16 LG.
Keyway for Models UM-7516 & UM-7523 is 1/4 x 1/8 x 1 1/2.
NOTE: When ordering, specify load and duty cycle.

*Model No. UM-7516: 17/32 dia. on 4.06 dia. bolt circle.
Model No. UM-7523: 21/32 dia. on 4.375 dia. bolt circle.
Model No. UM-7512: 25/64 dia. on 3.44 dia. bolt circle.

Typical 7500 Series Actuator with Inverted Rotating Screw

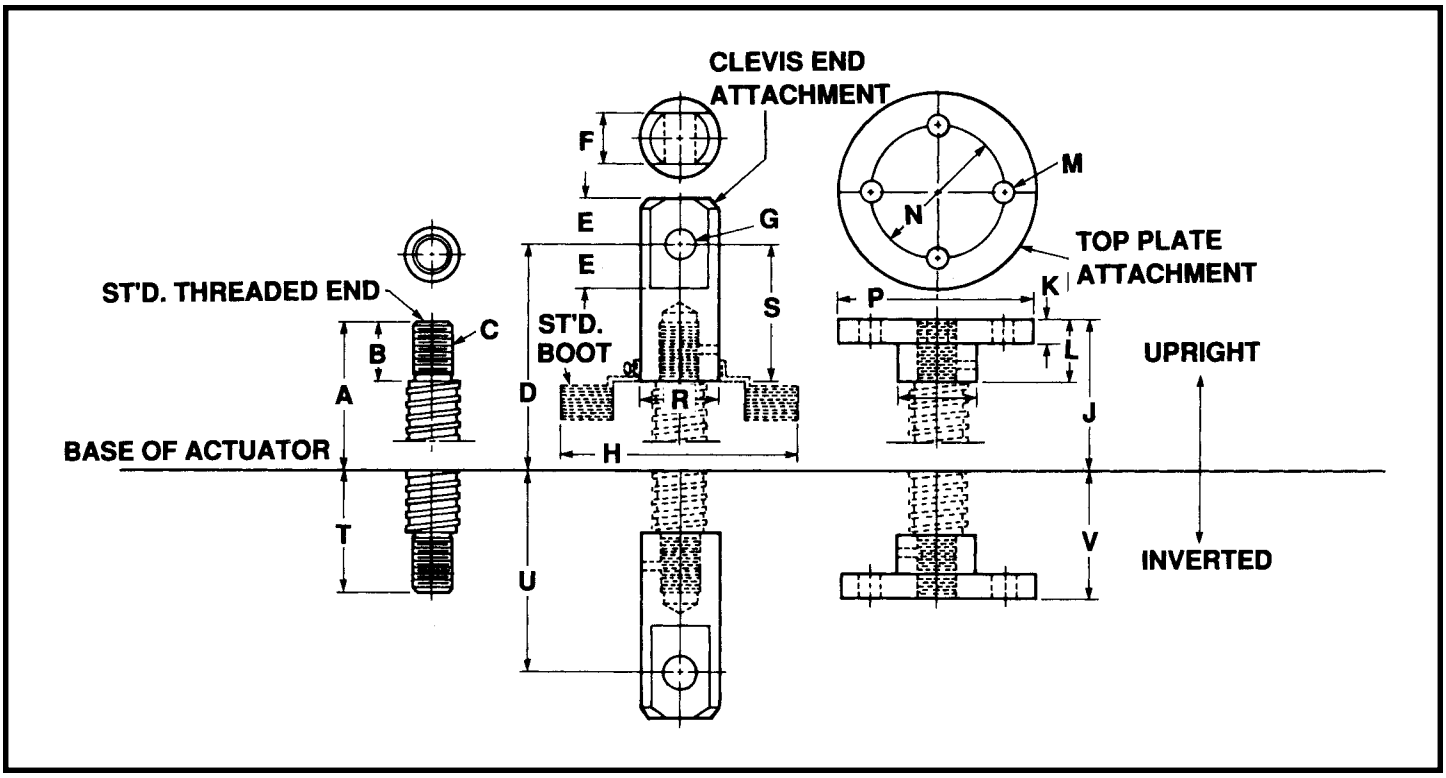


Model No.	Dimensions (inches)																							
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X†	Y
DM-7512	7	2.70	2.20	6	±.001 1.703	1.12	8.6	4.3	+.000 -.002 .750	+.000 -.002 .500	1/2 R	2 1/4	2 3/4	5 1/2	4 1/2	13/32	±.1 5 1/4	.832	1.13	4.250	3.395	3/4	±.005 2.500	1.171 Dia. .4130 Lead	3.75
DM-7516	8 3/4	2.88	2.00	7	+.003 -.000 2.589	1.81	11	5 1/2	+.000 -.002 1.000	+.000 -.002 1.000	7/8 R	2 7/8	3 3/4	7 1/2	5 3/4	11/16	±.1 5 3/4	.895	1	4.937	4.332	1	±.005 2.750	1 1/2 Dia. .474 Lead	4.75
DM-7523	13 3/4	5.13	3.75	11	+.005 -.000 3.750	2.38	14	7	+.000 -.002 1.750	+.000 -.002 1.000	1 3/8 R	3 3/4	5 1/8	10 1/4	7 1/2	13/16	±.1 7 3/4	±.010 1.582	2 1/4	5.375	±.040 6.706	1 1/2	±.005 3.750	2 1/4 Dia. .500 Lead	8.0

† Dimension includes diameter of ball screw with indicated lead for right-hand single thread
* *Keyway for Model DM-7512 is 1/8 x 5/64 x 15/16 LG.
Keyway for Models DM-7516 & DM-7523 is 1/4 x 1/8 x 1 1/2.
NOTE: When ordering, specify load and duty cycle.

*Model No. DM-7516: 17/32 dia. on 4.06 dia. bolt circle.
Model No. DM-7523: 21/32 dia. on 4.375 dia. bolt circle.
Model No. DM-7512: 25/64 dia. on 3.44 dia. bolt circle.

7500 Series Standard Screw Ends



Model No.	Dimensions (inches)																		
	A*	B	C	D*	E	F	G	H	J*	K	L	M	N	P	R	S	T*	U*	V*
7511	10 3/8	1 1/8	3/4"-16-UNF-2A	11 1/2	3/4	1	1/2" +.008/-.000	6 5/8	10 7/16	7/16	1 3/16	13/32	3	4 1/4	1 1/2	2 1/4	2	3 1/8	2 1/16
7515	11 1/4	1 1/8	1"-14-UNS-2A	13	1 1/4	1 1/4	3/4" +.010/-.000	7	11 1/4	5/8	1 1/4	11/16	3 1/2	5	1 3/4	2 7/8	2	3 3/4	2 1/16
7522	16 5/8	2 1/4	1 3/4"-12-UN-2A	19 1/8	1 1/2	1 3/4	1 3/4"-.010/-.000	9	16 5/8	1	2 5/16	13/16	5	7	2 5/8	4 3/4	3 3/8	5 7/8	3 7/16

*Closed dimensions may increase for actuator units supplied with bellows boots. Call factory.
Note: Lifting screws listed above are not keyed. Must be held to prevent rotation.

Life Expectancy- 7500 Series

Life expectancy is the life of the actuator in total inches of travel when operated at a given load. In the graph below, curves are provided for each basic high duty cycle actuator model. Each model curve includes the upright, inverted rotating and translating screw versions.

The load values on the chart are for axial loads applied symmetrically to the ball screw or ball nut. Where more than one load is involved in the application, consult Duff-Norton Engineering Department.

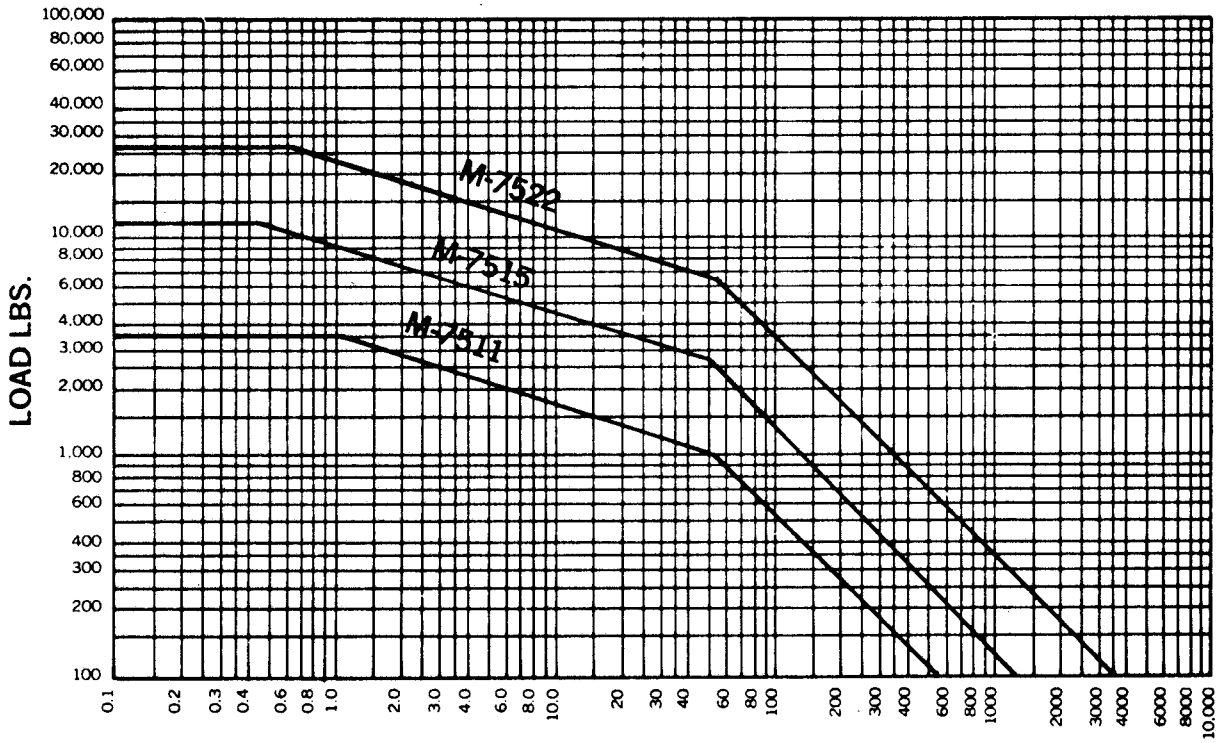
B_{10} Ball Screw Life Expectancy in Millions Inches of Travel

Model No.	100% Max. Cap.	75% Max. Cap.	50% Max. Cap.	25% Max. Cap.	10% Max. Cap.
7511	1.10	2.70	9.50	60.00	150.00
7515	.44	1.00	3.70	34.00	110.00
7522	.64	1.50	5.50	50.00	130.00
Max. Allow. Duty Cycle @1750 RPM Input*	33%	67%	100%	100%	100%

Note: The above Minimum Life Expectancy may be greatly reduced if High Duty Cycle Actuator units are subjected to misalignment, shock loads, side thrust, environmental contamination or lack of lubrication and maintenance.

*Duty Cycles are based on a 100°F temp. rise not to exceed 200°F using Duff-Norton's standard oil.

Life Expectancy
High Duty Cycle Actuators



Life Expectancy (1 = 1,000,000 in. of Travel)

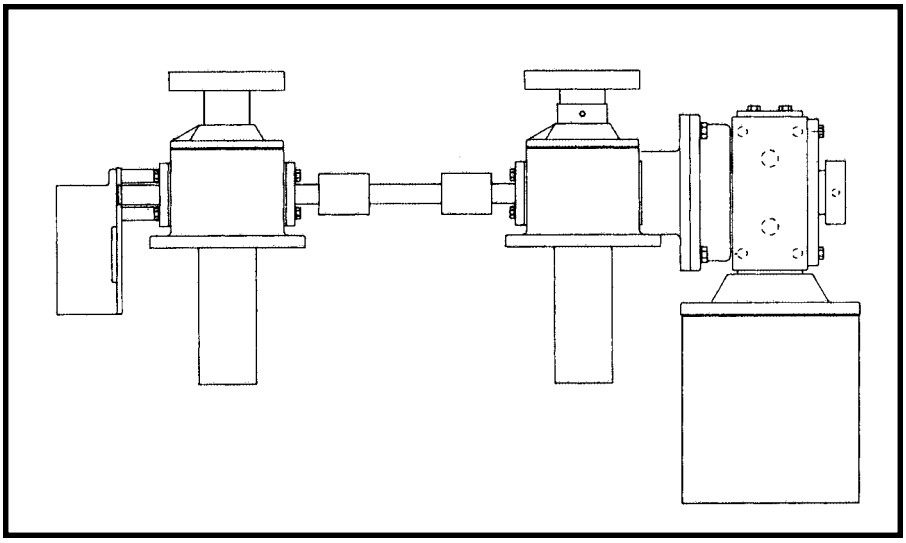
The above minimum life expectancy may be greatly reduced if high duty cycle actuator units are subjected to misalignment, shock loads, side thrust, environmental contamination or lack of lubrication and maintenance.

Motorized Actuator Models

Features:

- Actuator speed reducer drive motor and limit switch in one package.
- Machine screw and ball screw actuator models.
- 2-ton through 35-ton actuator capacity.
- Increased load capability over previously supplied motorized actuators.
- Allows one, two or three actuators to be driven with one motor and speed reducer.
- Four standard speed reduction ratios. Consult factory for other ratios.
- Top and bottom screw stops to prevent accidental overtravel (slave actuators do not have screw stops).
- Equipped with 1750 RPM, 230 / 460 volt, 3 phase motors. Consult factory for motors with other speeds, voltages and features.

Packaged Motorized Actuator System



To Order Motorized Actuators, Specify the Following:

- Actuator Model
- Translating or rotating screw version
- Upright or inverted configuration
- Type of screw end (translating screw actuators)
- Travel
- With or without boot
- With or without anti-backlash feature (machine screw actuators)
- With or without internal keying (translating machine screw actuators)
- With or without limit switch (and mounting position if with limit switch)
- Position indication (visual or digital) -if required
- Speed reducer ratio
- Motor horsepower
- Brake motor standard for ball screw actuators.
- Specify if brake motor is required for machine screw actuators.
- Side and position for speed reducer mounting
- Duty cycle parameters (application load, frequency of use, travel, etc.)
- For other requirements consult factory

Specifications for Machine Screw Actuators:

Driven by 1750 RPM Motors

Actuator Model	Actuator Ratio (:1)	Reducer Ratio (:1)	Lifting Speed (In/Min)	Actuators Per Reducer	Motor Horsepower/Frame Size							
					1/4 HP/56C		1/3 HP/56C		1/2 HP/56C		3/4 HP/56C	
					Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)
1802 7002 9002	6	5	14.6	1	913	1200	913	1700	913	2600	913	4000
				2	913	500	913	750	913	1200	913	1900
				3	913	300	913	450	913	750	913	1200
		10	7.3	1	913	2500	913	3400				
				2	913	1100	913	1600	913	2500	913	3900
				3	913	700	913	1000	913	1600	913	2500
		20	3.6	1	913	4000						
				2	913	2300	913	3100				
				3	913	1500	913	2000				
		40	1.8	1								
				2	913	4000						
				3	913	2600						
9005	6	5	21.9	1	917	700	917	1000	917	1600	917	2500
				2	917	200	917	350	917	700	917	1100
				3	917	50	917	150	917	350	917	700
		10	10.9	1	917	1500	917	2100	917	3300	917	5100
				2	917	650	917	950	917	1500	917	2400
				3	917	350	917	550	917	950	917	1500
		20	5.5	1	917	3000	917	4100	917	6300	917	9600
				2	917	1400	917	1900	917	3000	917	4700
				3	917	850	917	1200	917	1900	917	3000
		40	2.7	1	917	5300	917	7100	917	10000		
				2	917	2500	917	3400	917	5300	920	7800
				3	917	1600	917	2200	917	3400	920	5100
9010	8	5	21.9	1	917	550	917	950	917	1700	917	2800
				2			917	200	917	550	917	1100
				3					917	200	917	550
		10	10.9	1	917	1500	917	2300	917	3700	917	5800
				2	917	500	917	850	917	1500	917	2600
				3	917	150	917	400	917	850	917	1500
		20	5.5	1	917	3400	917	4700	917	7400	917	11000
				2	917	1400	917	2100	917	3400	917	5400
				3	917	750	917	1200	917	2100	917	3400
		40	2.7	1	917	6100	917	8300	917	12500	920	18500
				2	917	2800	917	3900	917	6100	920	9200
				3	917	1600	917	2400	917	3900	920	5900
9015	8	5	21.9	1	917	450	917	700	917	1300	917	2200
				2			917	150	917	450	917	850
				3					917	150	917	450
		10	10.9	1	917	1200	917	1700	917	2800	917	4500
				2	917	400	917	650	917	1200	917	2000
				3	917	100	917	300	917	650	917	1200
		20	5.5	1	917	2600	917	3600	917	5700	917	8800
				2	917	1100	917	1600	917	2600	917	4200
				3	917	600	917	900	917	1600	917	2600
		40**	2.7**	1	917	4700	917	6500	917	9900	920	14500
				2	917	2100	917	3000	917	4700	920	7100
				3	917	1300	917	1800	917	3000	920	4600
9020	8	5	21.9	1	917	200	917	450	917	1000	917	1800
				2					917	200	917	600
				3							917	200
		10	10.9	1	917	950	917	1400	917	2500	917	4000
				2	917	150	917	400	917	950	917	1700
				3			917	50	917	400	917	950
		20	5.5	1	917	2200	917	3200	917	5100	917	8000
				2	917	800	917	1300	917	2200	917	3700
				3	917	350	917	650	917	1300	917	2200
		40**	2.7**	1	917	4200	917	5800	917	9100	920	13500
				2	917	1800	917	2600	917	4200	920	6400
				3	917	1000	917	1500	917	2600	920	4100

* Lifting Capacity Per Actuator

** For reducer model 8, the reducer ratio is 39:1 and the lifting speed is 2.8 in. / min.

*** For reducer model 9, the reducer ratio is 41:1

Motor Horsepower/Frame Size													
1 HP/56C		1 1/2 HP/56C		2 HP/145TC		3 HP/182TC		5 HP/184TC		7 1/2 HP/213TC		10 HP/215TC	
Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)
913	2600												
913	1700												
917	3500	917	5300	917	7200	926	10000						
917	1600	917	2500	917	3500	926	5200	935	9000				
917	1000	917	1600	917	2200	926	3400	935	5900				
917	6800	917	10000										
917	3300	917	5100	920	6700	926	10000						
917	2100	917	3300	920	4400	926	7000	935	10000				
920	6200	926	9800										
920	4000	926	6400	926	8700								
926	10000												
926	7400	935	10000										
917	3900	917	6200	917	8400	926	12500	935	20000				
917	1700	917	2800	917	3900	926	6000	935	10500				
917	950	917	1700	917	2400	926	3800	935	6900				
917	8000	917	12000	920	16000								
917	3700	917	5800	920	7900	926	12500	935	20000				
917	2300	917	3700	920	5000	926	8200	935	13500	943	20000		
920	15000	926	20000										
920	7200	926	11500	926	15500	935	20000						
920	4600	926	7500	926	10000	935	14500						
926	13000	935	18500										
926	8700	935	12000	935	16000								
917	3000	917	4800	917	6500	926	9800	935	17000				
917	1300	917	2200	917	3000	926	4700	935	8200				
917	700	917	1300	917	1900	926	3000	935	5300				
917	6200	917	9500	920	12500	926	20000	935	30000				
917	2800	917	4500	920	6100	926	9800	935	16000	943	24000	943	30000
917	1700	917	2800	920	3900	926	6400	935	10500	943	16000	943	21000
920	11500	926	18000	926	24000	935	30000						
920	5600	926	8900	926	12000	935	17500	943	30000				
920	3600	926	5800	926	7900	935	11500	943	20000	8	30000		
926	21000	935	29000										
926	10000	935	14000	935	19000	943	30000						
926	6700	935	9400	935	12500	943	20000	8**	30000				
917	2600	917	4300	917	5900	926	9000	935	15500				
917	1000	917	1800	917	2600	926	4200	935	7500				
917	450	917	1000	917	1500	926	2600	935	4800				
917	5500	917	8600	920	11500	926	18500	935	30000	943	40000		
917	2500	917	4000	920	5500	926	8900	935	14500	943	22000	943	30000
917	1400	917	2500	920	3400	926	5700	935	9600	943	14500	943	20000
920	10500	926	16500	926	22000	935	32000						
920	5000	926	8100	926	11000	935	16000	943	28000	8	40000		
920	3100	926	5200	926	7100	935	10500	943	18500	8	28000	8	37000
926	19000	935	27000	935	36000								
926	9400	935	13000	935	17500	943	28000	8**	40000				
926	6100	935	8600	935	11500	943	18500	8**	32000				

* Lifting Capacity Per Actuator

** For reducer model 8, the reducer ratio is 39:1 and the lifting speed is 2.8 in./min.

*** For reducer model 9, the reducer ratio is 41:1

Specifications for Machine Screw Actuators:
Driven by 1750 RPM Motors *(continued)*

Actuator Model	Actuator Ratio (:1)	Reducer Ratio (:1)	Lifting Speed (In/Min)	Actuators Per Reducer	Motor Horsepower/Frame Size							
					1/4 HP/56C		1/3 HP/56C		1/2 HP/56C		3/4 HP/56C	
					Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)
9025	10.667	5	21.9	1			917	300	917	900	917	1800
				2							917	450
				3								
		10	10.9	1	917	800	917	1400	917	2500	917	4300
				2			917	250	917	800	917	1700
				3					917	250	917	800
		20	5.5	1	917	2300	917	3300	917	5500	917	8700
				2	917	700	917	1200	917	2300	917	3900
				3	917	150	917	500	917	1200	917	2300
		*** 40**	2.7**	1	917	4500	917	6300	917	9900	920	14500
				2	917	1800	917	2700	917	4500	920	7000
				3	917	900	917	1500	917	2700	920	4300
9035	10.667	5	21.9	1			917	50	917	550	917	1300
				2							917	200
				3								
		10	10.9	1	917	450	917	950	917	1800	917	3200
				2					917	450	917	1100
				3							917	450
		20	5.5	1	917	1600	917	2500	917	4200	917	6800
				2	917	400	917	800	917	1600	917	2900
				3			917	250	917	800	917	1600
		*** 40**	2.7**	1	917	3400	917	4800	917	7700	920	11500
				2	917	1200	917	2000	917	3400	920	5400
				3	917	550	917	1000	917	2000	920	3300

* Lifting Capacity Per Actuator
** For reducer model 8, the reducer ratio is 39:1 and the lifting speed is 2.8 in. / min.
*** For reducer model 9, the reducer ratio is 41:1

Motor Horsepower/Frame Size													
1 HP/56C		1 1/2 HP/56C		2 HP/145TC		3 HP/182TC		5 HP/184TC		7 1/2 HP/213TC		10 HP/215TC	
Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)
917	2700	917	4500	917	6400	926	9800	935	17000				
917	900	917	1800	917	2700	926	4400	935	8100				
917	300	917	900	917	1500	926	2600	935	5100				
917	6000	917	9400	920	12500	926	20000	935	33000	943	50000		
917	2500	917	4300	920	5900	926	9800	935	16000	943	25000	943	33000
917	1400	917	2500	920	3600	926	6200	935	10500	943	16000	943	22000
920	11500	926	18500	926	25000	935	36000						
920	5400	926	8900	926	12000	935	17500	943	31000	8	47000		
920	3300	926	5600	926	7800	935	11500	943	20000	8	31000	8	42000
926	21000	935	30000	935	40000								
926	10000	935	14500	935	19500	943	31000	8**	50000				
926	6500	935	9400	935	12500	943	20000	8**	35000	9***	50000		
917	2000	917	3400	917	4900	926	7700	935	13500				
917	550	917	1300	917	2000	926	3400	935	6300				
917	50	917	550	917	1000	926	1900	935	3900				
917	4600	917	7400	920	10000	926	16000	935	26000	943	40000	943	54000
917	1800	917	3200	920	4500	926	7600	935	12500	943	19500	943	26000
917	950	917	1800	920	2700	926	4800	935	8200	943	12500	943	17500
920	9200	926	14500	926	20000	935	29000	943	50000	8	70000		
920	4100	926	6900	926	9500	935	14000	943	24000	8	37000	8	50000
920	2400	926	4300	926	6000	935	9000	943	16000	8	24000	8	33000
926	17000	935	23000	935	32000	943	51000	8**	70000				
926	8100	935	11500	935	15500	943	25000	8**	42000	9***	67000		
926	5100	935	7300	935	10000	943	16500	8**	28000	9***	44000		

* Lifting Capacity Per Actuator

** For reducer model 8, the reducer ratio is 39:1 and the lifting speed is 2.8 in. / min.

*** For reducer model 9, the reducer ratio is 41:1

Specifications for Ball Screw Actuators:
Driven by 1750 RPM Motors

Actuator Model	Actuator Ratio (:1)	Reducer Ratio (:1)	Lifting Speed (In/Min)	Actuators Per Reducer	MOTOR HORSEPOWER/FRAME SIZE							
					1/4 HP/56C		1/3 HP/56C		1/2 HP/56C		3/4 HP/56C	
					Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)
2802 7802 9802	6	5	14.6	1	913	3200	913	4000				
				2	913	1400	913	2000	913	3200	913	4000
				3	913	900	913	1200	913	2000	913	3200
		10	7.3	1								
				2	913	3000	913	4000				
				3	913	1900	913	2700	913	4000		
		20	3.6	1								
				2								
				3	913	3800						
		40	1.8	1								
				2								
				3								
28021 78021 98021	6	5	58.3	1	913	700	913	1000	913	1700	913	2600
				2	913	200	913	400	913	700	913	1200
				3	913	50	913	150	913	400	913	700
		10	29.2	1	913	1600	913	2200	913	3400		
				2	913	650	913	950	913	1600	913	2500
				3	913	350	913	550	913	950	913	1600
		20	14.6	1	913	3100	913	4000				
				2	913	1400	913	2000				
				3	913	900	913	1200				
		40	7.3	1								
				2	913	2600						
				3	913	1600						
28003 98003	6	5	24.1	1	913	2000	913	2800	913	4400	913	6000
				2	913	850	913	1200	913	2000	913	3200
				3	913	450	913	750	913	1200	913	2000
		10	12.0	1	913	4100	913	5600				
				2	913	1900	913	2600	913	4100	913	6000
				3	913	1200	913	1600	913	2600	913	4100
		20	6.0	1								
				2	913	3800	913	5200				
				3	913	2400	913	3300				
		40	3.0	1								
				2	913	6000						
				3	913	4300						
9805	6	5	27.6	1	917	1400	917	2100	917	3400	917	5400
				2	917	500	917	800	917	1400	917	2400
				3	917	150	917	350	917	800	917	1400
		10	13.8	1	917	3200	917	4400	917	6900	917	10000
				2	917	1300	917	2000	917	3200	917	5100
				3	917	750	917	1100	917	2000	917	3200
		20	6.9	1	917	6400	917	8700				
				2	917	2900	917	4100	917	6400	917	9900
				3	917	1800	917	2500	917	4100	917	6400
		40	3.5	1	917	10000						
				2	917	5300	917	7200	917	10000		
				3	917	3400	917	4700	917	7300	920	10000
98051	6	5	58.3	1	917	400	917	700	917	1300	917	2100
				2			917	150	917	400	917	850
				3					917	150	917	400
		10	29.2	1	917	1200	917	1700	917	2800	917	4400
				2	917	350	917	650	917	1200	917	2000
				3	917	100	917	300	917	650	917	1200
		20	14.6	1	917	2600	917	3600	917	5600	917	8600
				2	917	1000	917	1500	917	2600	917	4100
				3	917	550	917	900	917	1600	917	2600
		40	7.3	1	917	4600	917	6300	917	9700		
				2	917	2100	917	2900	917	4600	920	7000
				3	917	1200	917	1800	917	2900	920	4500

*Lifting Capacity Per Actuator

MOTOR HORSEPOWER/FRAME SIZE													
1 HP/56C		1 1/2 HP/143TC		2 HP/145TC		3 HP/182TC		5 HP/184TC		7 1/2 HP/213TC		10 HP/215TC	
Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)
913	4000												
913	3600												
913	1700												
913	1000												
913	4400												
913	2800												
917	7300	917	10000										
917	3400	917	5400	917	7300	926	10000						
917	2100	917	3400	917	4700	926	7200						
917	6900	920	10000										
917	4400	920	6800	920	9300								
920	8500												
917	3000	917	4700	917	6400	926	9600						
917	1300	917	2100	917	3000	926	4600	935	8100				
917	700	917	1300	917	1800	926	2900	935	5200				
917	6000	920	9200	920	10000								
917	2800	920	4400	920	6000	926	9600						
917	1700	920	2800	920	3800	926	6200	935	10000				
920	10000												
920	5500	926	8700	926	10000								
920	3500	926	5700	926	7700	935	10000						
926	10000												
926	6600	935	9200										

*Lifting Capacity Per Actuator

Specifications for Ball Screw Actuators:
Driven by 1750 RPM Motors *(continued)*

Actuator Model	Actuator Ratio (:1)	Reducer Ratio (:1)	Lifting Speed (In/Min)	Actuators Per Reducer	MOTOR HORSEPOWER/FRAME SIZE							
					1/4 HP/56C		1/3 HP/56C		1/2 HP/56C		3/4 HP/56C	
					Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)
9810	8	5	20.7	1	917	1500	917	2300	917	4000	917	6400
				2	917	300	917	700	917	1500	917	2700
				3			917	150	917	700	917	1500
		10	10.4	1	917	3700	917	5300	917	8400	917	13000
				2	917	1400	917	2200	917	3700	917	6100
				3	917	650	917	1100	917	2200	917	3700
		20	5.2	1	917	7700	917	10500	917	16000		
				2	917	3400	917	4800	917	7700	917	12000
				3	917	1900	917	2900	917	4800	917	7700
		40	2.6	1	917	13500	917	18500				
				2	917	6400	917	8800	917	13500	920	20000
				3	917	3900	917	5500	917	8800	920	13000
98101	8	5	43.8	1	917	500	917	850	917	1600	917	2600
				2			917	150	917	500	917	1000
				3					917	150	917	500
		10	21.9	1	917	1400	917	2100	917	3400	917	5400
				2	917	450	917	800	917	1400	917	2400
				3	917	150	917	350	917	800	917	1400
		20	10.9	1	917	3200	917	4400	917	6900	917	10500
				2	917	1300	917	1900	917	3200	917	5000
				3	917	700	917	1100	917	1900	917	3200
		40	5.5	1	917	5700	917	7800	917	12000	920	17500
				2	917	2600	917	3600	917	5700	920	8600
				3	917	1500	917	2200	917	3600	920	5500
9820	8	5	21.9	1	917	50	917	900	917	2500	917	5000
				2					917	50	917	1300
				3							917	50
		10	10.9	1	917	2300	917	3800	917	7000	917	11500
				2			917	700	917	2300	917	4600
				3					917	700	917	2300
		20	5.5	1	917	6300	917	9300	917	15000	917	24000
				2	917	1900	917	3400	917	6300	917	10500
				3	917	500	917	1400	917	3400	917	6300
		40	2.7	1	917	12000	917	17000	917	27000	920	40000
				2	917	4900	917	7400	917	12000	920	19000
				3	917	2500	917	4100	917	7400	920	11500
9825	10.667	5	21.7	1	917	50	917	800	917	2400	917	4700
				2					917	50	917	1200
				3							917	50
		10	10.8	1	917	2100	917	3600	917	6500	917	10500
				2			917	650	917	2100	917	4300
				3					917	650	917	2100
		20	5.4	1	917	5900	917	8600	917	14000	917	22000
				2	917	1800	917	3200	917	5900	917	10000
				3	917	450	917	1300	917	3200	917	5900
		40	2.7	1	917	11500	917	16000	917	25000	920	38000
				2	917	4600	917	6900	917	11500	920	17500
				3	917	2300	917	3800	917	6900	920	11000

