

MOTION TECHNOLOGY

SCREW JACKS

DESIGN GUIDE





SCREW JACKS (MECHANICAL ACTUATORS)

Wherever there is a need to lift, position, align and hold a load, Screw Jacks can be found. Accordingly, they are common throughout many industrial processes. Their high reliability and synchronization make screw jacks suitable for a wide variety of uses especially those found in manufacturing.

SCREW JACK

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Duff-Norton has been manufacturing linear actuation products since 1883. We have earned a reputation for reliable, high quality products meeting the industrial lifting and positioning needs of our customers worldwide. Duff-Norton has been ISO 9001 registered since 1994.

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NOTE

Duff-Norton has made every effort to ensure that the information contained in the publication is accurate and reliable. Determining the suitability of our products for specific applications is the user's responsibility.

 **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 written statement from Duff-Norton, which authorizes the specific actuator used in your applications as suitable for moving people.

SCREW JACKS

WHAT'S NEW

New and Improved

B Series Actuators – Duff Norton has re-engineered several existing models keeping both customer preferences and performance improvements in mind. In most cases, new drop in equivalents are now available. In a few cases minor dimensional differences exist, but do so with performance improvements in mind.

Please see pages: 16, 17, 22, 52 and 56 for more information.

Expanded Actuator Worm / Gear Ratio Options - throughout our standard machine screw, stainless steel, and anti-backlash offerings; we have now expanded our gear set options to make it easier for our customers to achieve their desired performance parameters without involving secondary gearing.

Please see pages 15, 39, 46 and 47 for more information.

Metric G Series Actuators – Duff Norton now offers a comprehensive line up of European style metric actuators from 5kN to 500kN capacities. The G series offering includes both standard and anti-backlash models. These have become quite popular globally, and have the added benefit of dropping into the same spot as our traditional imperial actuators with minimal design adjustments.

See pages 80-93.

IEC Motor Adapters – designed for our G series actuators, these include many of the most common IEC motor sizes.

See pages 120-121.

Upgraded Controls Capabilities.

See pages 123-135.

Upgraded Magnetostrictive Position Sensing capabilities.

See page 134.



SCREW JACKS APPLICATIONS

Packaged Solutions, Countless Applications

Duff-Norton mechanical actuators, screw jacks and power transmission products are the best packaged solution for your linear actuation needs. With capacities ranging from 500 lb. to 250 tons, and for certain applications 300 to 350 tons, no one offers a broader range of solutions for your application needs. This extensive selection is designed to meet the requirements of the most challenging applications. Benefiting from the latest in advanced design techniques, manufacturing methods, and over 100 years experience, Duff-Norton Mechanical Actuators last longer and run smoother with little maintenance and no headaches. If you have a linear actuation application, Duff-Norton has the packaged solution for you.

Duff-Norton Customer Service Programs

Duff-Norton gives you the benefit of over a century of customer service. From stocking distributor programs, to expert application engineering, Duff-Norton is committed to providing you with the right solution every time. Our staff works hard to make sure you always get the product you need, when you need it.

The answers to all of your questions are always just a phone call away. Our Application Engineers and Customer Service Reps are ready to answer any question you may have about price, volume orders, availability or delivery. Additionally, there is always a District Sales Manager near you, ready to discuss your application and any special requirements you may have. Duff-Norton's Application Engineers will apply their years of experience to determine the right product to fit your needs, or to design a complete system to fulfill all of your requirements. This saves you time and money in the design, specification, procurement and installation of system components. Also, please visit our website and design your system online with our 3-D modeling software.

Whether you need a packaged solution, or one that has been custom designed to fit your specifications, Duff-Norton offers the expertise that comes from working closely with our worldwide customers. Combined with this history is a commitment to technology. We strive to constantly improve our manufacturing methods and stay ahead of industry trends in both our products and our philosophies. This comprehensive approach to customer service makes Duff-Norton actuators an exceptional value; we are always aware that we must provide the right solution every time.

Next time you have a linear motion need, call Duff-Norton first. Our Customer Service staff will take it from there!



SCREW JACK APPLICATIONS



Plastics Machinery

CHALLENGE: Raise and lower extrusion carriages while manufacturing large rolls of thin plastic film. The lifting screw jacks must withstand high dynamic shock and vibration in the extended position while holding a carriage table in various positions within tolerances of a thousandths of an inch.

SOLUTION: Four custom engineered 25 ton screw jacks were used on each corner of the extrusion table to handle the rigors of this application. The jacks were supplied with extremely tight tolerance lifting screws and special bottom bushings for handling side loads shock and vibration.

Duff-Norton products used in this application:

- 25 ton Mechanical Actuators
- Motor with extended shaft
- Handwheel



Beverage Bottling System

CHALLENGE: Meeting the demand for a variety of bottle sizes to fit the vast array of packaged soft drinks and bottled waters and the ability to quickly change from one package size to another. The conveying system needed precise adjustments in height to resolve the various size bottles.

SOLUTION: Linking a set of 4, ¼ ton screw jack actuators provided the mechanism needed to allow the operator to adjust for different bottle heights. A simple design that can be quickly adjusted by the operator based upon a single input.

Duff-Norton products used in this application:

- ¼ ton Screw Jacks
- Food Grade Grease

Duff-Norton products and systems can be found in industries including aluminum, steel, agriculture, construction, communications, energy, food & beverage and industrial machinery.

- Large satellite dish antenna movement (x, y, z axis)
- 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



Aircraft Assembly

CHALLENGE: Lift and position aircraft structural sections which need to be aligned accurately and held in place using pre-drilled holes and Cleco fasteners on the surface of the fuselage frame. Due to the size of the structures there was concern about alignment issues.

SOLUTION: A complete system combining four 10 ton screw jacks delivered highly accurate positioning. An electronic remote control pendant added control flexibility and accurate positioning of each jack. Redundant travel position sensors were used to provide absolute position feedback. The screw jack are controlled within ± 0.005 inches and can be moved in pairs for quick alignment.

Duff-Norton Products:

- 10 ton Screw Jacks
- Bidirectional Drives
- PLC Controller
- Remote Control Pendant w/Graphical User interface



Paper Production

CHALLENGE: Maintaining proper belt tension on the paper roll to ensure production quality with a steering system to ensure the paper is always centered on the roll at a very high speed.

SOLUTION: A servo driven 5 ton screw jack assembly with an embedded load cell for belt tensioning and a Servo Driven 5 ton actuator assembly steering package to center the paper product on machine rollers. The key to success was the ability to provide rapid adjustments in both tensioning and steering to achieve high quality paper.

Duff-Norton Products:

- 5 ton Ball Screw Jacks
- Servo Drive with Load Cell
- 1/2 ton Machine Screw Jacks

- | | |
|--|---|
| <ul style="list-style-type: none"> ■ Blast door locks ■ Headbox unit for paper machine ■ 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 ■ Injection molding machines-head adjustment ■ Mechanical brake linkage adjustment ■ Curing processes-constant speed ■ Feed rate movement ■ Air dampers | <ul style="list-style-type: none"> ■ Sheet slitter ■ 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 |
|--|---|

SELECTION GUIDE

USERS GUIDE

FOR SELECTING A MECHANICAL ACTUATOR

1. Define the application's operating parameters:

- Total load
- Load per actuator (if more than one is required)
- Desired lifting speed
- Travel (distance to move the load)
- Load type (tension, compression, guided, unguided)
- Ambient temperatures (-20° to 120°F, -29° to 50°C)

2. Determine which actuator type best suits the application:

Ball screw or machine screw? There are a wide variety of factors which influence the type of actuator selected. When comparing the two actuator types at the same capacity level, ball screw actuators, being much more efficient, require less motor horsepower to move the same load than do the equivalent machine screw actuators. However, many machine screw actuators are inherently load holding, offer a broader capacity range and a greater selection of special features or materials. Machine screw actuators are often favored in applications subject to constant vibration.



Ball Screw Actuators

- Continuous Duty models available.
- Anti-Rotation models available, contact the factory for details.
- Move loads and apply force more efficiently than machine screw actuators.
- Require less power by reducing screw friction.
- Permit faster operation and longer life under load.
- Long predictable ball screw and ball nut life.
- Handles full load in tension or compression.



Machine Screw Actuators

- Anti-backlash models available for ¼ to 150 Ton capacities.
- Stainless steel and metric models available for most capacities.
- Precise positioning within thousandths of one inch.
- Self locking - models featuring higher gear ratios are inherently load holding as long as the actuator is not subject to vibration.
- Uniform lifting speeds - since many actuators feature the same gear ratios different capacities can be used in the same application to lift unevenly distributed loads with uniform speeds.

3. Calculate actuator performance:

Find an actuator model with Capacity greater than the actuator load. Go to the applicable Actuator Performance Specification table and find Turns of Worm for 1" Raise, Worm Torque at No Load, and Worm Torque at Full Load.

A. For loads greater than 25% of actuator capacity, consider torque to be proportional to load:

$$\text{Actuator torque(in-lb)} = \frac{\text{Actuator Load(lbs)} \times \text{Worm Torque at Full Load}}{\text{Actuator Capacity (lbs)}}$$

For loads less than 25% of actuator capacity, add "Worm torque at no load" to the above calculated torque, to account for frictional losses.

B. Calculate input RPM. Shaft input should not exceed 1800 rpm.

$$\text{Input RPM} = \text{Desired Lifting Speed(in/min)} \times \text{Turns of Worm for 1" Raise}$$

C. Calculate actuator input HP.

$$\text{Actuator Input HP} = \frac{\text{Actuator torque(in-lb)} \times \text{rpm}}{63,000}$$

Compare required Input HP to the Maximum HP per Actuator shown in the Performance Table. If Required HP exceeds Maximum HP, an actuator with greater HP rating must be chosen to obtain the speed and capacity rating desired.

If using a gear reducer, motor horsepower must be multiplied by reducer efficiency to obtain reducer output (actuator input) horsepower.

D. Multiple actuator arrangements:

Two or more actuators are often shaft driven from one motor or gear reducer. For multiple actuator arrangements, sum the input HP requirement of all actuators. If using mitre gear boxes, allow for 2% power loss through each 90° turn in the power path.



Upright Translating



Inverted translating



Upright Rotating



Inverted Rotating

4. Determine the actuator configuration:

Considering capacity, speed, and duty cycle requirement, select the actuator type and configuration which most closely matches your application's configuration requirements.

SELECTION GUIDE

USERS GUIDE - Continued

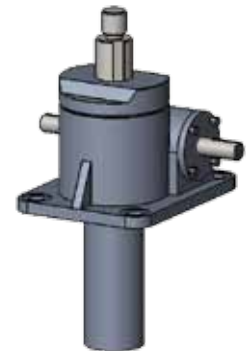
FOR SELECTING A MECHANICAL ACTUATOR

5. Unattached or unguided load considerations:

If your application involves a load which is unattached or the load is free to rotate, the translating screw actuator must be configured so that the lifting screw will extend when the actuator is in motion. To prevent the translating screw from rotating, machine screw actuators are supplied with a keyed shell and screw, and ball screw actuators are supplied with a square nut on the lifting screw's end, inside a square cover pipe. Both of these configurations ensure the actuator will properly perform for this type of application.



Anti-Rotating Ball Screw



Keyed Machine Screw

6. Verify the actuator selection:

Double check your application's travel requirements, and the actuator's ratio. Verify the actuator's capacity and speed. Also, determine which of the following actuator end fittings best suits your application's requirements.



Top Plate



Clevis End



Threaded End

Please see pages 101-108 for more detailed engineering information such as:

- Flange bolt information
- Lateral movement ratings
- Overhung loads
- Screw column strengths

NOTE

Please refer to our "Column Strength Charts" (pages 104-106) if the lifting screw is loaded in compression. It may be necessary to select a larger actuator if the maximum recommended screw length, regardless of load, or maximum load has been exceeded.

NOTE

As duty cycles are intermittent, there is an inverse relationship regarding an actuators maximum duty cycle and the load being moved. Please consult our application engineers for assistance in determining the most appropriate actuator.

WARNING

- Input RPM should not exceed 1800 RPM.
- Never exceed the actuator's static and dynamic capacity.
- Never exceed the horsepower listed in our actuator specification tables. If the maximum horsepower recommendation is exceeded, reduce the lifting speed, use a larger capacity actuator, choose another actuator ratio, or consider a more efficient actuator type such as a Ball Screw or Continuous Duty Actuator.
- Ball Screw and Continuous Duty Actuators are inherently self-lowering. Should one of these models be the best fit for an application, a brake motor with sufficient torque is required. Please contact our application engineers for assistance.

SCREW JACK

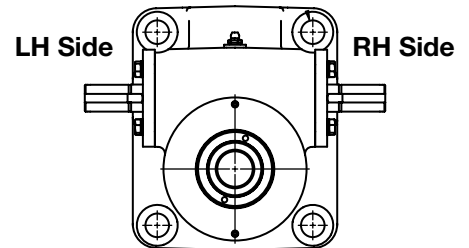
APPLICATION ANALYSIS FORM

Duff-Norton engineers will be pleased to make recommendations for your specific requirements. Complete this 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.

Name: _____ Company: _____
 Address: _____
 Email Address: _____
 Phone Number: _____ Ext: _____ Fax: _____

1. Type of application: _____
2. How many actuator units are needed? _____
3. Stroke (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. _____ FORMULA = (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. Mounting Position

Limit Switch (pg. 127) RH Side _____ (1, 2, 3, 4)
 LH Side _____ (1, 2, 3, 4)
 Reducer* (pg. 116) RH Side _____ (1, 2, 3, 4)
 LH Side _____ (1, 2, 3, 4)



* (On select models this is required to allow for proper lubrication of the gearbox. Choose the option that most closely matches the actual installed position.)

14. Load type: Guided Unguided Compression Tension Both compression & tension
15. Conditions: Vibration Impact Wet Corrosive Explosion Proof Other
16. Temp. Range: _____

17. Std. actuator model best suited to application: _____
18. Ultimate use of actuator units: In-plant Resale Lift people
19. Quotation desired on the following quantities: Total Per System



To mail please send completed sheet to:
 Duff-Norton
 Application Engineers
 P.O. Box 7010, Charlotte, NC 28241

To Fax or Email please send to:
 704-588-1994 • duffnorton@cmworks.com



WARNING

Improper use can result in personal injury. To avoid injury:

- Do not use actuators to lift, support, or transport people, without written approval from Duff-Norton.
- Read all product warnings and operating instructions.

SCREW JACK

CONTROLS GUIDE

Duff-Norton engineers will be pleased to make recommendations for your specific requirements. Complete this 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.

Name: _____ Company: _____

Address: _____

Email Address: _____

Phone Number: _____ Ext: _____ Fax: _____

SUPPLY VOLTAGE:

DC	AC Single Phase	AC Three Phase	Frequency	Other
<input type="checkbox"/> 12V	<input type="checkbox"/> 110/115/120	<input type="checkbox"/> 208 <input type="checkbox"/> 460/480	<input type="checkbox"/> 60 Hz	<input type="checkbox"/> _____ Hz
<input type="checkbox"/> 24V	<input type="checkbox"/> 220/230/240	<input type="checkbox"/> 230/240 <input type="checkbox"/> 575		<input type="checkbox"/> _____ Voltage

CONTROLS ENCLOSURE:

NEMA 1 NEMA 3R NEMA 4 NEMA 12 Other _____

ENCLOSURE MOUNTING:

Wall
 Free Standing
 Pedestal
 Console
 Other _____

CONTROLS ENVIRONMENT:

Indoor
 Outdoor
 Wash Down
 Hazardous
 Other _____

CONTROLS CERTIFICATION:

None
 UL
 cUL
 Other _____

OF MOTORS:

1
 2
 3
 4
 Other _____

CONTROLS OPERATION:

Jog	Positioning	Synchronous	Variable Speed
<input type="checkbox"/> Momentary	<input type="checkbox"/> Positioning Accuracy	<input type="checkbox"/> Synchronous Accuracy	<input type="checkbox"/> Speed Pot
<input type="checkbox"/> Maintained	_____ +/- <input type="checkbox"/> inch <input type="checkbox"/> mm	_____ +/- <input type="checkbox"/> inch <input type="checkbox"/> mm	<input type="checkbox"/> Numeric Speed Entry
	<input type="checkbox"/> Programmable Positions		<input type="checkbox"/> Preset Speeds
	_____ Number of Positions		_____ Number of Speeds

CONTROLS OPTIONS:

Pushbutton Pendant Digital Display
 HMI Pendant Touch Screen HMI
 Feedback Cable(s) Motor Cable(s)
 _____ Length ft mm _____ Length ft mm
 Other _____

FEEDBACK:

Incremental
 Absolute

CONTROLS FUNCTIONALITY:

ADDITIONAL INSTRUCTIONS:

Upon completion of this controls guide please Email or Fax to Duff-Norton.

P.O. Box 7010 • Charlotte NC • Phone: 800-477-5002 • Fax: 704-588-1994 • Email: duffnorton@cmworks.com

MACHINE

SCREW ACTUATORS

¼ to 350 TONS

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.

Thrust Bearing & Grease Seals

At each end of worm.
¼, ½ and 1 ton models do not have seals.

Worm Gear

Wear resistant Bronze. Accurately hobbled for greater gear contact.