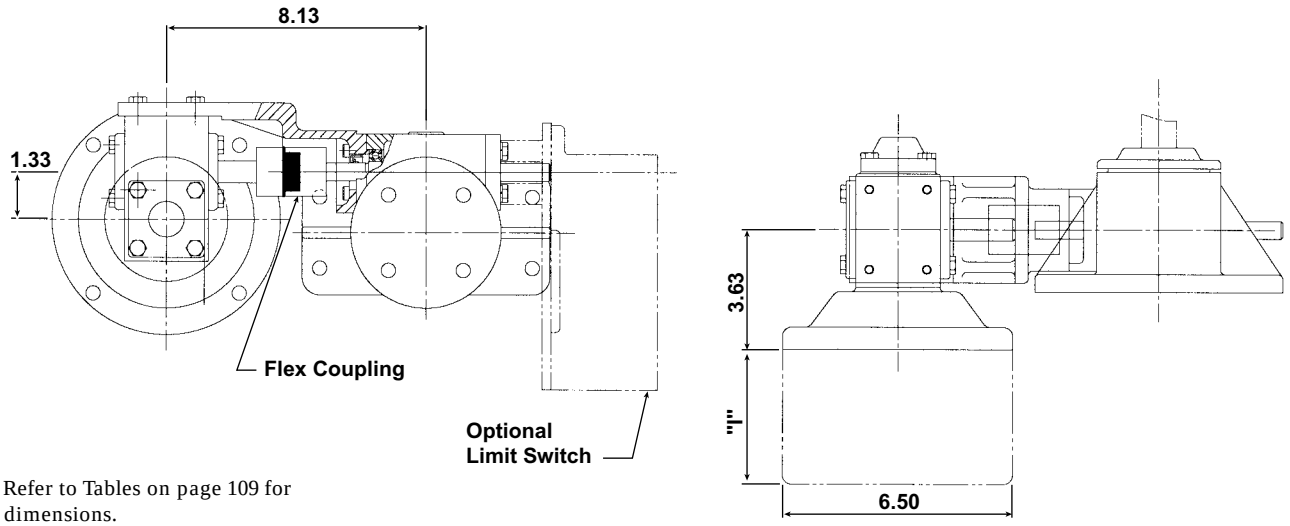
*Lifting Capacity Per Actuator

MOTOR HORSEPOWER/FRAME SIZE													
1 HP/56C		1 1/2 HP/143TC		2 HP/145TC		3 HP/182TC		5 HP/184TC		7 1/2 HP/213TC		10 HP/215TC	
Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)	Reducer Model	Lifting* Capacity (Lb)
917	8900	917	13500	917	18500								
917	4000	917	6400	917	8900	926	13500	935	20000				
917	2300	917	4000	917	5600	926	8700	935	15000				
917	17500												
917	8400	920	12500	920	17500								
917	5300	920	8300	920	11000	926	18000						
920	16000												
920	10000	926	16500	926	20000								
926	19000												
917	3700	917	5800	917	7900	926	11500	935	20000				
917	1600	917	2600	917	3700	926	5700	935	9900				
917	850	917	1600	917	2300	926	3600	935	6400				
917	7500	920	11000	920	15000	926	20000						
917	3400	920	5400	920	7400	926	11500	935	19000				
917	2100	920	3400	920	4700	926	7700	935	12500	943	19500		
920	14000	926	20000										
920	6800	926	10500	926	14500	935	20000						
920	4300	926	7000	926	9500	935	13500	943	20000				
926	12000	935	17000	935	20000								
926	8100	935	11000	935	15000	943	20000						
917	7500	917	12500	917	17500	926	26000	935	40000				
917	2500	917	5000	917	7500	926	12000	935	22000				
917	900	917	2500	917	4200	926	7300	935	14000				
917	16500	920	25000	920	35000								
917	7000	920	11500	920	16000	926	26000	935	40000				
917	3800	920	6900	920	10000	926	17000	935	28000	943	40000		
920	32000												
920	14500	926	24000	926	33000	935	40000						
920	9100	926	15000	926	21000	935	31000						
926	28000	935	39000										
926	18000	935	25000	935	35000								
917	7000	917	11500	917	16000	926	25000	935	44000				
917	2400	917	4700	917	7000	926	11000	935	20000				
917	800	917	2400	917	3900	926	6800	935	13000				
917	15000	920	23000	920	32000	926	50000						
917	6500	920	10500	920	15000	926	25000	935	41000				
917	3600	920	6400	920	9300	926	15500	935	26000	943	42000	943	50000
920	29000	926	47000										
920	13500	926	22000	926	31000	935	45000						
920	8400	926	14000	926	19500	935	29000	943	50000				
926	50000												
926	26000	935	37000	935	50000								
926	16500	935	24000	935	32000	943	50000						

*Lifting Capacity Per Actuator

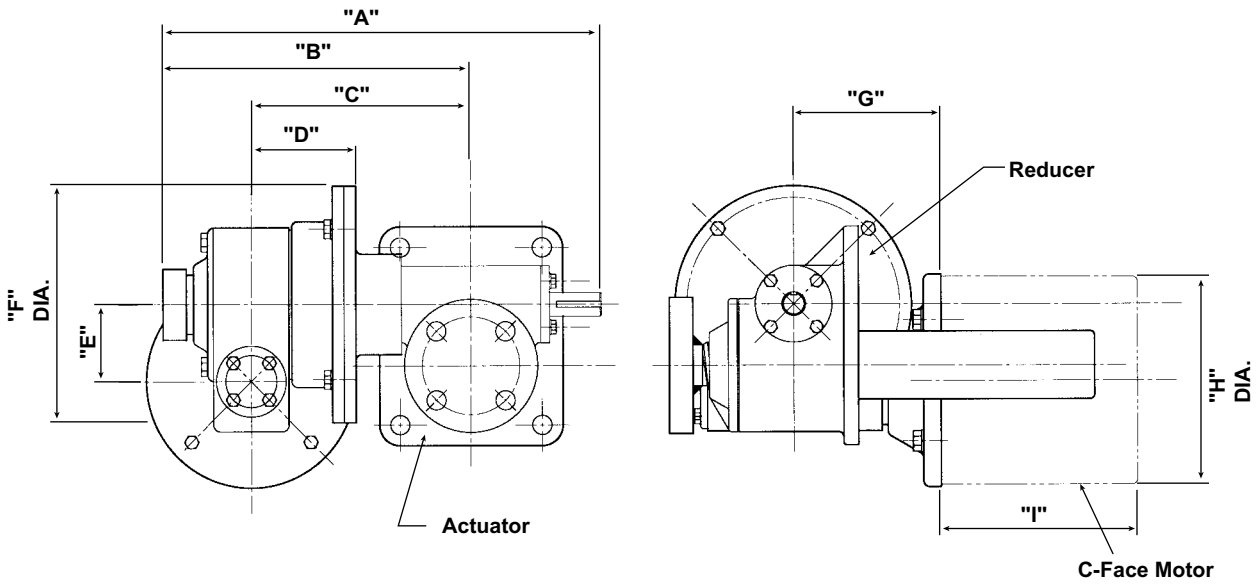
Motorized Actuators

Figure 1 - Dimensions for 2 and 3 Ton Actuators
Models 1802, 2802, 28021, 28003, 7002, 7802, 78021, 9002, 9802, 98021, and 98003



Refer to Tables on page 109 for dimensions.

Figure 2 - Dimensional Diagram for 5 through 35 Ton Actuators
Models 9005, 9010, 9015, 9020, 9025, 9035, 9805, 98051, 9810, 98101, 9820, 9825



Refer to Tables on page 109 for dimensions.

Note: Motorized Actuators are supplied with screw stops. Actuator closed heights and cover pipe lengths increase over those shown for standard actuators in the "Design Guide." Consult factory.

Motorized Actuator Specifications

Dimensions For Motorized Actuators

Actuator Capacity (tons)	Reducer Model	Motor Frame	A (in)	B (in)	C (in)	D (in)	E (in)	F (in)	G (in)	H (in)
5	917	56C/140TC	15.25	10.75	7.50	3.50	1.750	6.75	4.06	6.50
	920	56C/140TC	15.00	10.50	7.13	3.25	2.000	7.88	4.06	6.50
	926	56C/140TC	16.32	11.82	8.13	4.00	2.625	9.13	5.38	6.50
	926	180TC	16.32	11.82	8.13	4.00	2.625	9.13	5.56	9.00
	935	56C/140TC	18.44	13.94	9.50	4.00	3.500	11.00	5.81	6.50
	935	180TC	18.44	13.94	9.50	4.00	3.500	11.00	6.00	8.00
10	917	56C/140TC	17.13	11.63	8.38	4.38	1.750	6.75	4.06	6.50
	920	56C/140TC	17.13	11.63	8.25	4.38	2.000	7.88	4.06	6.50
	926	56C/140TC	18.22	12.72	9.03	4.91	2.625	9.13	5.38	6.50
	926	180TC	18.22	12.72	9.03	4.91	2.625	9.13	5.56	9.00
	935	56C/140TC	19.81	14.31	9.88	4.38	3.500	11.00	5.81	6.50
	935	180TC	19.81	14.31	9.88	4.38	3.500	11.00	6.00	9.00
	943	180TC	20.50	15.00	10.63	4.38	4.250	13.00	6.81	9.00
	943	210TC	20.50	15.00	10.63	4.38	4.250	13.00	6.81	9.00
15	917	56C/140TC	17.13	11.63	8.38	4.38	1.750	6.75	4.06	6.50
	920	56C/140TC	17.13	11.63	8.25	4.38	2.000	7.88	4.06	6.50
	926	56C/140TC	18.22	12.72	9.03	4.91	2.625	9.13	5.38	6.50
	926	180TC	18.22	12.72	9.03	4.91	2.625	9.13	5.56	9.00
	935	56C/140TC	19.81	14.31	9.88	4.38	3.500	11.00	5.81	6.50
	935	180TC	19.81	14.31	9.88	4.38	3.500	11.00	6.00	9.00
	943	180TC	20.50	15.00	10.63	4.38	4.250	13.00	6.81	9.00
	943	210TC	20.50	15.00	10.63	4.38	4.250	13.00	6.81	9.00
	8	180TC	21.82	16.32	10.63	4.38	4.600	14.25	7.31	9.00
	8	210TC	21.82	16.32	10.63	4.38	4.600	14.25	7.31	9.00
20	917	56C/140TC	17.13	11.63	8.38	4.38	1.750	6.75	4.06	6.50
	920	56C/140TC	17.13	11.63	8.25	4.38	2.000	7.88	4.06	6.50
	926	56C/140TC	18.22	12.72	9.03	4.91	2.625	9.13	5.38	6.50
	926	180TC	18.22	12.72	9.03	4.91	2.625	9.13	5.56	9.00
	935	56C/140TC	19.81	14.31	9.88	4.38	3.500	11.00	5.81	6.50
	935	180TC	19.81	14.31	9.88	4.38	3.500	11.00	6.00	9.00
	943	180TC	20.50	15.00	10.63	4.38	4.250	13.00	6.81	9.00
	943	210TC	20.50	15.00	10.63	4.38	4.250	13.00	6.81	9.00
	8	180TC	21.82	16.32	10.63	4.38	4.600	14.25	7.31	9.00
	8	210TC	21.82	16.32	10.63	4.38	4.600	14.25	7.31	9.00
25 & 35	917	56C/140TC	19.63	12.63	9.38	5.38	1.750	6.75	4.06	6.50
	920	56C/140TC	19.63	12.63	9.25	5.38	2.000	7.88	4.06	6.50
	926	56C/140TC	20.72	13.72	10.03	5.91	2.625	9.13	5.38	6.50
	926	180TC	20.72	13.72	10.03	5.91	2.625	9.13	5.56	9.00
	935	56C/140TC	22.31	15.31	10.88	5.38	3.500	11.00	5.81	6.50
	935	180TC	22.31	15.31	10.88	5.38	3.500	11.00	6.00	9.00
	943	180TC	23.00	16.00	11.63	5.38	4.250	13.00	6.81	9.00
	943	210TC	23.00	16.00	11.63	5.38	4.250	13.00	6.81	9.00
	8	180TC	24.32	17.32	11.63	5.38	4.600	14.25	7.31	9.00
	8	210TC	24.32	17.32	11.63	5.38	4.600	14.25	7.31	9.00
	9	210TC	25.69	18.69	12.88	5.38	5.167	15.50	8.75	9.00

Refer to Figure 2 for diagram.

Dimensions for Motors*

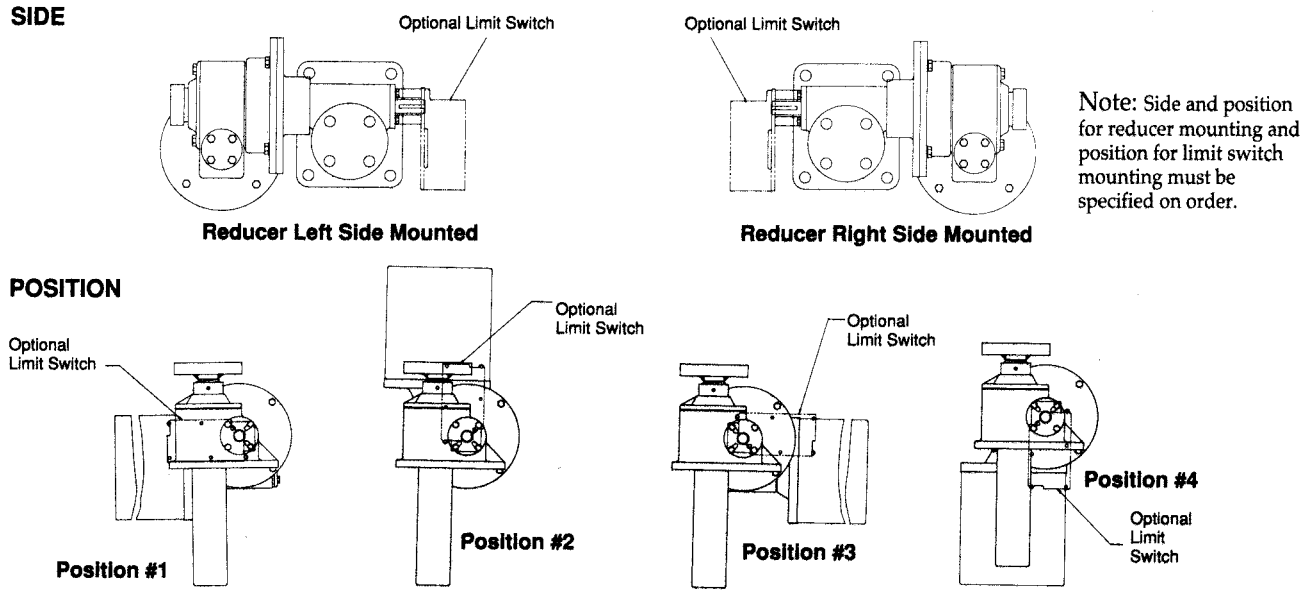
Motor Horsepower (HP)	Motor Without Brake		Motor With Brake	
	Frame	I (in.)	Frame	I (in.)
0.25	C56C	7.88	C56C	11.50
0.33	C56C	7.88	C56C	11.50
0.50	D56C	8.38	D56C	12.00
0.75	D56C	9.25	E56C	12.50
1.00	E56C	9.75	E56C	14.00
1.50	F56C	10.25	F145TC	14.88
2.00	F145TC	10.63	H145TC	15.88
3.00	F182TC	12.29	E182TC	17.19
5.00	F184TC	12.29	F184TC	17.69
7.50	LS213TC	15.25	LS213TC**	26.63
10.00	215TC	17.50	215TC**	25.88

Refer to Figure 2 for diagram

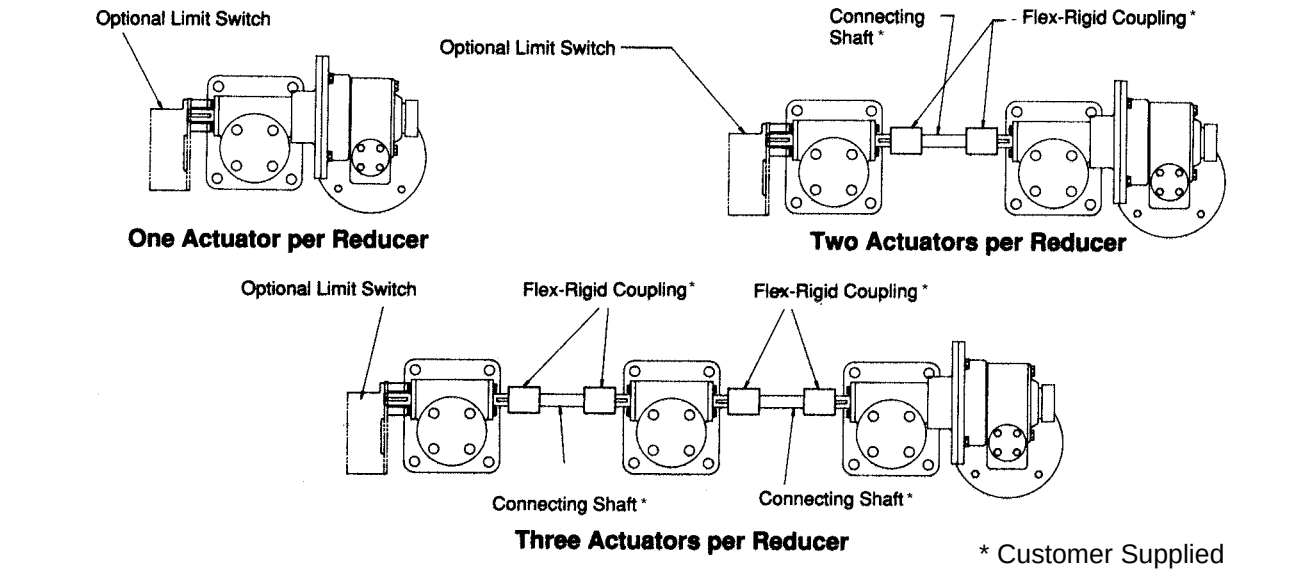
*Dimensions presented are typical for 1750 RPM, 230/460 volt, three phase, 60 Hertz, TEFC motors and are for reference only. Dimensions will vary with motor type, voltage, speed and manufacturer.

**Motors with double C-face brake.

Available Reducer Mounting Configurations



Typical Arrangements for One, Two and Three Actuators per Reducer



Accessories Overview

Duff-Norton machine screw and ball screw actuators can be used in a single arrangement or can be used in a multiple arrangement along with a complete line of accessories to provide for a mechanically interconnected and permanently synchronized system.

With readily available Duff-Norton accessories, connecting shafts can be coupled to the actuator, gear boxes can provide for the rotation and connection for a multiple actuator arrangement, and limit switches can be used to limit travel and provide for an up-stop and down-stop.

Bellows boots to protect the actuator from dirt and other contaminants and allow for longer life are available in both upright and inverted screw styles.

C-face motor actuators, available through 20-ton capacity, are designed with standard NEMA C-face dimensions and allow direct coupling of a motor shaft with either the left or right side actuator input shaft.

Analog or digital position indicators, when used with machine or ball screw actuator systems, allow for precision positioning in applications where a high degree of accuracy is required.

C-Face motor adapters available through 20-ton capacity are designed with standard NEMA C-face dimensions and allow direct coupling of a motor shaft with either the left or right side actuator input shaft. We also provide C-Face gear reducers and C-Face motor installations up to 50 ton in size.

If you have a special, unique requirement not shown in this catalog, please give us a call, as we may have already designed a similar system! Specials are made to order. Please do not hesitate to send us your requirements in confidence.

Accessories	**Catalog Page**
Bellows Boots	Pg. 112-114
Mitre Gear Boxes	Pg. 115-118
C-Face Motor Adapter	Pg. 119-120
Couplings	Pg. 121
AC Motor Controls	Pg. 122-124

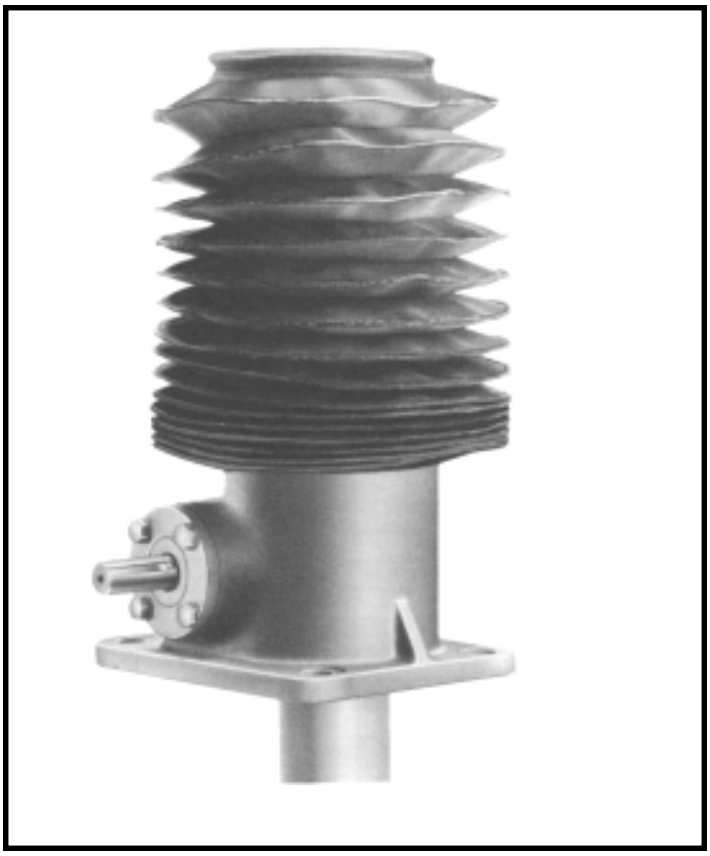
Positioning Solutions	**Number of Stops**	**Accuracy ***	**Cost**	**Catalog Page**
Duff-Norton Rotary Limit Switch	2	0.12 ➜ 0.01	Least expensive	Pg. 125-127
Gemco Electric Limit Switch	up to XX	0.25 ➜ 0.02		Contact Factory
Transducer		*0.07 ➜ 0.3*		*Pg. 128*
Visual Position Indicator		*1% ➜ 3%*		*Pg. 128*
Programmable Digital Position Indicator		*0.001 – 0.004*		*Pg. 129*
Standard Encoder	unlimited based on control logic	0.001 – 0.004		Pg. 130
Ring Kit Encoder	unlimited based on control logic	0.001 – 0.010		Pg. 131
Magnetostrictive Position Sensor	unlimited based on control logic	+/- 0.002	Most expensive	Pg. 132

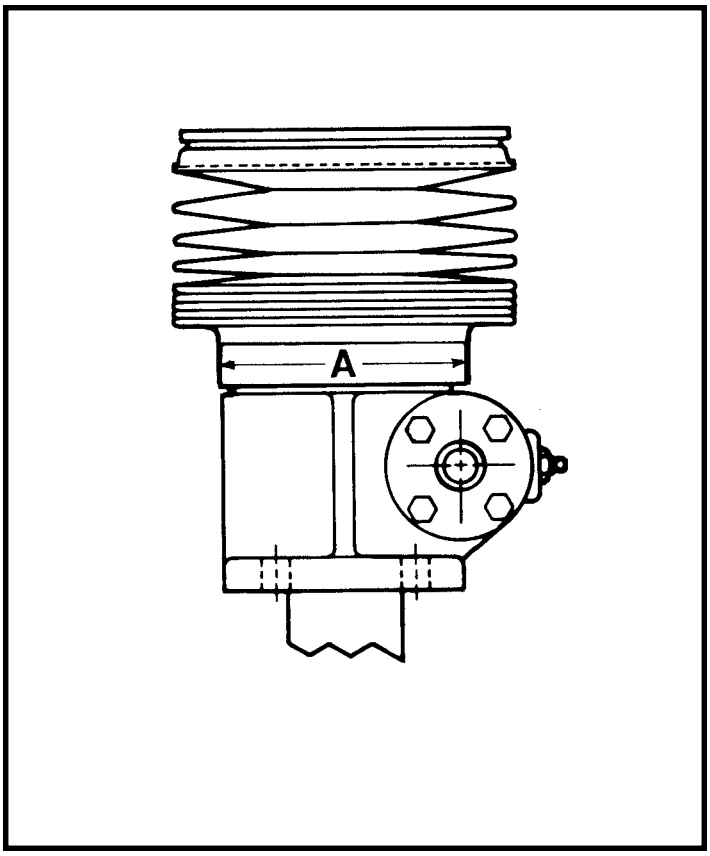
Please contact our application engineers for advice on the best positioning device for your needs.

* For non-reversing loads. The actuator drive system must be considered to properly position actuators. Does not include deflection.

Bellows Boots

- Features: Protects the screw from dust and dirt.
- Helps maintain the proper lubrication.
- Guards against moisture and corrosive contaminants.
- Boots are made of neoprene-coated nylon with sewn construction. Other materials are available for applications involving high temperatures, highly corrosive atmospheres and other special conditions.



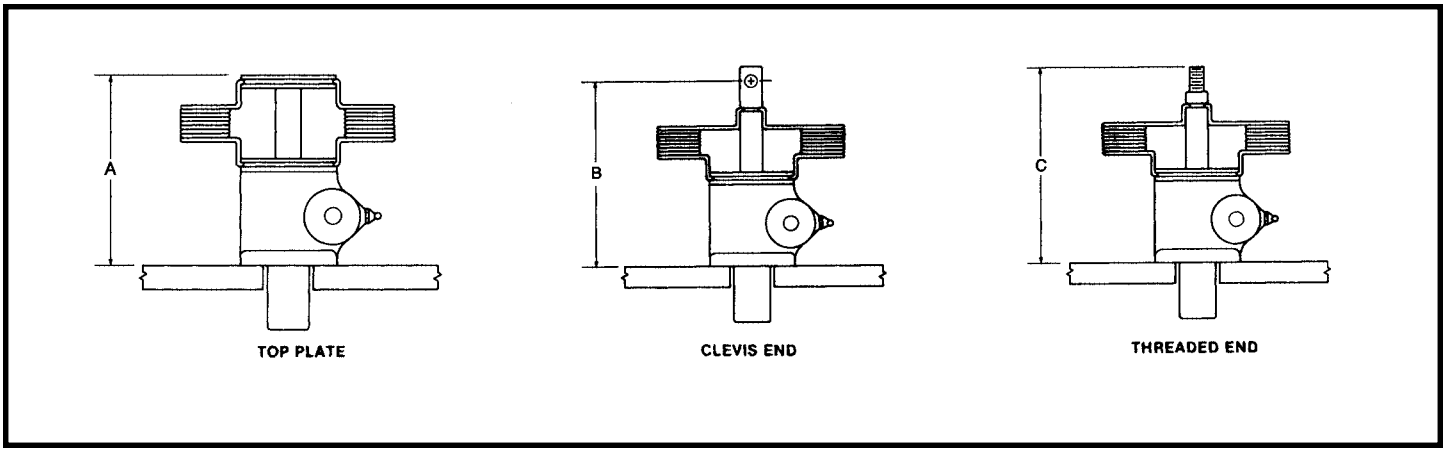


Boot Installation Data

Shell Cap Diameter "A"	Capacity															
	500 lb.	1000 lb.	1 Ton	2 Ton	3 Ton	5 Ton	10 Ton	15 Ton	20 Ton	25 Ton	35 Ton	50 Ton	75 Ton	100 Ton	150 Ton	250 Ton
Machine Screw	2 1/4	2 1/4	2 3/4	3 1/2	N.A.	4 1/2	5 1/4	5 5/8	6	7 1/2	7 7/8	11 1/4	13 1/4	10	10	16
Ball Screw	N.A.	2 1/4	N.A.	3 1/2	3 1/2	5 3/8	4 1/2	N.A.	7	8 7/8	N.A.	9 1/2	N.A.	N.A.	N.A.	N.A.

Note: For horizontal installation exceeding 18” of travel, internal boot guides are recommended.

Closed Height When Optional Bellows Boots Are Required On Standard Upright Actuators

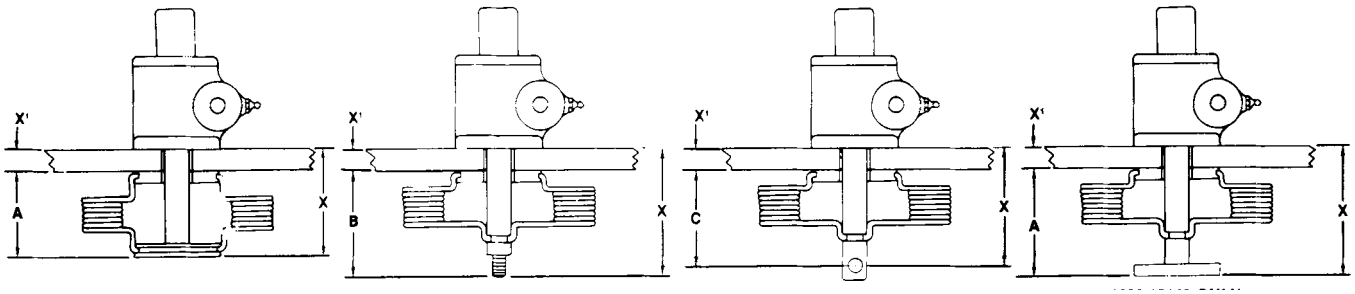


		Raise																							
Model	Boot	up to 12"			over 12" to 18"			over 18" to 24"			over 24" to 30"			over 30" to 36"			over 36" to 48"			over 48" to 60"			over 60" to 72"		
No.	O.D.	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
2555	4.25	4	4	4 1/4	4 3/4	4 5/8	5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2625	4.25	4	4	4 1/2	4 1/4	4 5/8	4 1/2	4 1/4	4 5/8	4 1/2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2501	6.0	4 1/2	5	5 3/8	5 1/8	5 5/8	6	5 1/2	5 3/4	6 1/4	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1802	7.75	5 1/4	6 1/2	7 1/4	5 1/4	7 1/2	8 1/4	5 3/4	7 1/2	8 1/4	5 3/4	7 1/2	8 1/4	6 1/4	8 1/2	9 1/4	---	---	---	---	---	---	---	---	---
7002	7.75	5 1/4	6 1/2	7 1/4	5 1/4	7 1/2	8 1/4	5 3/4	7 1/2	8 1/4	5 3/4	7 1/2	8 1/4	6 1/4	8 1/2	9 1/4	---	---	---	---	---	---	---	---	---
9002	7.75	5 1/4	6 1/2	7 1/4	5 1/4	7 1/2	8 1/4	5 3/4	7 1/2	8 1/4	5 3/4	7 1/2	8 1/4	6 1/4	8 1/2	9 1/4	---	---	---	---	---	---	---	---	---
9005	7.75	7	7	8	7	8 1/2	9 1/2	7	8 1/2	9 1/2	8	8 1/2	9 1/2	8	10	11	9	10	11	---	---	---	---	---	---
9010	9.0	7 1/4	8 1/2	9 3/4	7 1/4	8 1/2	9 3/4	7 1/4	9 1/2	10 3/4	8 1/2	9 1/2	10 3/4	8 1/2	9 1/2	10 3/4	9 1/2	10 1/2	11 3/4	10 1/2	11 1/2	12 3/4	11 1/2	12 1/2	13 3/4
9015	9.0	8	8 1/2	9 3/4	8	10	11 1/4	8	10	11 1/4	9	10	11 1/4	9	10	11 1/4	11	12	12 1/4	11	12	13 1/4	12	13	14 1/4
9020	9.0	9 1/4	10	11 1/2	9 1/4	11	12 1/2	9 1/4	11	12 1/2	10 1/2	12	13 1/2	10 1/2	12	13 1/2	11 1/2	13	14 1/2	12 1/2	14	15 1/2	13 1/2	15	16 1/2
9025	10.75	11	12	13 3/4	11	12	13 3/4	11	13 1/4	15	12	13 1/4	15	12	14 1/2	16 1/4	13	15 3/4	17 1/2	14	15 3/4	17 1/2	15	16 3/4	18 1/2
9035	11.0	12	13	15	12	13	---	12	13	15	12	13 3/4	15 3/4	12	13 3/4	15 3/4	12 7/8	14 3/4	16 3/4	13 3/4	15 1/2	17 1/2	14 3/4	16 1/2	18 1/2
1850	14.5	13	15	17 1/2	13	16	18 1/2	13	16	18 1/2	14	16	18 1/2	14	17	19 1/2	15	18	20 1/2	16	18	20 1/2	17	19	21 1/2
9050	14.5	13	15	17 1/2	13	16	18 1/2	13	16	18 1/2	14	16	18 1/2	14	17	19 1/2	15	18	20 1/2	16	18	20 1/2	17	19	21 1/2
9075	16.5	17 1/2	19	21 1/2	17 1/2	19	21 1/2	17 1/2	19	21 1/2	17 1/2	19	21 1/2	17 1/2	19	21 1/2	18 1/2	20	20 1/2	19 1/2	21	23 1/2	20 1/2	22	24 1/2
9099	11.25	24	24	25	24	24	25	24	24	25	24	24	25	24 1/2	24 1/2	25 1/2	25	25 1/2	26 1/2	26	26 1/2	27 1/2	27	27 1/2	28 1/2
18150	12.25	24	24	25	24	24	25	24	24	25	24	24	25	24 1/2	24 3/8	25 3/8	25	25 1/8	26 1/8	26	26 7/8	26 7/8	27	26 5/8	27 5/8
2250	16.0	30	---	---	30	---	---	30	---	---	30 1/2	---	---	30 1/2	---	---	31 1/2	---	---	31 1/2	---	---	32	---	---
28631	4.5	---	---	5	--	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2802	6.63	---	---	7 1/2	---	---	7 1/2	---	---	7 1/2	---	---	8 1/2	---	---	---	---	---	---	---	---	---	---	---	---
7802	6.63	---	---	7 1/2	---	---	7 1/2	---	---	7 1/2	---	---	8 1/2	---	---	---	---	---	---	---	---	---	---	---	---
28021	6.63	---	---	7 1/2	---	---	7 1/2	---	---	7 1/2	---	---	8 1/2	---	---	---	---	---	---	---	---	---	---	---	---
78021	6.63	---	---	7 1/2	---	---	7 1/2	---	---	7 1/2	---	---	8 1/2	---	---	---	---	---	---	---	---	---	---	---	---
98021	6.63	---	---	7 1/2	---	---	7 1/2	---	---	7 1/2	---	---	8 1/2	---	---	---	---	---	---	---	---	---	---	---	---
9802	6.63	---	---	7 1/2	---	---	7 1/2	---	---	7 1/2	---	---	8 1/2	---	---	---	---	---	---	---	---	---	---	---	---
28003	6.63	---	---	9 1/4	---	---	9 1/4	---	---	9 1/4	---	---	10 1/4	---	---	10 1/4	---	---	11 1/4	---	---	---	---	---	---
98003	6.63	---	---	9 1/4	---	---	9 1/4	---	---	9 1/4	---	---	10 1/4	---	---	10 1/4	---	---	11 1/4	---	---	---	---	---	---
9805	7.5	---	---	10 3/4	---	---	10 3/4	---	---	10 3/4	---	---	12 1/2	---	---	12 1/2	---	---	13 3/4	---	---	---	---	---	---
98051	7.5	---	---	10 3/4	---	---	10 3/4	---	---	10 3/4	---	---	12 1/2	---	---	12 1/2	---	---	13 3/4	---	---	---	---	---	---
9810	7.0	---	---	10 3/8	---	---	10 3/8	---	---	10 3/8	---	---	11 5/8	---	---	11 5/8	---	---	12 7/8	---	---	---	---	---	---
98101	7.0	---	---	10 3/8	---	---	10 3/8	---	---	10 3/8	---	---	11 5/8	---	---	11 5/8	---	---	12 7/8	---	---	---	---	---	---
9820	9.0	---	---	16 1/2	---	---	16 1/2	---	---	16 1/2	---	---	16 1/2	---	---	16 1/2	---	---	18 1/2	---	---	20 1/2	---	---	21 1/2
9825	11.0	---	---	19 3/4	---	---	19 3/4	---	---	19 3/4	---	---	19 3/4	---	---	21 1/4	---	---	21 1/4	---	---	22 3/4	---	---	24 1/4
2860	12.0	---	---	25 3/8	---	---	25 3/8	---	---	25 3/8	---	---	25 3/8	---	---	26 3/8	---	---	26 3/8	---	---	27 3/8	---	---	28 3/8

Note: (---) indicates “Not Applicable.”

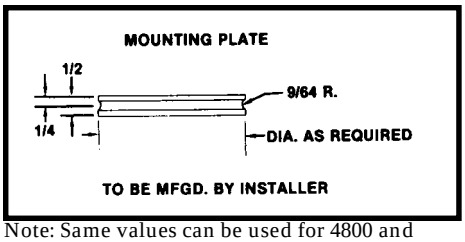
Using Optional Bellows Boots - On Standard Inverted Actuators

Inverted Machine Screw Actuators



Top Plate | Threaded End | Clevis End | 1898-18149 Only

Reference Dimensions Only – Consult Duff-Norton Company



Note: Same values can be used for 4800 and 9400 series actuator units.

Machine Screw Actuator Chart

Model No.	Raise (Inches)											
	1"-6"			7"-12"			13"-18"			19"-24"		
	A	B	C	A	B	C	A	B	C	A	B	C
2554	2	2 3/8	2	2	2 3/8	2	2 1/8	---	---	---	---	---
2624	2	2 5/8	2 1/8	2	2 5/8	2 1/8	2 1/8	3 1/4	2 3/4	---	---	---
2500	2 1/16	3	2 5/8	2 1/16	3	2 5/8	2 11/16	3 5/8	3 1/4	3 1/16	4	3
1801, 7001& 9001	2 3/8	4 3/8	3 5/8	2 3/8	4 3/8	3 5/8	2 7/8	5 3/8	4 5/8	3	5 3/8	4 5/8
9004	3 3/16	4 3/16	3 3/16	3 3/16	4 3/16	3 3/16	3 3/16	5 11/16	4 11/16	3 1/2	5 11/16	4 11/16
9009	3 1/4	5 3/4	4 1/2	3 1/4	5 3/4	4 1/2	3 1/4	5 3/4	4 1/2	3 9/16	7	5 3/4
9014	3 1/4	5 1/4	4	3 1/4	5 1/4	4	3 1/4	6 3/4	5 1/2	3 9/16	6 3/4	5 1/2
9019	3 1/4	5 9/16	4 1/16	3 1/4	5 9/16	4 1/16	3 1/4	6 9/16	5 1/16	3 1/4	6 9/16	5 1/16
9024	3 3/8	6 3/4	5	3 3/8	6 3/4	5	3 3/8	6 3/4	5	3 3/8	7 3/4	6
9034	4 1/2	7 1/2	5 1/2	4 1/2	7 1/2	5 1/2	4 1/2	7 1/2	5 1/2	4 1/2	7 1/2	5 1/2
1849 & 9049	4 7/8	9 5/16	6 13/16	4 7/8	9 5/16	6 13/16	4 7/8	10 5/16	7 13/16	4 7/8	10 5/16	7 13/16
9074[abc]	2 3/8	6 7/8	4 7/8	2 3/4	7 1/4	5 1/4	3	7 1/2	5 1/2	3 3/8	7 7/8	5 7/8
9098	*7 11/16	*8 11/16	**7 11/16	*7 11/16	*8 11/16	**7 11/16	*7 11/16	*8 11/16	**7 11/16	*7 11/16	*8 11/16	**7 11/16
18149	*7 11/16	*8 11/16	**7 11/16	*7 11/16	*8 11/16	**7 11/16	*7 11/16	*8 11/16	**7 11/16	*7 11/16	*8 11/16	**7 11/16

a. If A + X^1 is less than 51/2, X= 5 1/2". b. If B + X^1 is less than 9 1/2", X = 91/2".
c. If C + X^1 is less than 7", X= 7".
*If A + X^1 and B + X^1 are less than 12", X= 12". If greater than 12", use dimensions shown.
** If C + X^1 is less than 9", X= 9". If greater than 9", use dimensions shown.

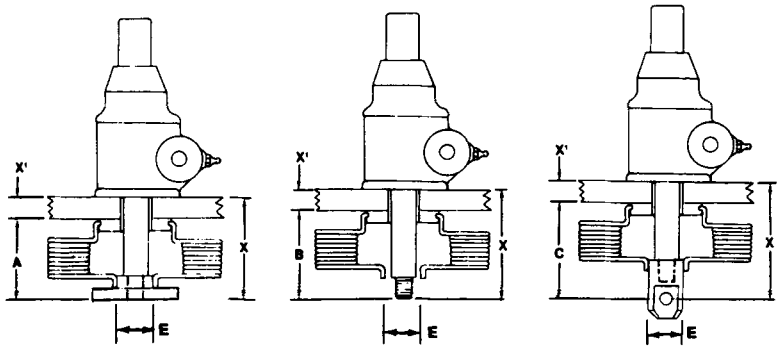
Finding minimum closed dimensions

Add your structure thickness X^1 to A, B or C from appropriate chart to find minimum closed dimension. Other styles and sizes of boots can be supplied.

In order to use a standard boot, make the mounting plate diameter the same as the shell cap diameter of the appropriate machine screw or ball screw actuator.

When boots are required for rotating screw jacks, consult Duff-Norton.

Ball Screw Actuators



Top Plate | Threaded End | Clevis End

Reference Dimensions Only – Consult Duff-Norton Company

Ball Screw Actuator

Model No.	Raise (Inches)												Std. Boot Collar Dia.
	1"-6"			7"-12"			13"-18"			19"-24"			
	A	B	C	A	B	C	A	B	C	A	B	C	E
28630	2	2	2 3/4	2 3/8	2 3/8	3 1/4	2 3/4	2 3/4	3 3/4	3 1/4	3 1/4	4 1/4	.75
2801& 28011 7801 & 78011 9801 &98011	4 3/16	4 5/8	5 1/4	4 3/16	4 5/8	5 1/4	4 3/16	4 5/8	5 1/4	4 3/16	4 5/8	5 1/4	1.5
28002 & 98002	4 3/16	4 5/8	5 1/4	4 3/16	4 5/8	5 1/4	4 3/16	4 5/8	5 1/4	4 3/16	4 5/8	5 1/4	1.5
9804 & 98041	4 3/16	5 1/8	6 1/8	4 5/8	5 1/8	6 1/8	4 5/8	5 1/8	6 1/8	4 5/8	5 1/8	6 1/8	1.75
9809 & 98091	4 3/4	5 1/8	6 1/8	4 3/4	5 1/8	6 1/8	4 3/4	5 1/8	6 1/8	4 3/4	5 1/8	6 1/8	1.5
9819	6 3/4	8	9 3/4	6 3/4	8	9 3/4	6 3/4	8	9 3/4	6 3/4	8	9 3/4	2.615
9824	5 1/2	6 3/4	9 1/2	5 1/2	6 3/4	9 1/2	5 1/2	6 3/4	9 1/2	5 1/2	6 3/4	9 1/2	3.5
2859	7 1/4	7 1/4	10 7/8	7 1/4	7 1/4	10 7/8	7 1/4	7 1/4	10 7/8	7 1/4	7 1/4	10 7/8	4.5

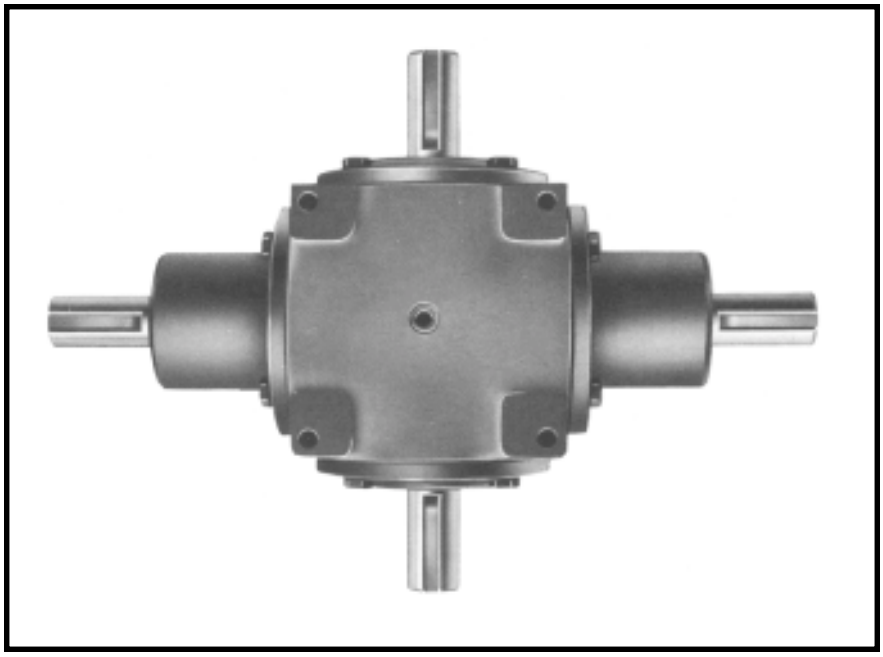
Note: Dimensions subject to change without notice.

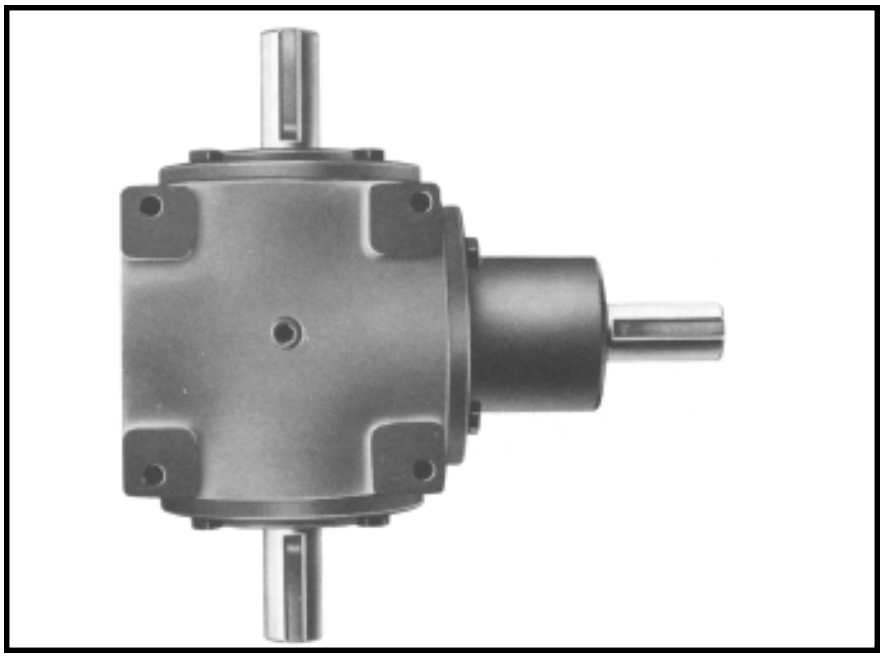
Mitre Gear Boxes

For Machine Screw or Ball Screw Actuators

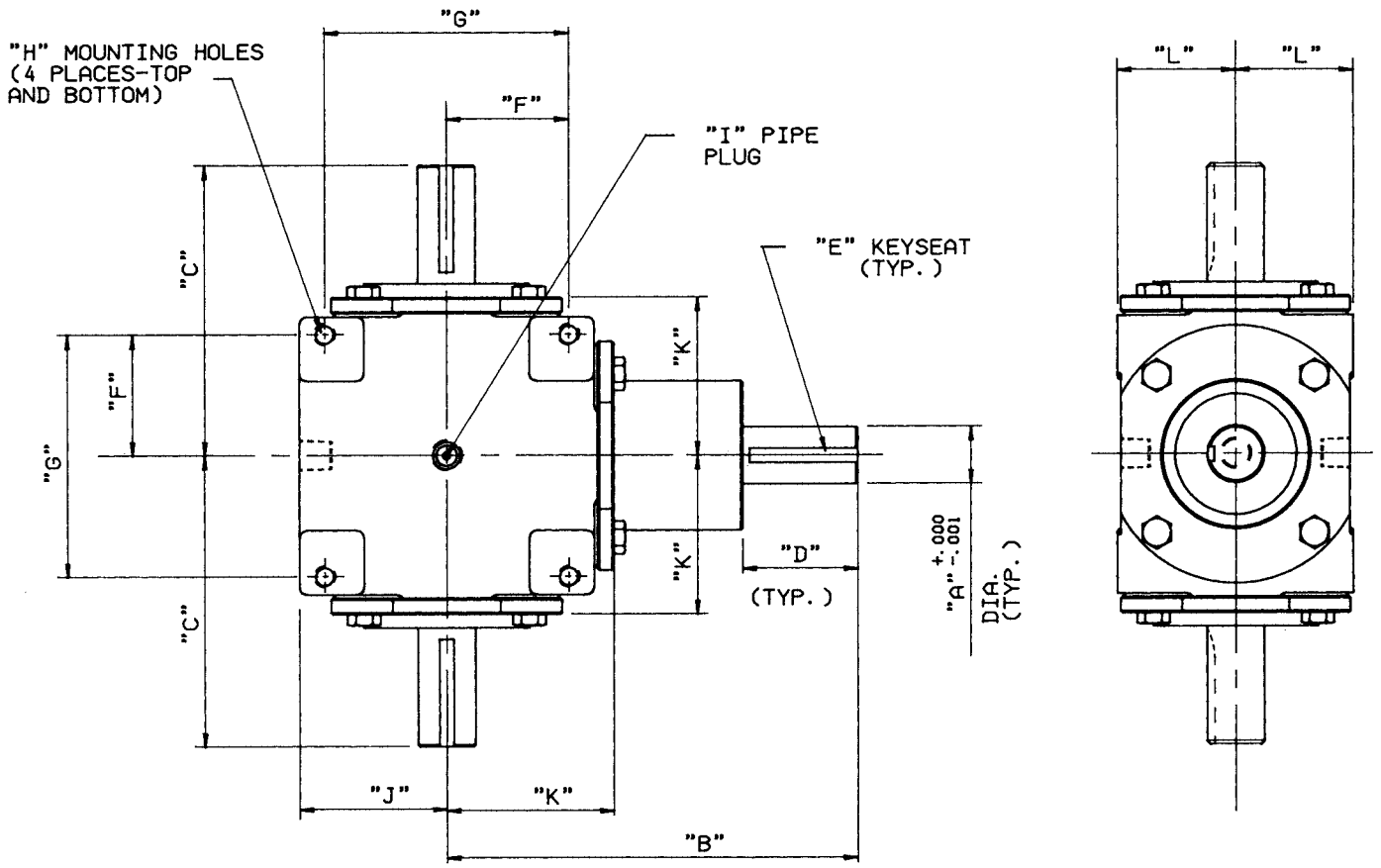
Features:

- Offered in 1: 1 ratios in 3-way and 4-way straight bevel gear configurations in three sizes.
- Can be effectively used in single, tandem or multiple arrangements.
- Rugged cast iron housings for rigid gear and bearing support.
- Alloy steel shafting for greater strength.
- Anti-friction bearings on all shaft.
- Equipped for oil lubrication, but supplied less lubricant.
- Heavy industrial seals keep lubricant in and dirt out.
- Universal mounting assures maximum design flexibility.
- Actuators, gear boxes and prime movers connected by shafting and couplings are mechanically interconnected and thus completely and permanently synchronized.



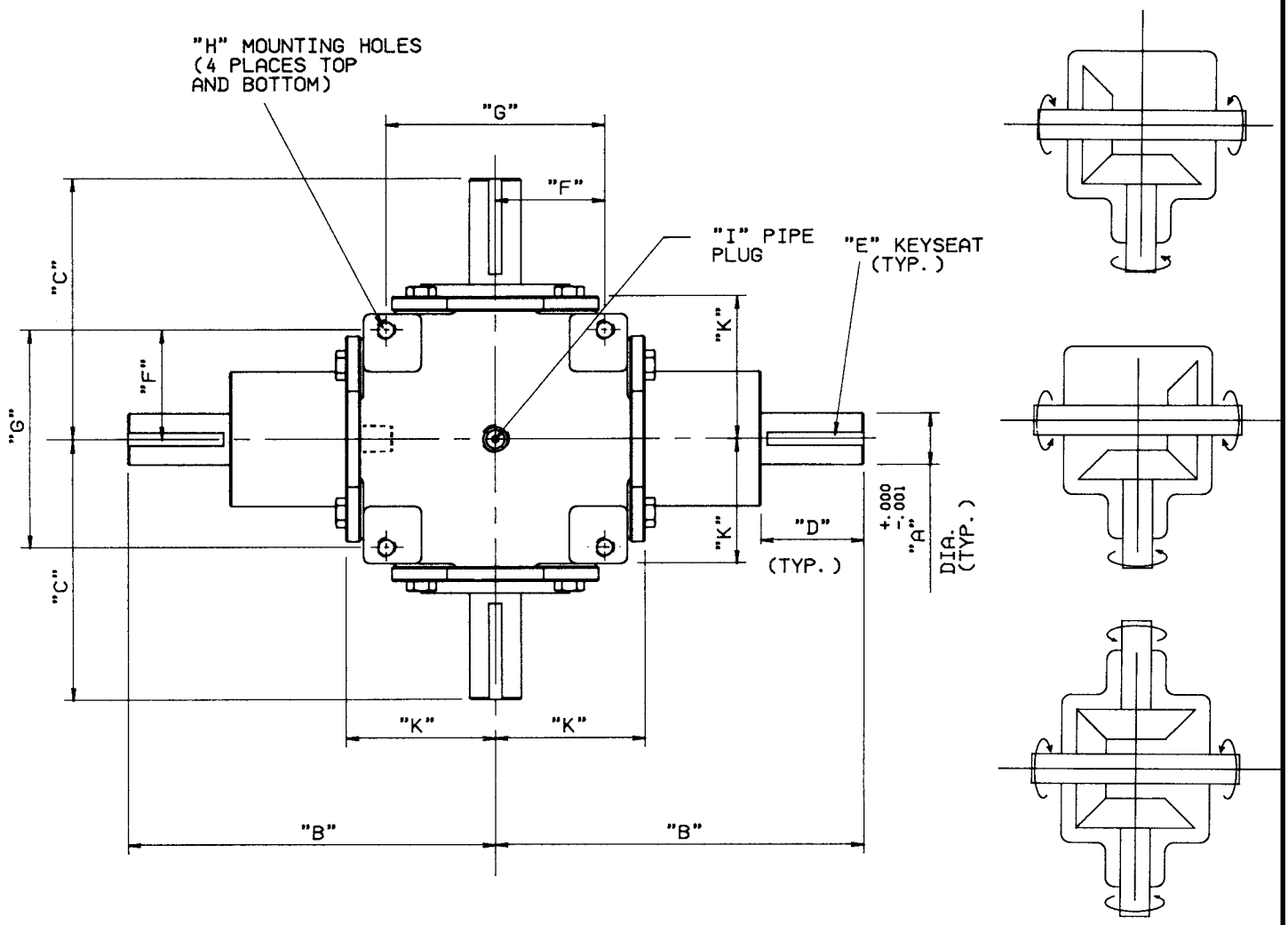


Mitre Gear Box Specifications



Model No.	Style	Max. Output Torque Continuous (In.-Lbs.)	Max. Output Torque Intermittent (In.-Lbs.)	Max. RPM	Max. Input HP	"A"	"B"	"C"	"D"	"E" Width (In.) x Depth (In.) x Length (In.)
SK2516AB100B	A&B	90	113	1800	2.25	.625	4.56	3.23	1.50	.1875 x .093 x 1.16
SK2516GG100B	GG	90	113	1800	2.25	.625	4.56	3.23	1.50	.1875 x .093 x 1.16
SK2519AB100B	A&B	1040	1300	1800	17	1.0005	7.16	5.09	2.00	.250 x .125 x 1.53
SK2519GG100B	GG	1040	1300	1800	17	1.0005	7.16	5.09	2.00	.250 x .125 x 1.53
SK2522AB100B	A&B	3650	4560	1800	44	1.3765	10.87	7.91	3.00	.3125 x .156 x 2.31
SK2522GG100B	GG	3650	4560	1800	44	1.3765	10.87	7.91	3.00	.3125 x .156 x 2.31

Note: Other sizes, ratios, 2-way styles and spiral bevel gear options are available.



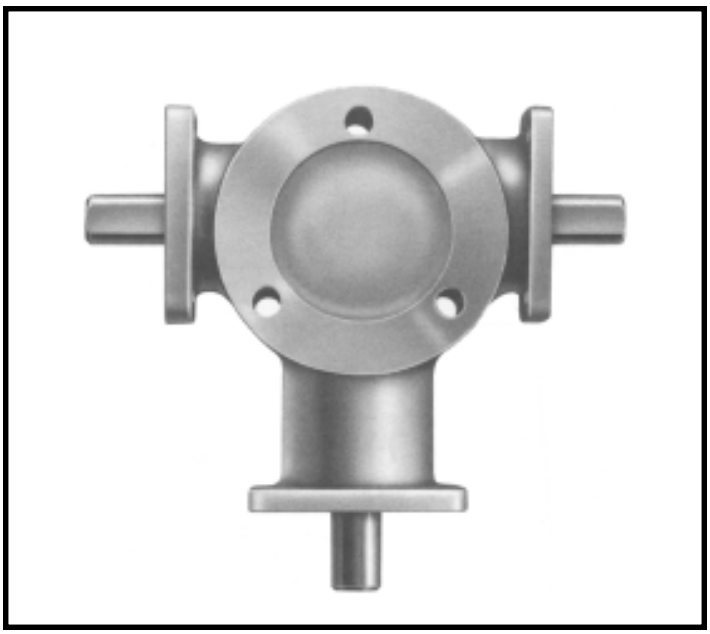
Model No.	Style	"F"	"G"	"H" Thread x Depth (In.)	"I" Size (In.) & No. Req.d	"J"	"K"	"L"	Oil Capacity* (Pints)	Approx. Weight (Lbs.)
SK2516AB100B	A&B	1.125	2.250	5/16-18UNC x .44	1/8 NPT (3)	1.63	1.75	1.594	.25	10
SK2516GG100B	GG	1.125	2.250	5/16-18UNC x .44	1/8 NPT (2)	---	1.75	1.594	.25	15
SK2519AB100B	A&B	2.125	4.250	3/8-16UNC x .69	1/4 NPT (3)	2.56	2.84	2.062	.75	27
SK2519GG100B	GG	2.125	4.250	3/8-16UNC x .69	1/4 NPT (2)	---	2.84	2.062	.75	36
SK2522AB100B	A&B	3.250	6.500	1/2-13UNC x 1.0	1/2 NPT (3)	3.85	4.59	4.094	5.00	88
SK2522GG100B	GG	3.250	6.500	1/2-13UNC x 1.0	1/2 NPT (2)	---	4.59	4.094	5.00	112

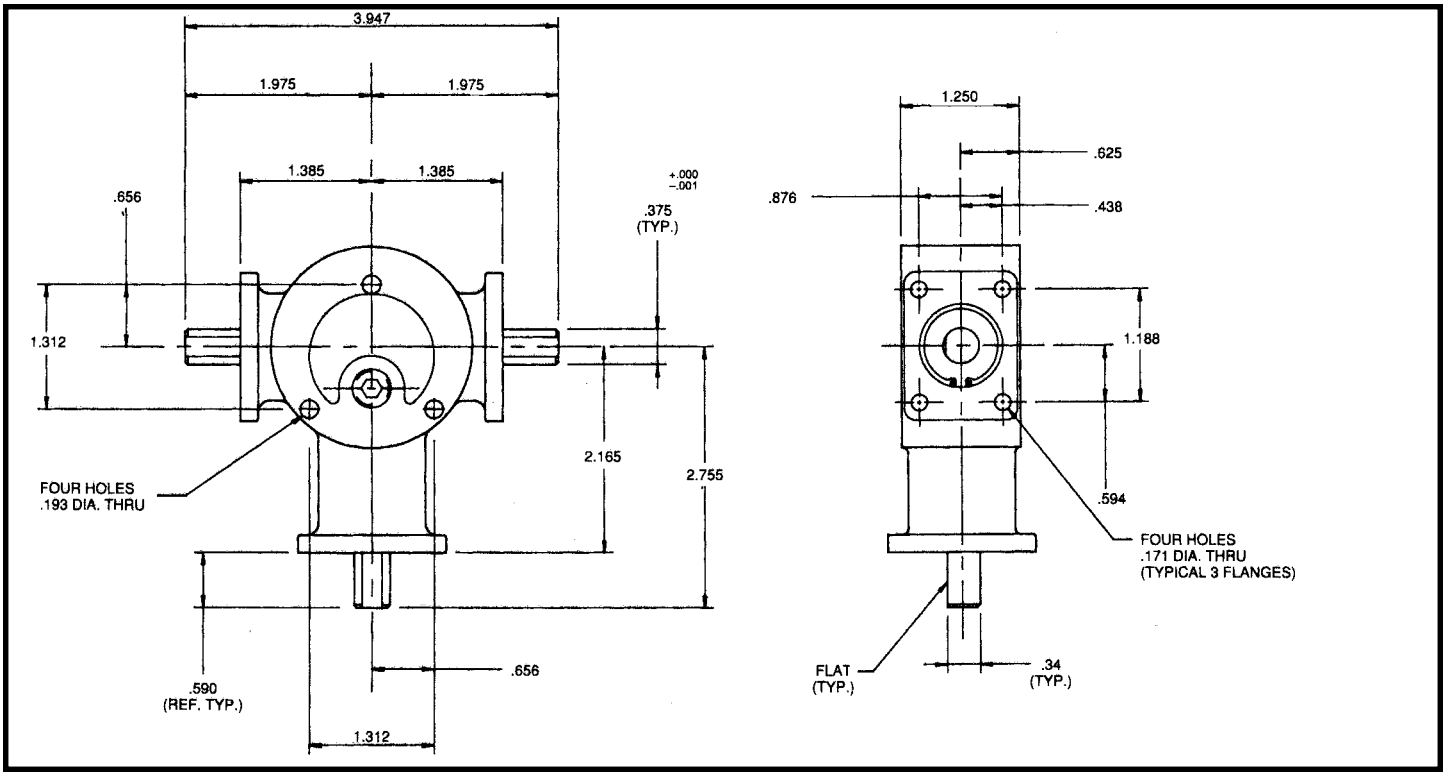
*Shipped without lubricant.

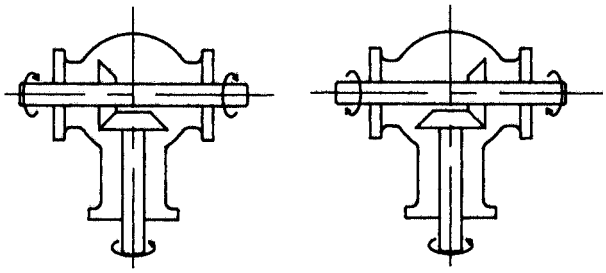
Mitre Gear Boxes For Miniature Actuators

Features:

- Offered in 3-way gear box with a 1:1 ratio spiral bevel gear configuration.
- Cast aluminum housing designed to resist corrosion and provide rigid gear and bearing support.
- Stainless steel shafts provide resistance to corrosion.
- Precision ball bearings to accommodate higher operating speeds.
- Spiral bevel gearing to assure low noise level at higher operating speeds.
- Factory lubricated for life to assure trouble-free service.
- Universal mounting surfaces to assure maximum design flexibility.
- Can be effectively used in single tandem or multiple arrangements.
- 2-way styles and other ratios are available upon request.







STYLE A STYLE B

SK2513AB100S
Mitre Gear Box Ratings

Maximum Continuous Torque (In.-Lb.)	36
Maximum Intermittent Torque (In.-Lb.)	45
Maximum RPM	1800
Maximum Input HP	.91
Maximum Overhung Shaft Load (Lb.)*	25
Maximum Shaft Thrust (Lb.)	50

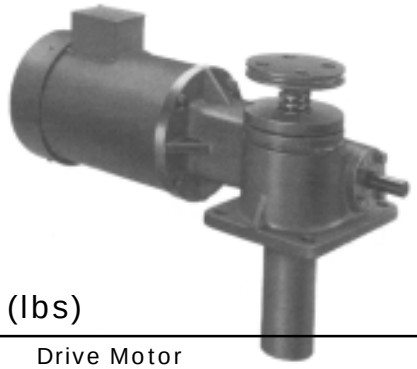
*Assumes load at midpoint of shaft extension.

C -Face Motor Adaptor

- Available for 2- to 20-ton machine, ball screw and high duty cycle actuators.
- Designed with standard NEMA C-face dimensions.
- Allows direct coupling of motor shaft with either the left or right side actuator input shaft.
- Comes with coupling keys and mounting hardware.

To direct couple a motor to an actuator, match motor horsepower to actuator load. Lifting speeds and maximum actuator load capacities for actuators with various motor horsepowers are shown in the table below.

CAUTION: All ball screw and high duty cycle actuators are self-lowering and require motors with brakes. Standard ratio machine screw actuators are not always self-locking and require motors with brakes. Optional ratio machine screw actuators are usually self- locking and do not require brakes; however, if self-locking is absolutely necessary , a motor brake or other restraining device should be considered.