Worm

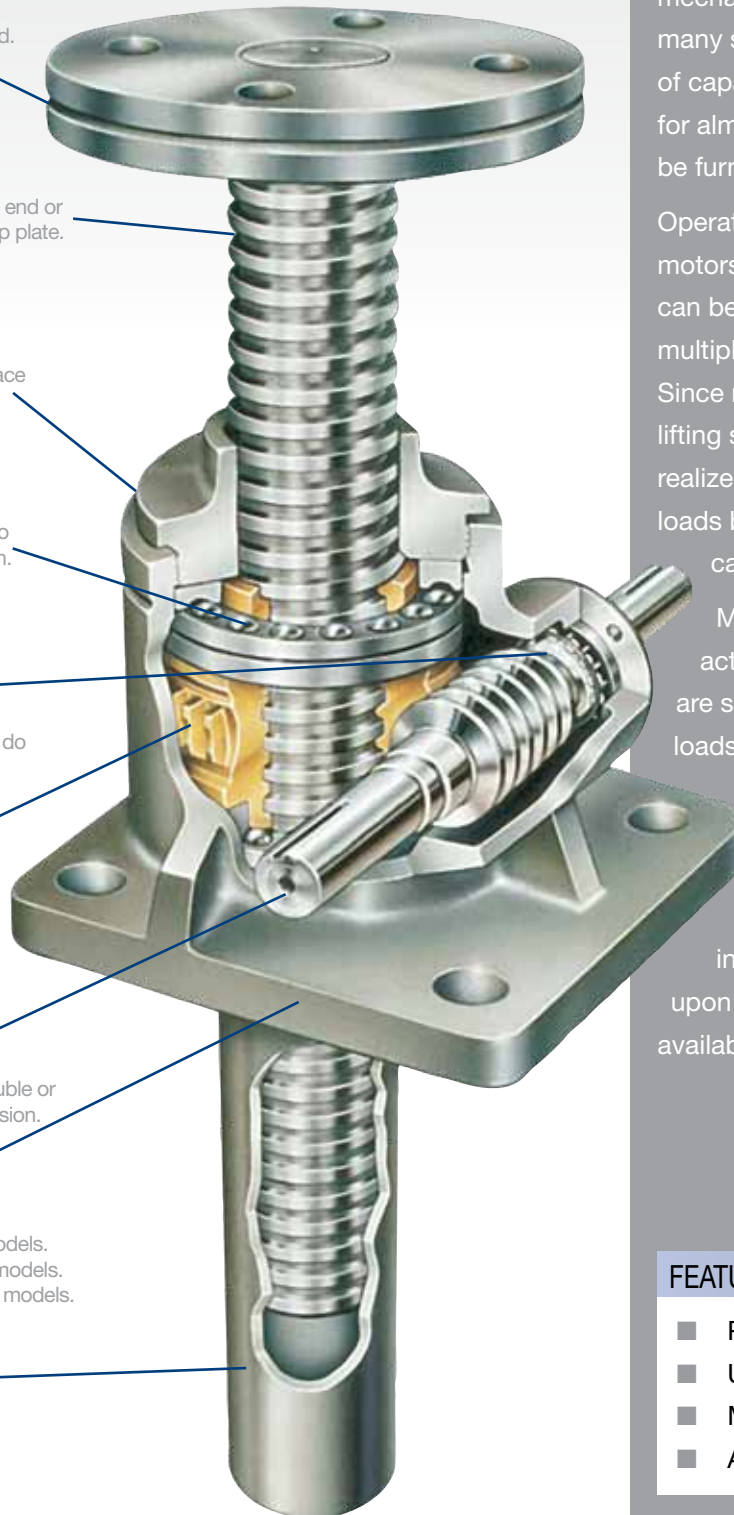
Available with double or single shaft extension.

Housing

Aluminum on ¼ to 1 ton models.
Ductile iron on 2 to 50 ton models.
Cast steel on 75 to 350 ton models.

Coverpipe

Protects lifting screw threads.



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 350 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 135). 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, and apply pressure 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.

FEATURES

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

www.duffnorton.com
Ph: (800) 477-5002 • Fax: (704) 588-1994

MACHINE SCREW ACTUATORS MODEL NUMBERING SYSTEM

FL - TKM - 9002 - 6 - 1R

Model Prefix

R - Reducer
F - C-face Adapter
H - Hand Wheel
L - Limit Switch
E - Encoder
J - Rotary Counter

Screw End & Configuration

T - Threaded End
C - Clevis End
M - Top Plate
P - Plain End
K - Keyed Screw
CC - Double Clevis
D - Inverted Rotating
U - Upright Rotating
N - Numeric Ratio

Series & Capacity No.

Series:

Machine Screw
(90xx, 18xx, 70xx, 25xx)
Special MS
(100xx, 20xx, 80xx, 35xx)

(1800 series base configurations are available only on 2 and 50 Ton models)

Capacities:

Upright model suffixes end with the capacity number. Inverted model suffixes lower the capacity number by one digit. Rotating model suffixes raise the capacity number by one digit.

M - Base Model

Travel

1" increment travels are always represented using the exact travel amount.

Travels with fractional lengths are quoted using that length, but are serialized when the order is processed.

Serialized digits in this position may also be used for other models containing special features

Model Suffix

B - Boot
L - Single End Worm Ext. Left
R - Single End Worm Ext. Right
1 - Optional Ratio #1
2 - Optional Ratio #2
X - Supplied without cover pipe

B9003 TV - 10.50 - LX2 - BFL

Capacity

B9225 - 500 Lbs
B9250 - 1000 Lbs
B9003 - 3 Ton

Screw End

C - Clevis End Screw
CC - Double Clevis Ends
M - Top Plate Screw
P - Plain End Screw
T - Threaded End Screw

Travel

1" Incremental travels are always represented using the exact travel amount. Fractional lengths are represented and processed to the nearest 100ths.

Base Model

None - Upright Translating
D - Inverted Rotating
K - Keyed, anti-rotation
U - Upright Rotating
V - Inverted Translating

Key Accessories

B - Boot
E - Encoder
F - C-face Adapter
H - Hand Wheel
J - Rotary Counter
L - Limit Switch
R - Reducer

Model Suffix

L - Single End Worm Extension Left
N - Numeric Gear Ratio - 100 turns/inch
R - Single End Worm Extension Right
X - Supplied without Cover Pipe
1 - Alternate Gear Ratio #1
2 - Alternate Gear Ratio #2

Alphabet characters representing features and suffixes should always be used in alphabetic order to avoid questions of hierarchy.

Models for actuators with specialized features will have a serialized suffix such as B9225T-0001.

MACHINE SCREW ACTUATORS PERFORMANCE TABLE

Performance Table Instructions – pages 15, 39, 47, 52, 55, 76, and 82

When reviewing any Duff-Norton Actuator Performance Specifications Table, as part of the process of selecting the best-suited actuator for your application, there are several important worm-gear ratios to consider.

Standard Ratio – is frequently chosen when higher speeds and efficiency ratings are desired.

Optional Ratio – is frequently chosen when the application requires higher lifting capacities, lower speeds, or to ease the use of a handwheel.

Numeric Ratio – is frequently chosen for applications requiring fine adjustments, higher lifting capacities, lower speeds, the easy use of a handwheel, self locking applications, and also offers the benefit of an even number of worm input turns per inch of stroke.

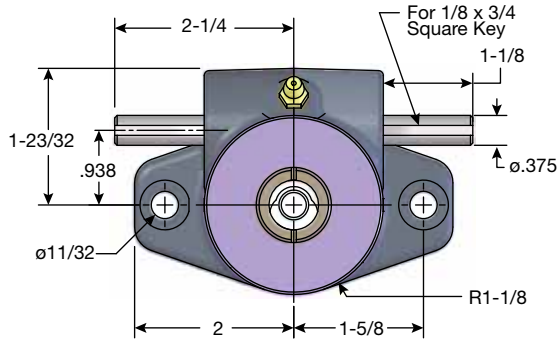
Specifications - Standard, Optional, and Numeric Ratios																		
Capacity (Tons)		1/4	1/2	1	2	3	5	10	15	20	25	30	35	50	75	100	150	250†
Max. Speed C-face Driven (in/min)** Pg.118		—	—	—	72.0	72.0	108.0	108.0	108.0	108.0	107.0	107.5	107.0	—	—	—	—	—
Max. Speed Reducer Driven (in/min)** Pg. 110		—	—	—	14.4	21.9	21.9	21.9	21.9	21.9	22.2	22.2	22.4	12.2	—	—	—	—
Dimensional Information Pg. 115		16	17	18	19-21	22	23	10	25	26	27	28	29	30-31	32	33	34	35
Lifting Screw	Diameter (in)	1/2	5/8	3/4	1	1	1-1/2	2	2-1/4	2-1/2	3	3	3-3/4	4-1/2	5	6	7	9
	Pitch (Std. & Opt.)	0.250	0.125	0.200	0.250	0.250	0.375	0.500	0.500	0.500	0.666	0.666	0.666	0.666	0.666	0.750	1.000	1.000
	Pitch (Numerical)	—	—	—	—	—	0.250	0.250	0.250	0.250	0.320	0.32	0.320	0.320	—	—	—	—
	Type	ACME	ACME	ACME	ACME	ACME	ACME	ACME	ACME	ACME	ACME	ACME	ACME	Mod. Sq.	Mod. Sq.	Mod. Sq.	Mod. Sq.	Mod. Sq.
Worm Gear Ratios	Standard	5:1	5:1	5:1	6:1	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	10-2/3:1	12:1	12:1	50:1
	Optional No. 1	—	—	20:1	24:1	24:1	24:1	24:1	24:1	24:1	32:1	32:1	32:1	32:1	32:1	36:1	36:1	—
	Optional No. 2	—	—	—	12:1	12:1	12:1	—	—	—	—	—	—	—	—	—	—	—
	Numeric Ratio	—	—	20:1	25:1	25:1	25:1	25:1	25:1	25:1	32:1	32:1	32:1	32:1	—	—	—	—
Turns of Worm for 1 inch Stroke	Standard	20	40	25	24	24	16	16	16	16	16	16	16	16	16	16	12	50
	Optional No. 1	—	—	100	96	96	64	48	48	48	48	48	48	48	48	48	36	—
	Optional No. 2	—	—	—	48	48	32	—	—	—	—	—	—	—	—	—	—	—
	Numeric Ratio	—	—	100	100	100	100	100	100	100	100	100	100	100	—	—	—	—
Worm Torque at No Load (in-lb)	Standard	2	2	5	5	5	10	20	20	30	40	40	50	100	150	200	250	200
	Optional No. 1	—	—	5	5	5	10	20	20	30	40	40	50	100	150	200	250	—
	Optional No. 2	—	—	—	5	5	10	—	—	—	—	—	—	—	—	—	—	—
	Numeric Ratio	—	—	5	5	5	10	20	20	30	40	40	50	100	—	—	—	—
Maximum Horsepower per Actuator	Standard	1/3	1/3	1/2	2	2	4	5	5	5	8	8	8	15	15	25	25	35
	Optional No. 1	—	—	1/4	1/2	3/4	3/4	1-1/2	1-1/2	1-1/2	2-1/2	2-1/2	2-1/2	6	6	11	11	—
	Optional No. 2	—	—	—	3/4	1-1/4	2	—	—	—	—	—	—	—	—	—	—	—
	Numeric Ratio	—	—	1/4	1/2	1/2	3/4	1-1/2	1-1/2	1-1/2	2-1/2	2-1/2	2-1/2	6	—	—	—	—
Worm Torque at Full Load* (in-lb)	Standard	13	21	55	120	165	450	750	1430	1811	2220	2640	4000	7500	12000	16000	28110	20000
	Optional No. 1	—	—	25	50	75	185	400	820	1035	1401	1685	2400	4200	6601	8600	15500	—
	Optional No. 2	—	—	—	75	105	275	—	—	—	—	—	—	—	—	—	—	—
	Numeric Ratio	—	—	25	48	72	175	370	640	925	1500	1800	2411	4040	—	—	—	—
Efficiency Rating (%)	Standard	30.6	18.9	23.1	22.1	24.2	22.1	26.5	20.9	22.0	22.4	22.4	17.4	13.3	12.4	12.4	14.2	8.0
	Optional No. 1	—	—	12.7	13.3	13.3	13.4	16.6	12.1	12.8	11.8	11.8	9.7	7.9	7.5	7.7	8.6	—
	Optional No. 2	—	—	—	17.7	19.0	18.1	—	—	—	—	—	—	—	—	—	—	—
	Numeric Ratio	—	—	12.7	13.3	13.2	9.1	8.6	7.5	6.9	5.3	5.3	4.6	3.9	—	—	—	—
Key Torque (in-lb)	Std. & Opt. 1 & 2	40	70	175	460	670	1750	4700	7580	10625	14000	16800	26500	47110	73000	118200	216000	423300
	Numeric Ratio	—	—	175	460	670	1599	4077	6645	9369	11474	13770	18561	30970	—	—	—	—
Maximum Worm Speed at Full Load (RPM)	Standard	1616	1000	573	1051	766	560	420	220	174	227	190	126	126	79	98	56	110
	Optional No. 1	—	—	630	630	631	278	236	115	91	112	94	66	90	57	81	45	—
	Optional No. 2	—	—	—	630	751	458	—	—	—	—	—	—	—	—	—	—	—
	Numeric Ratio	—	—	630	657	437	270	256	148	102	105	87	65	94	—	—	—	—
Maximum Load at Full Horsepower and 1750 RPM (lb)	Standard	455	527	520	2332	2521	3047	4386	3406	3370	5691	5691	4220	5949	4939	8865	7003	26780
	Optional No. 1	—	—	400	1156	1888	1064	1791	1276	956	1839	1839	1193	2831	1537	4670	2875	—
	Optional No. 2	—	—	—	1258	2402	2339	—	—	—	—	—	—	—	—	—	—	—
	Numeric Ratio	—	—	400	1210	1162	1031	1944	1646	1074	1714	1714	1187	2946	—	—	—	—
Weight with 6 inch Stroke (Raise) (lb)		2	2	5	17	17	35	52	66	93	160	160	240	410	650	1200	1350	2700
Weight per Add.1 inch Stroke (Raise) (lb)		0.1	0.1	0.3	0.3	0.3	0.9	1.4	1.5	2.6	2.5	2.5	3.7	5.5	6.5	9.0	12.6	23.0

** Speed is a function of how the actuator is driven. Please see the indicated pages for more information.

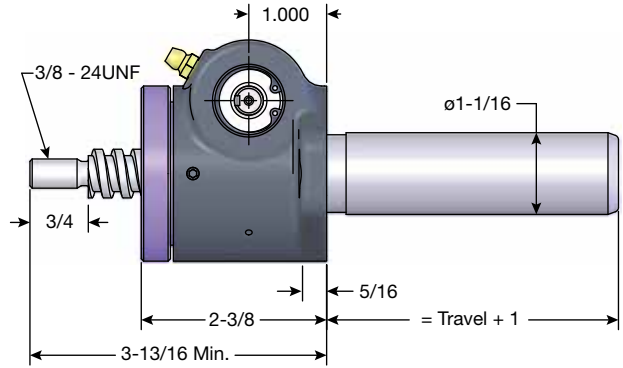
† Duff Norton has provided special actuators rated at 300 tons and 350 tons for certain applications. Actuators at these capacities are provided under specific Duff Norton / customer agreement as to the actuator's performance parameters. Please contact our Application Engineering group for more information.

Note: All actuator units can be supplied with standard raises up to 24 inches. Special raises up to 20 feet are available upon request. Closed height dimensions may increase for actuators supplied with bellows boots. See pages 148-149.