C-Face Motor Frame Sizes

Motor HP	Motor RPM	
	1725	1140
1/2	56C	56C
3/4	56C, 143TC	56C, 143TC
1	56C, 143TC	56C, 143TC
1 1/2	56C, 143TC	182TC
2	56C, 143TC	184TC
3	182TC	
5	184TC	

Maximum Actuator Load Capacity (lbs)

Lifting Speed (In/Min)								Drive Motor							
Model No.	Worm Gear Ratio	@Motor RPM		1/2 HP		3/4 HP		1 HP		1 1/2 HP		2 HP		3HP	5HP
		1725 RPM	1140 RPM	1725 RPM	1140 RPM	1725 RPM	1140 RPM	1725 RPM	1140 RPM	1725 RPM	1140 RPM	1725 RPM	1140 RPM	1725 RPM	1725 RPM
1802 7002 9002	6:1	72.0	47.5	450	700	700	1150	1000	1650	1650	2550	2250	---	---	---
	24:1	18.0	12.0	1150	1850	---	---	---	---	---	---	---	---	---	---
9005	6:1	108.0	71.0	---	---	350	650	550	950	950	1550	1350	2150	2150	---
9005	24:1	27.0	18.0	450	900	900	1650	---	---	---	---	---	---	---	---
9010	8:1	108.0	71.0	---	---	---	---	400	900	900	1600	1350	2300	2300	4200
9010	24:1	36.0	24.0	---	---	300	1000	750	1700	1700	3100	---	---	---	---
9015	8:1	108.0	71.0	---	---	---	---	300	700	700	1250	1050	1800	1800	3250
9015	24:1	36.0	24.0	---	---	200	700	550	1200	1200	2200	---	---	---	---
9020	8:1	108.0	71.0	---	---	---	---	100	450	450	950	750	1450	1450	2850
9020	24:1	36.0	24.0	---	---	---	---	150	800	800	1700	---	---	---	---
2802 7802 9802	6:1	72.0	47.5	1250	1950	1950	3050	2800	4000	4000	---	---	---	---	---
	24:1	18.0	12.0	2700	4000	---	---	---	---	---	---	---	---	---	---
28021 78021 98021	6:1	288.0	190.0	150	350	350	650	550	1000	1000	1600	1400	---	---	---
	24:1	72.0	47.5	450	900	---	---	---	---	---	---	---	---	---	---
28003	6:1	119.0	78.0	700	1200	1200	1900	1700	2700	2700	4200	3700	---	---	---
98003	24:1	30.0	20.0	1700	2800	---	---	---	---	---	---	---	---	---	---
9805	6:1	136.0	90.0	350	750	750	1350	1150	2000	2000	3250	2850	4500	4500	---
9805	24:1	34.0	22.5	1000	2000	2000	3600	---	---	---	---	---	---	---	---
98051	6:1	288.0	190.0	---	---	100	350	300	650	650	1200	1000	1750	1750	---
98051	24:1	72.0	47.5	---	---	300	1000	---	---	---	---	---	---	---	---
9810	8:1	102.0	67.5	150	650	650	1400	1150	2250	2250	3800	3250	5350	5350	9550
9810	24:1	34.0	22.5	350	1350	1350	3000	2500	4750	4750	8000	---	---	---	---
98101	8:1	216.0	142.0	---	---	150	450	350	800	800	1500	1250	2150	2150	3950
98101	24:1	72.0	47.5	---	---	300	1000	750	1700	1700	3100	---	---	---	---
9820	8:1	108.0	71.0	---	---	---	---	---	---	750	2350	1800	3900	3900	8150
9820	24:1	36.0	24.0	---	---	---	---	---	---	1800	5450	---	---	---	---
7511	6:1	119.0	78.5	600	1050	1050	1700	1500	2350	2350	---	---	---	---	---
7515	8:1	102.0	67.5	150	700	700	1550	1250	2400	2400	4100	3550	5800	5800	10350
7522	10 2/3:1	81.0	53.5	---	---	---	---	---	850	850	2750	2100	4600	4600	9550

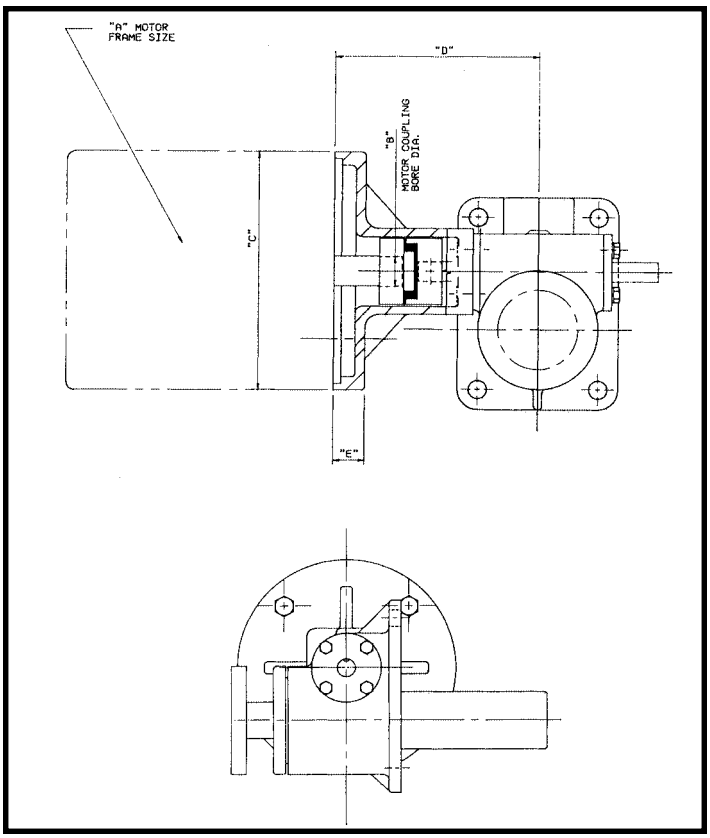
Ordering the Right C-Face Motor Adaptor

Please provide the following information when ordering:

- Actuator model
- Translating or rotating screw
- Upright or inverted configuration
- Type of screw end (translating screw actuators)
- Worm gear ratio
- Travel
- With or without boot
- With or without anti-backlash feature (machine screw actuators)
- Motor horsepower
- Motor frame size
- Left or right motor adaptor position
- Other special requirements

When direct coupling a motor to an actuator, it is necessary to match motor horsepower to actuator load. Lifting speeds and maximum actuator load capacities for actuators with various motor horsepowers are shown in the table on the previous page. It is important that motors do not exceed the maximum horsepowers shown.

CAUTION: All ball screw and high duty cycle actuators are self lowering and require motors with brakes. Standard ratio machine screw actuators are not always self locking and require motors with brakes. Optional ratio machine screw actuators are usually self-locking and do not require brakes; however, if self-locking is absolutely necessary, a motor brake or other restraining device should be considered.



Specifications

Model No.	"A"	"B" (+.001/-.000)	"C"	"D"	"E"
1802 / 2802	56C	.625	6.75	6.16	.50
	143TC; 145TC	.875	6.75	6.16	.50
7002, 7802, 9002 & 9802	56C	.625	6.75	6.16	.50
	143TC; 145TC	.875	6.75	6.16	.50
28021 & 28003	56C	.625	6.75	6.16	.50
	143TC; 145TC	.875	6.75	6.16	.50
78021, 98021 & 98003	56C	.625	6.75	6.16	.50
	143TC; 145TC	.875	6.75	6.16	.50
9005	56C	.625	6.75	7.12	.62
	143TC; 145TC	.875	6.75	7.12	.62
	182TC; 184TC	1.125	9.00	7.95	1.45
9805 & 98051	56C	.625	6.75	7.12	.62
	143TC; 145TC	.875	6.75	7.12	.62
	182TC; 184TC	1.125	9.00	7.95	1.45
9010	56C	.625	6.75	8.13	.65
	143TC; 145TC	.875	6.75	8.13	.65
	182TC; 184TC	1.125	9.00	8.97	1.47
9810 & 98101	56C	.625	6.75	8.13	.65
	143TC; 145TC	.875	6.75	8.13	.65
	182TC; 184TC	1.125	9.00	8.97	1.47
9015	56C	.625	6.75	8.13	.70
	143TC; 145TC	.875	6.75	8.13	.70
	182TC; 184TC	1.125	9.00	8.97	1.54
9020 & 9820	56C	.625	6.75	8.13	.65
	143TC; 145TC	.875	6.75	8.13	.65
	182TC; 184TC	1.125	9.00	8.97	1.49
7511	56C	.625	6.75	6.98	0.50
	143TC; 145TC	.875	6.75	6.98	0.50
7515	56C	.625	6.75	8.06	0.65
	143TC; 145TC	.875	6.75	8.06	0.65
	182TC; 184TC	1.125	9.00	8.9	1.47
7522	56C	.625	6.75	9.62	0.65
	143TC; 145TC	.875	6.75	9.62	0.65
	182TC; 184TC	1.125	9.00	10.46	1.49

Flexible Couplings

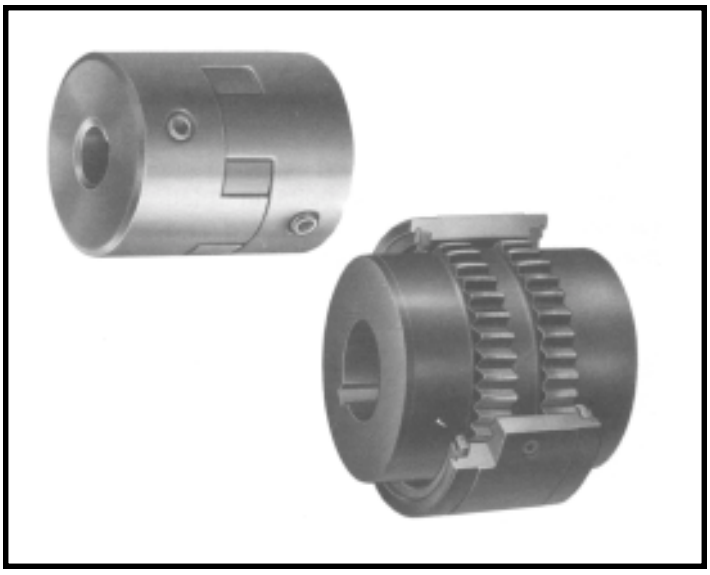
Whether actuators are used singly, in tandem or in multiple arrangements, flexible couplings are important to transmit power.

Jaw Type Couplings

- No need for lubrication.
- Are smaller and lighter than other equally rated couplings.
- Are recommended for use with actuators through 3-ton capacity.

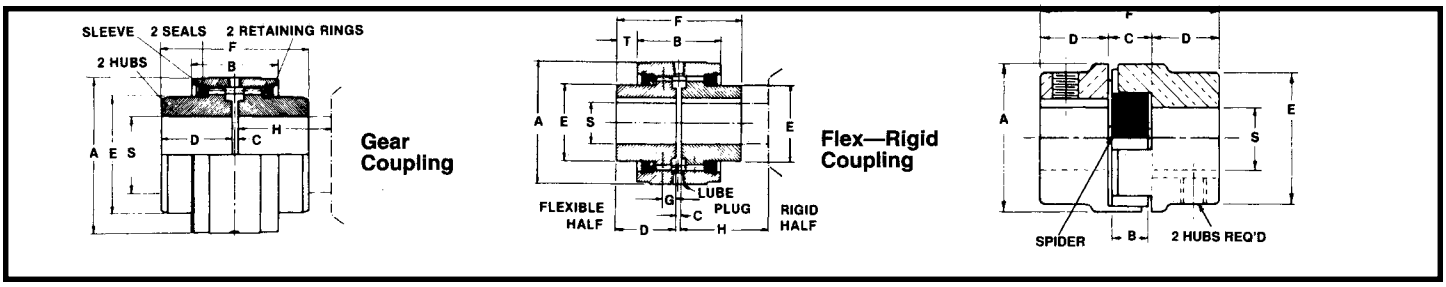
Full-Flex and Flex-Rigid Gear Couplings

- Give great strength under load due to compact design and construction.
- Allow for incremental system adjustment.



Ordering the Right Couplings

1. Flexible couplings are made up of three components which must be ordered separately. Select two hubs each with a bore and keyway to match the shafts being coupled and a sleeve kit (for gear-type couplings) or a spider (for jaw-type couplings) .The bores in the coupling hubs are sized to give a slip fit on actuator worm shafts.
2. Determine required coupling torque with the following formula:
   Torque Requirement per Actuator X Number of Actuators to Be Driven by the Coupling.
   Refer to gear coupling specs chart, below.
3. Verify the required coupling torque. Make sure it's not greater than the maximum rating in the accompanying coupling tables.
4. Full-flex gear couplings are recommended for close coupled arrangements.
5. Flex-rigid gear couplings are recommended for floating shaft arrangements with the rigid hub mounted to the floating shaft.
6. For maximum performance, the actuators, shafts, gear boxes and motor should be carefully aligned.



Gear Coupling Specifications

"S" HT Bore	Torque Rating (In.-Lbs.)	Flex Hub Part No.	Rigid Hub Part No.	Sleeve** Kit Part No.	A	B	C	D	E	F	H	Keyway	Wt. Lbs.*	WR² Lbs. In.² Solid Core	Misalignment (Max.) Parallel	Angular
0.751	6,300	SK-2405-H	SK-2404-H	SK-2405-S	3 5/16	2	1/8	1 1/2	2	3 1/8	2 1/8	3/16 x 3/32	5	6	+	1/2°
1.001	6,300	SK-2410-H	SK-2409-H	SK-2405-S	3 5/16	2	1/8	1 1/2	2	3 1/8	2 1/8	1/4 x 1/8	5	6	+	1/2°
1.376	18,900	SK-2425-H	SK-2424-H	SK-2425-S	3 3/4	2 17/32	1/8	1 13/16	2 3/8	3 3/4	2 21/32	5/16 x 5/32	8	13	+	1/2°
1.501	18,900	SK-2450-H	SK-2449-H	SK-2425-S	3 3/4	2 17/32	1/8	1 13/16	2 3/8	3 3/4	2 21/32	3/8 x 3/16	8	13	+	1/2°
1.751	50,000	SK-2499-H	SK-2498-H	SK-2499-S	4 3/4	2 9/16	1/8	2 1/16	3 1/4	4 1/4	2 11/16	1/2 x 1/4	13	33	+	1/2°

*Includes sleeve kit and two hubs. **Kit includes sleeve, 2 seals, 2 retaining rings and 2 lube hole plugs ***Tolerance for all bores is +.001 an d-.000 +.005 Flex .000 Rigid

Jaw Type Coupling Specifications

"S" ** Bore	Torque Rating (In.-Lbs.)	Hub Part No.	Spider Part No.	A	B	C	D	E	F	Keyway	Wt. Lbs.*	WR² Lbs. In.² Solid Core	Misalignment (Max.) Parallel	Angular
.375	50	SK-2555-29H1	SK-2555-29S	1 5/64	7/16	15/32	5/8	1 5/64	1 23/32	NONE	1/4	.054	.015	1/2°
.376	50	SK-2555-29H2	SK-2555-29S	1 5/64	7/16	15/32	5/8	1 5/64	1 23/32	1/8 x 1/16	1/4	.054	.015	1/2°
.501	250	SK-2402J-H1	SK-2402-JS	1 3/4	15/32	1/2	13/16	1 3/4	2 1/8	1/8 x 1/16	1	.388	.015	1/2°
.626	250	SK-2402J-H2	SK-2402-JS	1 3/4	15/32	1/2	13/16	1 3/4	2 1/8	3/16 x 3/32	1	.388	.015	1/2°

*Weight includes spider and two hubs. **Tolerance for all bores is +.001 and -.000

AC Motor Controls

Duff -Norton offers constant speed AC Motor Control Systems for machine and ball screw actuators. These new control systems provide the option of jogging-inching, or maintained operation, when specified as part of a Duff-Norton Linear Positioning System. Numerous options are available including short circuit protection, pilot lamps, illuminated push buttons, and loose limit switches, as well as single and three phase power up to 575 VAC. Contact Duff -Norton for all your special control applications needs. Duff -Norton can be your single source for complete linear positioning systems.

For application analysis form, see front of guide. Assembled with UL and CE listed components.

Jogging-Inching Operation with Constant Speed AC Motor

Duff -Norton Jogging-Inching AC Motor Controls provide simple operation and reliable service. The operator must hold the push button down to activate motion in a direction, and release the push button to stop motion. If the end of travel limit switch is activated while in operation, the system stops automatically.

Jogging-Inching Controls Feature

- NEMA 12 Enclosure
- Full Voltage Reversing Motor Starter
- Horsepower Rated Overload Relay
- Fused Control Voltage Transformer
- Extend and Retract Push Buttons
- Customer Connection Terminal Strips
- With Fused Short Circuit Disconnects

AC Motor Control unit for Jogging-Inching Operation

Optional fused short circuit protection.

Application Notes

- End of travel limit switches are available through Duff-Norton.
- Motor short circuit protection is available through Duff-Norton.

Maintained Operation with Constant Speed AC Motor

Duff-Norton Maintained Operation AC Motor Controls are designed for systems that do not require monitoring while in operation. To activate the system the operator must engage the pushbutton in a direction. The operation will continue until the end of travel limit switch is tripped, at which time the operation will stop. The operation can be stopped at any time by activating the stop push button.

Maintained Operation Controls Feature

- NEMA 12 Enclosure
- Full Voltage Reversing Motor Starter
- Horsepower Rated Overload Relay
- Fused Control Voltage Transformer
- Extend and Retract Push Buttons
- Stop Push Button
- Customer Connection Terminal Strips

Optional circuit breaker and disconnect

Application Notes

- End of travel limit switches are available through Duff-Norton.
- Motor short circuit protection is available through Duff -Norton.

Standard Features for all Control Boxes

- All starters meet or exceed IEC, UL, CSA, CE, V DE, BS and other international standards.
- All starters are built in the USA
- Full rated IEC Full Voltage Motor Starter
- 115 VAC Control Voltage Transformer with Fused Primary and Secondary on all 3-Phase Units
- Single Phase Protection of Three Phase Circuits
- Overload Trip Indication on Starter
- Interchangeable Overload Relays to Accommodate Motor Full Load Ratings
- Adjustable Overload Relays to Accomodate Full Load and Service Factor Variables
- Designed for 1.5 Million Cycles
- Compact Design -20" H x 10" W x 8" D
- Door Mounted Reset Push Button to Reset Overload Relay if Tripped without Opening the Enclosure

Optional Features for AC Motor Controls

AC Motor Control unit for maintained operation equipped with optional "Power On" pilot lamp, overload tripped pilot lamp, jog/maintain selector switch, end of travel pilot lamps and travelling illuminated push buttons.

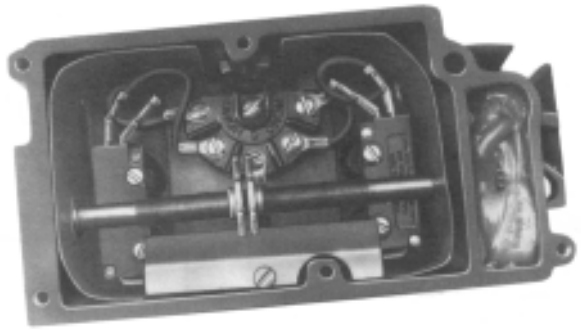
- **Power On pilot Lamp**
  The pilot lamp is mounted to the enclosure door and wired to indicate the presence of control power in the enclosure.
- **Overload Tripped Pilot Lamp**
  The pilot lamp is mounted to the enclosure door and wired to indicate that the motor overload relay has tripped.
- **Loose Limit Switches**
  Limit switches (2) supplied loose. NEMA 4 rated, with adjustable rollers (not rotary) for customer mounting. (Rotary switches directly mounted by the factory to the actuator are also available.)

Loose adjustable roller type limit switches.

- **Fused Short Circuit Protection**
  Provides fuses and fuse holders mounted and wired within the enclosure to provide motor and component protection.
- **Circuit Breaker Short Circuit Protection and Disconnect**
  Provides motor and component protection and includes a door mounted and interlocked switch mechanism allowing access to panel with power off.
- **NEMA 4 Rated Enclosure and Operating Devices**
  The NEMA 4 rated enclosure provides dust, dirt, and water protection in wash down duty situations such as food, drug, washing, and cleaning applications. Standard enclosure is NEMA 12 rated for dust, dirt and oil protection.
- **End of Travel Pilot Lamps**
  Provides 2 pilot lamps mounted on the enclosure door and wired to indicate when the end of travel is reached. Limit switches are required for this and must be ordered separately.
- **Traveling Illuminated Push Buttons**
  These provide illumination within the existing push buttons to indicate that a control in engaged.

Rotary Limit Switches

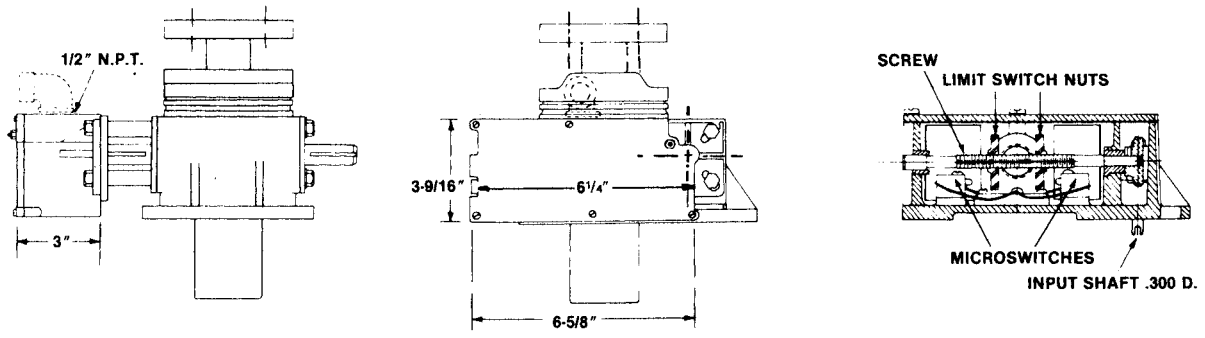
SKA Series Rotary Limit Switch



SKA-6000-A

Features:

- Designed especially for all Duff-Norton machine screw and ball screw actuators (except for miniature and one-ton) .
- Available in three voltages -250, 480 or 600 volts -and in three gear ratios.
- Sturdy and compact. Constructed of corrosion- resistant materials, with housing of anodized aluminum. Meets NEMA-4 water tightness requirements.
- Lifetime lubricated.
- Can be mounted on right or left extension of actuator worm shaft in any of four quadrants.
- Simple to adjust. Two microswitches, one for up / stop and one for down / stop, are activated by the adjustable limit-switch nuts which travel laterally when the internal screw is rotated through gear reduction.
- Can be used in applications where there is a need to limit the rotation of equipment that rotates and / or reverses.
- Operating temperature range -20° to + 150°F.
- Optional 4-position limit switch available. Consult factory for dimensions.



Rotary Limit Switches

Limit Switch Ratings

Model No.	Max. Voltage AC	Max. Voltage DC	Max. Amps AC	Max. Amps DC
SKA-6000-A	250	---	15	---
SKA-6000-B	480	125	15	.50
	---	250	---	.25
SKA-6000-C	600	125	15	.80
	---	230	---	.40

Limit Switch Worm Gear Ratios

Gear Ratios	Maximum Input Revolutions SKA-6000-A	SKA-6000-B	SKA-6000-C
10:1	1095	750	675
20:1	2190	1500	1350
40:1	4380	3000	2700

Note: A and B models are SPDT; C model is 2-circuit, double break.

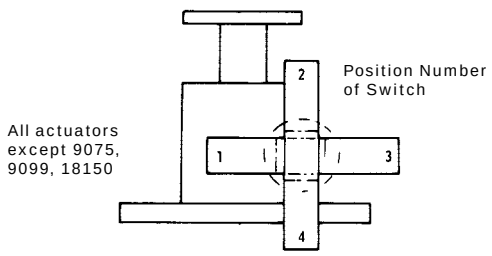
Ordering the Right Limit Switch

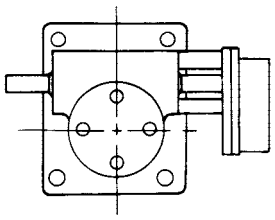
To ensure that limit switch has sufficient travel capability for the actuator unit, use the following formula:

$$\text{Max. raise of actuator model in inches} = \frac{\text{Maximum Input Revolutions}}{\text{Turns of Actuator Worm per Inch of Raise}}$$

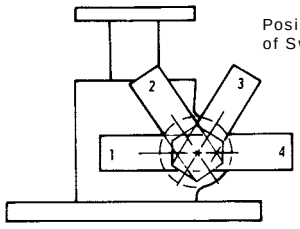
Note: For water-tight connection, use a weather-tight connector and sealant around threads. Limit switches will be damaged if overtraveled. For shipping purposes, the 1/2" NPT hole is closed with a plastic plug which is not water tight.

Rotary Limit Switch Specifications
(Mountings and Adjustment Instructions)





Typical Top View Showing Switch Mounted on R.H. Worm Extension



Rotary Limit Switch Specifications

Position	Extended Mount R.H. 1	2	3	4	L.H. 1	2	3	4	Close Mount R.H. 1	2	3	4	L.H. 1	2	3	4
1802, 2802, 28021, 7002, 7802, 78021, 9002, 9802, 98021, 28003 & 98003	C	A&B	B&D	---	B&D	A&B	C	---	---	---	---	---	---	---	---	---
9005 & 9805	X	A	D	C	D	A	X	C	X	A&B	D	---	D	A&B	X	---
9010 & 9810	X	A	D	C	D	A	X	C	X	A&B	D	---	D	A&B	X	---
9015	X	A	D	C	D	A	X	C	---	A&B	D	---	D	A&B	---	---
9020 & 9820	X	A	X	C	X	A	X	C	X	A&B	X	---	X	A&B	X	---
9025 & 9825	X	X	X	C	X	X	X	C	X	B	X	---	X	B	X	---
9035	X	X	X	C	X	X	X	C	X	B	X	---	X	B	X	---
1850 & 2860	X	X	X	C	X	X	X	C	---	X	X	---	---	X	X	---
9050	X	X	X	C	X	X	X	C	X	X	X	C	X	X	X	C
9075	X	X	X	C	X	X	X	C	X	X	X	C	X	X	X	C
9099	X	X	X	X	X	X	X	X	---	X	X	X	---	X	X	X
18150	X	X	X	X	X	X	X	X	---	X	X	X	---	X	X	X

Restrictions

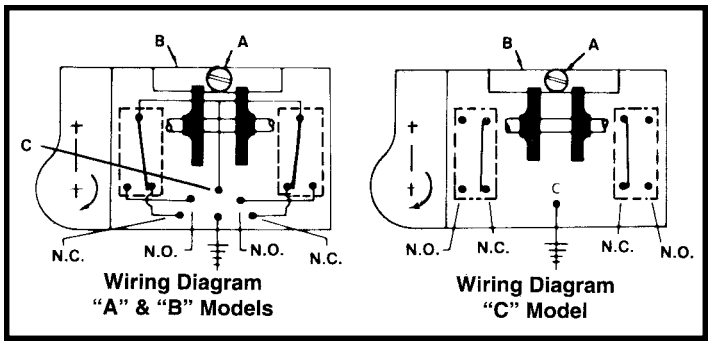
For 2 & 3 Ton Inverted Position, 2 Extended is the Only One Practical.
(A) Special Closed Height
(B) Boot Interference
(C) Rotary Limit Switch Extends Below Base of Actuator Unit.
(D) Sealed Electric Elbow Would Extend Below Base of Actuator Unit.
(X) Recommended
(---) Not Recommended

Note: 4800 and 9400 Series same as 1800 and 9000.

Rotary Limit Switch Electrical Specifications

Wiring Diagrams, Voltage and Ratios

1. CAUTION: Disconnect power before making any adjustment.
2. Check drift before adjusting limits.
3. Remove screw "A" and nut guide keeper "B" to adjust limits.
4. Run actuator unit to desired limit.
5. Rotate appropriate nut until switch clicks, then turn 1/2 turn more.
6. Replace "A" and "B. "
7. Run actuator unit to other limit.
8. Repeat steps 2, 4 and 5 to adjust this nut. Slight adjustments may be necessary. See chart to the right for notch adjustment value.



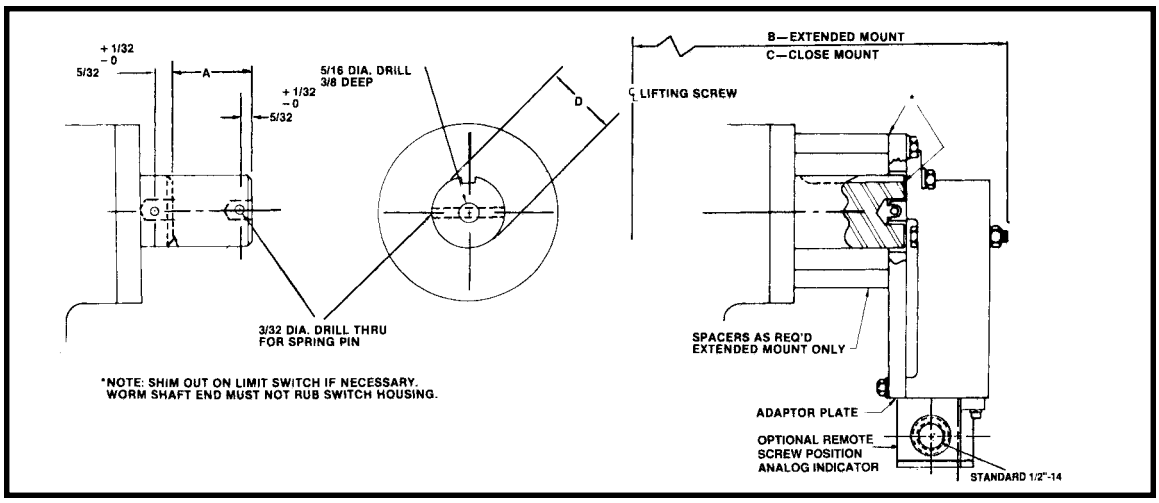
N.O. = Normally Open
N.C. = Normally Closed

Rotary Limit Switch Electrical Specifications

Model No.	Max. Voltage AC	Max. Voltage DC	Max. Amps AC	Max. Amps DC	Max. Worm Rev.	Max. Raise	Max. Allow-able Drift	Notch Adjustment
SKA-6000-A-10	250		15		1095	1095/TPI	24/TPI	1/TPI
SKA-6000-A-20					2190	2190/TPI	48/TPI	2/TPI
SKA-6000-A-40					4380	4380/TPI	96/TPI	4/TPI
SKA-6000-B-10	480	125	15	.50	750	750/TPI	29/TPI	1/TPI
SKA-6000-B-20					1500	1500/TPI	57/TPI	2/TPI
SKA-6000-B-40		250		.25	3000	3000/TPI	115/TPI	4/TPI
SKA-6000-C-10	600	115 230	15	.80	675	675/TPI	38.5/TPI	1/TPI
SKA-6000-C-20					1350	1350/TPI	77/TPI	2/TPI
SKA-6000-C-40				.40	2700	2700/TPI	154/TPI	4/TPI

TPI = Turns per Inch of Raise of Actuator Unit

Limit Switch Field Installation Dimensions



Worm Shaft Dimensions

Model No.	A + 1/32 - 0 Cutoff Close Mount	B Extended Mount	C Close Mount	D Worm Shaft Dia.
1802, 2802, 28021, 7002, 7802 78021, 9002, 9802, 98021	---	6 3/4	---	.500
28003 & 98003	1 9/32	6 3/4	5 1/2	.625
9005, 9805 & 98051	1 17/32	7 3/4	6 1/4	.750
9010, 9810 & 98101	1 21/32	8 3/4	7 1/8	1.000
9015	1 29/32	8 3/4	6 7/8	1.000
9020 & 9820	1 3/8	8 3/4	7 13/32	1.000
9025 & 9825	2 7/32	10 1/4	8 1/16	1.375
9035	2 7/32	10 1/4	8 1/16	1.375
1850 & 9050& 2860	4 21/32	14 1/4	9 5/8	1.500
9075	4 1/2	15 1/4	10 3/4	1.750
9099	3 3/4	14 3/4	11 1/32	1.750
18150	3 3/4	14 3/4	11 1/32	1.875

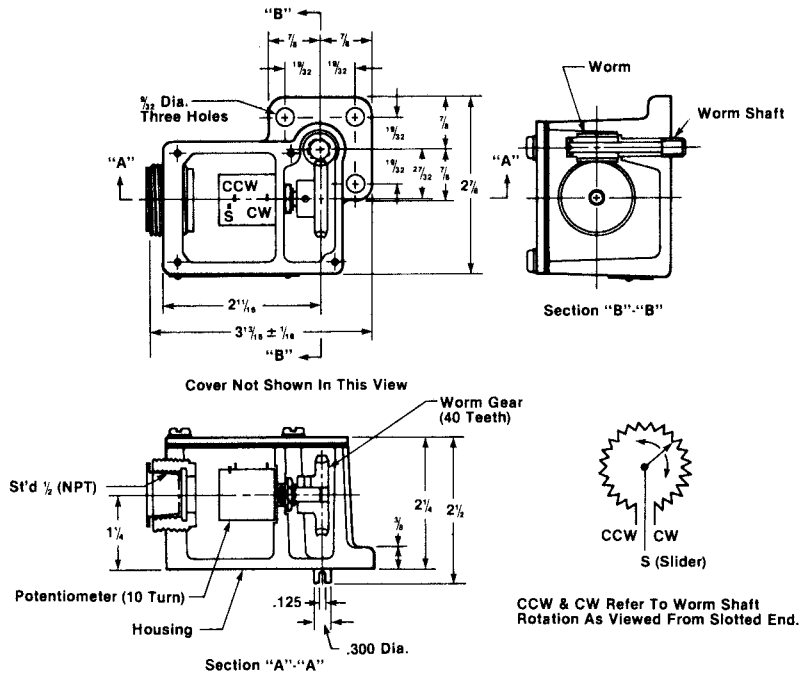
Note: Limit switch cannot be fitted directly to 1/4,1/2 and 1 ton series. 4800 and 9400 Series mounting is the same as 1800 and 9000 Series. Dimensions are subject to change without notice.

Note: Extended mount is standard.

Transducer -
SKA-6200-T Remote Screw Position Analog Indicator

The Duff-Norton SKA-6200-T position transducer is designed to mount on the end of any SKA-6000-T limit switch. Its major component is a potentiometer which has a slider tap and a tap at each end of the element.

Gear ratios of 10:1, 20:1 and 40:1 allow for a wide range of raises. Total resistance of element is 500 ohms. Other resistances are available on special order. Consult Duff-Norton for additional information.



NOTE:

- Included with each position transducer are the following mounting parts:
  3 socket head cap screws
  3 lock washers
  (Position transducer shipped assembled in separate package to be installed at site by customer.)
- Transducer supplied with black anodized finish as standard.

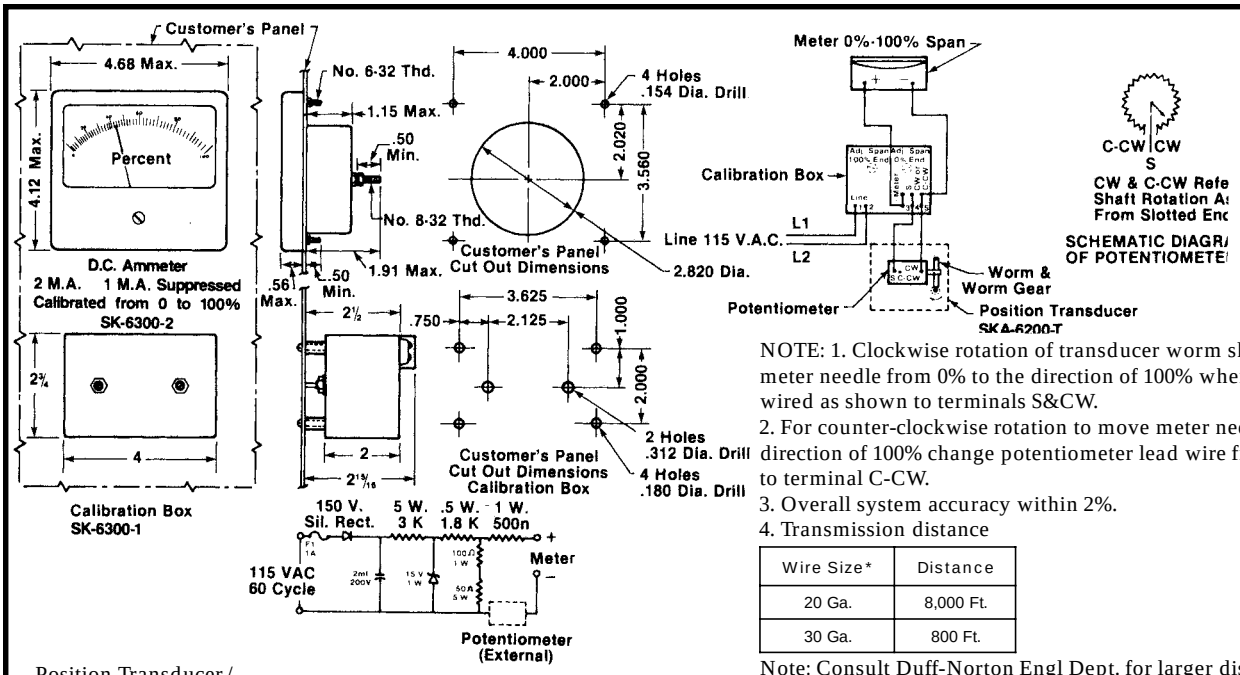
Position Transducer Available in Following Models.

Model No.	Gear Ratio	Max. Turns Transducer Worm Shaft
SKA-6200-T-10	10:1	100
SKA-6200-T-20	20:1	200
SKA-6200-T-40	40:1	400

Power Rating:
2.0 watts @ 40°C
0 watts @85°C
Total resistance = 500 ohms

Visual Position Indicator

Designed especially for the SKA-6200-T position transducer, the Duff-Norton SK-6300 visual position indicator consists of a graduated meter and a calibration box. The meter is calibrated in percent of travel from zero to 100. Both meter and box can be panel mounted. A terminal block is provided for making electric connection on back of box. No external wiring is furnished.



Position Transducer /
Visual Position Indicator Wiring Diagram

NOTE: 1. Clockwise rotation of transducer worm shall will move meter needle from 0% to the direction of 100% when potentiometer is wired as shown to terminals S&CW.
2. For counter-clockwise rotation to move meter needle from 0% to the direction of 100% change potentiometer lead wire from terminal CW to terminal C-CW.
3. Overall system accuracy within 2%.
4. Transmission distance

Wire Size*	Distance
20 Ga.	8,000 Ft.
30 Ga.	800 Ft.

Note: Consult Duff-Norton Engl Dept. for larger distances
*American Wire Gage
All Dimensions in Inches

Programmable Digital Position Indicator

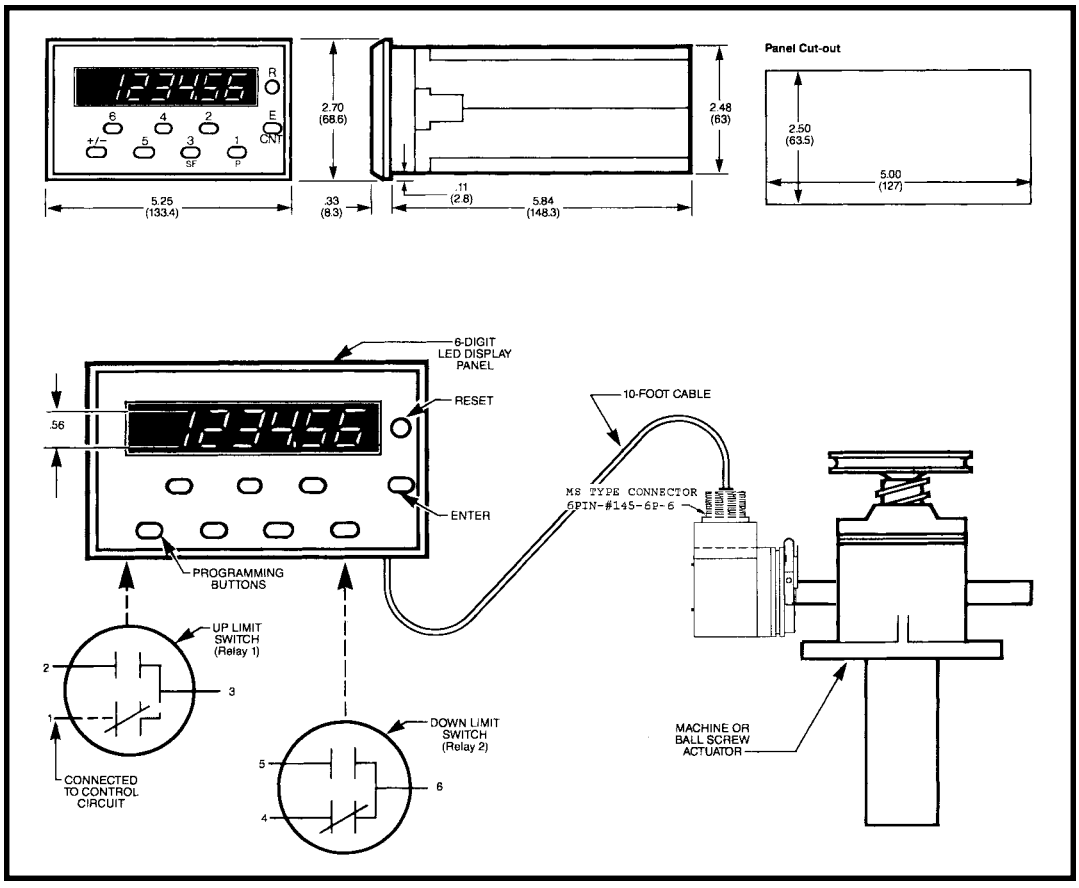
Displays position of actuator lifting screws in increments of up to .001", depending on PPR (Accuracy is relative to ratio and backlash. Please consult factory for details).

- For use in precision positioning applications with Duff- Norton 2 through 150 ton machine or ball screw actuators.
- Field programmable from front panel to control up / down travel limits.
- Non-volatile E2-PROM Memory retains all programmed information and count value in event of power interruption.
- Two adjustable up / down output limits with 0 to + / - 999999.
- Five digit input scaling with 0.0000 to + / - 5.000, programmable decimal point location and lead zero blanking.
- Compact, die cast NEMA 4 rated front panel has six digit LED display with 0.56" high characters and negative sign (-). Display convertible to English, metric or other units of measurement.
- Shaft encoder drive gives precise, reliable and maintenance-free operation.
- Programmable front panel functions may be locked out to prevent unauthorized adjustment.
- On-line self-test permits complete check of all functions and reset capability allows reset to zero from front panel.
- Input power requirement is 115 VAC, 50 / 60 Hz.
- Can be provided with optional 20 ma. current loop to provide capability of 2-way digital communication.

The Duff-Norton Digital Position Indicator provides a high degree of accuracy and versatility when incorporated in machine or ball screw actuator systems. Operating as a revolution counter, it is ideal for use in a wide range of precision positioning applications to indicate inches or millimeters of lifting screw travel. Two built-in relays act as limit switches for travel limit control. Start-up / shut-off, audio / visual warning, multiple actuator system sequencing or the initiation of subsequent operations may also be controlled.

The indicator is furnished as a complete kit which includes a sealed digital readout panel (designed to fit a 2½ " x 5" panel cut-out), an optical shaft encoder, mating 6-pin connector with 10-foot cable.

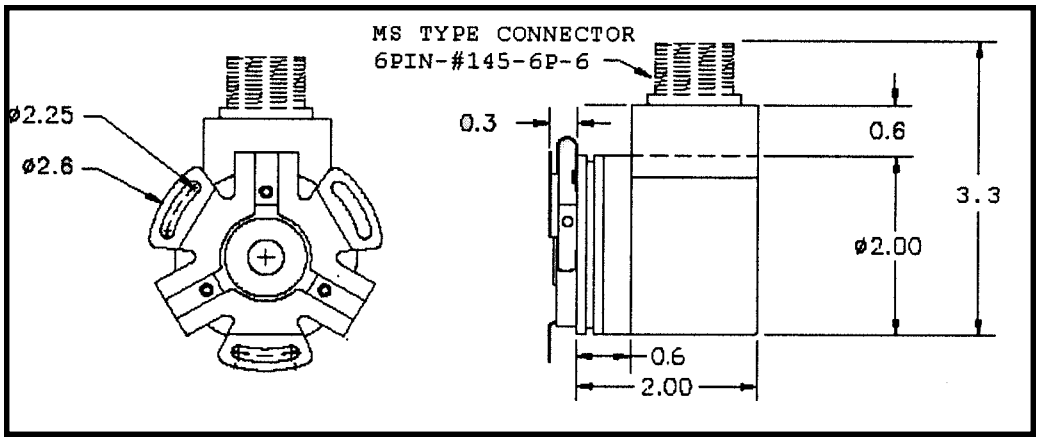
Electrical connections are made at the rear of the unit to UL recognized terminal strips. Clamp-type pressure plate terminals accept AWG-14 wire without lugs.

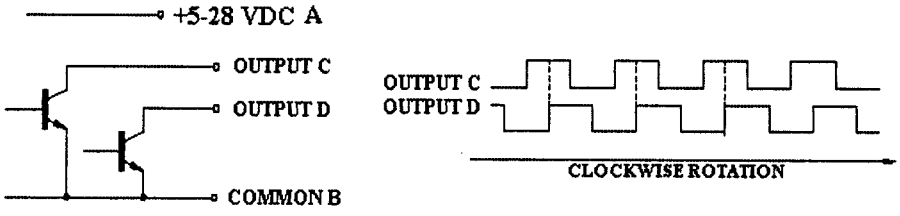


Standard Encoder

This encoder is designed for harsh factory and plant floor environments. It is shock rated at 75 Gs for 11 milliseconds duration. The bearings are rated for 80 pounds maximum axial and radial shaft loading for long life. The encoder has very low drag and can be held in place with a simple cable tie.

Encoder Dimensions



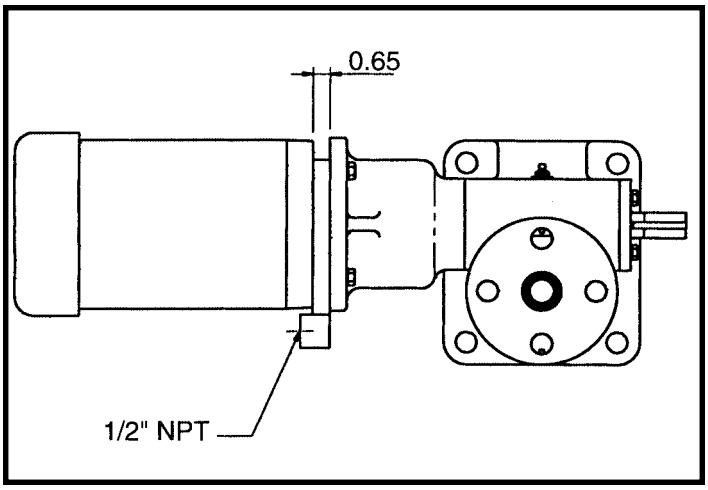


Open Collector Output Circuit with pin out

Quadrature Output Waveform

Pulses Per Revolution	10
Input Voltage	5 to 28 VDC
Input Current	100mA max
Output	Open collector will sink up to 100mA
Quadrature Phasing	90 electrical degrees ± 22.5°.
Rise Time	Less then 1 Microsecond
Operating Temperature	32° -158° F (0°- 70° C)

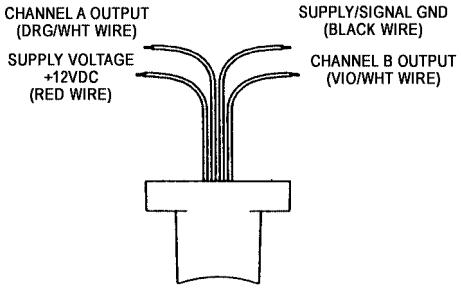
Ring Kit Encoder



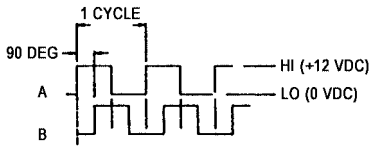
Factory installed ring kit encoder for actuators with C-Face mounted motors and for motorized actuators. The encoder is mounted between the motor and adaptor or reducer. The actuator worm shaft opposite the encoder is free for driving another actuator or for a limit switch.

Available for 56C and 140TC motors.

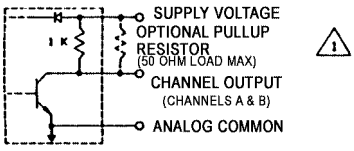
Dual channel quadrature design measures both motor speed and direction.



Electrical Connections



Output Channel Waveforms



Output Channel Schematic (Channels A & B)

Specifications

Sensor Type -Bidirectional shaft speed sensor

Pulses Per Revolution -60 cycles each channel

Supply Voltage -+12 Volts DC +/ -5%

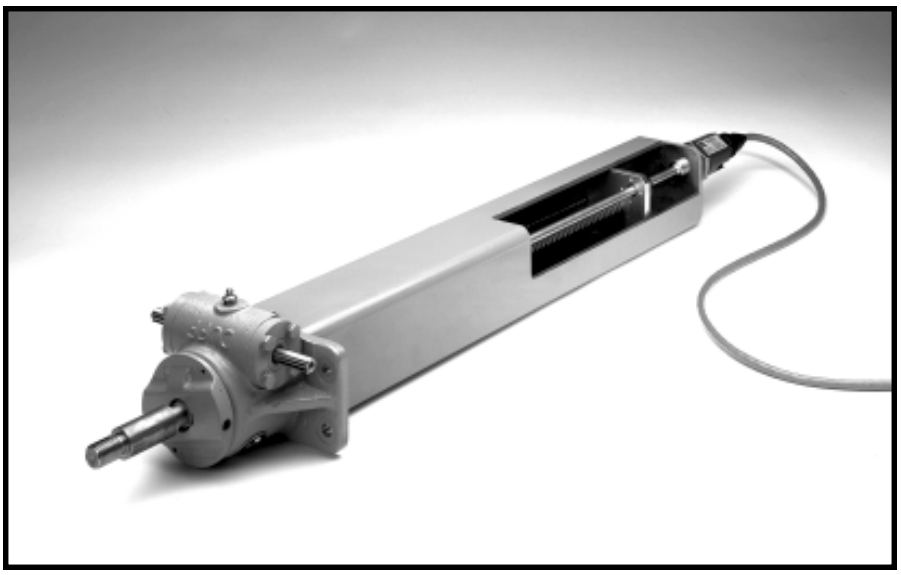
Supply Current -60 mA typical (115 mA maximum)

Output Drive Capability -250 mA per channel continuous

Maximum Load - 50 ohms per channel

To obtain an actuator with a ring kit encoder specify ring kit encoder at time of order.

Magnetostrictive Position Sensor



Duff -Norton now has available magnetostrictive position sensors for machine and ball screw actuators. These sensors offer analog or digital outputs, and can be used for accurate position indication or with a PLC in a closed loop control system. Magnetostrictive position sensors are non-contacting, resulting in longer life than other linear transducers or potentiometers.

Due to the fact that the magnet senses actual screw displacement, position indication is absolute and unaffected by gearset backlash.

Features

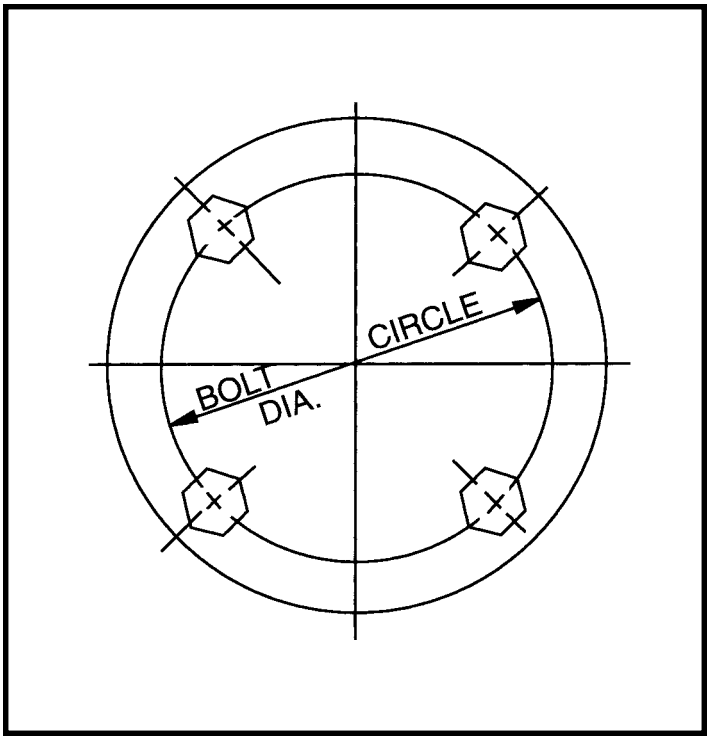
- Absolute Position Indication
- Non-Contacting, Magnetostrictive Technology
- Replaceable Sensing Element
- Fully Enclosed in Actuator Coverpipe
- Lengths up to 60 inches 0525mm)
- Shock and Vibration Resistant
  - Analog or Digital Outputs:
  - Voltage 0 to +10 VDC or +10 to 0 VDC
  - Current (4-20 MA or 0-20 MA Grounded)
  - Start / Stop
  - Pulse Width Modulated
- Open or Closed Loop Control
- Available for a wide range of Duff - Norton Machine and Ball Screw Actuators

Parameter	Specification
Supply Voltage	+15 to 26 VDC
Non-Linearity	± 05% of Full Scale or :to.002 in. (± 0.05 mm) whichever is greater
Repeatability	± 0.001% of Full Scale. or ± 0.0001 in. (±0.002 mm) whichever is greater
Hysteresis	0.0008 in. (0.076 mm) maximum
Measuring Range	U.S. Customary: 1 to 60 in. (0.1 in. increments) Metric: 50 to 1500 mm (5 mm increments)

Engineering Guide

Refer to respective catalog dimensional drawings for orientation on flange bolts in relation to the horizontal ℄ for 4-hole pattern and 30° to horizontal ℄ for 6-hole pattern.

Flange Bolt Information



Actuator Rating		B.C. Dia.	Bolt Information
500 Lb.		---	No Flange Bolts
1000 Lb.		---	No Flange Bolts
1 Ton		---	No Flange Bolts
2 Ton		1 11/16"	Four 1/4-20 x 3/4" Lg. Eq. Spaced @ 90º
3 Ton		1 11/16"	Four 1/4-20 x 3/4" Lg. Eq. Spaced @ 90º
5 Ton		2 3/8"	Four 5/16-18 x 3/4" Lg. Eq. Spaced @ 90º
10 Ton	1810 Series	2 3/4"	Four 5/16-18 x 3/4" Lg. Eq. Spaced @ 90º
	9010 Series	3"	Four 5/16-18 x 3/4" Lg. Eq. Spaced @ 90º
15 Ton		2 3/4"	Four 5/16-18 x 1" Lg. Eq. Spaced @ 90º
20 Ton		3 1/2"	Four 3/8-16 x 1" Lg. Eq. Spaced @ 90º
25 Ton		4 1/8"	Four 3/8-16 x 1 1/4" Lg. Eq. Spaced @ 90º
35 Ton		4 1/4"	Four 1/2-13 x 1 1/4" Lg. Eq. Spaced @ 90º
50 Ton		5 1/4"	Four 5/8-11 x 1 1/2" Lg. Eq. Spaced @ 90º
75 Ton		5 3/4"	Six 5/8-11 x 1 1/2" Lg. Eq. Spaced @ 60º
100 Ton		6 1/4"	Six 5/8-11 x 1 1/2" Lg. Eq. Spaced @ 60º
150 Ton		6 1/4"	Six 5/8-11 x 1 1/2" Lg. Eq. Spaced @ 60º
250 Ton		8 1/4"	Six 3/4-10 x 2" Lg. Eq. Spaced @ 60º

Engineering Guide

Overhung Load Capacity of Actuator Worm Shafts (Lbs.)

Model No.	
2555	50
2625	45
28631	45
2501	55
1802, 2802, 28021, 7002, 7802, 78021, 9002, 9802 & 98021	30
28003 & 98003	120
9005, 9805 & 98051	105
9010, 9810 & 98101	305
9015	390
9020 & 9820	325
9025 & 9825	735
9035	665
1850 & 2860	350
9075	630
9099	650
18150	350
2250	1310

Notes:

1. These ratings are based on use of roller chain and sprocket. For other conditions, divide ratings by following factors:
   1.25 for overhung gear
   1.50 for overhung “V” belt
   2.50 for overhung flat belt
2. Ratings are based on standard actuator model worm shaft extensions and are calculated on the basis of concentrated load applied at a point 1/2 the keyway length measured from extreme end of worm shaft.
3. Above ratings apply to actuators carrying any load up to their rated capacity.

Overhung Load Ratings for Gear Box (Lbs.)

	RPM						
Shaft Diameter	1750	1150	850	690	400	300	100
3/8" Through Shaft	25	25	25	25	25	25	25
5/8" Through Shaft	177	205	240	267	330	378	400
1" Through Shaft	175	260	305	345	425	500	775
1 3/8" Through Shaft	250	300	385	450	565	630	1075

Notes:

1. All overhung load ratings apply to either stub shaft or drive shaft.
3. Overhung load ratings based on use of roller chain and sprocket. For other conditions, divide overhung load ratings by following factors:
   1.25 for overhung gear
   1.50 for overhung “V” belt
   2.50 for overhung flat belt
3. Overhung load ratings are based on standard shaft extensions and are calculated on basis of concentrated load applied at a load rating point 1/2 the keyway length measured from extreme end of shaft.
4. For intermediate speeds, above overhung load ratings can be interpolated.

Engineering Guide

Key Torque for Actuators

This is the torque caused by tendency of the lifting screw to rotate. It is a function of the screw pitch, screw efficiency and the load, and is not affected by the actuator unit ratio.

Note:

These key torques are given at rated actuator model capacities. For smaller load, reduce key torque in direct proportion.

Model No.	Actuator Model Capacity (Tons)	Screw Pitch (in.)	Key Torque Inch/Pounds
2555	1/4	.250	40
2625	1/2	.125	70
28631	1/2	.200	35
2501	1	.200	175
1802, 7002 & 9002	2	.250	460
2802, 7802 & 9802	2	.250	175
28021, 78021 & 98021	2	1.000	700
28003 & 98003	3	.413	440
9005	5	.375	1,750
9805	5	.474	850
98051	5	1.000	1,800
9010	10	.500	4,700
9810	10	.474	1,700
98101	10	1.000	3,500
9015	15	.500	7,580
9020	20	.500	10,625
9820	20	.500	3,500
9025	25	.666	14,000
9825	25	.660	6,000
9035	35	.666	26,500
1850 & 9050	50	.666	47,110
2860	50	1.000	17,700
9075	75	.666	73,000
9099	100	.750	118,200
18150	150	1.000	216,000
2250	250	1.000	423,300

Quick Reference Charts-Side Thrust Ratings

1800, 7000 & 9000 Series Machine Screw Actuators Loads and Raises

Duff-Norton recommends that side thrust and eccentric loading be avoided when possible by using guides external to the actuator. The maximum allowable side thrusts at various loads and raises are given in the following charts.

For raises other than those given, the maximum allowable side thrust may be calculated by dividing the maximum bending moment by the raise.

The maximum allowable eccentric load may be calculated by dividing the maximum bending moment by the distance from the centerline of the lifting screw to the centerline of the load.

2555 Tension Loaded

Load on Actuator (Lbs.)	Side Thrust Rating - lbs. Raise - in. 3	6	9	12	15	MRBM* in-lb
100	55	27	18	14	11	165
200	50	25	17	12	10	150
300	44	22	15	11	**	132
400	40	20	13	10	**	120
500	36	18	12	**	**	108

2555 Compression Loaded

Load on Actuator (Lbs.)	Side Thrust Rating - lbs. Column Length (Raise) - in. 3 (1.4)	6 (4.4)	8 (6.4)
100	26	9	4
200	24	8	3
300	23	7	2
400	21	6	2
500	19	5	1

2625 Tension Loaded

Load on Actuator (Lbs.)	Side Thrust Rating - lbs. Raise - in. 3	6	9	12	15	18	21	24	MRBM* in-lb
200	105	52	35	26	21	18	15	14	315
400	103	51	34	25	20	17	14	13	310
600	95	47	32	24	19	16	13	12	286
800	88	44	29	22	18	14	12	11	265
1000	80	40	27	20	16	13	11	10	240

2625 Compression Loaded

Load on Actuator (Lbs.)	Side Thrust Rating - lbs. Column Length (Raise) - in. 3 (1.8)	6 (4.8)	9 (7.8)	12 (10.8)
200	49	19	7	2
400	45	17	6	1
600	41	15	4	**
800	37	13	3	**
1000	33	11	2	**

2501 Tension Loaded

Load on Actuator (Lbs.)	Side Thrust Rating - lbs. Raise - in. 3	6	9	12	15	18	21	24	MRBM* in-lb
400	150	75	50	37	30	25	21	19	450
800	140	70	47	35	28	23	20	17	420
1200	128	64	43	32	26	21	18	16	385
1600	120	60	40	30	24	20	17	15	360
2000	112	56	37	28	22	18	16	14	335

2501 Compression Loaded

Load on Actuator (Lbs.)	Side Thrust Rating - lbs. Column Length (Raise) - in. 3 (1.8)	6 (4.8)	9 (7.8)	12 (10.8)
400	89	41	11	4
800	80	37	8	1
1200	71	33	5	**
1600	58	26	**	**
2000	53	24	**	**

1801, 7002 & 9002 Tension Loaded

Load on Actuator (Lbs.)	Side Thrust Rating - lbs. Raise - in. 3	6	9	12	15	18	21	24	MRBM* in-lb
500	420	210	140	105	84	70	60	52	1260
1000	400	200	133	100	80	66	57	50	1200
2000	375	187	125	94	75	62	53	46	1125
3000	330	165	110	85	65	55	47	41	990
4000	300	150	100	75	60	50	43	36	900

1802, 7002 & 9002 Compression Loaded

Load on Actuator (Lbs.)	Side Thrust Rating - lbs. Column Length (Raise) - in. 3 (2)	6 (5)	9 (8)	12 (11)	15 (14)	18 (17)
500	239	120	62	25	11	6
1000	224	112	57	21	8	3
2000	194	97	47	13	2	**
3000	163	82	37	6	**	**
4000	133	66	27	**	**	**

9005 Tension Loaded

Load on Actuator (Tons)	Side Thrust Rating - lbs. Raise - in. 3	6	9	12	18	24	30	36	MRBM* in-lb
1	1600	800	530	400	265	200	160	130	4800
2	1440	720	480	360	240	180	140	120	4320
3	1350	675	450	340	225	170	135	110	4050
4	1250	625	415	310	210	155	125	105	3750
5	1200	600	400	300	200	150	120	100	3600

9005 Compression Loaded

Load on Actuator (Tons)	Side Thrust Rating - lbs. Column Length (Raise) - in 3(1.3)	6(4.3)	9(7.3)	12(10.3)	18(16.3)	24(22.3)	27(24.3)
1	660	330	220	150	35	10	5
2	570	285	190	125	20	**	**
3	485	240	160	105	5	**	**
4	395	200	130	85	**	**	**
5	310	155	105	60	**	**	**

Quick Reference Charts - Side Thrust Ratings

1800 & 9000 Series Machine Screw Actuators Loads and Raises

9010 Tension Loaded

Load on Actuator (Tons)	Side Thrust Rating - lbs. Raise - in.								MRBM* in-lb
	3	6	9	12	18	24	30	36	
2	3700	1850	1230	925	620	460	370	310	11,100
4	3400	1700	1135	850	565	425	340	280	10,200
6	3000	1500	1000	750	500	375	300	250	9,000
8	2700	1350	900	675	450	340	270	225	8,100
10	2400	1200	800	600	400	300	240	200	7,200

9010 Compression Loaded

Load on Actuator (Tons)	Side Thrust Rating - lbs. Column Length (Raise) - in.						
	6(4.4)	9(7.4)	12(10.4)	18(16.4)	24(22.4)	30(28.4)	36(34.4)
2	734.4	489.55	367.17	160.46	55.17	20.00	5.75
4	619.84	413.23	309.92	122.30	26.55	**	**
6	505.34	336.89	252.67	84.13	**	**	**
8	390.84	260.56	195.42	45.96	**	**	**
10	276.34	184.23	138.17	7.80	**	**	**

** Use larger actuator

9015 Tension Loaded

Load on Actuator (Tons)	Side Thrust Rating - lbs. Raise - in.								MRBM* in-lb
	3	6	9	12	18	24	30	36	
3	5480	2740	1825	1370	915	385	550	455	16,440
6	5000	2500	1665	1250	835	625	500	415	15,000
9	4400	2200	1465	1100	735	550	440	365	13,200
12	4000	2000	1365	1000	665	500	400	335	12,000
15	3200	1600	1065	800	535	400	320	265	9,600

9015 Compression Loaded

Load on Actuator (Tons)	Side Thrust Rating - lbs. Column Length (Raise) - in.						
	6 3.9)	9(6.9)	12(9.9)	18(15.9)	24(21.9)	30(27.9)	36(33.9)
3	1200	800	600	390	140	60	20
6	1000	660	500	320	90	20	**
9	790	530	400	260	40	**	**
12	590	390	290	190	**	**	**
15	390	260	190	120	**	**	**

** Use larger actuator

9020 Tension Loaded

Load on Actuator (Tons)	Side Thrust Rating - lbs. Raise - in.								MRBM* in-lb
	3	6	9	12	18	24	30	36	
4	7260	3600	2400	1800	1200	900	720	600	21,600
8	6500	3250	2165	1625	1085	810	650	540	19,500
12	5600	2800	1885	1400	935	700	560	485	16,800
16	5000	2500	1665	1250	835	625	500	415	15,000
20	4000	2000	1335	1000	685	500	400	330	12,000

9020 Compression Loaded

Load on Actuator (Tons)	Side Thrust Rating - lbs. Column Length (Raise) - in.						
	6(3.9)	9(6.9)	12(9.9)	18(15.9)	24(21.9)	30(27.9)	36(33.9)
4	1840	1230	920	610	320	140	70
8	1530	1020	760	510	240	80	10
12	1220	810	610	410	160	20	**
16	900	600	450	300	80	**	**
20	590	390	300	200	**	**	**

** Use larger actuator

9025 Tension Loaded

Load on Actuator (Tons)	Side Thrust Rating - lbs. Raise - in.								MRBM* in-lb
	3	6	9	12	18	24	30	36	
5	18,700	9350	6235	4675	3105	2335	1870	1580	56,100
10	17,600	8800	5865	4400	2930	2200	1760	1460	52,800
15	16,400	8200	5465	4100	2735	2050	1640	1365	49,200
20	15,200	7600	5065	3800	2535	1900	1520	1265	45,600
25	13,600	6800	4535	3400	2265	1700	1360	1135	40,800

9025 Compression Loaded

Load on Actuator (Tons)	Side Thrust Rating - lbs. Column Length (Raise) - in.						
	6(3.9)	9(6.9)	12(9.9)	18(15.9)	24(21.9)	30(27.9)	36(33.9)
5	4410	2940	2210	1470	1100	700	380
10	3900	2600	1950	1300	970	600	290
15	3380	2250	1690	1130	850	500	210
20	2870	1910	1430	960	720	390	120
25	2350	1570	1180	780	590	290	40

9035 Tension Loaded

Load on Actuator (Tons)	Side Thrust Rating - lbs. Raise - in.								MRBM* in-lb
	3	6	9	12	18	24	30	36	
7	26.000	13,000	8665	6500	4335	3250	2600	2165	78,000
14	24,000	12,000	8000	6000	4000	3000	2400	2000	72,000
21	21,600	10,800	7200	5400	3600	2700	2160	1800	64,800
28	19,800	9900	6600	4950	3300	2475	1980	1650	59,400
35	17,600	8800	5865	4400	2935	2200	1760	1465	52,800

9035 Compression Loaded

Load on Actuator (Tons)	Side Thrust Rating - lbs. Column Length (Raise) - in.						
	6(2.9)	9(5.9)	12(8.9)	18(14.9)	24(20.9)	30(26.9)	36(32.9)
7	10,020	6680	5010	3340	2500	2000	1610
14	9080	6050	4540	3030	2270	1815	1450
21	8140	5420	4070	2710	2030	1630	1290
28	7200	4800	3600	2400	1800	1440	1140
35	6260	4170	3130	2090	1560	1250	980