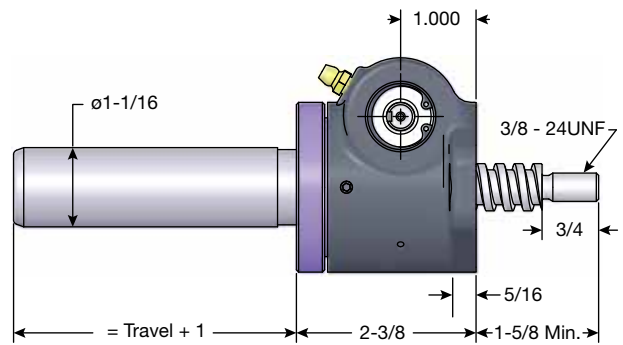
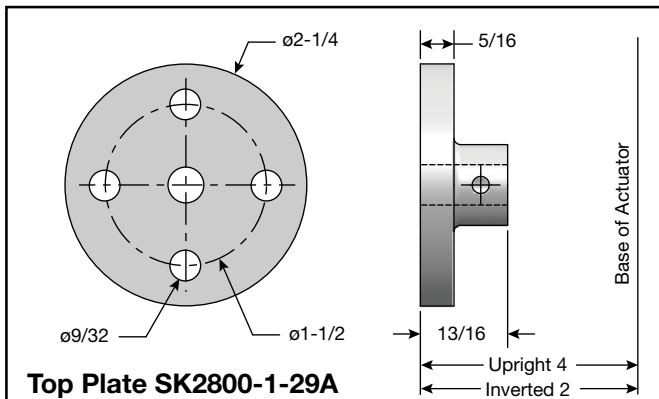
MACHINE SCREW ACTUATORS 500 LB CAPACITY



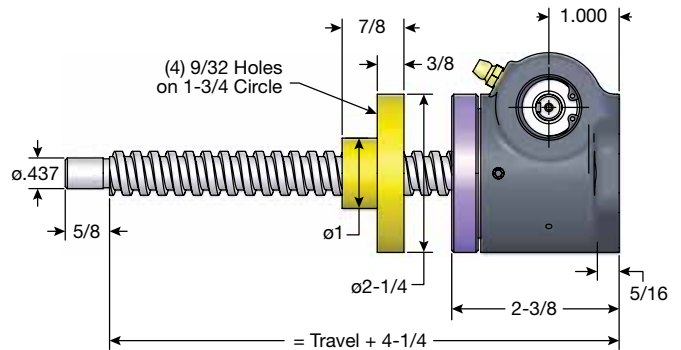
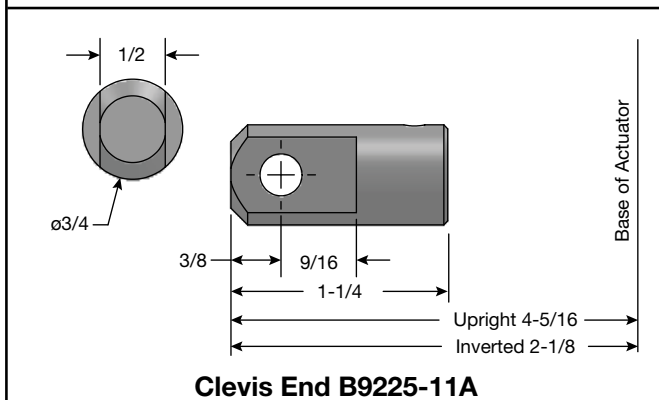
5/8 Diameter x .250 Lead Lifting Screws



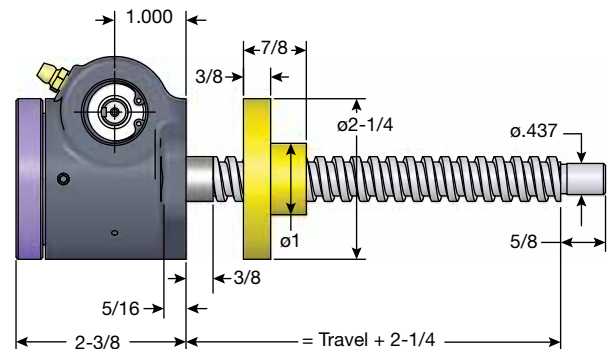
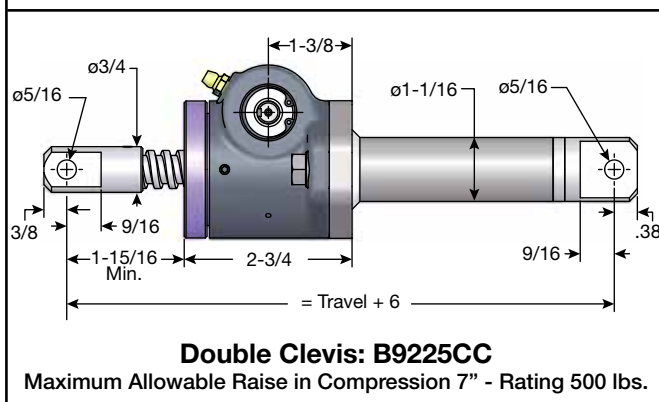
Upright: B9225T



Inverted: B9225TV



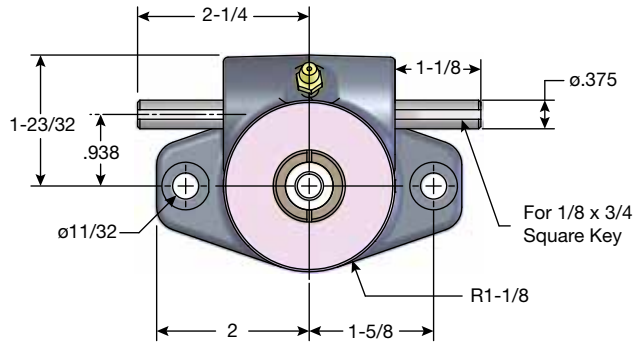
Upright Rotating: B9225U



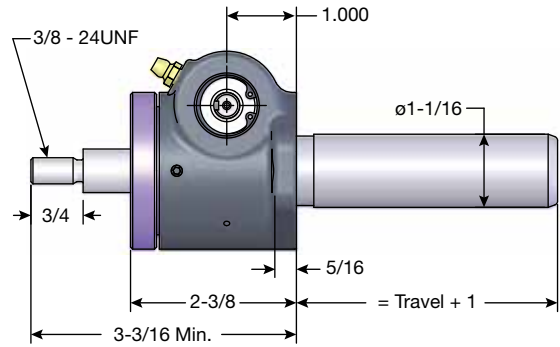
Inverted Rotating: B9225D

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 148-149. 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.

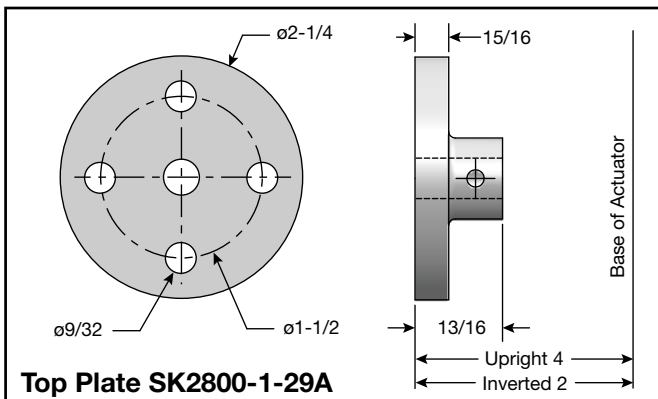
MACHINE SCREW ACTUATORS 1000 LB CAPACITY



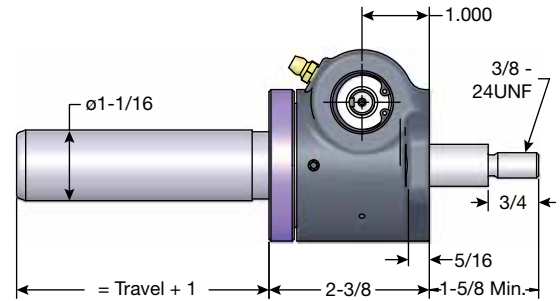
5/8 Diameter x .125 Lead Lifting Screws



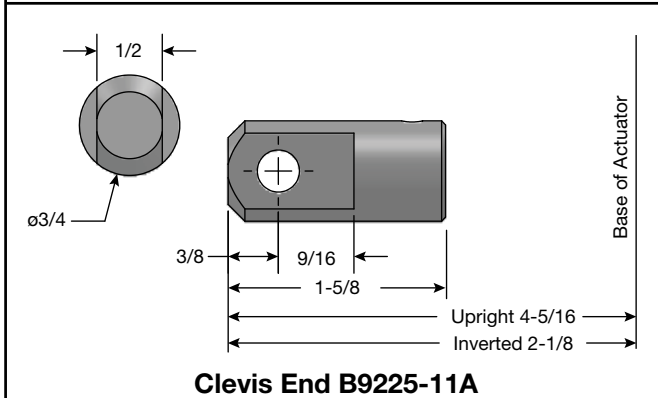
Upright: B9250T



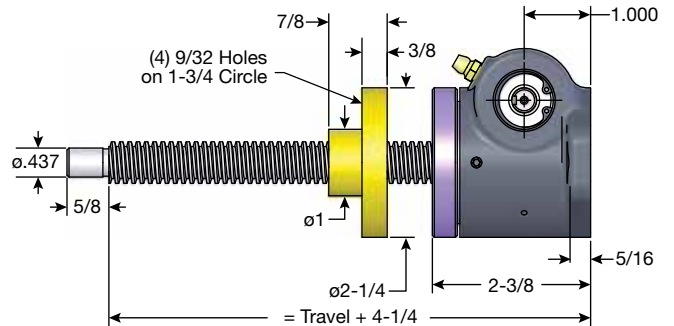
Top Plate SK2800-1-29A



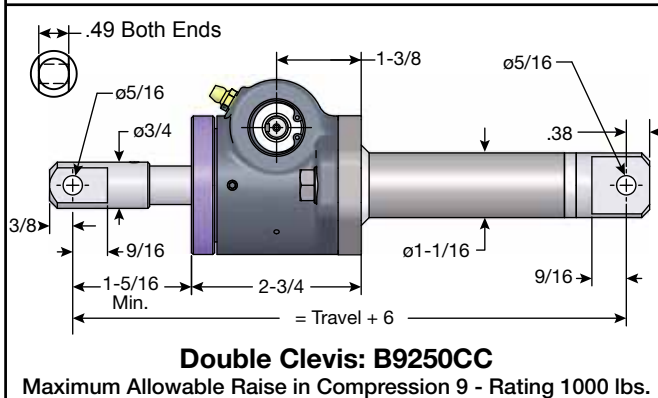
Inverted: B9250TV



Clevis End B9225-11A

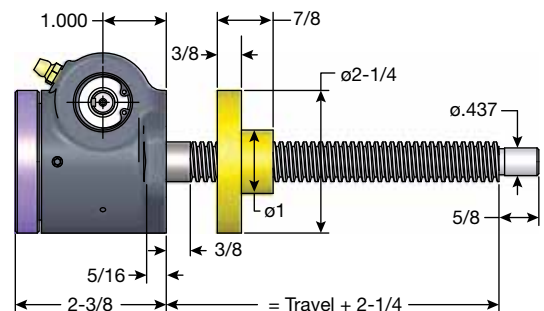


Upright Rotating: B9250U



Double Clevis: B9250CC

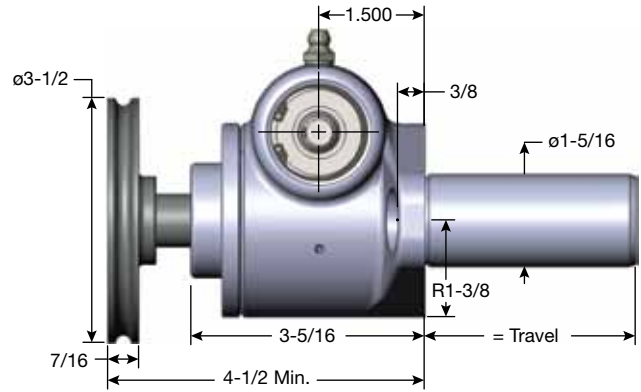
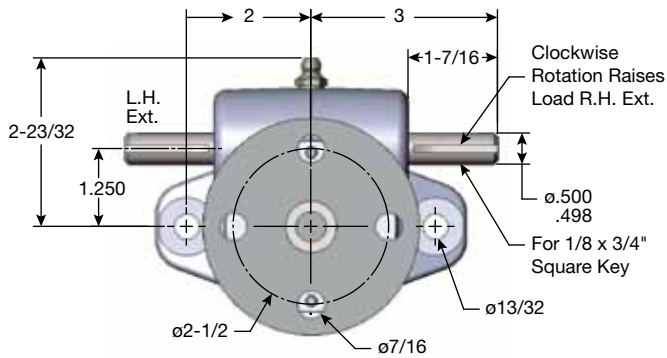
Maximum Allowable Raise in Compression 9 - Rating 1000 lbs.



Inverted Rotating: B9250D

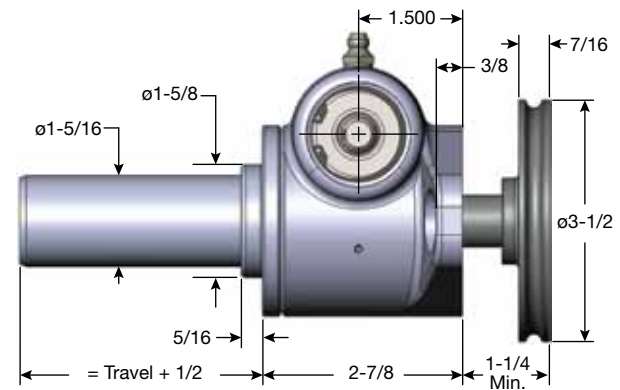
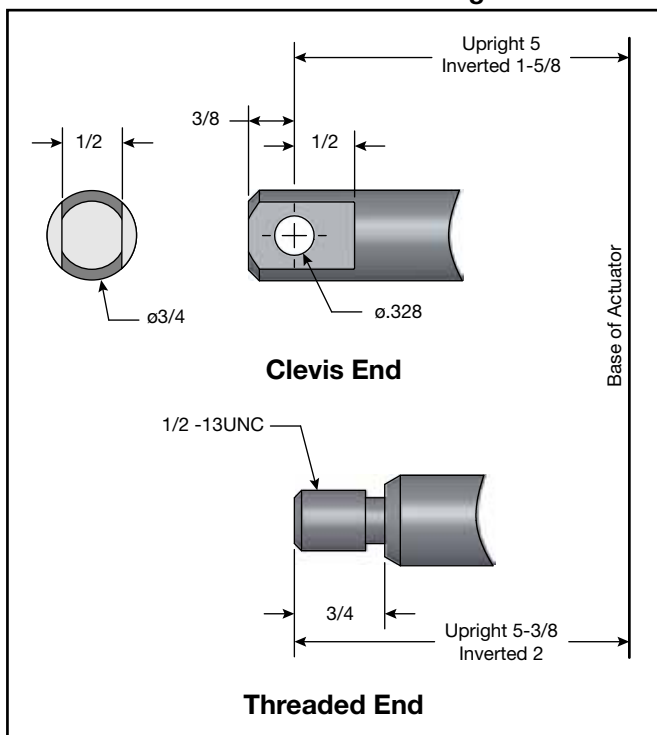
Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 148-149. Dimensions are subject to change without notice. When the lifting screw is keyed, the holes in the top plate will not necessarily be in the position shown.

MACHINE SCREW ACTUATORS 1 TON CAPACITY

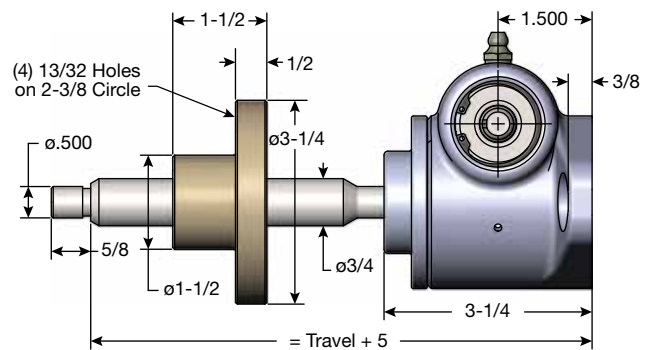


Upright: M-2501

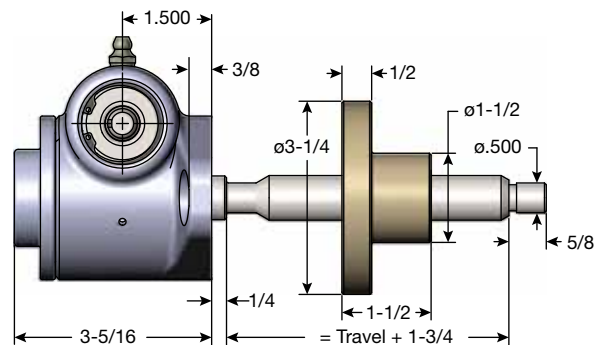
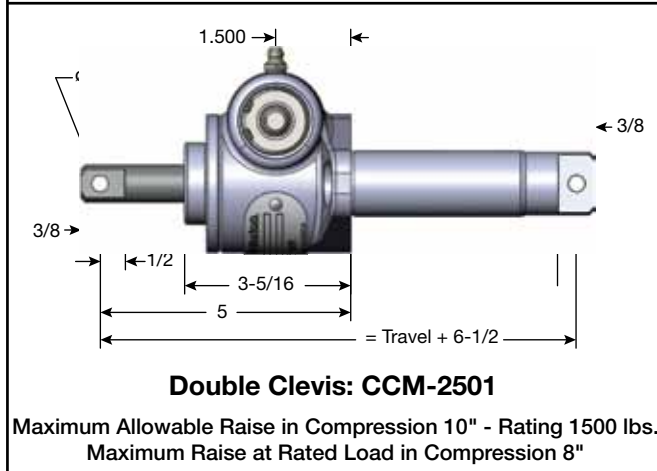
3/4 Diameter x .200 Lead Lifting Screws



Inverted: M-2500



Upright Rotating: UM-2502

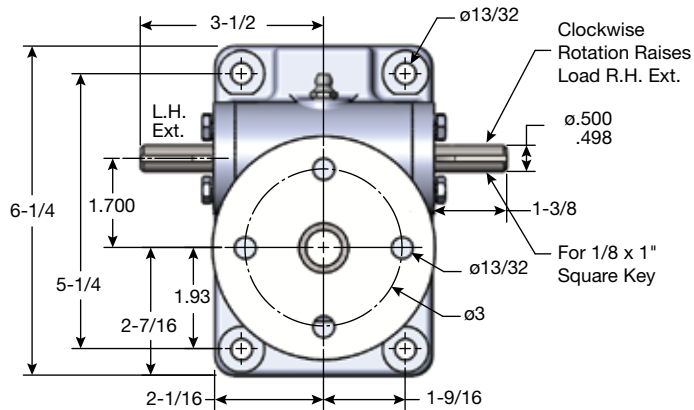


Inverted Rotating: DM-2502

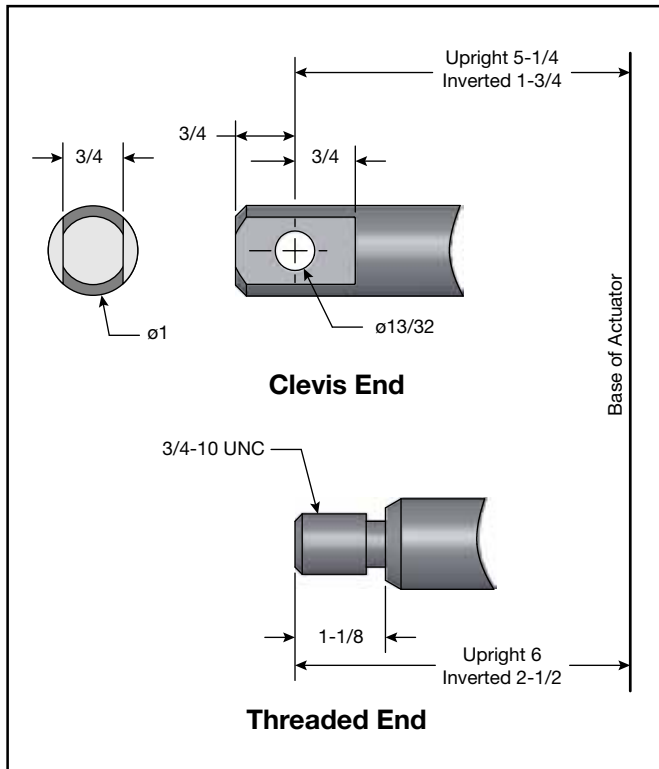
Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 148-149. Dimensions are subject to change without notice.