1850 & 9050 Tension Loaded

Load on Actuator (Tons)	Side Thrust Rating - lbs. Raise - in.								MRBM* in-lb
	3	6	9	12	18	24	30	36	
10	48,600	24,300	16,200	12,150	8100	8075	4860	4050	145,800
20	44,500	22,250	14,800	11,100	7400	5600	4450	3700	133,500
30	41,000	20,500	13,700	10,250	6800	5125	4100	3400	123,000
40	37,000	18,500	12,300	9250	6200	4600	3700	3100	111,000
50	34,400	17,200	11,500	8600	5700	4300	3400	2900	103,200

1850 & 9050 Compression Loaded

Load on Actuator (Tons)	Side Thrust Rating - lbs. Column Length (Raise) - in.						
	6(3.9)	9(6.9)	12(9.9)	18(15.9)	24(21.9)	30(27.9)	36(33.9)
10	19,800	13,200	9900	6600	4950	3960	3300
20	18,120	12,080	9060	6040	4530	3620	3020
30	16,440	10,960	8220	5480	4110	3290	2740
40	14,760	8,840	7380	4920	3690	2950	2460
50	13,080	8,720	6540	4360	3270	2620	2180

Quick Reference Charts-Side Thrust Ratings

1800 & 9000 Series Machine Screw Actuators Loads and Raises

9075 Tension Loaded

Load on Actuator (Tons)	Side Thrust Rating - lbs. Raise - in. 3	6	12	18	24	30	36	42	MRBM* in-lb
15	65,000	32,500	16,300	10,800	8,100	6,500	5,400	4,600	195,000
30	59,000	29,500	14,800	9,800	7,400	5,900	4,900	4,200	177,000
45	53,000	26,500	13,300	8,900	6,600	5,300	4,400	3,700	159,000
60	47,300	23,600	11,800	7,900	5,900	4,700	3,900	3,300	142,000
75	40,000	20,000	10,000	6,700	5,000	4,000	3,300	2,800	120,000

9075 Compression Loaded

Load on Actuator (Tons)	Side Thrust Rating - lbs. Column Length (Raise) - in. 6(3)	12(9)	18(15)	24(21)	30(27)	36(33)	42(39)
15	25,070	12,540	8,360	6,270	5,010	4,180	3,580
30	22,320	11,170	7,440	5,580	4,470	3,720	3,190
45	19,580	9,790	6,530	4,890	3,920	3,260	2,800
60	16,830	8,410	5,610	4,210	3,370	2,800	2,400
75	14,080	7,040	4,690	3,520	2,820	2,350	2,010

9099 Tension Loaded

Load on Actuator (Tons)	Side Thrust Rating - lbs. Raise - in. 3	6	12	18	24	30	36	48	MRBM* in-lb
20	111,000	55,500	27,800	18,500	13,900	11,100	9,200	6,900	333,000
40	101,000	50,500	25,300	16,800	12,600	10,100	8,400	6,300	303,000
60	90,000	45,000	22,500	15,000	11,300	9,000	7,500	5,800	270,000
80	78,000	39,000	19,500	13,000	9,800	7,800	6,500	4,800	234,000
100	70,000	35,000	17,500	11,700	8,800	7,000	5,800	4,400	210,000

9099 Compression Loaded

Load on Actuator (Tons)	Side Thrust Rating - lbs. Column Length (Raise) - in. 12(5)	18(11)	24(17)	36(29)	48(41)	60(53)	72(65)
25	21,580	14,390	10,790	7,190	5,400	3,960	2,180
50	19,390	12,930	9,700	6,463	4,850	3,520	1,810
75	17,200	11,470	8,600	5,730	4,300	3,080	1,450
100	15,010	10,010	7,500	5,000	3,750	2,640	1,080
150	12,820	8,550	6,410	4,270	3,200	2,210	720

18150 Tension Loaded

Load on Actuator (Tons)	Side Thrust Rating - lbs. Raise - in. 3	6	12	18	24	36	48	60	MRBM* in-lb
25	150,000	75,000	37,500	25,000	18,800	12,500	9,400	7,500	450,000
50	138,000	69,000	34,500	23,000	17,300	11,500	8,600	6,900	414,000
75	127,000	63,500	31,700	21,200	15,900	10,800	7,900	6,380	381,000
100	114,000	57,000	28,500	19,000	14,300	9,500	7,100	5,700	342,000
150	92,000	48,000	23,000	15,400	11,500	7,800	5,700	4,800	276,000

18150 Compression Loaded

Load on Actuator (Tons)	Side Thrust Rating - lbs. Column Length (Raise) - in. 12(5)	18(11)	24(17)	36(29)	48(41)	60(53)	72(65)
20	34,550	23,030	17,280	11,520	8,640	6,910	4,970
40	31,360	20,900	15,680	10,450	7,840	6,270	4,430
60	28,160	18,770	14,080	9,390	7,040	5,630	3,900
80	24,970	16,650	12,480	8,320	6,240	4,990	3,370
100	18,580	12,390	9,290	6,190	4,640	3,720	2,300

2250 Tension Loaded

Load on Actuator (Tons)	Side Thrust Rating - lbs. Raise - in. 6	12	18	24	36	48	60	72	MRBM* in-lb
50	192,000	96,000	64,000	48,000	32,000	24,000	19,200	18,000	1,152,000
100	174,000	87,000	58,000	43,500	29,000	21,750	17,400	14,500	1,044,000
150	156,000	78,000	52,000	39,000	25,900	19,500	15,800	13,000	936,000
200	138,000	69,000	46,000	34,500	23,000	17,200	13,800	11,500	828,000
250	120,000	60,000	40,000	30,000	20,000	15,000	12,000	10,000	720,000

2250 Compression Loaded

Load on Actuator (Tons)	Side Thrust Rating - lbs. Column Length (Raise) - in. 12(5)	18(11)	24(19)	36(29)	48(41)	60(53)	72(65)
50	82,300	54,900	41,200	27,400	20,600	16,500	13,700
100	73,800	49,200	36,900	24,600	18,400	14,800	12,300
150	65,200	43,500	32,600	21,700	16,300	13,000	10,900
200	56,600	37,800	28,300	18,900	14,200	11,300	9,400
250	48,100	32,000	24,000	16,000	12,000	9,600	8,000

2800, 7800 & 9800 Series Ball Screw Actuator Models Loads and Raises

Model Number	Side Thrust Rating (Lbs.) At Following Increments of Raise 0-3"	6"	9"	12"	15"	18"	21"	24"	MRBM*
28631	60	30	20	15	12	10	0	0	180
2802, 7802 & 9802	300	150	100	75	60	50	45	35	900
28003 & 98003	500	250	167	125	100	84	72	63	1500
9805 & 98051	1120	560	370	280	225	185	160	140	3350
9810 & 98101	500	270	180	135	110	90	80	70	1620
9820	3200	1600	1005	800	640	535	455	400	9600
9825	7665	3835	2555	1915	1530	1275	1095	980	23,000
2860	17,600	8800	5870	4400	3520	2935	2515	2200	52,800

Note: The figures given above are permissible side thrust ratings, however, we recommend that all side load be carried by guides in your arrangement and not by screw and nut. Life of the ball screw and nut will be adversely affected the more side load they see. For raises other than those given, the maximum allowable side thrust may be calculated by dividing the maximum bending moment MRBM by the raise. The maximum allowable eccentric load can be calculated by dividing the maximum bending moment by the distance from the centerline of the lifting screw to the centerline of the load.

Lateral Movement Ratings (In)

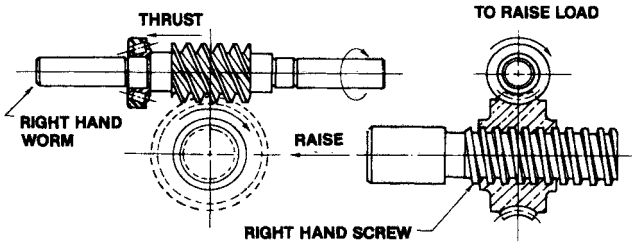
1800, 7000 & 9000 Series Machine Screw Actuators at Various Raises

Raise (In.)	255	2625	2501	1802	7002 & 9002	9005	9010	9015	9020	9025	9035	1850 & 9050	9075	9099	18150	2250
3	.040	.050	.020	.020	.020	.030	.025	.030	.025	.035	.040	.060	.050	.050	.050	.090
6	.085	.075	.030	.035	.035	.050	.040	.045	.040	.060	.050	.090	.060	.060	.060	.100
9	.090	.105	.040	.055	.055	.070	.055	.065	.050	.085	.060	.120	.070	.070	.070	.110
12	.115	.135	.050	.070	.070	.090	.070	.080	.070	.105	.070	.150	.080	.080	.080	.120
15	.140	.165	.060	.090	.090	.110	.085	.100	.080	.130	.080	.180	.090	.090	.090	.130
18	.165	.195	.070	.100	.100	.1030	.100	.120	.095	.155	.090	.215	.100	.100	.100	.140
21	.190	.225	.080	.120	.120	.150	.115	.133	.105	.175	.100	.245	.110	.110	.110	.150
24	.215	.255	.090	.135	.135	.170	.135	.150	.125	.200	.110	.275	.120	.120	.120	.160

Notes:

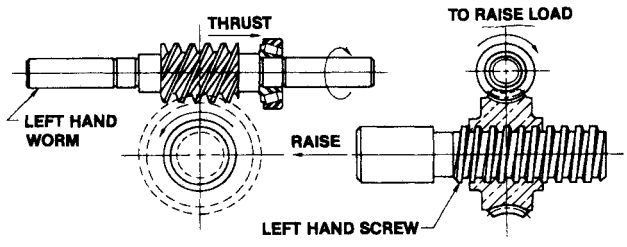
1. Does not allow for possible deflection due to side thrust.
2. Lateral movements are for information only. For best results, we suggest guides where possible.
3. The above movements apply to 1800 and 9000 Series machine screw actuator models only and not to the ball screw series. Permitting lateral movement on the ball screw under load will exert side thrust on the ball screw and ball nut, and will be detrimental to ball screw and ball screw nut life. Ball screw applications should be guided to ensure a minimum of lateral movement.

Worm Rotation Chart



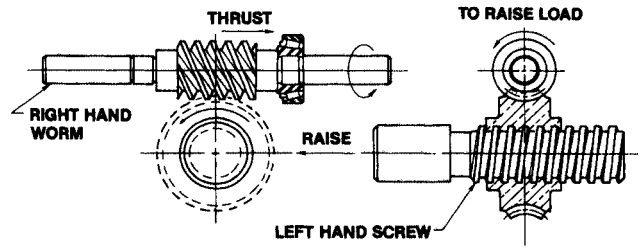
STANDARD FOR ALL
EXCEPT 1850, 9050, 2860, 9075

Clockwise Rotation of Worm
Raises Load



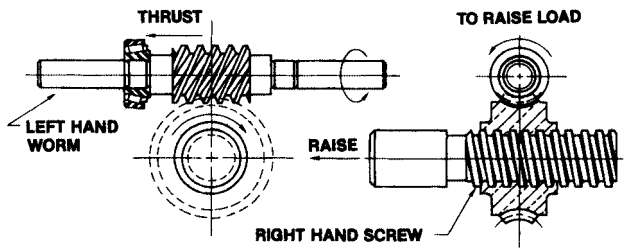
STANDARD FOR 1850, 9050 & 9075
SPECIAL FOR ALL OTHER ACTUATOR
UNITS AT EXTRA COST

Clockwise Rotation of Worm
Raises Load



SPECIAL FOR ALL ACTUATOR UNITS

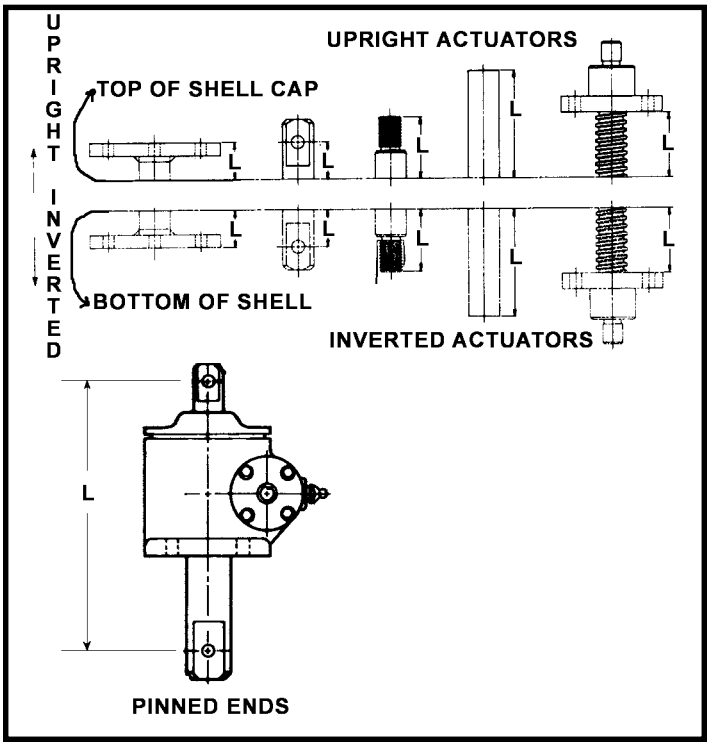
Counter-Clockwise Rotation of
Worm Raises Load



STANDARD FOR 2860
SPECIAL FOR ALL OTHER ACTUATOR
UNITS AT EXTRA COST

Counter-Clockwise Rotation of
Worm Raises Load

Instructions For Use Of Compression Load Screw Column Strength Curves



Actuator Model	Actuator Rating (Tons)	Max. Permissible Screw Length Regardless of Load (In.) Fixed Free	Fixed Guided	Max. Pin-to-Pin Length Pinned Ends
2555	1/4	9	24	19
2625	1/2	11	30	24
28631	1/2	11	30	24
2501	1	11	33	26
1802, 7002 & 9002	2	17	45	36
2802, 28021, 7802, 78021, 9802, 98021	2	20	51	41
28003 & 98003	3	21	54	44
9005	5	26	67	54
9805 & 98051	5	27	71	57
9810 & 98101	10	27	71	57
9010	10	35	91	73
9015	15	41	107	85
9820	20	44	116	93
9020	20	47	122	98
9825	25	59	155	124
9025	25	61	160	128
9035	35	79	207	166
2860	50	79	208	167
1850 & 9050	50	98	256	205
9075	75	104	273	219
9099	100	122	320	256
18150	150	147	386	309
2250	250	187	492	393

Screw Length -Screw lengths for strength curves are defined as shown.

Note: Screw length can be converted to actuator raise or actuator raise can be converted to screw length by use of appropriate dimensional diagrams in the design guide for standard actuator models or special dimensions and dimensional diagrams for special actuator models.

Caution: Actual loads on any actuator should never exceed catalog load rating for that actuator.

Safety Factor - The loads on the vertical axis for the strength curves are theoretical buckling loads as predicted by the Euler column formula in sloping portions and twice rated actuator loads in the horizontal portions. See AISC or other applicable codes for selecting appropriate safety factors. .

End Fixity Conditions - The horizontal axis of the strength curves has three screw length scales. The top scale is for the housing end of the screw fixed and the load end of the screw free from guiding. The middle scale is for trunnion or pin mounted actuators. The bottom scale is for the housing end of the screw fixed and the load end of the screw guided. Duff-Norton recommends that load end of actuator screws be guided so that forced misalignment does not occur.

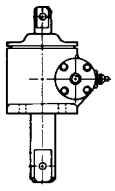
Maximum Permissible Screw Length - The strength curves terminate at a screw length where the screw slenderness ratio is 200. Maximum length versus actuator model is tabulated in the right portion of this page. Screw lengths longer than shown are not recommended regardless of load.

Steps To Follow - To select an actuator suitable for a specific load at a specific screw length with specific end fixity conditions.

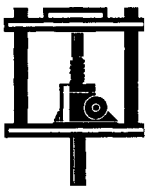
1. Select safety factor from AISC or other applicable codes suitable for actuator application.
2. Multiply load by safety factor to determine failure load.
3. Locate failure load on vertical axis.
4. Locate screw length on appropriate horizontal axis.
5. Project horizontally right from failure load and vertically up from screw length to where projections intersect.
6. Any actuator with its curve above the intersection is suitable for the application provided that the actuator's load rating and its maximum permissible screw length are not exceeded.

Typical Screw End Condition

One end fixed, one end free



Pinned Ends



One end fixed, one end guided

Example - Select a standard upright clevis end machine screw actuator for a 14,000 lb. unguided load and a 25 in. raise. For first approximation assume screw length equal raise.

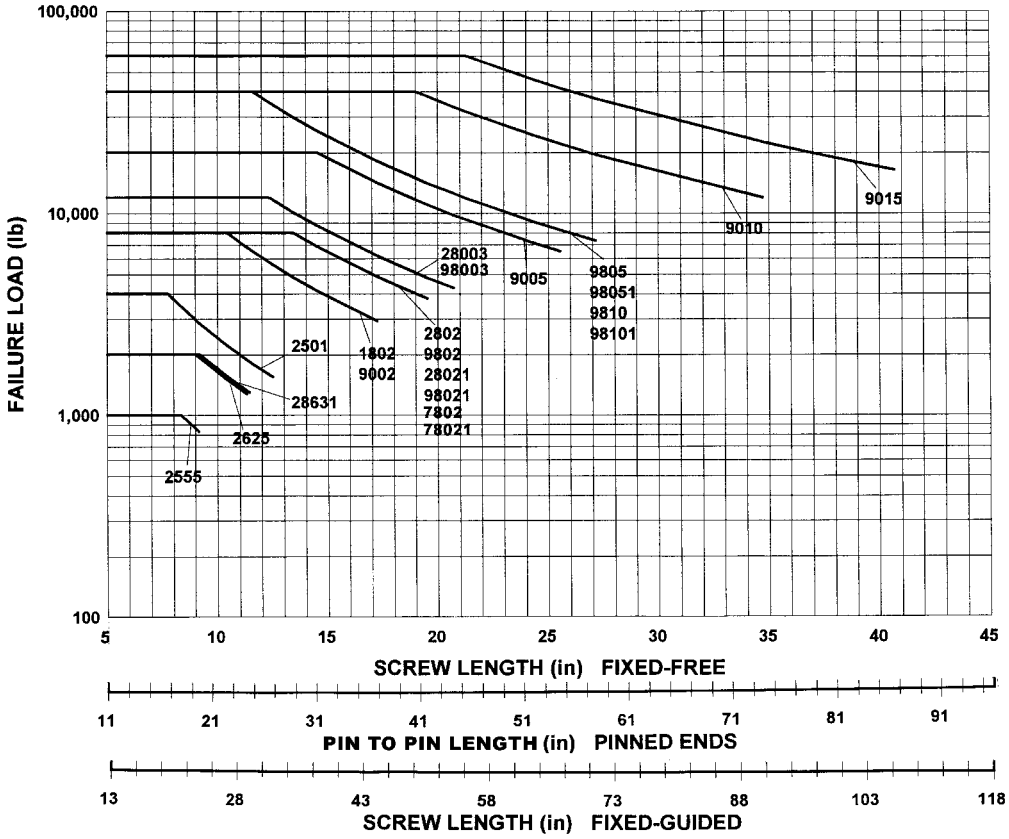
1. Select safety factor. For example 1.92 from AISC specifications. 2. Multiply 14,000 lb. load by 1.92 safety factor to obtain 26,880 lb. failure load.
3. Locate 26,880 lb. load on vertical axis.
4. Locate 25 in. screw length on upper horizontal axis scale.
5. Project horizontally right from 26,880 lb. load and vertically up from 25 in. screw length.
6. Select 9015 actuator since its strength curve is above the intersection, the 14,000 lb. load is less than the 30,000 lb. rated load and the 25 in. screw length is less than the 41 in. maximum permissible screw length.

Recheck actuator selection using true screw length.
Convert 25 in. actuator raise to true screw length.

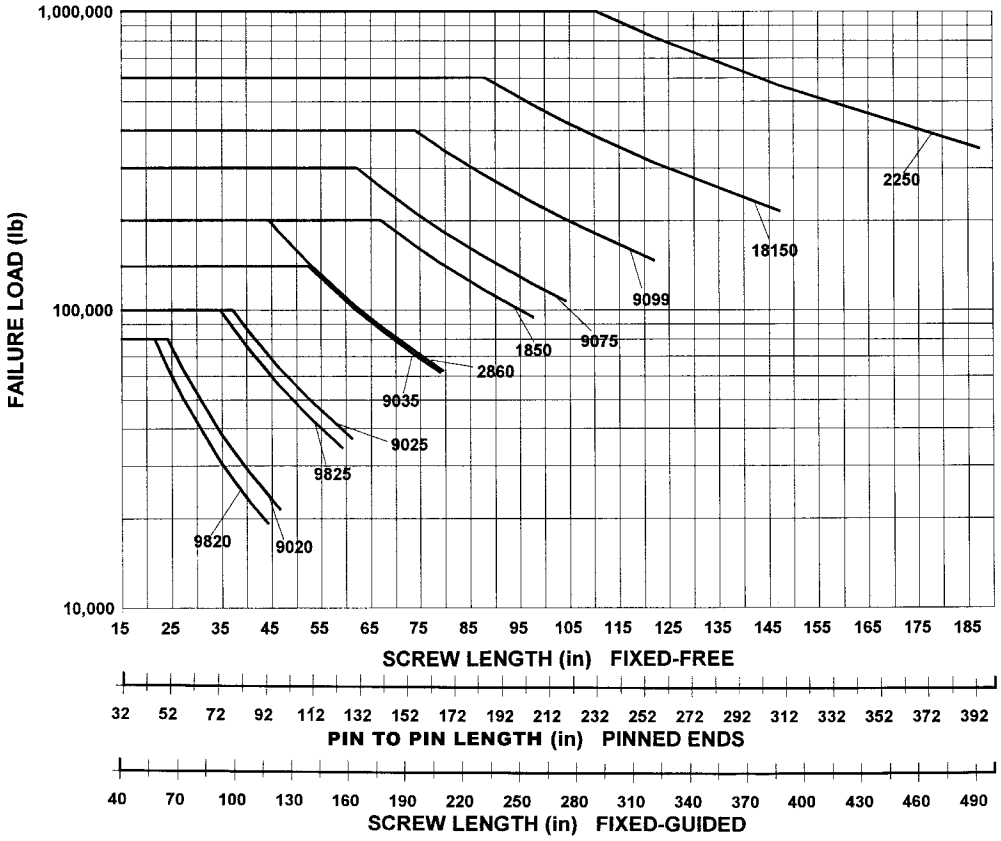
8.50 in.	"A" dimension for clevis type screw end from screw end dimension diagram.
-6.31 in.	Mounting face to top of shell cap from 9015 dimensional diagram.
2.19 in.	Screw length at no raise.
+ 25.00 in.	Raise.
27.19 in.	True screw length at 25 in. raise.

Use failure load of 26,880 lb. and true screw length of 27.19 in. and re-enter chart to verify that 9015 is a safe selection.

Screw Column Strength Chart
For Actuators to 15 Ton Capacity



Screw Column Strength Chart
For Actuators Above 15 Ton Capacity



Maxi-Pac™ Models

Machine Screw Models M-9700 Series

Features:

- Rated loads to 9,000 pounds.
- Six standard models.
- Lifting speeds to 18 inches per minute.
- Self-locking -holds load without creeping when not subjected to vibration.
- Anti-backlash option reduces vertical backlash between the screw and the worm gear nut.

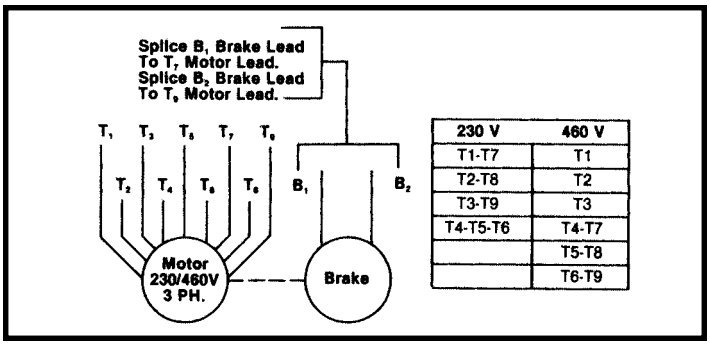
Ball Screw Models M -9900 Series

Features:

- Rated loads to 7 tons.
- Ten standard models.
- Lifting speeds to 48 inches per minute.
- Efficient ball bearing type screw and nut design provide overall efficiency as high as 70%.
- Brake motor is standard for load-holding applications.
- Adjustable rotary limit switches available.

Duff-Norton machine screw and ball screw Maxi-Pacs may be specified with standard raises of up to 24 inches in one-inch increments. Raises of up to 10 feet are available. Over 10 feet please consult Duff-Norton. Units may be installed singly or in multiples and synchronized to push, pull, apply pressure and as linear positioner.

230/460 VAC, 3 Phase, 60 Hz, Single-Speed Motor Brake with 3 Ft-Lb. Brake*



230 V	460 V
T1-T7	T1
T2-T8	T2
T3-T9	T3
T4-T5-T6	T4-T7
	T5-T8
	T6-T9

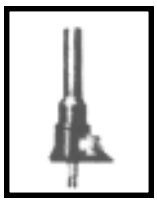
Intermittent-duty, single-speed, TENV motor especially designed for actuator duty is supplied as standard.
Full-load running current at 230 VAC is 3.8 amperes; at 460 VAC, 1.9 amperes.

*Motor brake is standard on M-9900 Series Maxi-Pac actuators.

Technical Data Maxi-Pac™

Translating Screw (Upright)

Rotating Screw (Upright)



Translating Screw (Inverted)

Rotating Screw (Inverted)

Duff-Norton machine screw Maxi-Pac™ actuators are available in six standard models (see table below). Units may be specified in three general types: translating screw (upright or inverted) in which the nut is fixed to a rotating gear within the housing and the lifting screw moves up and down the nut; the rotating screw (upright or inverted) in which the screw is fixed to the rotating gear and the nut travels up and down the screw; and the double clevis mount which is essentially a translating screw model suspended by a clevis at each end of the unit to permit it to move through an arc.

M-9700 Machine Screw Maxi-Pac Actuator Specifications

Model No.	Type	Rated Lifting Capacity (lbs.)	Lifting Speed (in./min.) Single-Speed Motor	Diameter of Lifting Screw (in.)	Maximum Bending Moment (in.-lbs.)	Minimum Closed Height (in.)	Base Size (in.)	Weight** with 6-in. Raise (lbs.)	Weight for each add'l 1-in. Raise (lbs.)
M-9704 ◆	Translating Screw, Inverted	3,000 5,000	18 9	1 1/2 .375 Pitch Acme	4,000	2 1/2	6 x 8	77	0.9
M-9705 ◆	Translating Screw, Upright	3,000 5,000	18 9	1 1/2 .375 Pitch Acme	4,000	7	6 x 8	77	0.9
CCM-9705*** ◆	Double-Clevis Mount	3,000 5,000	18 9	1 1/2 .375 Pitch Acme	4,000	10 3/4 + Raise (Pin-to-Pin)	6 x 8	79	1.0
M-9709 ●	Translating Screw, Inverted	5,200 9,200	6 3	2 .500 Pitch Acme	9,600	2 3/4	7 1/2 x 8 3/4	94	1.4
M-9710 ●	Translating Screw, Upright	5,200 9,200	6 3	2 .500 Pitch Acme	9,600	8 1/4	7 1/2 x 8 3/4	94	1.4
CCM-9710*** ●	Double-Clevis Mount	5,200 9,200	6 3	2 .500 Pitch Acme	9,600	11 3/4 + Raise (Pin-to-Pin)	7 1/2 x 8 3/4	96	1.6

Duff-Norton ball screw Maxi-Pac™ actuators are available in ten standard models (see table below}. Units may be specified in three general types (same as for machine screw models, described below).

Note: Translating screw models are covered by U.S. Patent No. 3,178,958.

M-9900 Ball Screw Maxi-Pac Actuator Specifications

Model No.	Type	Rated Lifting Capacity (lbs.)	Lifting Speed (in./min.) Single-Speed Motor	Diameter of Lifting Screw (in.)	Maximum Bending Moment (in.-lbs.)	Minimum Closed Height (in.)	Base Size (in.)	Weight** with 6-in. Raise (lbs.)	Weight for each add'l 1-in. Raise (lbs.)
M-99041 +	Translating Screw, Inverted	3,000 5,000	48 24	1 1/2 1.000 Lead	3,360	1 3/8	6 x 8	84	0.9
M-99051 +	Translating Screw, Upright	3,000 5,000	48 24	1 1/2 1.000 Lead	3,360	10 3/4	6 x 8	84	0.9
M-99091 ‡	Translating Screw, Inverted	3,200 5,600	36 18	1 1/2 1.000 Lead	1,650	1 1/2	7 1/2 x 8 3/4	94	0.9
M-99101 ‡	Translating Screw, Upright	3,200 5,600	36 18	1 1/2 1.000 Lead	1,650	10 3/8	7 1/2 x 8 3/4	94	0.9
M-9904 +	Translating Screw, Inverted	7,000 10,000	23 11 1/2	1 1/2 .474 Lead	3,360	1 3/8	6 x 8	84	0.9
M-9905 *	Translating Screw, Upright	7,000 10,000	23 11 1/2	1 1/2 .474 Lead	3,360	10 3/4	6 x 8	84	0.9
CCM-9905***+	Double-Clevis Mount	7,000 10,000	23 11 1/2	1 1/2 .474 Lead	3,360	16 1/4 + Raise (Pin-to-Pin)	6 x 8	90	1.0
M-9909 ‡	Translating Screw, Inverted	8,000 14,000	17 8 1/2	1 1/2 .474 Lead	1,650	1 1/2	7 1/2 x 8 3/4	94	0.9
M-9910 ‡	Translating Screw, Upright	8,000 14,000	17 8 1/2	1 1/2 .474 Lead	1,650	10 3/8	7 1/2 x 8 3/4	94	0.9
CCM-9910***‡	Double-Clevis Mount	8,000 14,000	17 8 1/2	1 1/2 .474 Lead	1,650	16 + Raise (Pin-to-Pin)	7 1/2 x 8 3/4	103	1.0

**Total weight depends on total raise.
+ For these models, see M-9805 for housing size and dimensions.
◆For these models, see M-9005 for housing size and dimensions.
‡ For these models, see M-9810 for housing size and dimensions.
● For these models, see M-9010 for housing size and dimensions.