MACHINE SCREW ACTUATORS

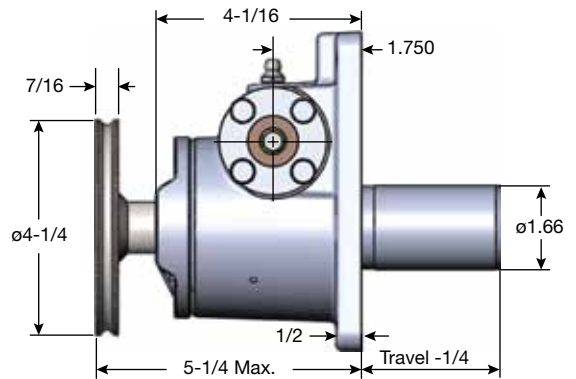
2 TON CAPACITY — 9000 SERIES



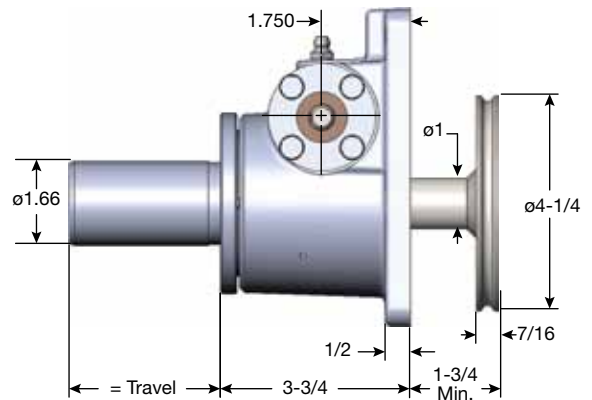
1" Diameter x .250 Lead Lifting Screws



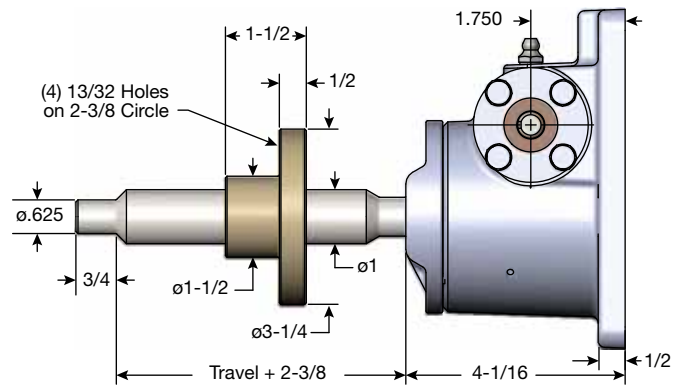
Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 148-149. Dimensions are subject to change without notice.



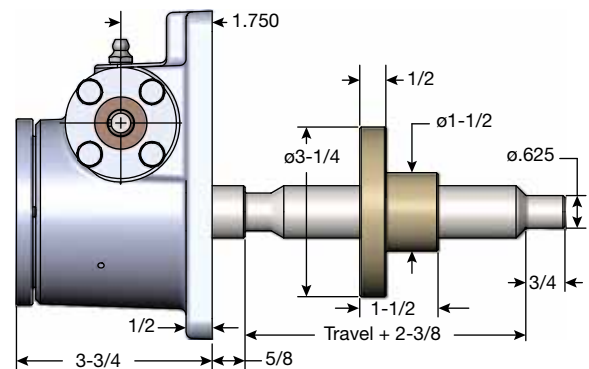
Upright: M-9002



Inverted: M-9001



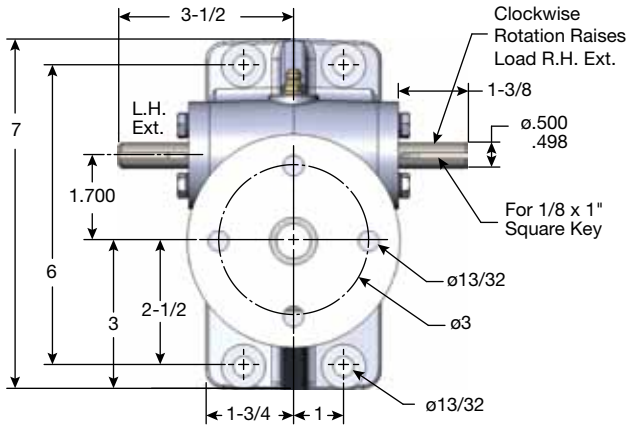
Upright Rotating: UM-9003



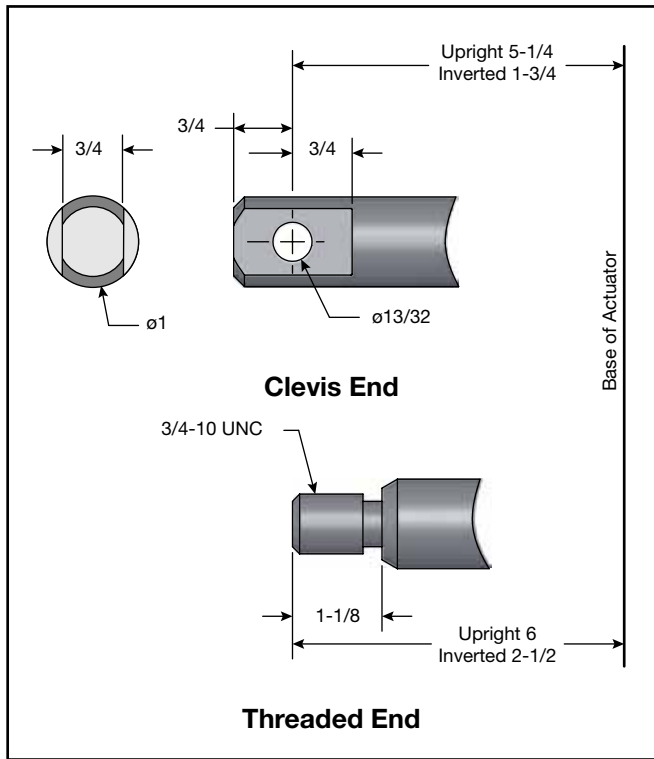
Inverted Rotating: DM-9003

MACHINE SCREW ACTUATORS

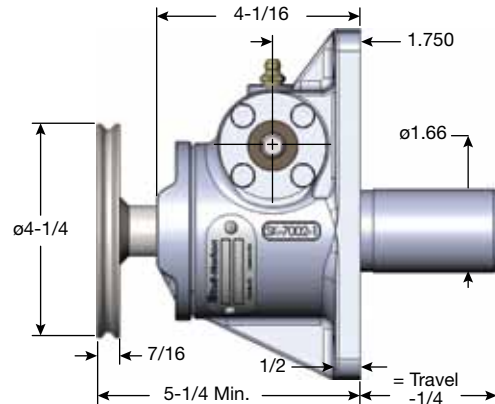
2 TON CAPACITY — 7000 SERIES



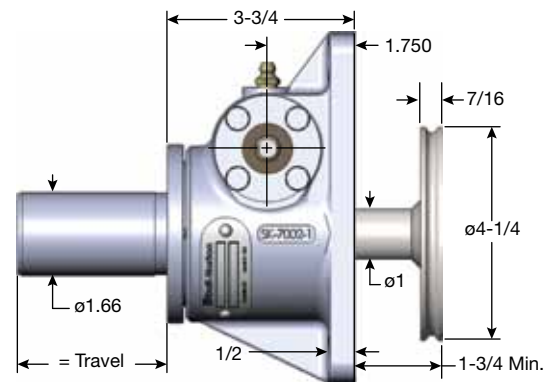
1" Diameter x .250 Lead Lifting Screw



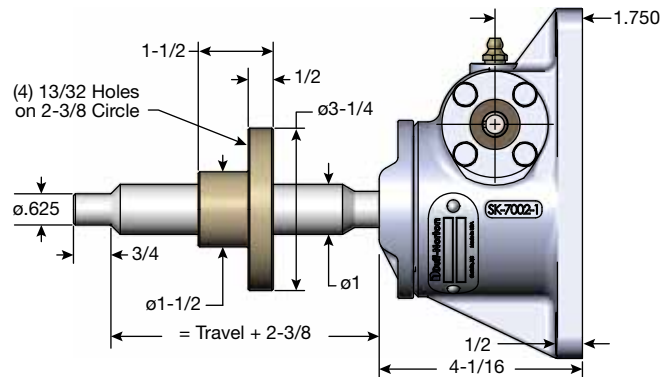
Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 148-149. Dimensions are subject to change without notice.



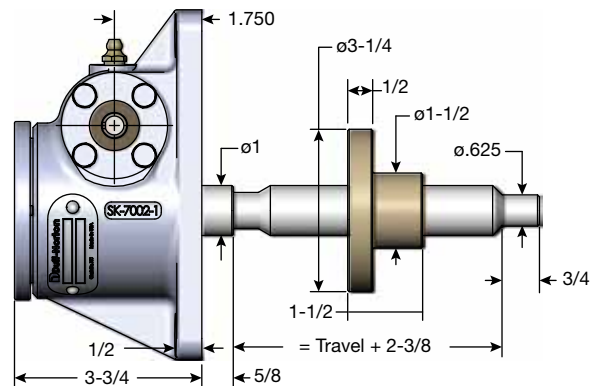
Upright: M-7002



Inverted: M-7001



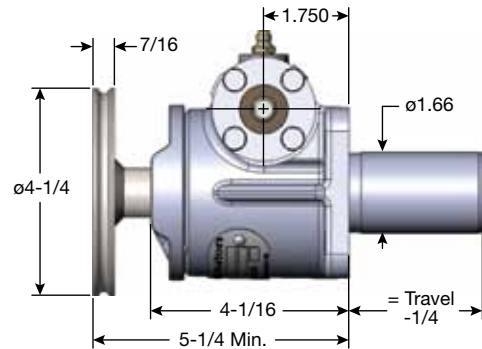
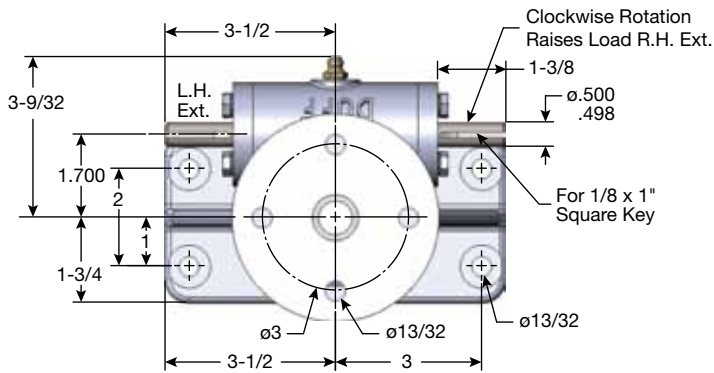
Upright Rotating: UM-7003



Inverted Rotating: DM-7003

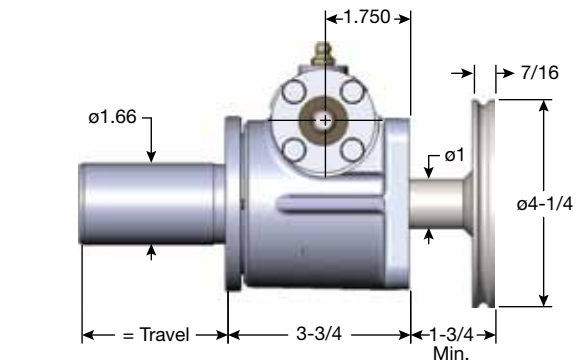
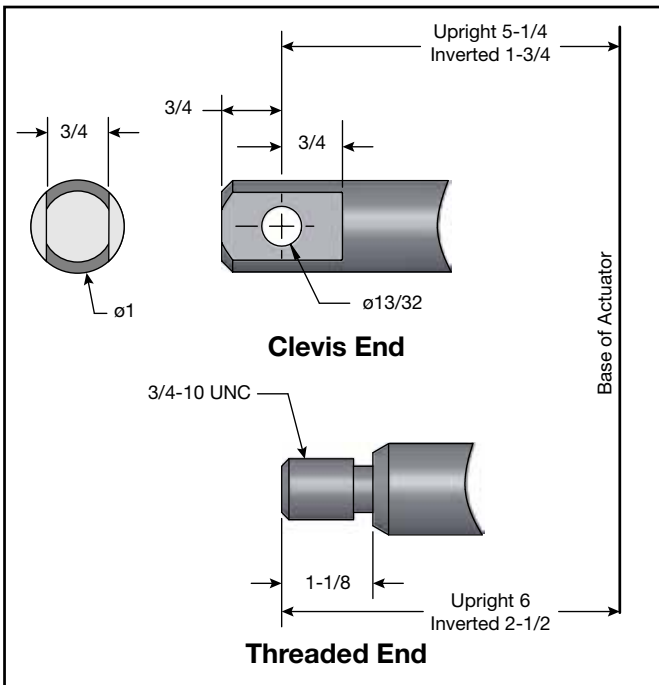
MACHINE SCREW ACTUATORS

2 TON CAPACITY — 1800 SERIES

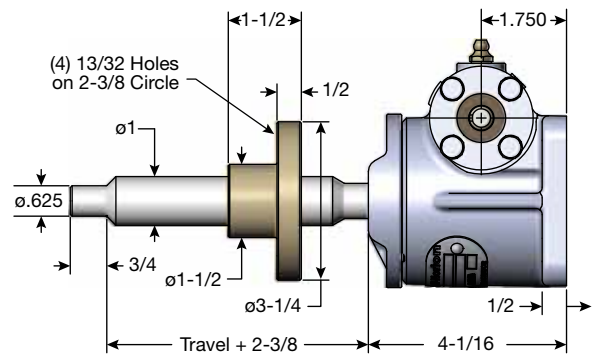


Upright: M-1802

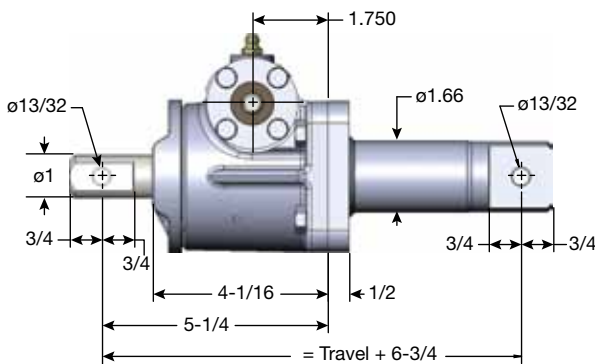
1" Diameter x .250 Lead Lifting Screws



Inverted: M-1801

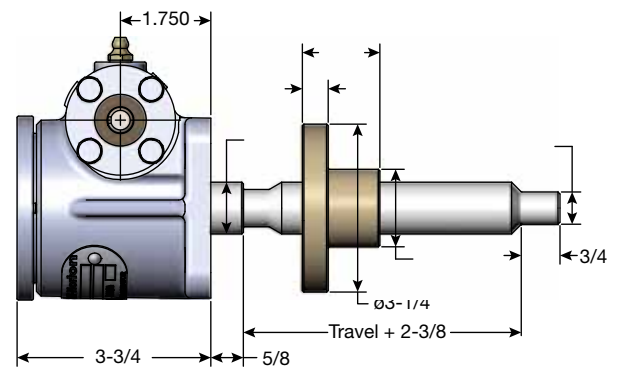


Upright Rotating: UM-1803



Double Clevis: CCM-1802

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

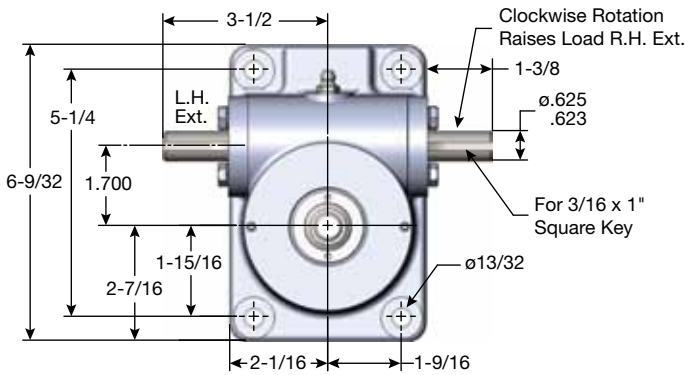


Inverted Rotating: DM-1803

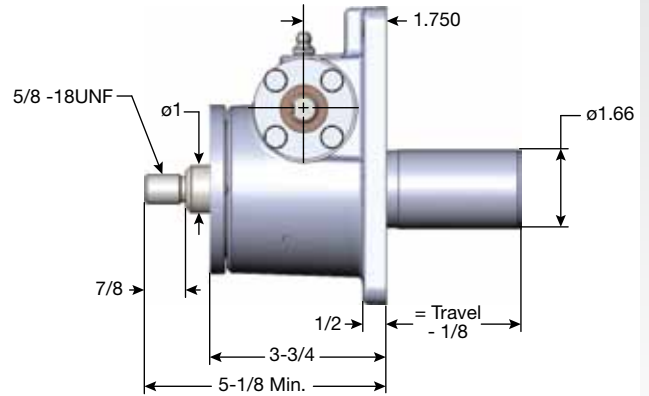
Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 148-149. Dimensions are subject to change without notice.