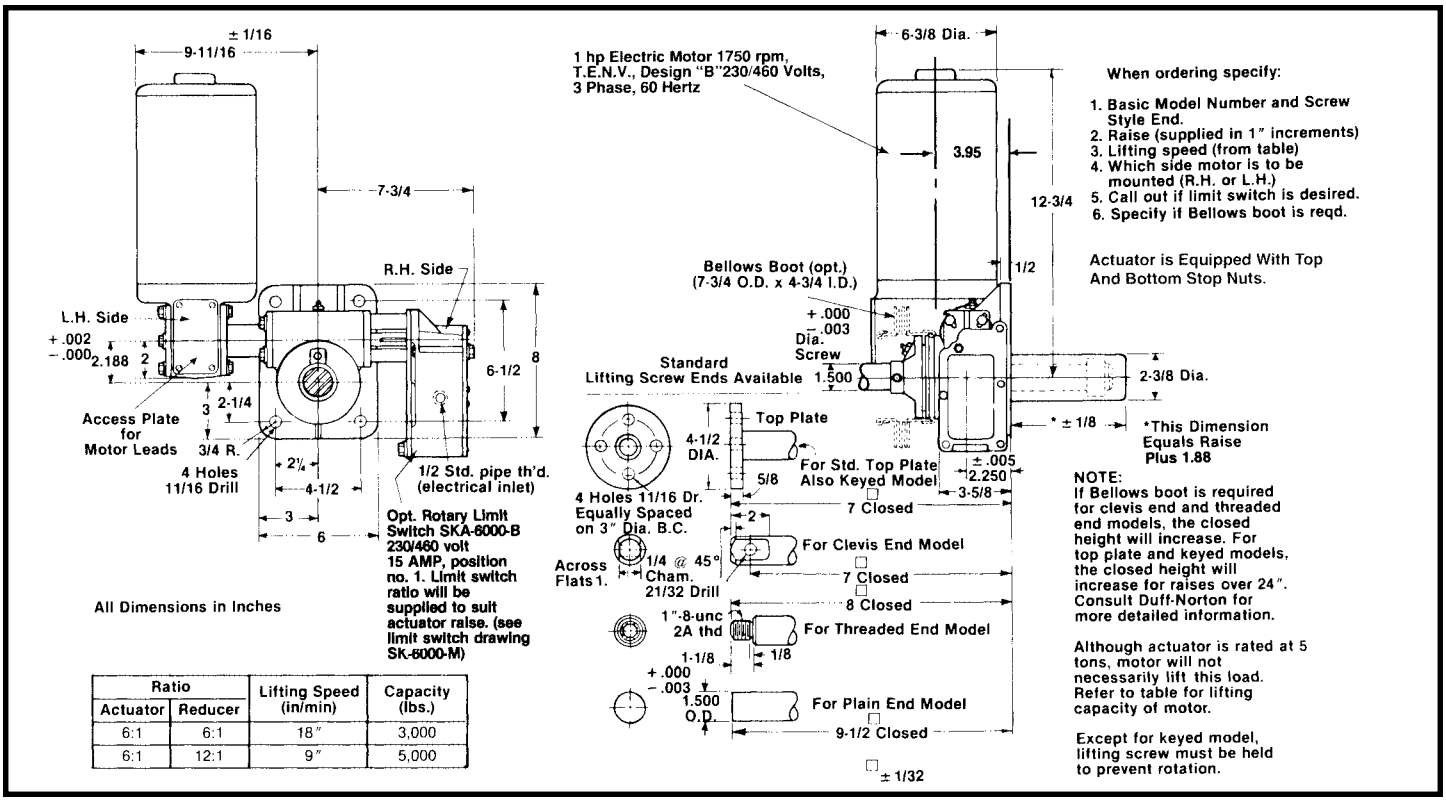
***For CCM-9905 loaded in compression
Max. raise at 7,000 lb load = 20 in
Max. raise at 10,000 lb load = 16 in
Max. raise regardless of load = 20 in
Max. load at max. raise = 7,300 lb

***For CCM-9910 loaded in compression
Max. raise at 8,000 lb load = 19 in
Max. raise at 14,000 lb load = 12 in
Max. raise at 20,000 lb load = 9 in
Max. raise regardless of load = 20 in
Max. load at max. raise = 7,300 lb

***For CCM-9705 loaded in compression
Max. raise at 3,000 lb load = 21 in
Max. raise at 5,000 lb load = 21 in
Max. raise at 10,000 lb load = 16 in
Max. raise regardless of load = 21 in
Max. load at max. raise = 6,500 lb

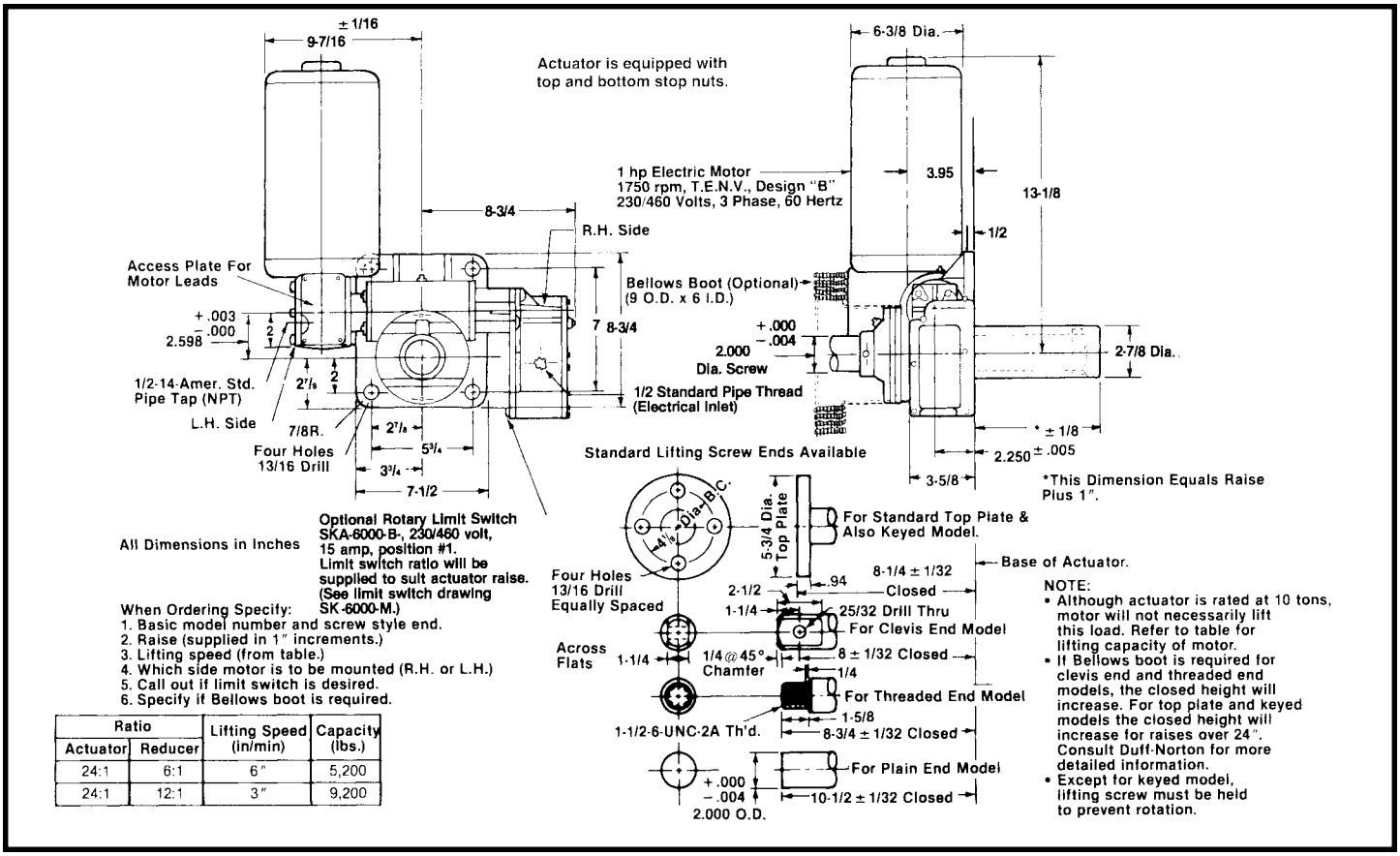
***For CCM-9710 loaded in compression
Max. raise at 5,200 lb load = 30 in
Max. raise at 9,200 lb load = 30 in
Max. raise at 20,000 lb load = 22 in
Max. raise regardless of load = 30 in
Max. load at max. raise = 12,000 lb

Typical M-9705 Maxi-Pac™ Actuator



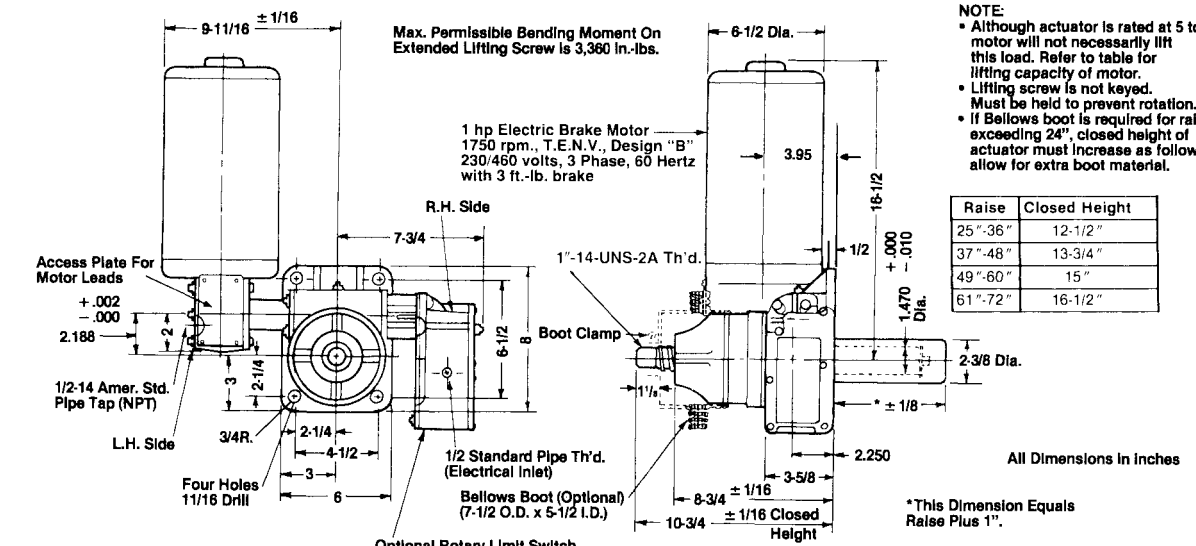
Ratio		Lifting Speed (in/min)	Capacity (lbs.)
Actuator	Reducer		
6:1	6:1	18"	3,000
6:1	12:1	9"	5,000

Typical M-9710 Maxi-Pac™ Actuator



Ratio		Lifting Speed (in/min)	Capacity (lbs.)
Actuator	Reducer		
24:1	6:1	6"	5,200
24:1	12:1	3"	9,200

Typical M-9905 Maxi-Pac™ Actuator



NOTE:
- Although actuator is rated at 5 tons, motor will not necessarily lift this load. Refer to table for lifting capacity of motor.
- Lifting screw is not keyed. Must be held to prevent rotation.
- If Bellows boot is required for raises exceeding 24", closed height of actuator must increase as follows to allow for extra boot material.

Raise	Closed Height
25"-36"	12-1/2"
37"-48"	13-3/4"
49"-60"	15"
61"-72"	16-1/2"

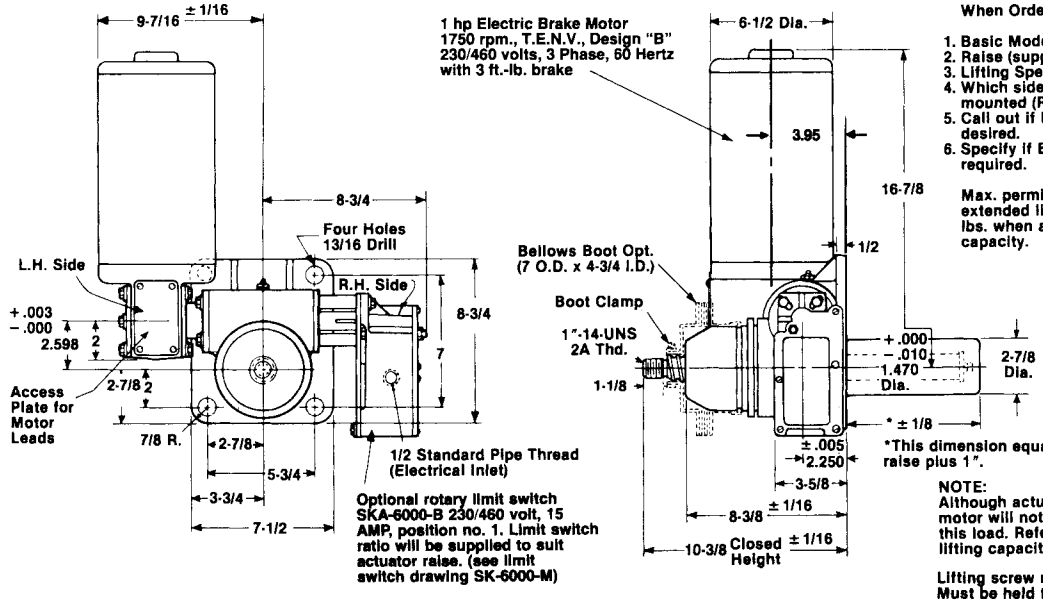
All Dimensions In Inches

*This Dimension Equals Raise Plus 1".

When Ordering Specify:
1. Basic Model Number
2. Raise (supplied in 1" increments.)
3. Lifting speed (from table.)
4. Which side motor is to be mounted (R.H. or L.H.)
5. Call out if limit switch is desired.
6. Specify if Bellows boot is required.

Ratio		Lifting Speed (in/min)	Capacity (lbs.)
Actuator	Reducer		
6:1	6:1	23"	7,000
6:1	12:1	11-1/2"	10,000

Typical M-9910 Maxi-Pac™ Actuator



When Ordering Specify:
1. Basic Model Number
2. Raise (supplied in 1" increments)
3. Lifting Speed. (from table)
4. Which side motor is to be mounted (R.H. or L.H.)
5. Call out if limit switch is desired.
6. Specify if Bellows boot is required.

Max. permissible bending movement on extended lifting screw is 1,650 in.-lbs. when actuator is loaded to capacity.

*This dimension equals raise plus 1".

NOTE:
Although actuator is rated at 10 tons, motor will not necessarily lift this load. Refer to table for lifting capacity of motor.

Lifting screw not keyed. Must be held to prevent rotation.

Ratio		Lifting Speed (in/min)	Capacity (lbs.)
Actuator	Reducer		
8:1	6:1	17"	8,000
8:1	12:1	8-1/2"	14,000

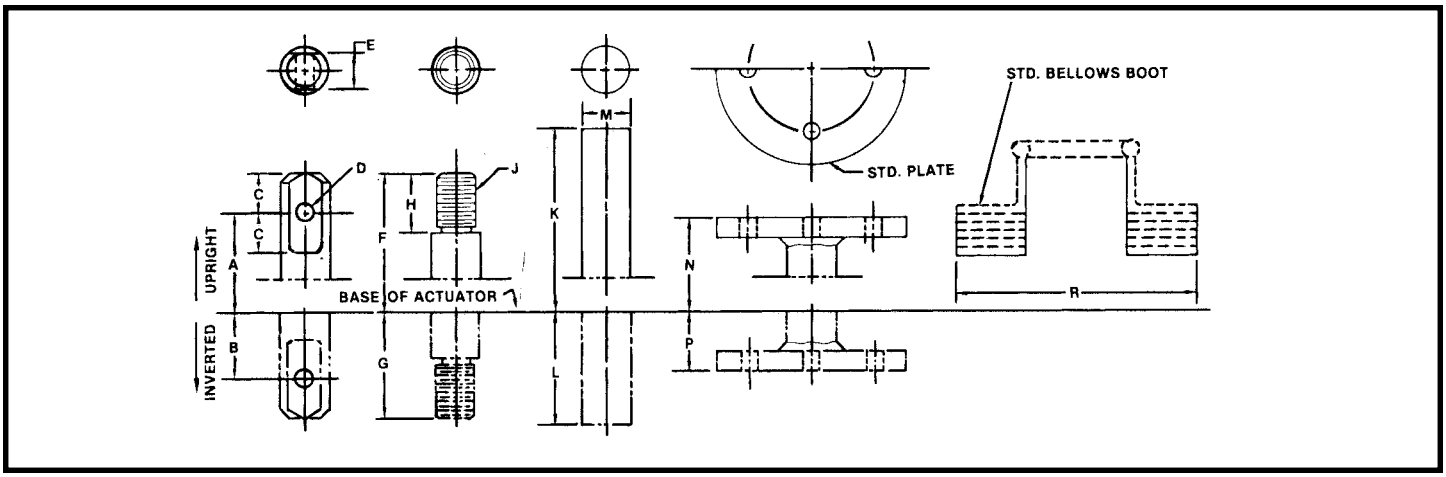
If bellows boot is required for raises exceeding 24", closed height of actuator must increase as follows to allow for extra boot material.

Raise	Closed Height
25"-36"	11-5/8"
37"-48"	12-7/8"
49"-60"	14-1/8"
61"-72"	15-3/8"
73"-84"	16-5/8"
85"-96"	17-7/8"

Note: Dimensions are subject to change without notice.

Maxi-Pac™ Model

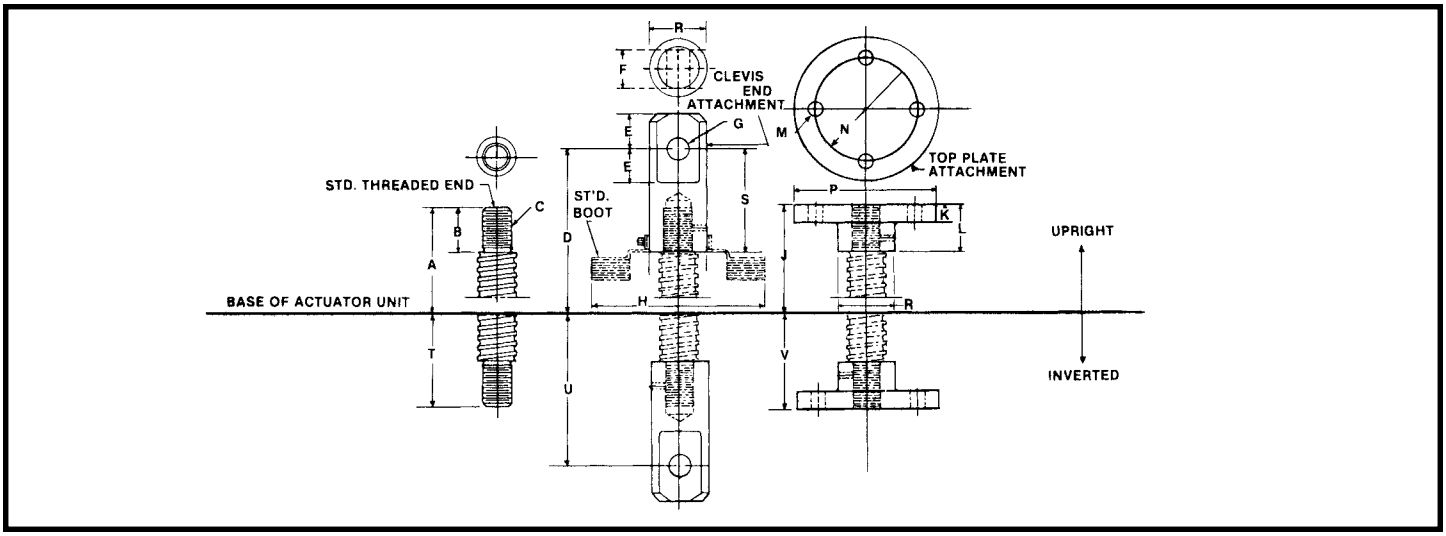
M-9700 Series Standard Screw Ends



Model No.	A*	B*	C	D	E	F*	G*	H	J	K*	L*	M	N*	P*	R
M-9704	---	2 1/2	1	21/32	1	---	3 1/2	1 1/8	1"-8-UNC-2A	---	5	1 1/2	---	2 1/2	7 3/4
M-9705	7	---	1	21/32	1	8	---	1 1/8	1"-8-UNC-2A	9 1/2	---	1 1/2	7	---	7 3/4
CCM-9705	A+B = 10 3/4" Plus Raise		1	21/32	1	---	---	---	---	---	---	---	---	---	7 3/4
M-9709	---	3	1 1/4	25/32	1 1/4	---	4 1/4	1 5/8	1 1/2"-6-UNC-2A	---	6	2	---	2 3/4	9
M-9710	8	---	1 1/4	25/32	1 1/4	8 1/4	---	1 5/8	1 1/2"-6-UNC-2A	10 1/2	---	2	8 1/4	---	9
CCM-9710	A+B = 11 3/4" Plus Raise		1 1/4	25/32	1 1/4	---	---	---	---	---	---	---	---	---	9

*Closed dimensions may increase for Maxi-Pac units supplied with bellows boot. Consult Duff-Norton Company.

M-9900 Series Standard Screw Ends



All dimensions are in inches.

Model No.	A*	B	C	D*	E	F	G**	H	J*	K	L	M	N	P	R	S	T*	U*	V*
M-99041	---	1 1/8	1"-14-UNS-2A	---	1 1/4	1 1/4	3/4	7 1/2	---	5/8	1 1/4	11/16	3 1/2	5	1 3/4	2 7/8	1 3/8	3 1/8	1 7/16
M-99051	10 3/4	1 1/8	1"-14-UNS-2A	12 1/2	1 1/4	1 1/4	3/4	7 1/2	10 3/4	5/8	1 1/4	11/16	3 1/2	5	1 3/4	2 7/8	---	---	---
M-99091	---	1 1/8	1"-14-UNS-2A	---	1 1/4	1 1/2	1	7 1/2	---	3/4	1 3/8	13/16	4 1/8	5 3/4	***	2 7/8	1 1/2	3 1/4	1 9/16
M-99101	10 3/8	1 1/8	1"-14-UNS-2A	12 1/8	1 1/4	1 1/2	1	7	10 3/8	3/4	1 3/8	13/16	4 1/8	5 3/4	***	2 7/8	---	---	---
M-9904	---	1 1/8	1"-14-UNS-2A	---	1 1/4	1 1/4	3/4	7 1/2	---	5/8	1 1/4	11/16	3 1/2	5	1 3/4	2 7/8	1 3/8	3 1/8	1 7/16
M-9905	10 3/4	1 1/8	1"-14-UNS-2A	12 1/2	1 1/4	1 1/4	3/4	7 1/2	10 3/4	5/8	1 1/4	11/16	3 1/2	5	1 3/4	2 7/8	---	---	---
CCM-9905	---	---	---	†	1 1/4	1 1/4	3/4	7 1/2	---	---	---	---	---	---	††	2 7/8	---	†	---
M-9909	---	1 1/8	1"-14-UNS-2A	---	1 1/4	1 1/2	1	7	---	3/4	1 3/8	13/16	4 1/8	5 3/4	***	2 7/8	1 1/2	3 1/4	1 9/16
M-9910	10 3/8	1 1/8	1"-14-UNS-2A	12 1/8	1 1/4	1 1/2	1	7	10 3/8	3/4	1 3/8	13/16	4 1/8	5 3/4	***	2 7/8	---	---	---
CCM-9910	---	---	---	†	1 1/4	1 1/2	1	7	---	---	---	---	---	---	††	2 7/8	---	†	---

*Closed dimensions may increase for Maxi-Pac units supplied with bellows boot. Consult Duff-Norton Company.

** This dimension has tolerances of +.010 and -.000

*** For models M-99091, M-9909 and M-9910, R dimension of Clevis Attachment is 2", Top Plate Attachment is 1 3/4".

† For model CCM-9905, D + U = 15 3/4 plus raise (pin-to-pin).
For model CCM-9910, D + U = 16" plus raise (pin-to-pin).

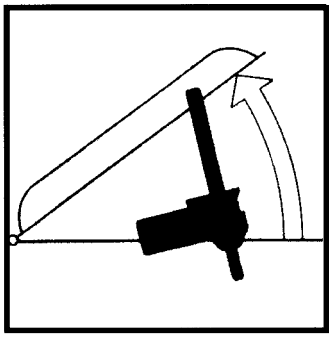
†† For model CCM-9905, R dimension for Top Clevis = 1 3/4 and 2 3/8" for Bottom Clevis.
For model CCM-9910, R dimension for Top Clevis = 2" and 2 7/8" for Bottom Clevis.

Note: Dimensions are subject to change without notice.

Maxi-Pac™ with Double-Clevis Mount

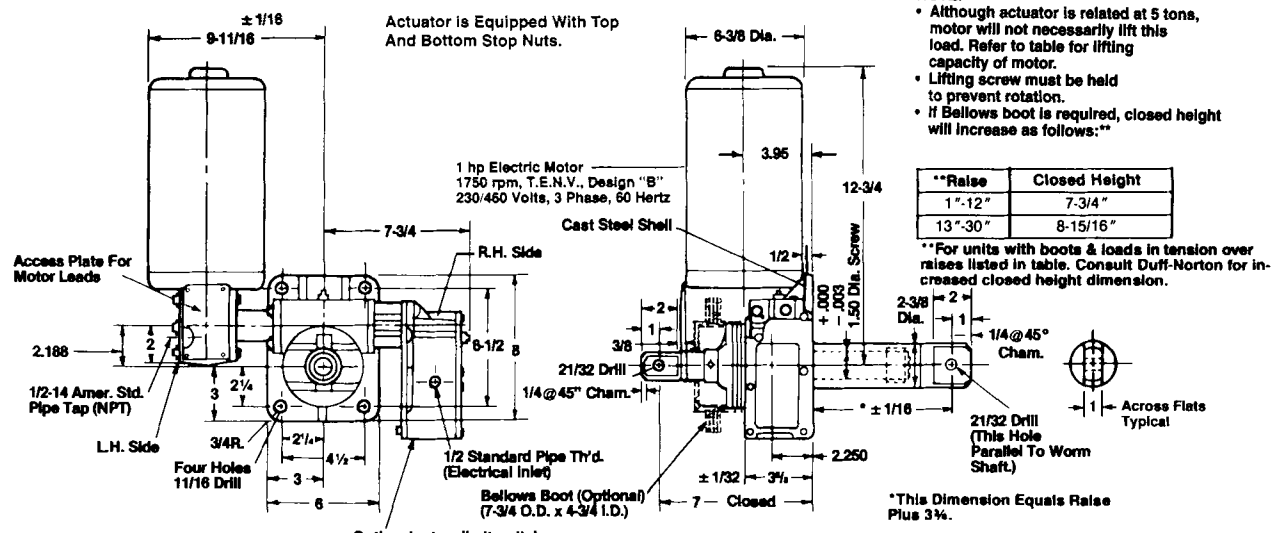
Features:

- Used for lifting or tilting loads through an arc.
- Four basic models:
  -Two machine screw models;
  Rated loads to 4.6 tons.
  -Two ball screw models;
  Rated loads to 7 tons.
- Raises up to 36 inches may be specified in one-inch increments.
- Lifting speeds to 23 inches per minute.
- Standard motor I HP 1750 RPM, Class B insulated, TENV motor 230 / 460 VAC, 3 phase 60 Hz. Ball screw model motor comes equipped with integral 3 ft.-lb. brake.
- Adjustable rotary limit switch is optional.
- For specifications refer to page 143.



Degree of arc will vary with the specified raise of the Maxi.Pac™ unit, and the points on the machinery at which the clevises are attached.

Typical CCM-9705 Maxi-Pac ™ Actuator with Double-Clevis Mount



NOTE:
- Although actuator is related at 5 tons, motor will not necessarily lift this load. Refer to table for lifting capacity of motor.
- Lifting screw must be held to prevent rotation.
- If Bellows boot is required, closed height will increase as follows:**

**Raise	Closed Height
1"-12"	7-3/4"
13"-30"	8-15/16"

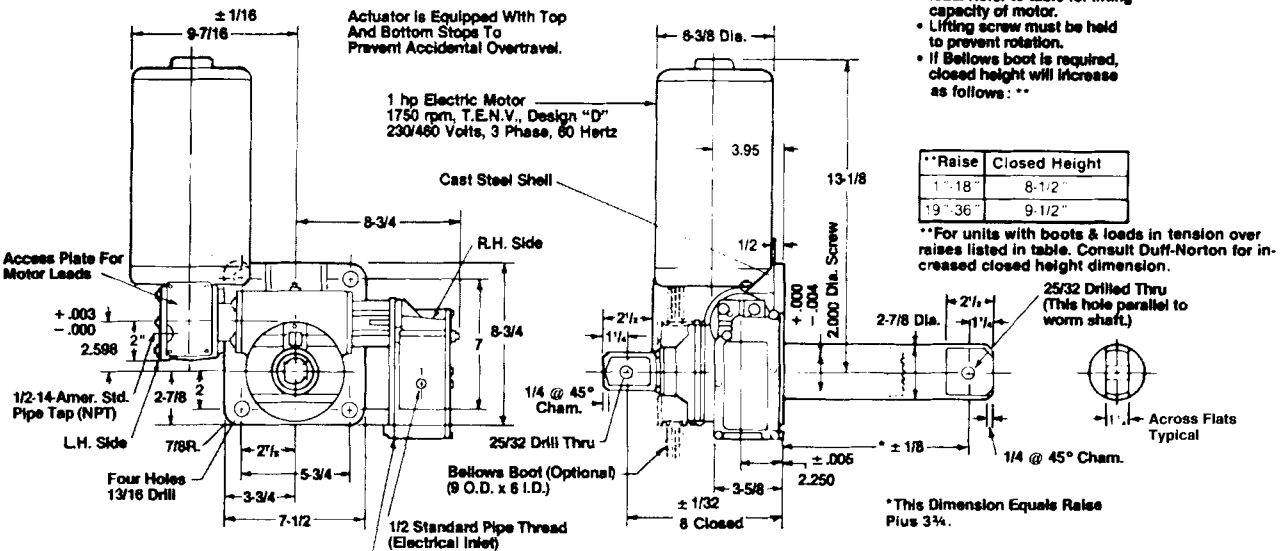
**For units with boots & loads in tension over raises listed in table. Consult Duff-Norton for increased closed height dimension.

*This Dimension Equals Raise Plus 3¼.

When Ordering Specify:
1. Basic Model Number
2. Raise (supplied in 1" increments.)
3. Lifting speed (from table.)
4. Which side motor is to be mounted (R.H. or L.H.)
5. Call out if limit switch is desired.
6. Specify if Bellows boot is required.

Ratio		Lifting Speed (in/min)	Capacity (lbs.)
Actuator	Reducer		
6:1	6:1	18	3,000
6:1	12:1	9	5,000

Typical CCM-9710 Maxi-Pac ™ Actuator with Double-Clevis Mount



NOTE:
- Although actuator is rated at 10 tons, motor will not necessarily lift this load. Refer to table for lifting capacity of motor.
- Lifting screw must be held to prevent rotation.
- If Bellows boot is required, closed height will increase as follows: **

**Raise	Closed Height
1"-18"	8-1/2"
19"-36"	9-1/2"

**For units with boots & loads in tension over raises listed in table. Consult Duff-Norton for increased closed height dimension.

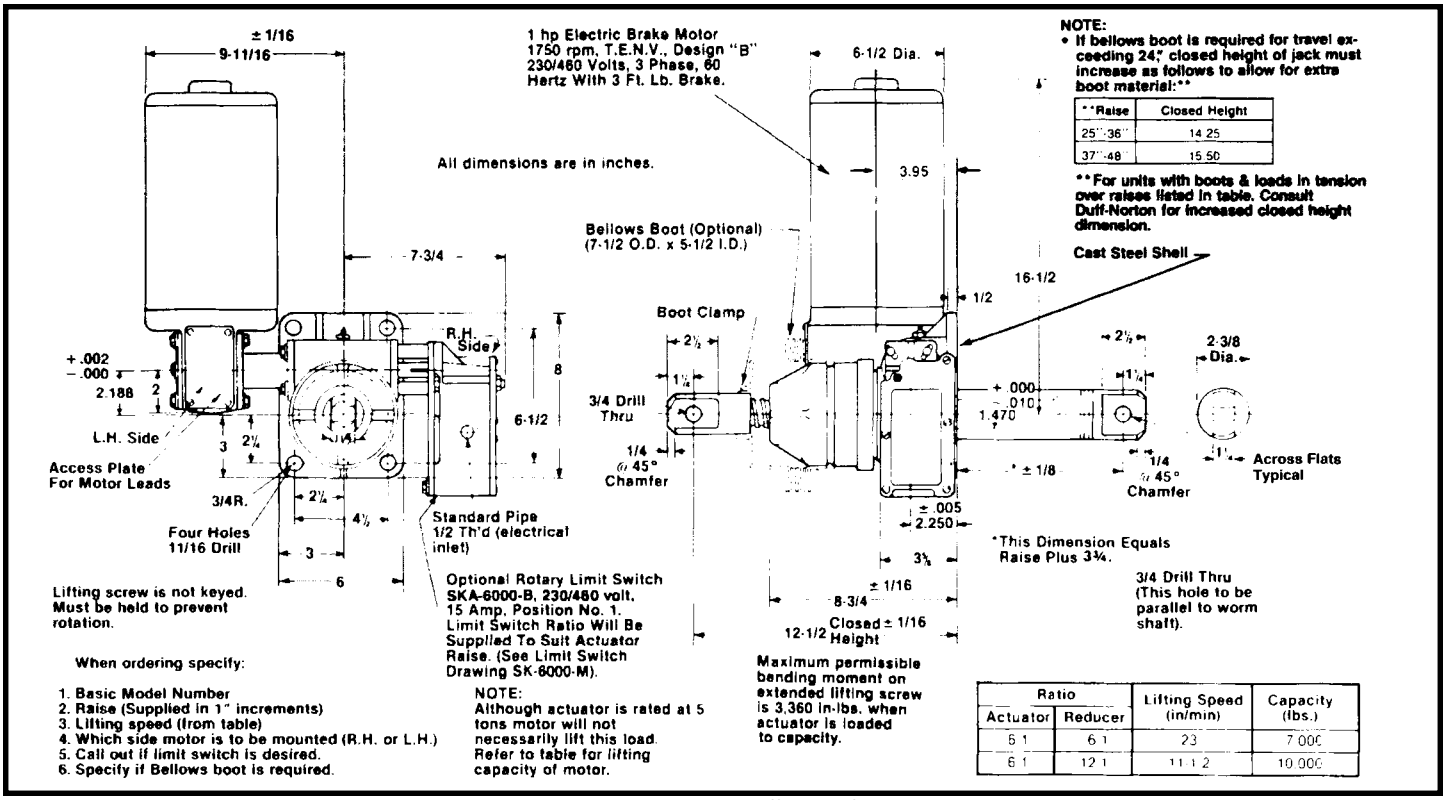
*This Dimension Equals Raise Plus 3¼.

When Ordering Specify:
1. Basic model number.
2. Raise (supplied in 1" increments).
3. Lifting speed (from table).
4. Which side motor is to be mounted (R.H. or L.H.)
5. Call out if limit switch is desired.
6. Specify if Bellows boot is required.

Ratio		Lifting Speed (in/min)	Capacity (lbs.)
Actuator	Reducer		
24:1	6:1	6	5,200
24:1	12:1	3	9,200

Note: dimensions are subject to change without notice.