MACHINE SCREW ACTUATORS

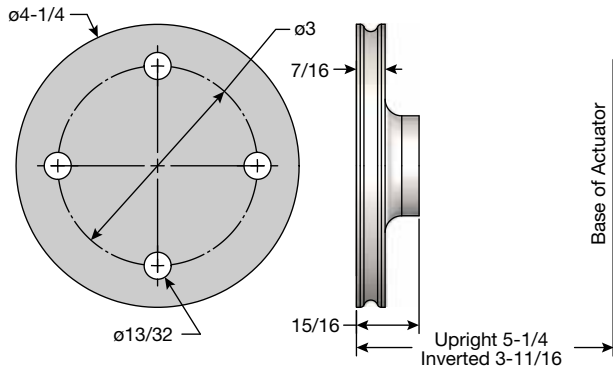
3 TON CAPACITY



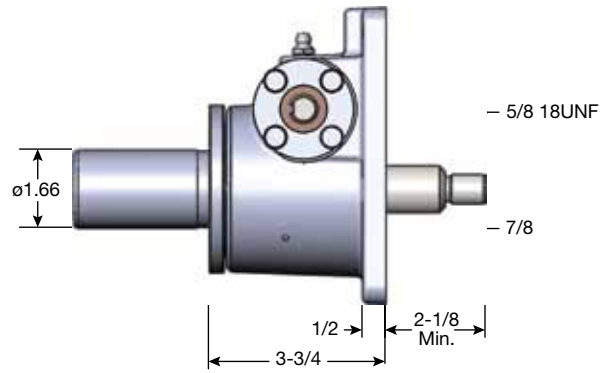
Top View: B9003 1" Diameter x .250"



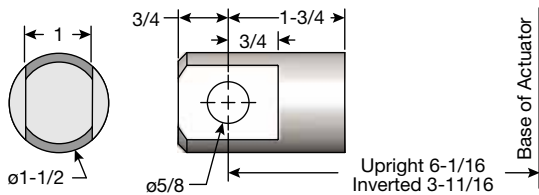
Upright: B9003T



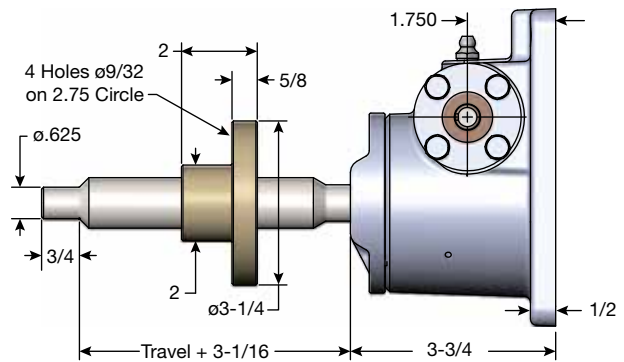
Top Plate SK90003-6A



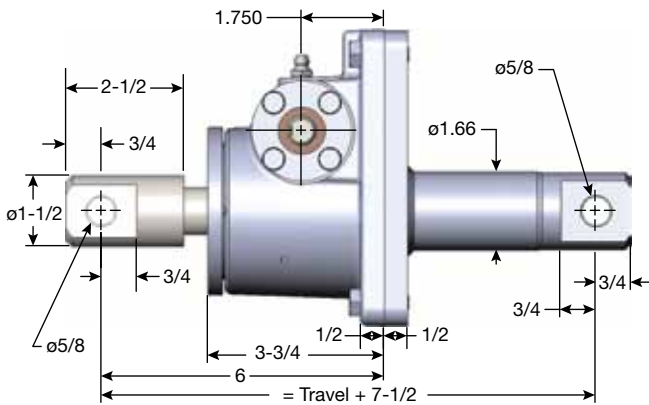
Inverted: B9003TV



Clevis End SK90003-18A

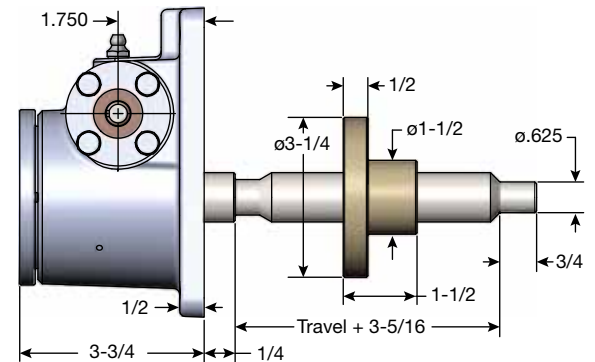


Upright Rotating: B9003U



Double Clevis: CCM-9003

Maximum Allowable Raise in Compression 14" - Rating 3000 Lbs.
Maximum Raise at Rated Load in Compression 9"

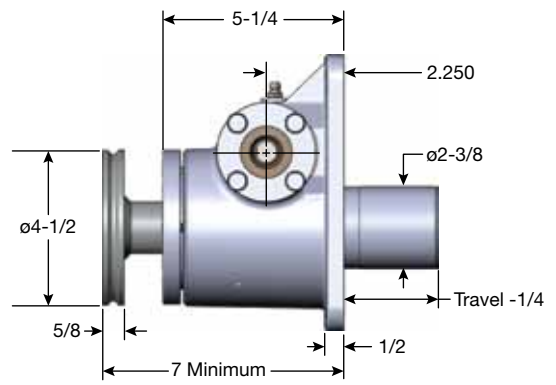
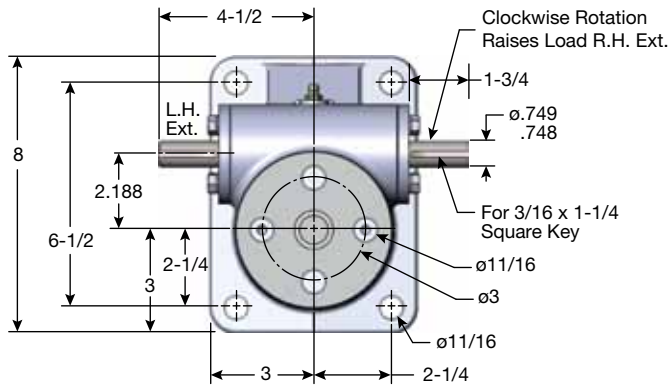


Inverted Rotating: B9003D

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 148-149. Dimensions are subject to change without notice.

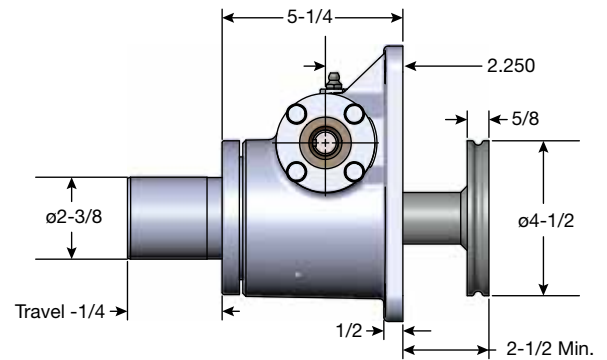
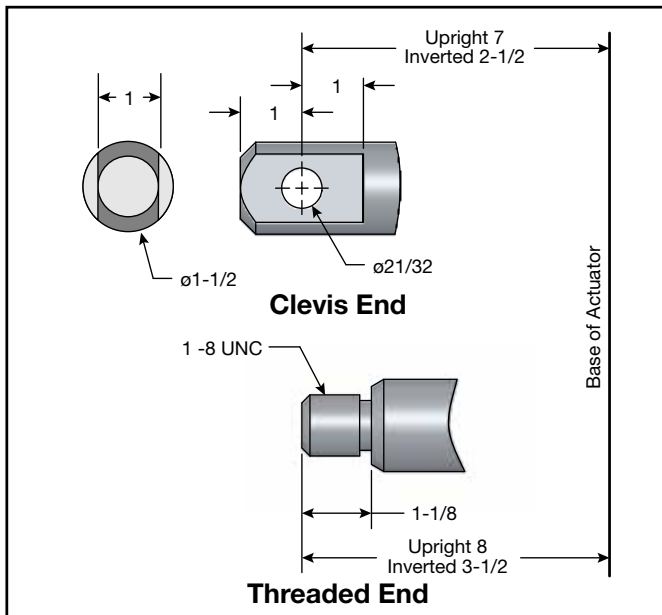
MACHINE SCREW ACTUATORS

5 TON CAPACITY

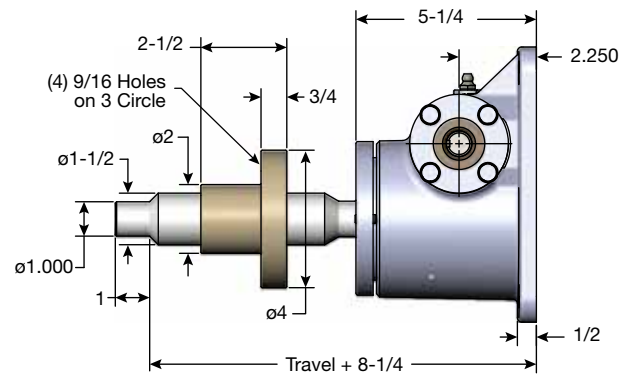


Upright: M-9005

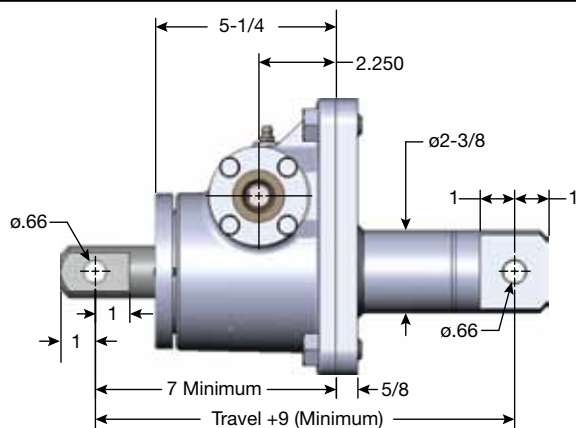
1-1/2" Diameter x .375 Lead Lifting Screws



Inverted: M-9004



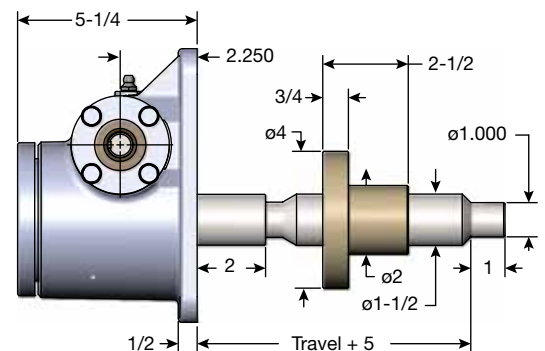
Upright Rotating: UM-9006



Double Clevis: CCM-9005

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

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 148-149. Dimensions are subject to change without notice.

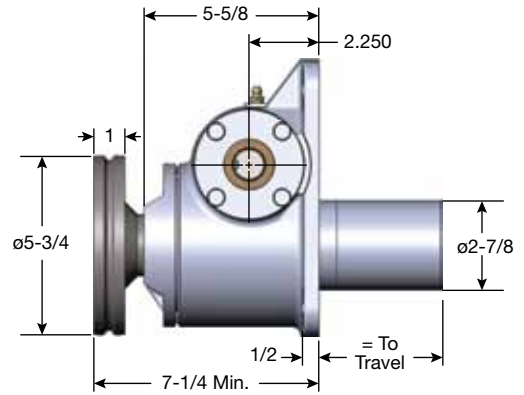
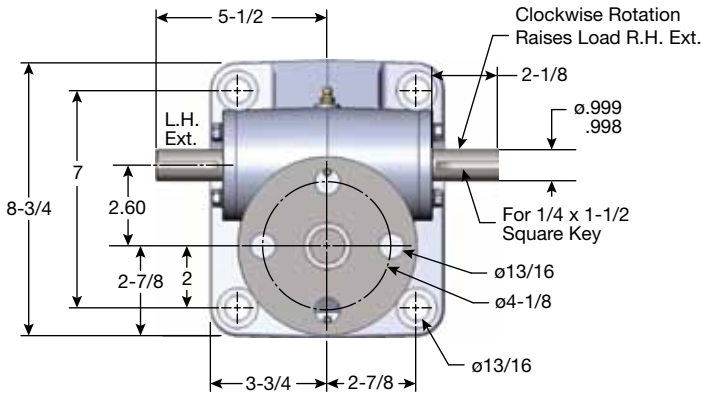


Inverted Rotating: DM-9006

MACHINE SCREW

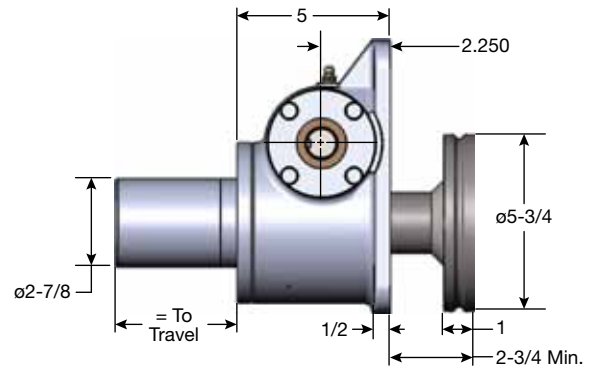
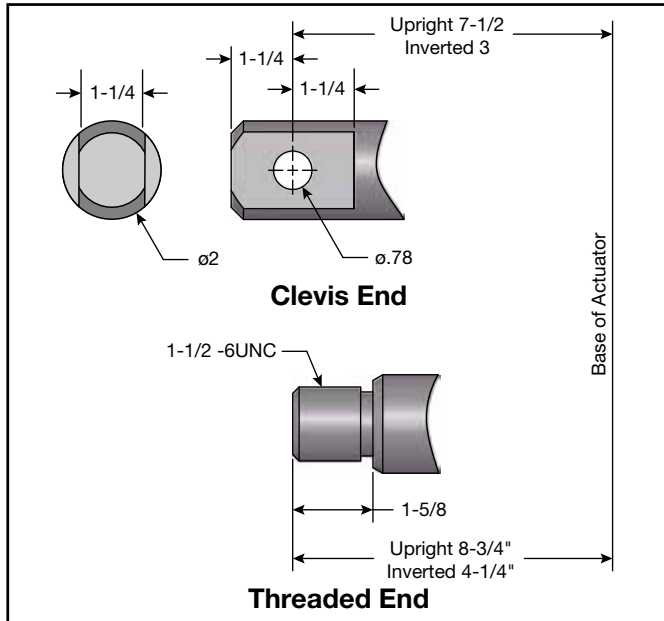
ACTUATORS