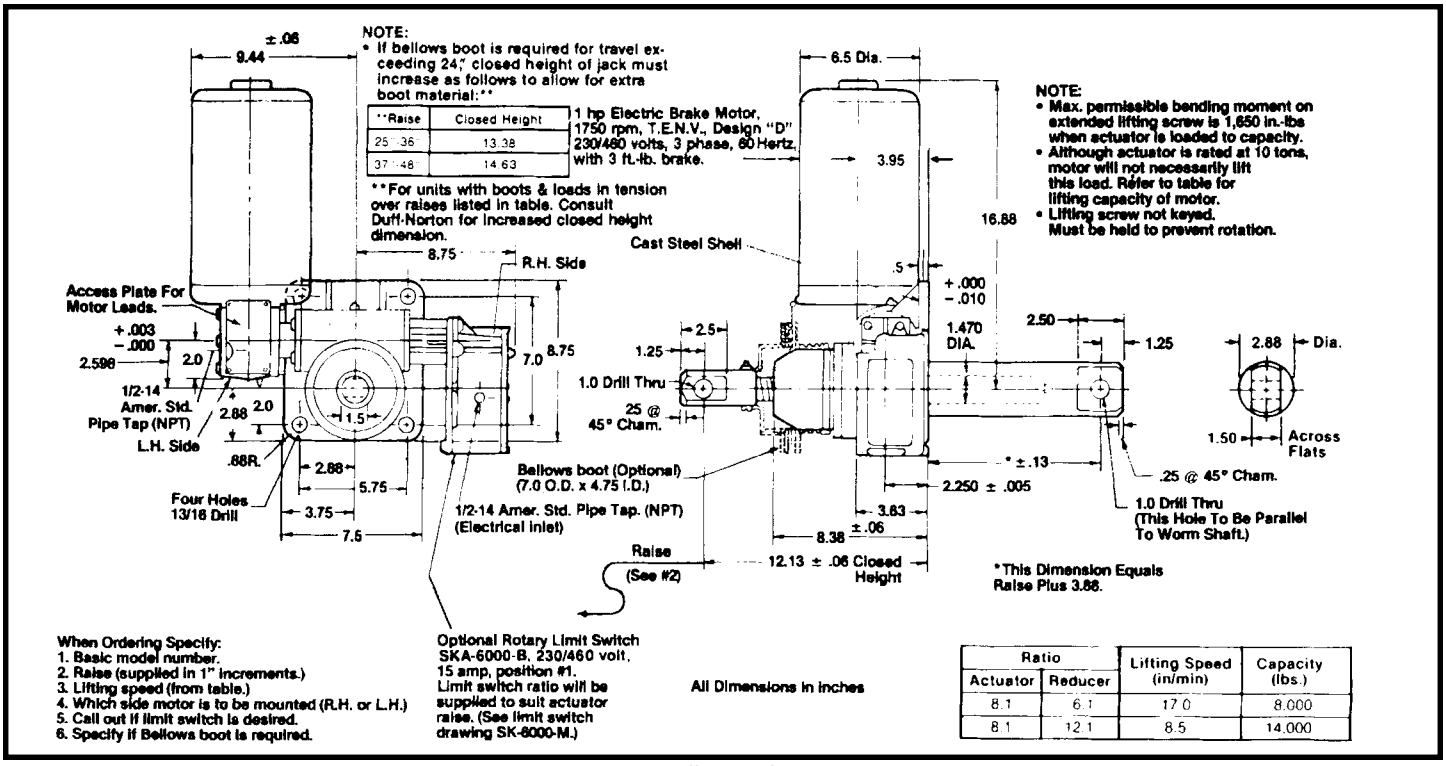
Typical CCM-9905 Maxi-Pac ™ Actuator with Double-Clevis Mount



Ratio		Lifting Speed (in/min)	Capacity (lbs.)
Actuator	Reducer		
5:1	6:1	23	7,000
5:1	12:1	11.5	10,000

**For units with boots and loads in tension and raises over max. compression raises. Consult Duff-Norton for increase in closed height when bellows boot is required.

Typical CCM-9910 Maxi-Pac ™ Actuator with Double-Clevis Mount



Ratio		Lifting Speed (in/min)	Capacity (lbs.)
Actuator	Reducer		
8:1	6:1	17.0	8,000
8:1	12:1	8.5	14,000

**For units with boots in tension and raises over max. compression raises. Consult Duff-Norton for increase in closed height when bellows boot is required.

Dimensions are subject to change without notice.

Maxi-Pac™ C-Face Motor Mount

The Duff-Norton Maxi-PacTM C-face motor mount actuator gives you a custom power option. The C-face mount is engineered to accept any NEMA

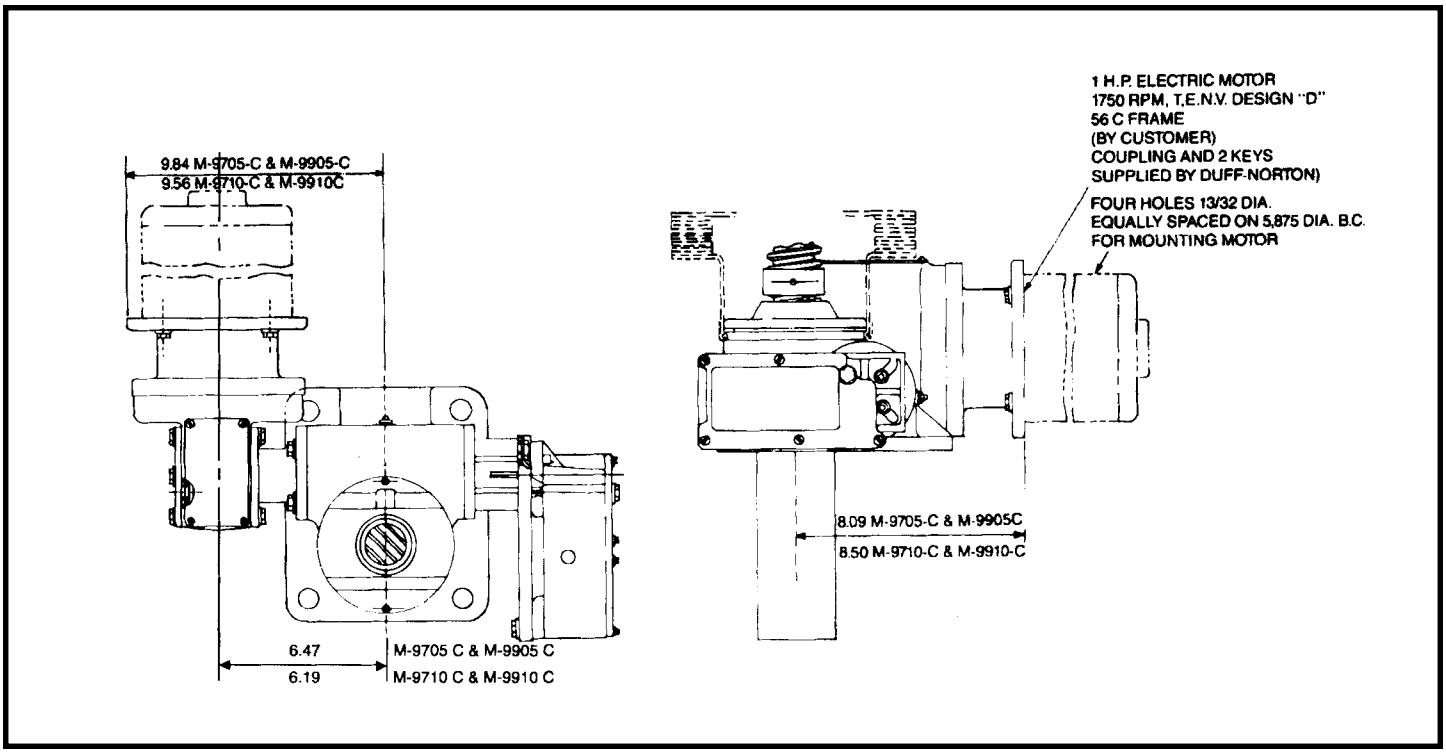
56 C-face motor. So you can choose the actuator- motor combination that suits your needs.

The M-9700-C machine screw actuators are available in six standard models. M-9900-C ball screw actuators are available in ten standard models.

Specifications for the M-9700-C Series correspond to specifications for the M-9700 Series machine screw Maxi-PacTM actuators.

Specifications for the M-9900-C series correspond to M-9900 ball screw series specifications.

When ordering C-face models, be sure to add "C" to model numbers found in the specification charts.



Ball Screw Systems

Highly efficient ball screw systems provide long, predictable, accurate performance for a variety of linear and rotary motion applications.

Duff-Norton Ball Screw Systems provide quiet, precise rotary-to-linear and / or linear-to-rotary motion for machine tools and other applications with negligible transmission loss. They can be used with smaller, more economical motors than Acme screw systems, and can be used in synchronized, multiple configurations easily.

The ball bearing design is 90% efficient, more efficient than Acme screws. The high efficiency virtually eliminates friction-induced heat. Rolled thread ball screws provide accurate positioning with maximum lead error only ± .009 inch per foot cumulative.

Life of the system can be predicted accurately once operating conditions are known. The system will perform like new for its entire operating life, never needing adjustment. Its simple design is virtually maintenance-free, requiring only lubrication.

Standard ball screw ends and end journals are also available and can be used for either fixed or supported end bearing arrangements. See page 152 for recommended bearing arrangements.

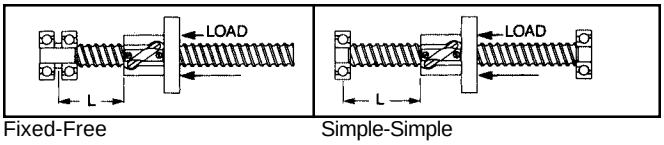
Especially suited for applications requiring:

- Accurate positioning
- High efficiency
- Back-driving
- Synchronization
- Superior rigidity
- Simple design

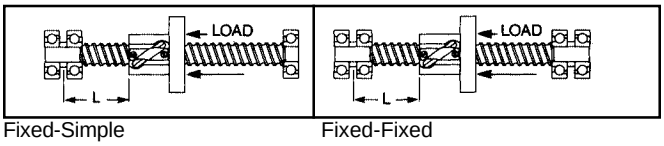
Performance Specifications

Compression Loads

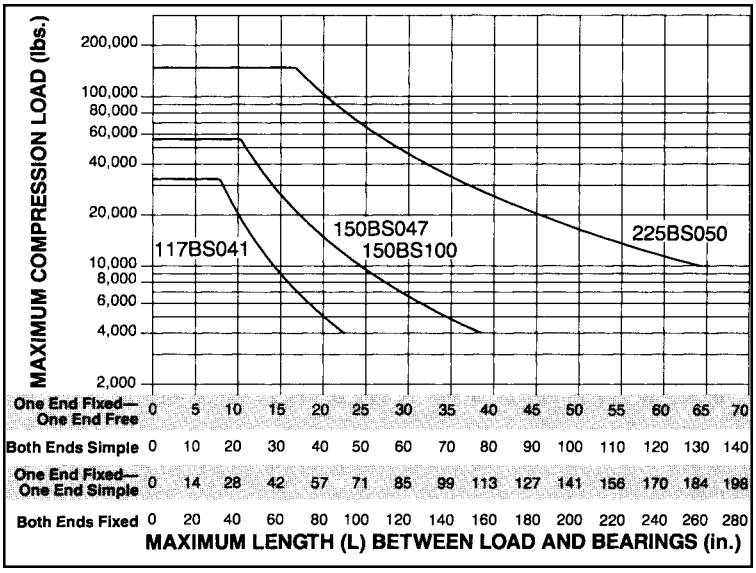
1. Determine the maximum compression load the ball screw will see.
2. Determine the type of end fixity to be used (see Bearing Support Arrangement).
3. Determine the maximum length between the bearing support and the load.
4. Locate the point where a vertical line (representing length between bearing support and load) intersects a horizontal line (representing compression load). Select the proper screw size on or to the right of this point.



Fixed-Free | Simple-Simple

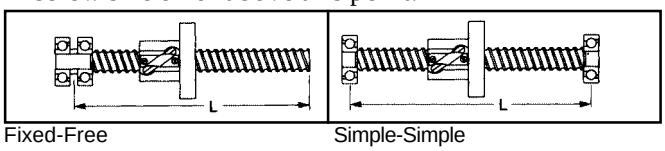


Fixed-Simple | Fixed-Fixed

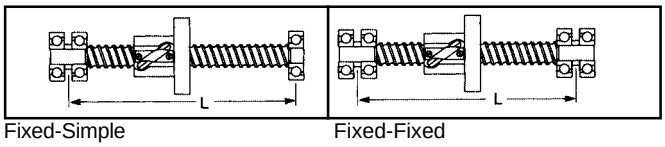


Critical Speed

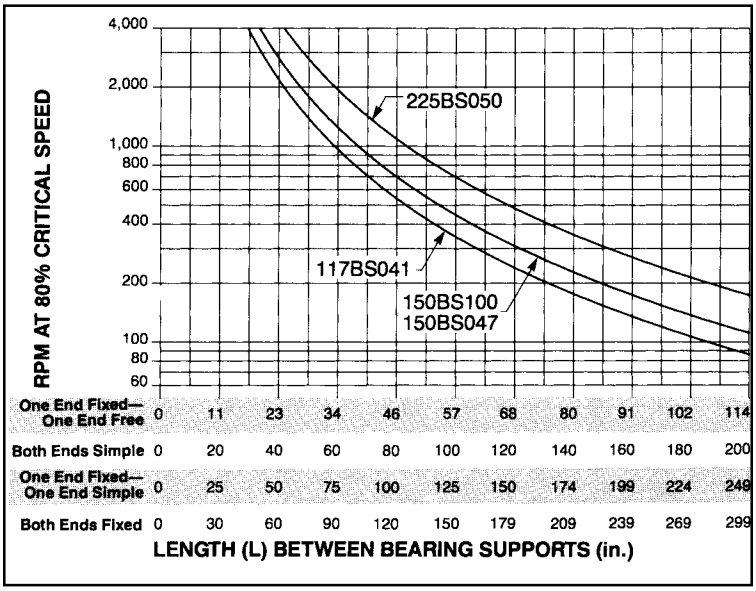
1. Determine the maximum rpm the ball screw will see.
2. Determine the type of end fixity to be used (see Bearing Support Arrangement).
3. Determine the length between bearing supports.
4. Locate the point where a vertical line (representing length between bearing supports) intersects a horizontal line (maximum rpm). Select the proper screw size on or above this point.



Fixed-Free | Simple-Simple



Fixed-Simple | Fixed-Fixed

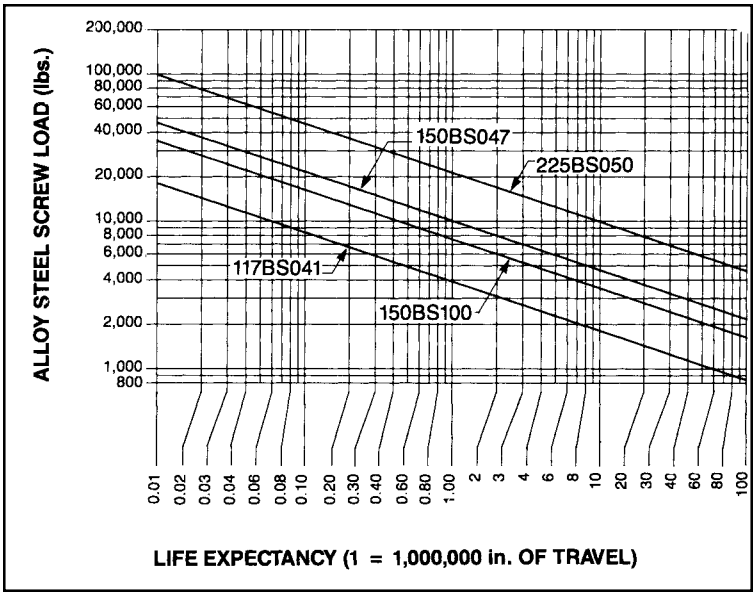


Load Life

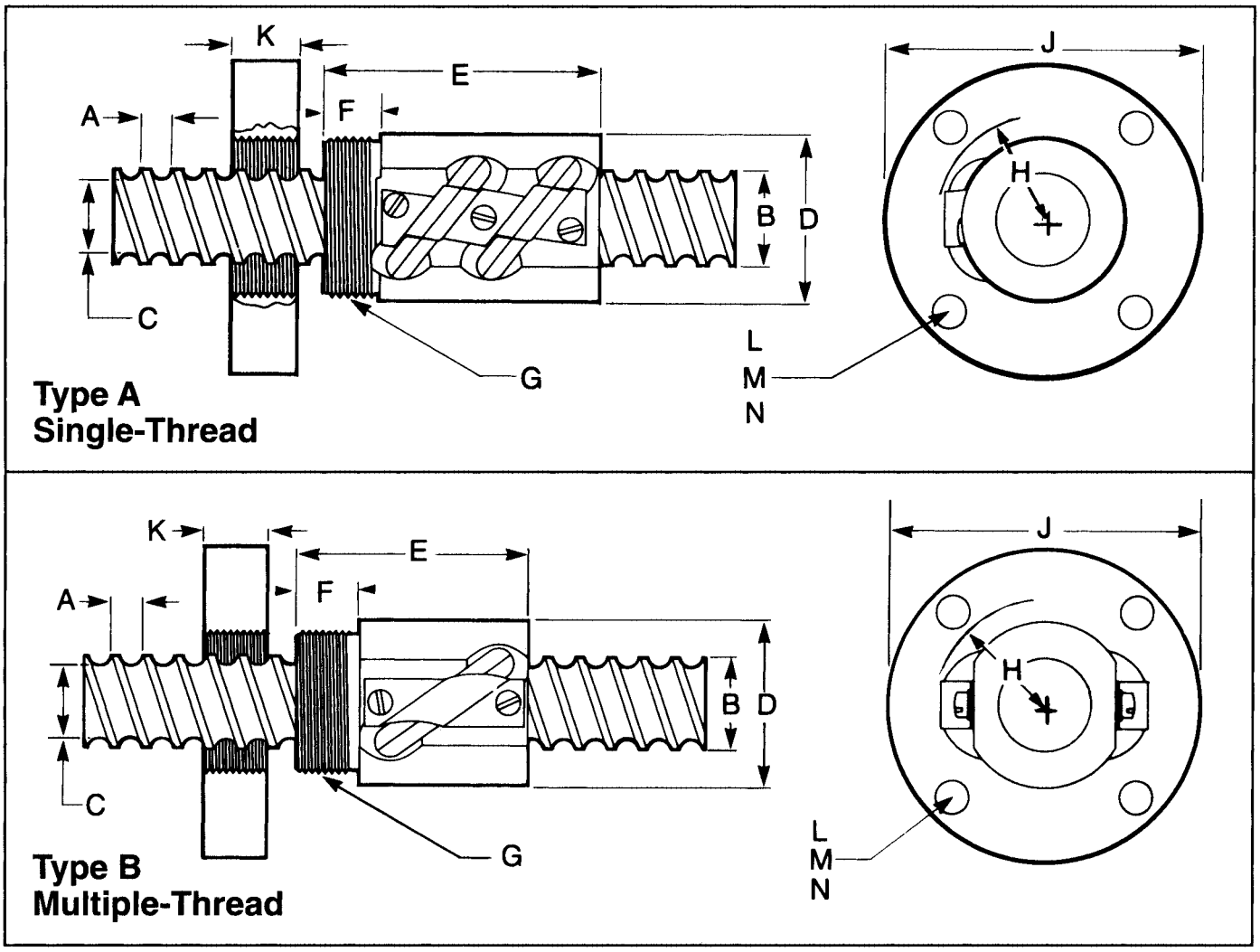
1. Determine the operating load the ball screw and nut will see.
2. Determine the desired life.
3. Locate the point where a vertical line (representing desired life) intersects a horizontal line (operating load). Select the proper screw size on or to the right of this point.

The graph at right illustrates the relationship between the operating load and the operating life that can be expected from a ball screw. Operating life is considered to end at the first sign of surface fatigue.

The relationship between load and life is a cubic equation. For example, halving the load increases operating life by a factor of eight.



Dimensional Specifications



Ball Screw

Ball Circle Diameter	A Lead	LH/RH	B-Maximum Major Diameter	C Root Diameter	Standard Length	Model Number
1.171	0.413	RH	1.160	0.870	13' 4"	117BS041
1.500	0.474	RH	1.470	1.140	13' 4"	150BS047
1.500	1.000	RH	1.480	1.140	13' 4"	150BS100
2.250	0.500	RH	2.230	1.850	19' 8"	225BS050

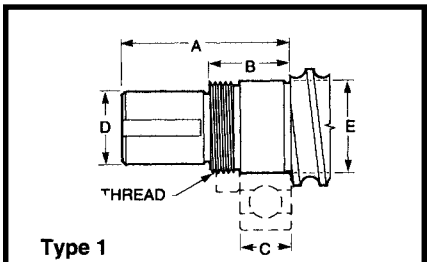
Ball Nut

Ball Circle Diameter	A Lead	Type	LH/RH	D - Maximum Outside Diameter	E - Maximum Overall Diameter	F - Maximum Thread Length	G Thread Size	H - Maximum Radius Over Tube	Model Number
1.171	0.413	A	RH	2.127	3.380	0.810	1.967-18NF-3	1.386	117BN041
1.500	0.474	A	RH	2.627	4.317	0.880	2.548-18NF-3	1.613	150BN047
1.500	1.000	B	RH	2.627	3.633	1.005	2.250-20UN-2A	1.720	150BN100
2.250	0.500	A	RH	3.377	6.693	1.572	3.137-12NF-3	2.272	225BN050

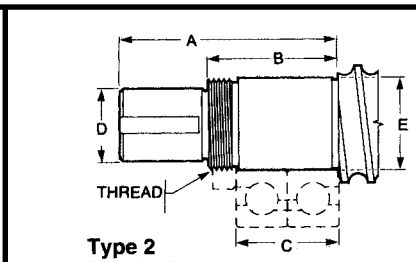
Flange

Ball Circle Diameter	A Lead	J Diameter	K Width	L - Bolt Circle Diameter	M - Number of Mounting Holes	N - Mounting Hole Diameter	Part Number
1.171	0.413	4.200	0.832	3.440	4	0.397	SK-28004-6
1.500	0.474	4.937	0.895	4.062	4	0.531	SK-2807-1
1.500	1.000	4.937	1.020	4.125	4	0.531	SK-3806-8
2.250	0.500	5.375	1.582	4.375	6	0.656	SK-2821-3

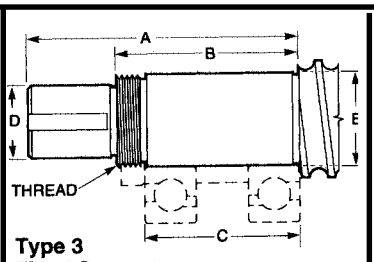
Standard End Journals



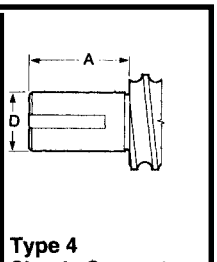
Type 1
Simple Support



Type 2
Simple Support



Type 3
Fixed Support



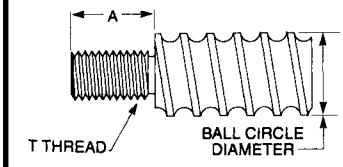
Type 4
Simple Support

Model No.	A	B	C	D Dia.	E Dia.	A	B	C	D Dia.	E Dia.	A	B	C	D Dia.	E Dia.	A	D Dia
117BS041	2.375	1.060	.5512	.625 .624	.7877 .7873	2.926	1.611	1.1024	.625 .624	.7877 .7873	4.028	2.713	2.204	.625 .624	.7877 .7873	2.844	.8750 .8745
150BS047	2.680	1.120	.5906	.750 .749	.9846 .9842	3.271	1.711	1.1811	.750 .749	.9846 .9842	4.453	2.893	2.364	.750 .749	.9846 .9842	3.250	1.1250 1.1245
150BS100	2.680	1.120	.5906	.750 .749	.9846 .9842	3.271	1.711	1.1811	.750 .749	.9846 .9842	4.453	2.893	2.364	.750 .749	.9846 .9842	3.250	1.1250 1.1245
225BS050	3.730	1.540	09843	1.375 1.374	1.7721 1.7716	4.714	2.524	1.9685	1.375 1.374	1.7721 1.7716	6.682	4.492	3.936	1.375 1.374	1.7721 1.7716	4.938	1.7500 1.7495

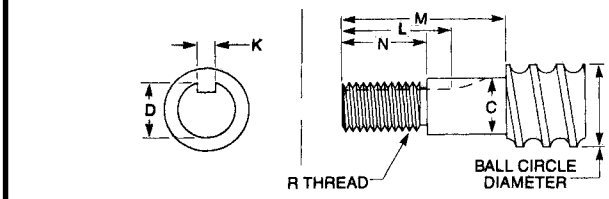
Model No.	Bearing O.D.	Standard Bearings/by End Journal Type 1 Single Row	2 Angular Contact	3 Angular Contact	4 Pillow Block	Lock Nut Type	Lock Nut Thread	Lock Washer	Key Size Type 1, 2, 3 Sq. x Long	Key Size Type 4 Sq. x Long
117BS041	1.8504	204	204	204	014	N-04	.781-32NF-3	W-04	3/16 x 5/8	3/16 x 1 1/2
150BS047	2.0472	205	205	205	102	N-05	.969-32NF-3	W-05	3/16 x 1	1/4 x 1 3/4
150BS100	2.0472	205	205	205	102	N05	.969-32NF-3	W-05	3/16 x 1	1/4 x 1 3/4
225BS050	3.9370	309	309	309	112	N-09	1.767-18NF-3	W-09	5/16 x 1 1/2	3/8 x 3

All dimensions are in inches unless otherwise stated.

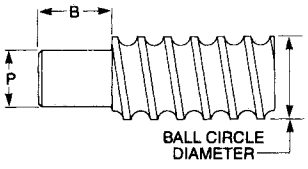
Standard Ball Screw Ends



Type 5



Type 6

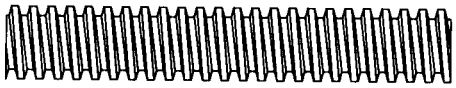


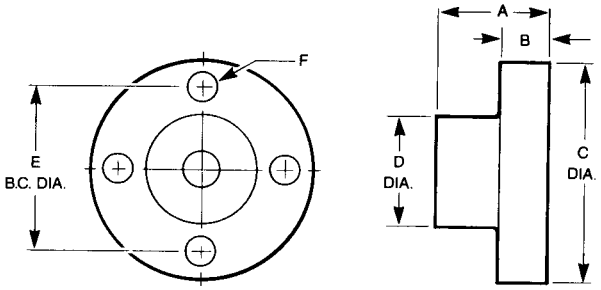
Type 7

Model No.	T Thread SIze	A	C Diameter	D	K	L	M	N	R Thread SIze	P Diameter	B
117BS041	3/4-16UNF-2A	1.13	0.7485 +.000 -.003	0.642 +.000 -.008	0.118 ±.001	2.20	4.20	0.80	3/4-10UNC-2A	0.750 +.000 -.002	1.13
150BS047	1-14UNS-2A	1.13	0.9985 +.000 -.003	0.803 +.000 -.010	0.313 ±.001	3.00	5.00	1.50	7/8-14UNF-2A	1.000 +.000 -.002	1.00
150BS100	1-14UNS-2A	1.13	0.9985 +.000 -.003	0.861 +.000 -.015	0.250 +.002 -.000	3.00	5.41	1.20	1-14UNS-2A	1.000 +.000 -.002	1.00
225BS050	1 3/4-12UN-2A	2.25	1.498 +.000 -.003	1.273 +.000 -.010	0.375 +.002 -.000	5.56	7.80	2.50	1 1/2-12UNF-2A	1.750 +.000 -.002	2.50

All dimensions are in inches unless otherwise stated.

Rolled Screw Stock and Lifting Nuts





Screw Length	Screw Stock Number	Screw Dia.	Pitch	Lead	Thread	Remarks	Lifting Nut Number	A	B	C	D	E	F
11'6"	SK-2327-7-1	.500	.250	.250 (Single)	Stub Acme		SK-2556-2	.875	.375	2.25	1.0	1.75	Four 9/32 Dia.
11'6"	SK-2327-7-4	.625	.125	.125 (Single)	St'd Acme	303 St. Steel	SK-2626-2	.875	.375	2.25	1.0	1.75	Four 9/32 Dia.
11'6"	SK-2327-7-2	.625	.250	.500 (Double)	Stub Acme								
11'6"	SK-2327-7-5	.750	.200	.200 (Single)	St'd Acme		SK-2502-6	1.5	.50	3.25	1.5	2.375	Four 13/32 Dia.
11'6"	SK-2327-7-8	.875	.250	.500 (Double)	St'd Acme		SK-2462-6	1.5	.50	1.710	1 3/8-12UNF-2A		
15'	SK-2327-7-3	1.000	.250	.250 (Single)	St'd Acme		SK-2003-11	1.5	.50	3.25	1.5	2.375	Four 1 13/32 Dia.
							SK-2463-6	1.5	.50	1.710	1 3/8-12UNF-2A		
13'6"	SK-9000-1-5	1.500	.375	.375 (Single)	St'd Acme		SK-9006-8	2.5	.75	4.0	2.0	3.0	Four 9/16 Dia.
13'6"	SK-9000-1-10	2.000	.500	.500 (Single)	St'd Acme		SK-9011-8	3.0	1.00	6.0	3.0	4.5	Four 13/16 Dia.
13'6"	SK-9000-1-15	2.250	.500	.500 (Single)	St'd. Acme		SK-9016-8	3.0	1.00	6.5	3.5	5.0	Four 13/16 Dia.
13'6"	SK-9000-1-20	2.500	.500	.500 (Single)	St'd Acme		SK-9021-8	3.0	1.00	7.5	3.75	5.5	Four 15/16 Dia.
13'6"	SK-9000-1-25	3.000	.6666	.6666 (Single)	Stub Acme		SK-9026-8	5.5	1.25	8.5	4.5	6.5	Four 1 1/16 Dia.
13'6"	SK-9000-1-35	3.750	.6666	.6666 (Single)	Stub Acme		SK-9036-8	5.5	1.50	9.0	5.0	7.0	Four 1 1/16 Dia.

Installation And Maintenance Tips

The following installation and maintenance tips are for the 1/4- to 1-ton and 1800 Series, 2800 Series, 9000 Series, 9400 Series, 9800 Series 4800 Series actuator models and mitre gear boxes.

General care should be taken to ensure that equipment selection is sufficient to handle the load.

1. The structure on which the actuator unit is mounted should have ample strength to carry the maximum load, and be rigid enough to prevent undue deflection or distortion of the actuator unit supporting members.
2. It is essential that the actuator unit 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 actuator unit, shafting, and gear boxes 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 actuating system is then ready for normal operation.
3. The actuator unit should have a greater raise than is needed in the actuator installation. If it is necessary to operate the actuator at the extreme limits of travel, it should be done with caution.

   CAUTION: Do not allow screw travel below catalog closed height of the actuator unit or serious damage to internal mechanism may result. Refer to table of specifications for closed height of respective units.
4. The input horsepower to these actuators should not exceed the hp rating shown in the specification table. Maximum RPM should not exceed 1800.
5. The lifting screw should not be permitted to accumulate dust and grit on the threads. If possible, lifting screws should be returned to closed position when not in use.
6. The ball screws in the ball screw actuator units should be checked periodically for excessive backlash and spalling of raceways.
7. A periodic check of backlash of the lifting screw thread is recommended to check wear of the worm gear internal threads on the machine screw actuator models. Backlash in excess of 50% of the thread thickness indicates the need to replace the worm gear. (See question 29, page 21).
8. Unless otherwise specified, actuator units and gear boxes are shipped packed with grease, which should be sufficient for one month of normal operation. For normal operation, the actuator units and gear boxes should be lubricated about once a month, using Shell Albida LC EP-2 grease, Product Code 70311.

   This grease has been thoroughly evaluated in Duff-Norton actuators and has demonstrated superior lubricating properties affecting both wear life and maximum duty cycle. **Duff-Norton is not aware of an equivalent grease**. If this grease is not available in your area please contact your local supplier for their recommendations. Greases containing molybenum disulfide should never 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.
9. On ball screw actuator model applications, periodically lubricate the exposed ball screw grooves with a cloth dampened with a good grade 10W30 oil for most applications. An instrument grade oil should be used in dirty and heavy duty environments, and bearing grease for environments at extremely high temperatures. Extreme temperature and other environmental conditions should be referred to Duff -Norton company for recommended lubricating procedures.

   CAUTION: Where ball screws are not protected from airborne dirt, dust, etc., bellows boots should be used. Inspect frequently at regular intervals to be certain a lubricating film is present. Ball screws should never be run dry.
10. Due to the high efficiency of the ball screw actuator design, a brake must be used in conjunction with motor selected to position the actuator unit. (Refer to question 24 page 20 and how to select the brake page 23.)

WARRANTY

Subject to the condition 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.

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 Duff- Norton Company which authorizes the specific actuator unit as used in your applications suitable for moving people.

Duff-Norton has manufactured quality industrial lifting, positioning, and material-handling equipment since 1883.

Mechanical actuators are just one category of a wide range of products manufactured under the ISO 9001 standard. Our product line includes:

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Antibacklash actuators
Metric actuators
Ball-screw actuators
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Anode jacks
Mitre-gear boxes
Reducers
Limit switches
Couplings
Ball-screw systems
Control packages

For more information about the products in this design guide, or other Duff-Norton products and services, contact your nearest distributor. Or feel free to call us direct at 800-477-5002 or send us an e-mail at duffnorton@cmworks.com

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