10 TON CAPACITY

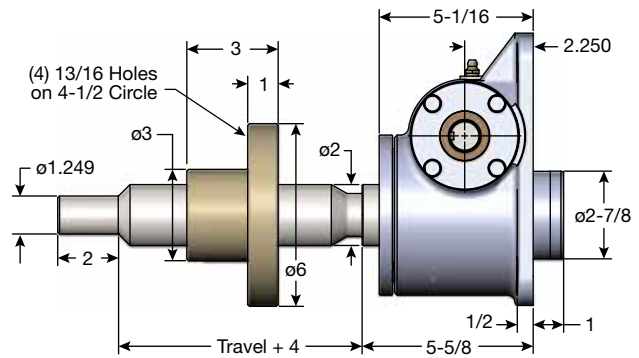


Upright: M-9010

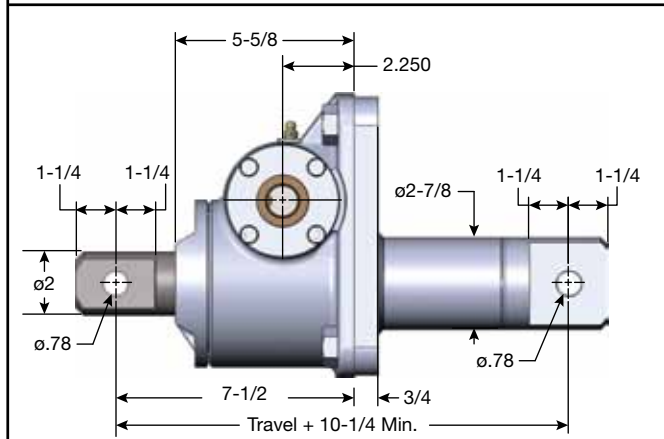
2" Diameter x .500 Lead Lifting Screws



Inverted: M-9009

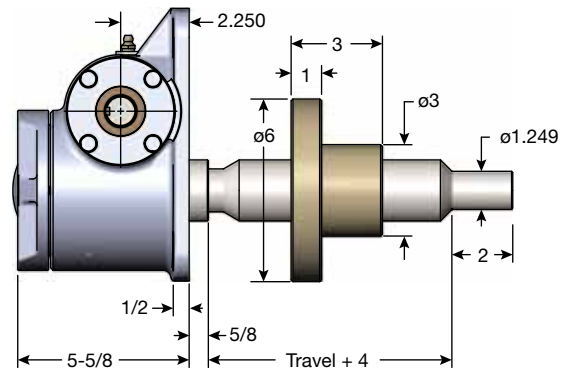


Upright Rotating: UM-9011



Double Clevis: CCM-9010

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

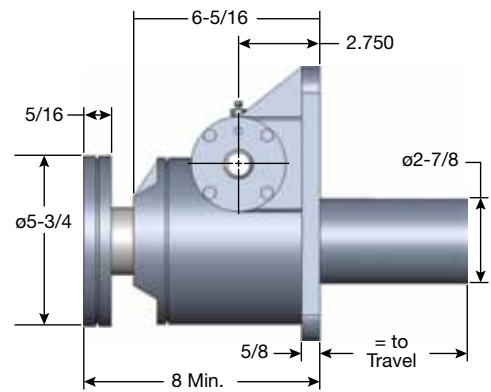
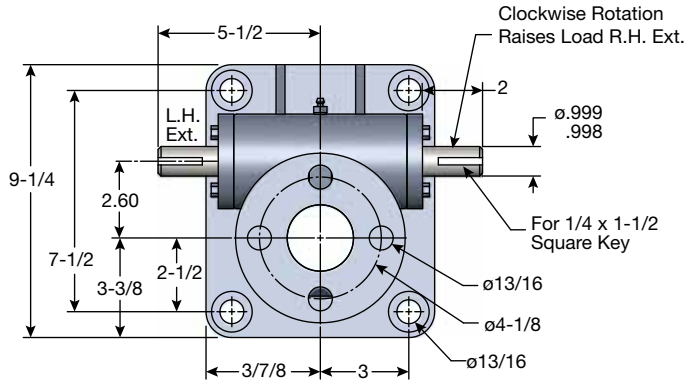


Inverted Rotating: DM-9011

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 148-149. Dimensions are subject to change without notice.

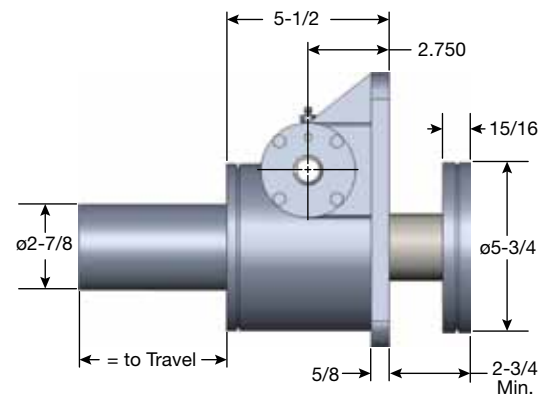
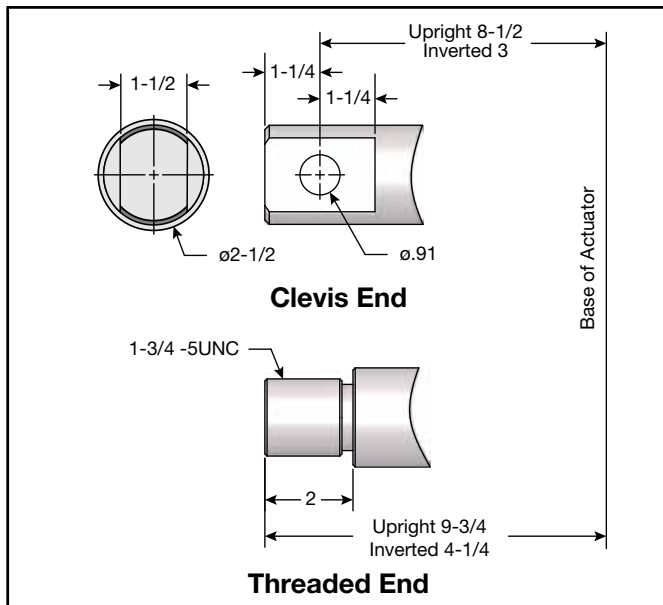
MACHINE SCREW ACTUATORS

15 TON CAPACITY

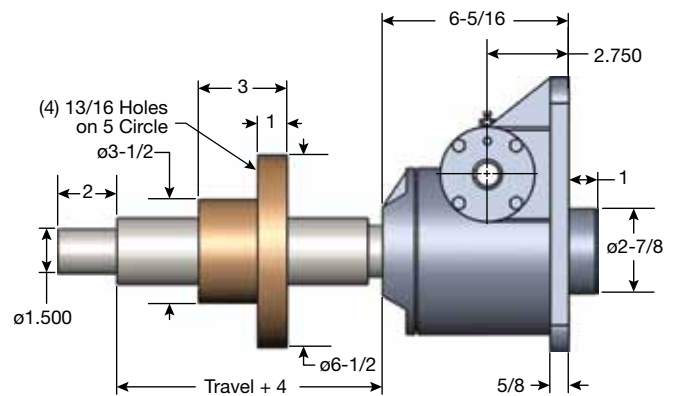


Upright: M-9015

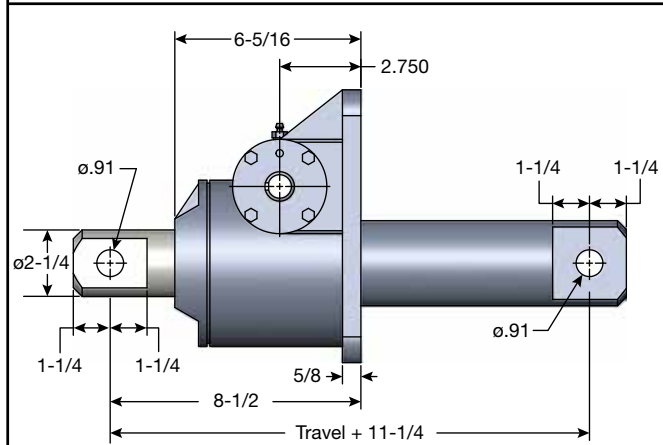
2-1/4" Diameter x .500 Lead Lifting Screws



Inverted: M-9014

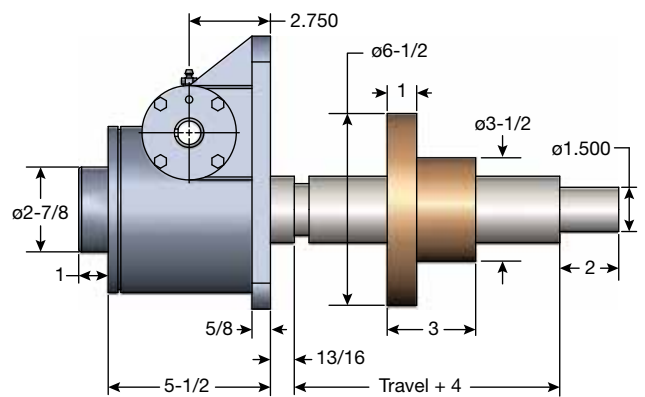


Upright Rotating: UM-9016



Double Clevis: CCM-9015

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

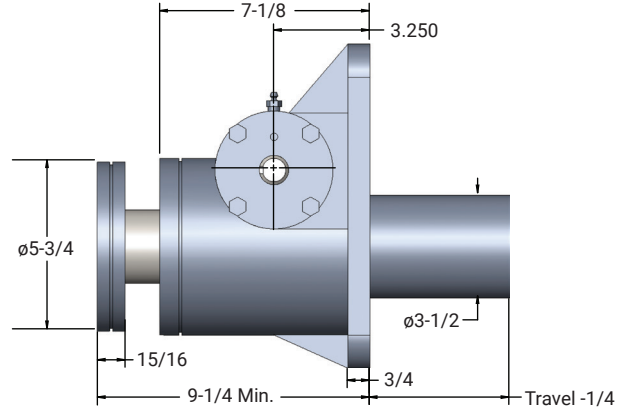
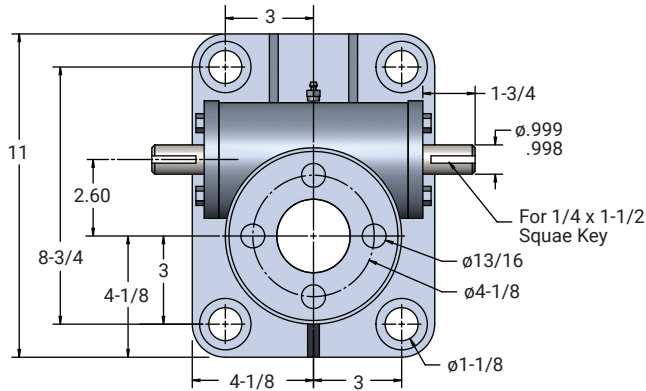


Inverted Rotating: DM-9016

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 148-149. Dimensions are subject to change without notice.

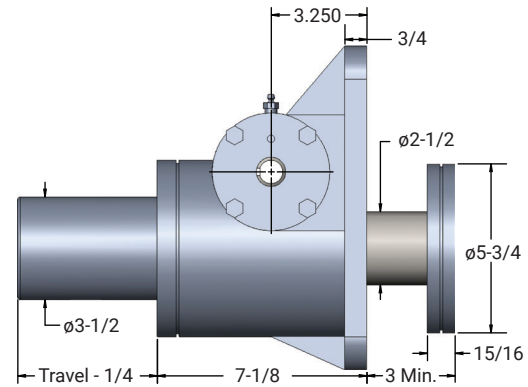
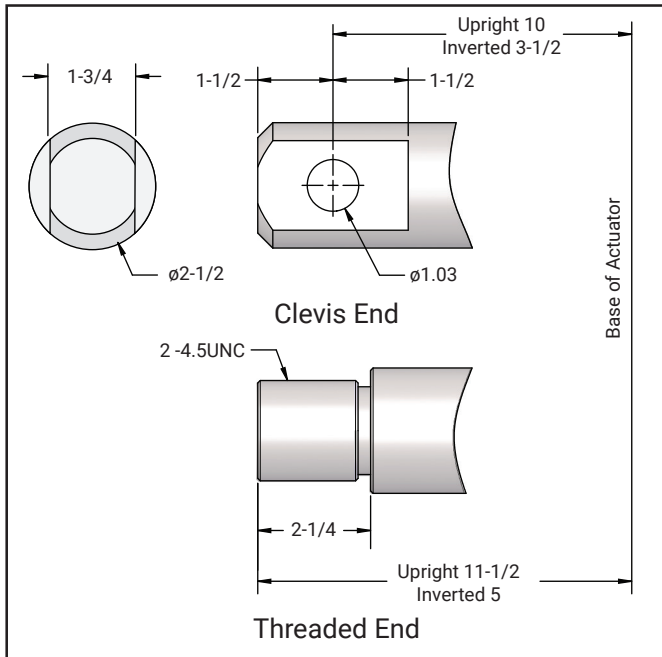
MACHINE SCREW ACTUATORS

20 TON CAPACITY

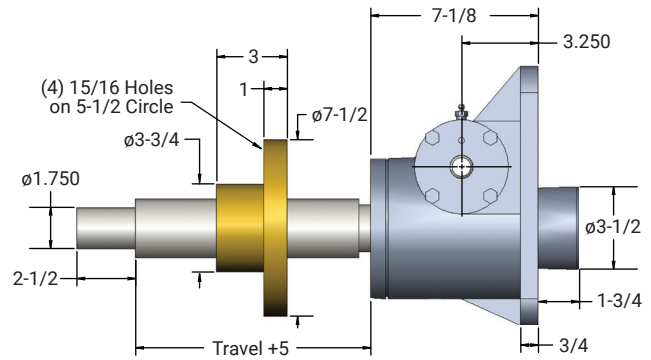


Upright: M-9020

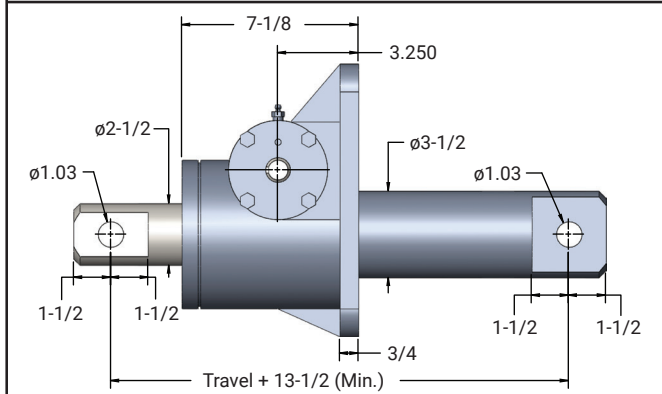
2-1/2" Diameter x .500 Lead Lifting Screws



Inverted: M-9019

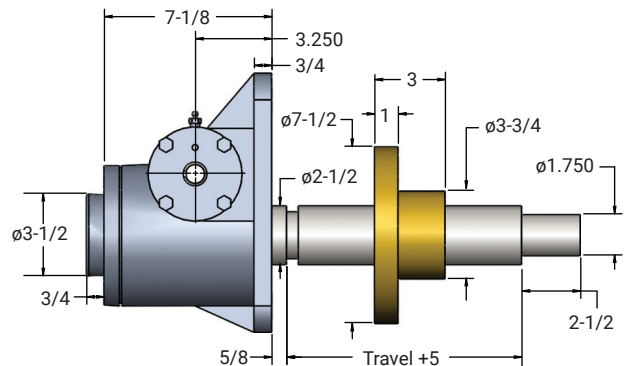


Upright Rotating: UM-9021



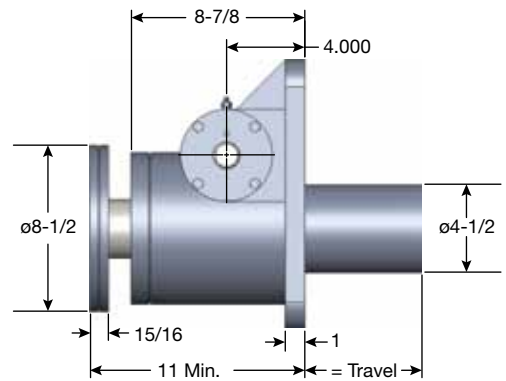
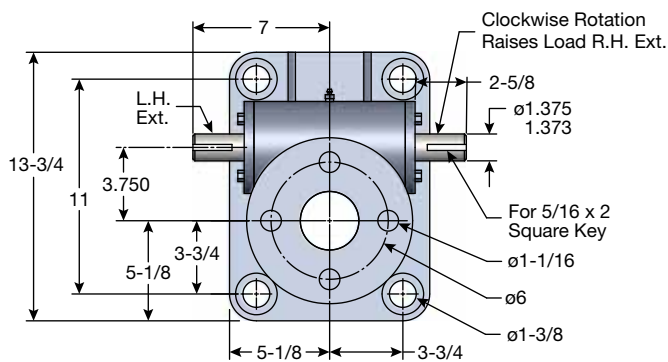
Double Clevis: CCM-9020

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



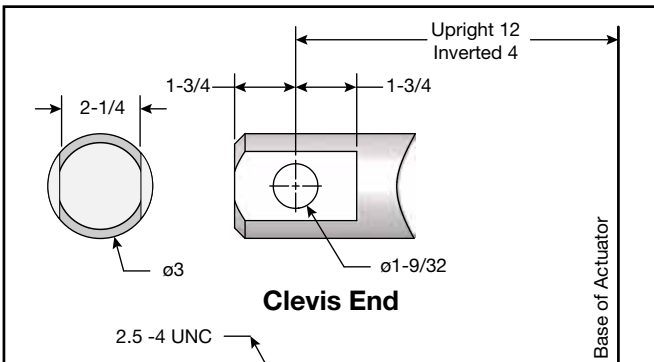
Inverted Rotating: DM-9021

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 148-149. Dimensions are subject to change without notice.



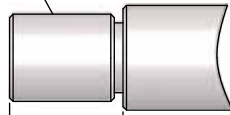
Upright: M-9025

3" Diameter x .666 Lead Lifting Screws



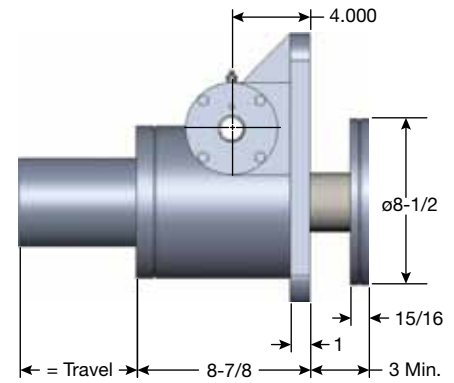
Clevis End

2.5-4 UNC

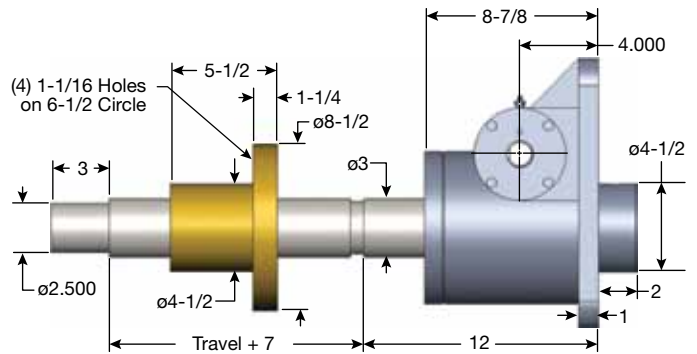


Threaded End

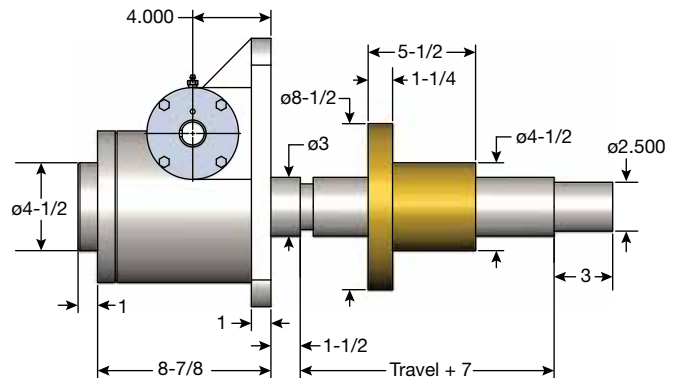
Base of Actuator



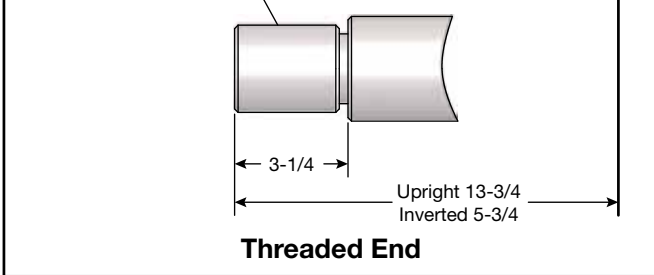
Inverted: M-9024



Upright Rotating: UM-9026



Inverted Rotating: DM-9026



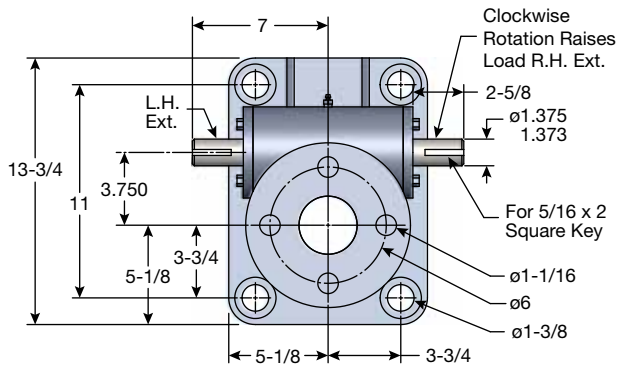
Double Clevis: CCM-9025

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

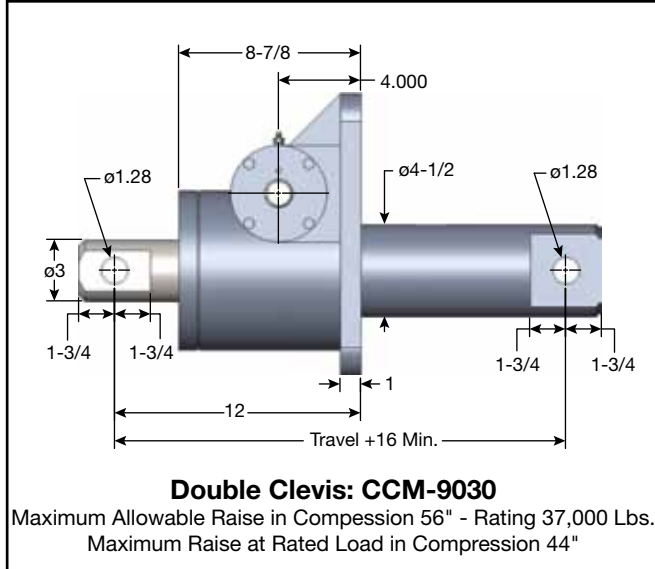
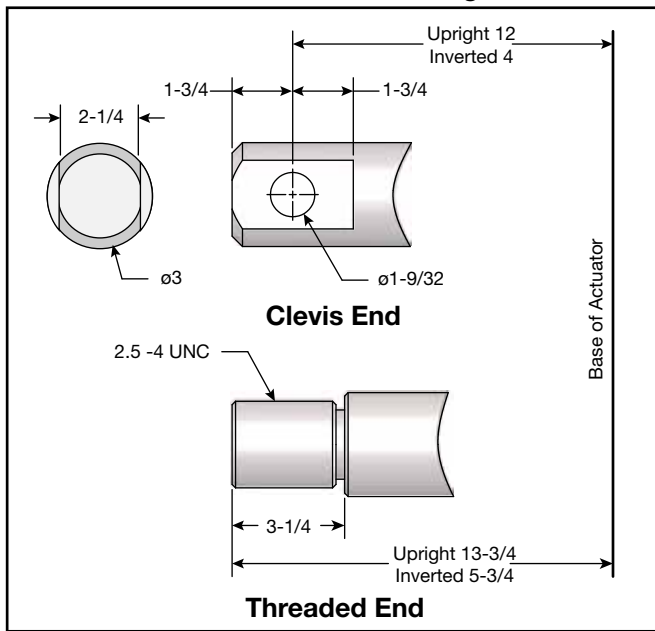
Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 148-149. Dimensions are subject to change without notice.

MACHINE SCREW ACTUATORS

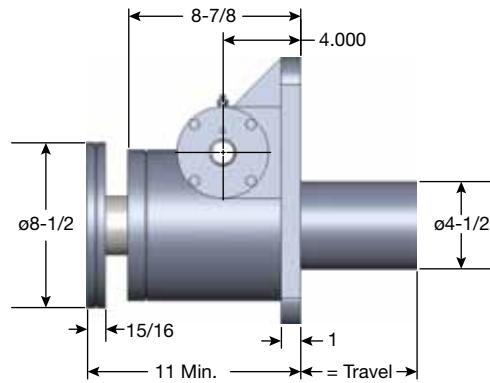
30 TON CAPACITY



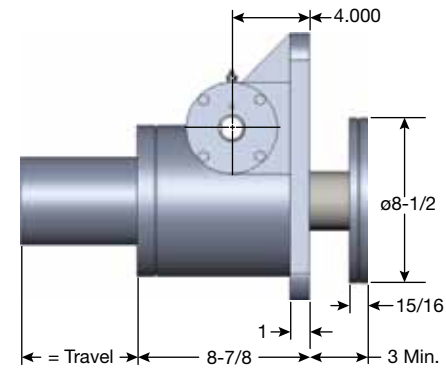
3" Diameter x .666 Lead Lifting Screws



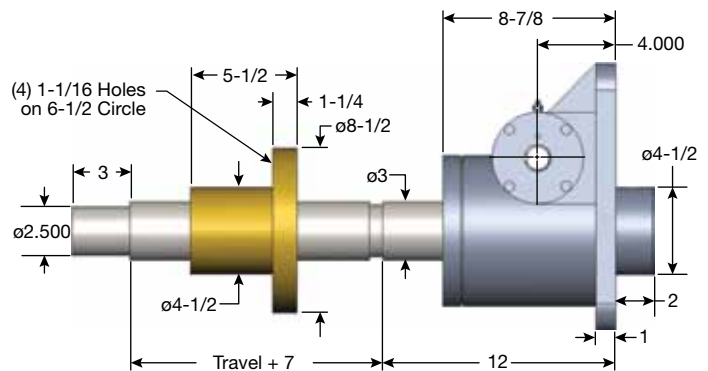
Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 148-149. Dimensions are subject to change without notice.



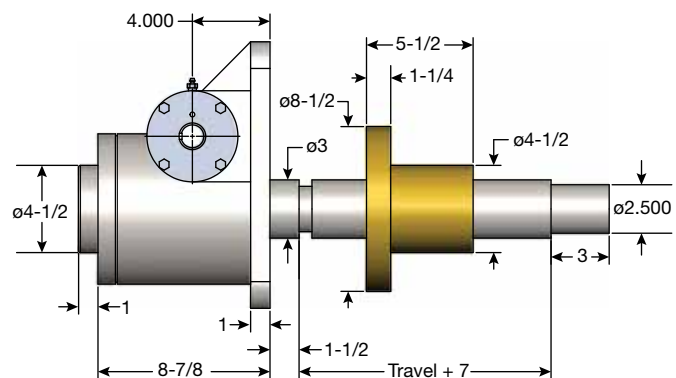
Upright: M-9030



Inverted: M-9029



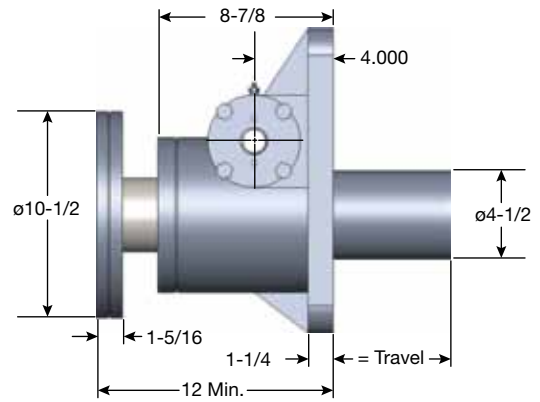
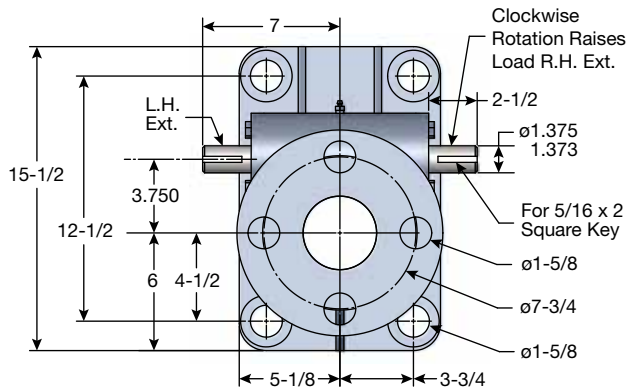
Upright Rotating: UM-9031



Inverted Rotating: DM-9031

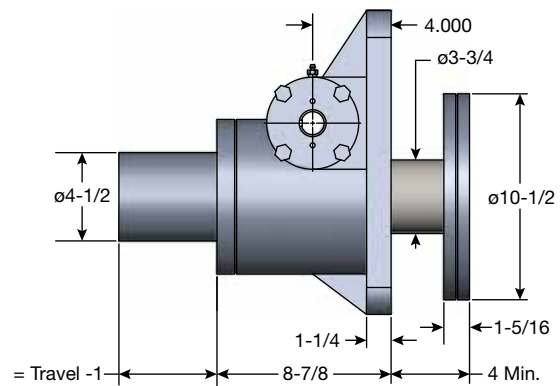
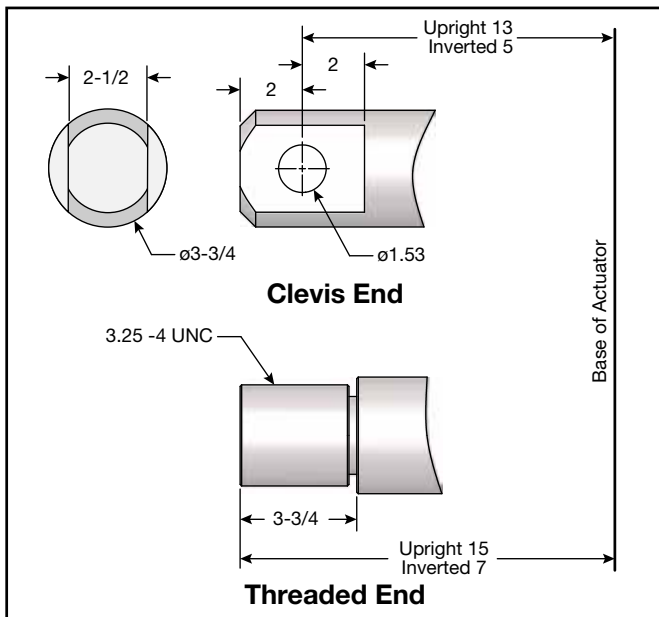
MACHINE SCREW ACTUATORS

35 TON CAPACITY

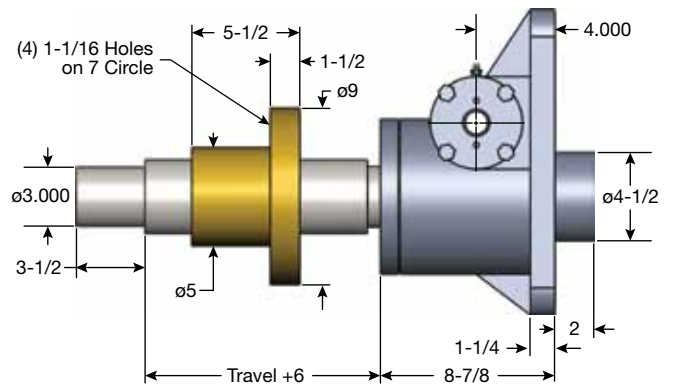


Upright: M-9035

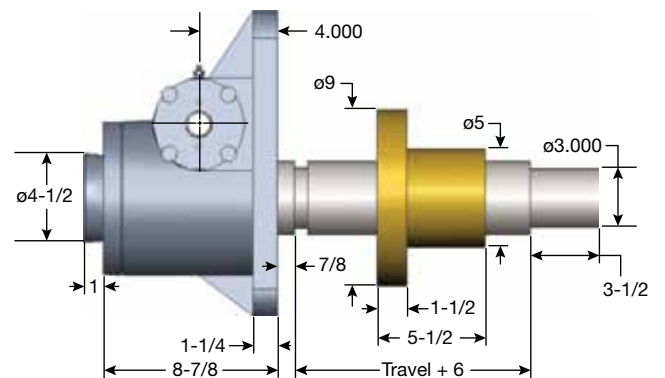
3-3/4" Diameter x .666 Lead Lifting Screws



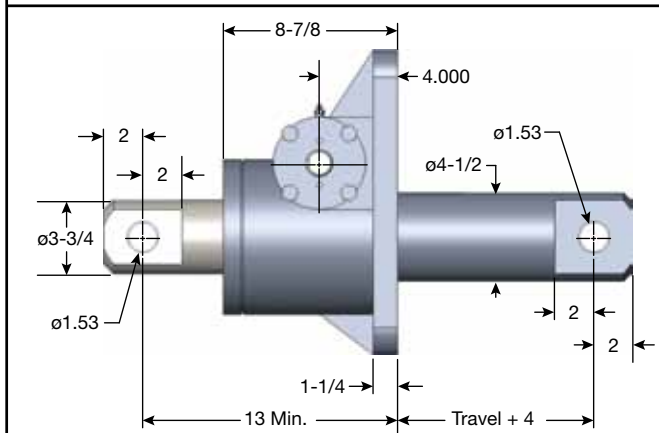
Inverted: M-9034



Upright Rotating: UM-9036



Inverted Rotating: DM-9036



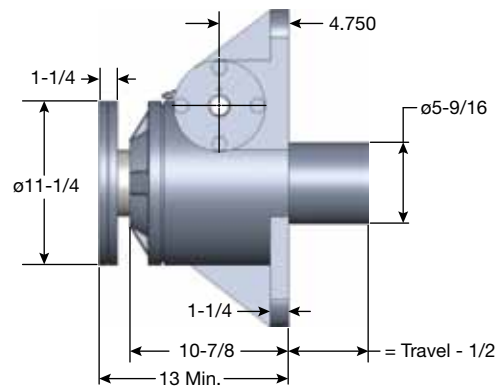
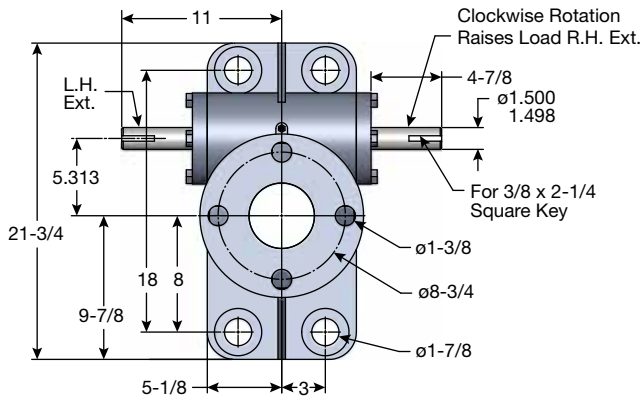
Double Clevis: CCM-9035

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

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 148-149. Dimensions are subject to change without notice.

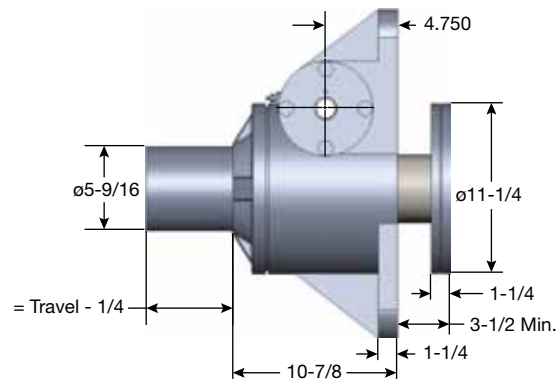
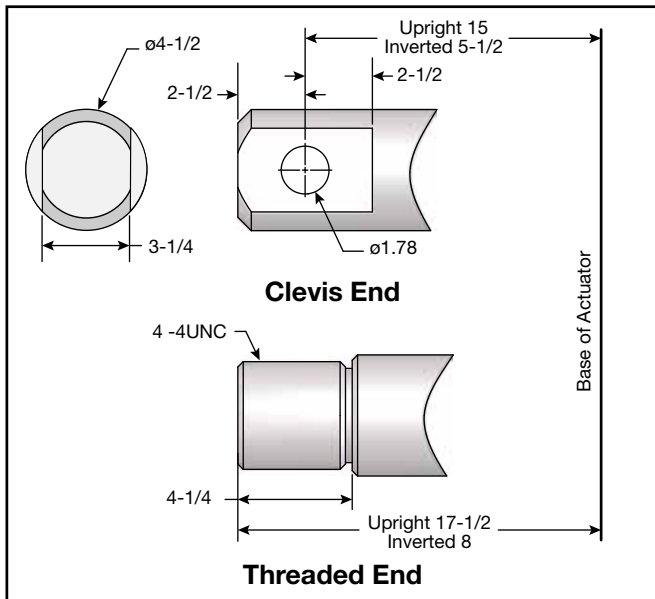
MACHINE SCREW ACTUATORS

50 TON CAPACITY — 9000 Series

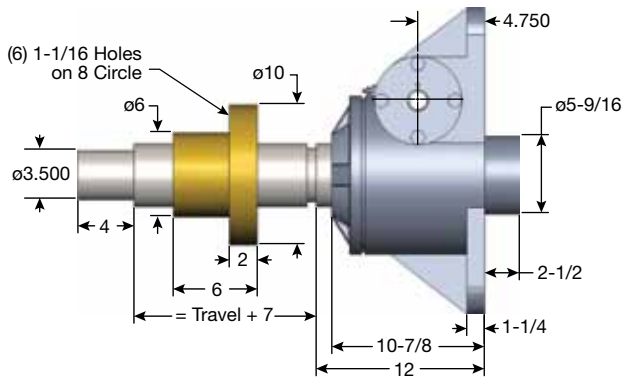


Upright: M-9050

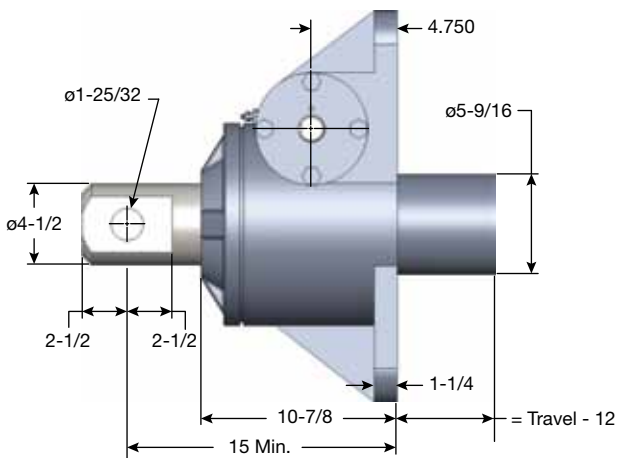
4-1/2" Diameter x .666 Lead Lifting Screws



Inverted: M-9049

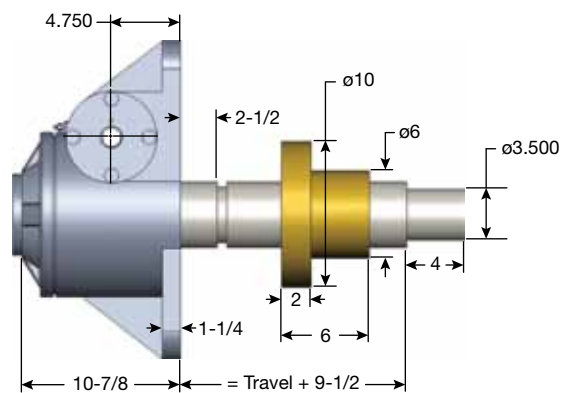


Upright Rotating: UM-9051



Double Clevis: CCM-9050

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

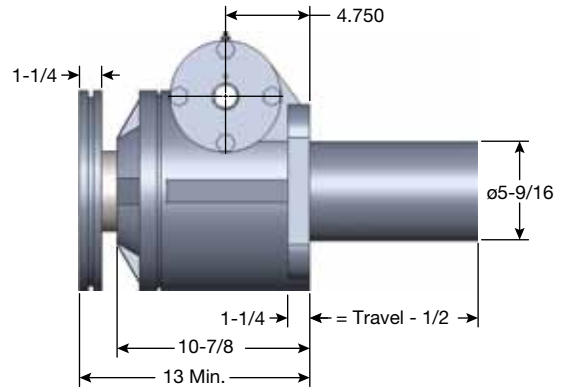
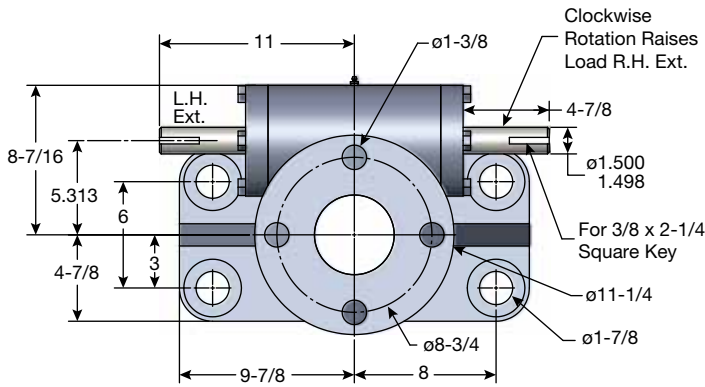


Inverted Rotating: DM-9051

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 148-149. Dimensions are subject to change without notice.

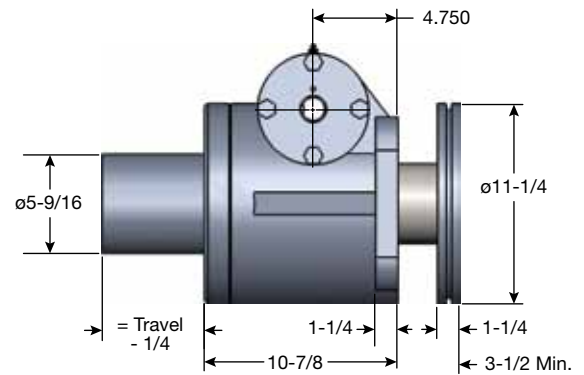
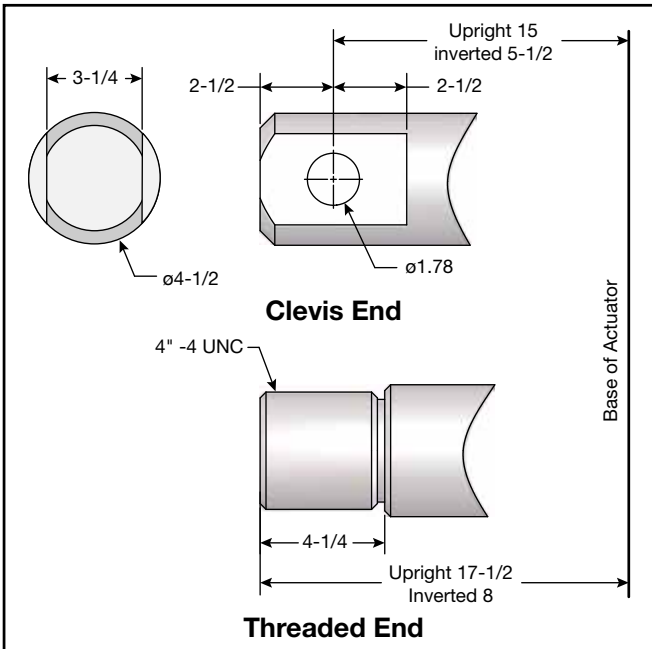
MACHINE SCREW ACTUATORS

50 TON CAPACITY — 1800 Series

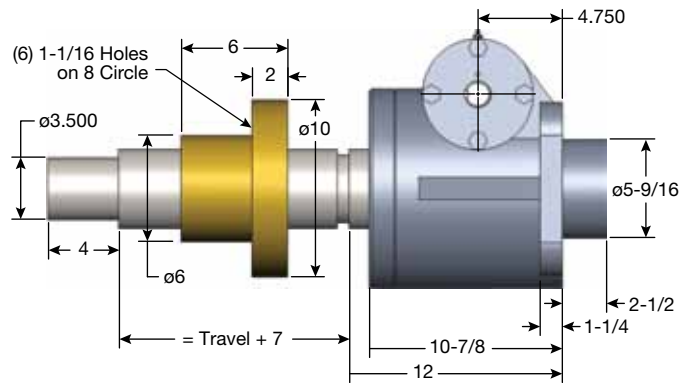


Upright: M-1850

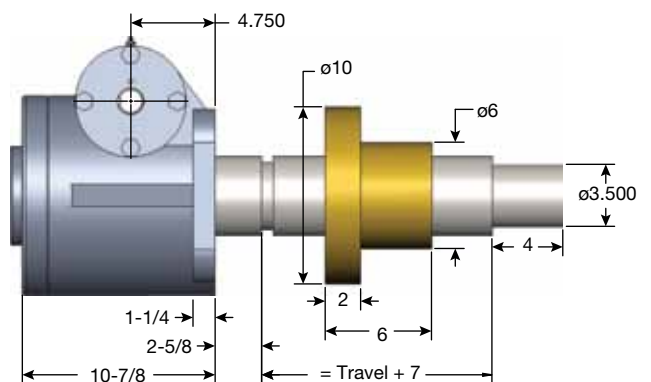
4-1/2" Diameter x .666 Lead Lifting Screws



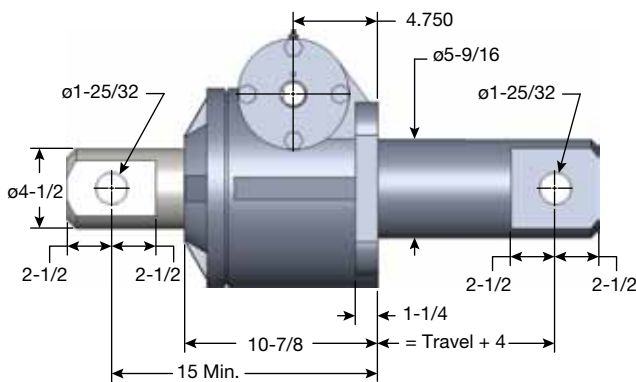
Inverted: M-1849



Upright Rotating: UM-1851



Inverted Rotating: DM-1851

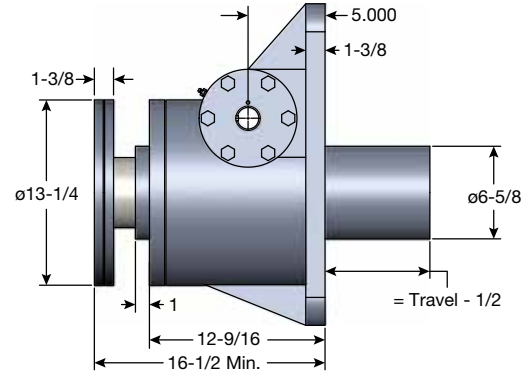
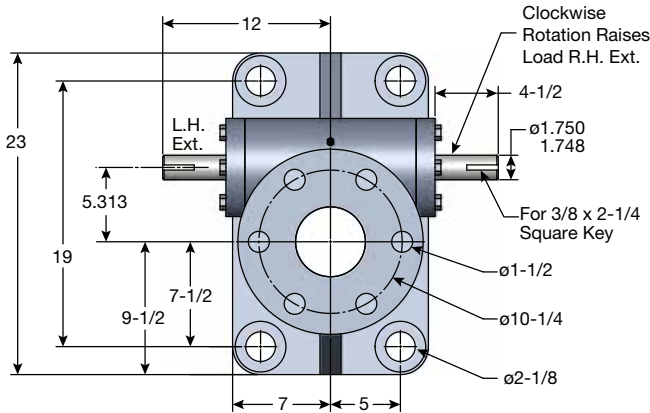


Double Clevis: CCM-1850

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

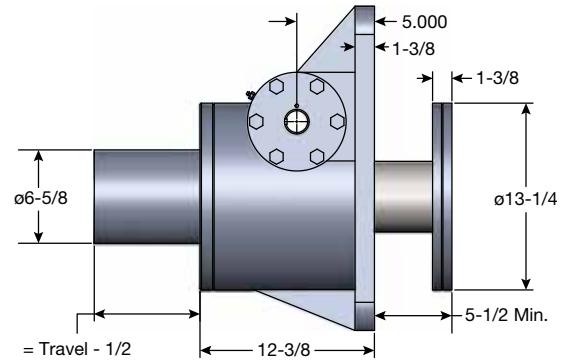
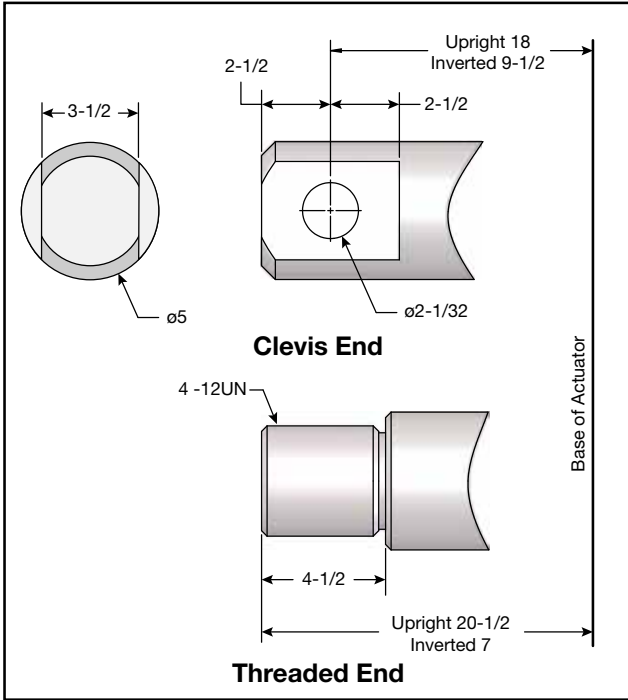
Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 148-149. Dimensions are subject to change without notice.

MACHINE SCREW ACTUATORS 75 TON CAPACITY

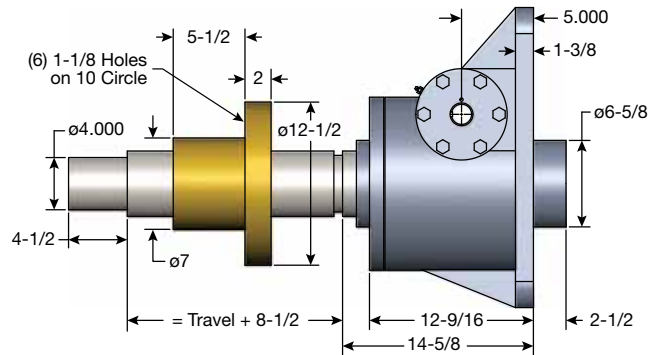


Upright: M-9075

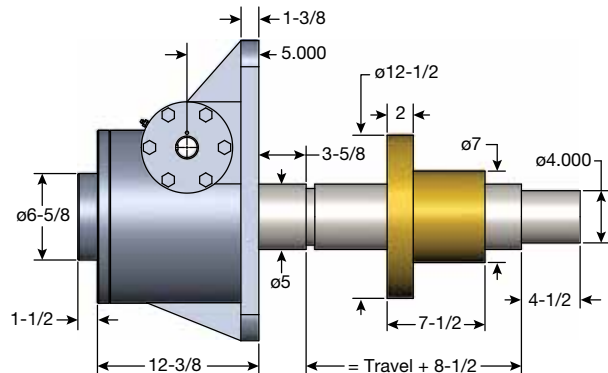
5" Diameter x .666 Lead Lifting Screws



Inverted: M-9074



Upright Rotating: UM-9076

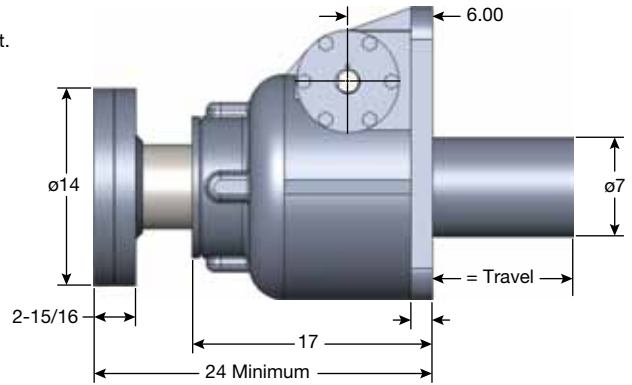
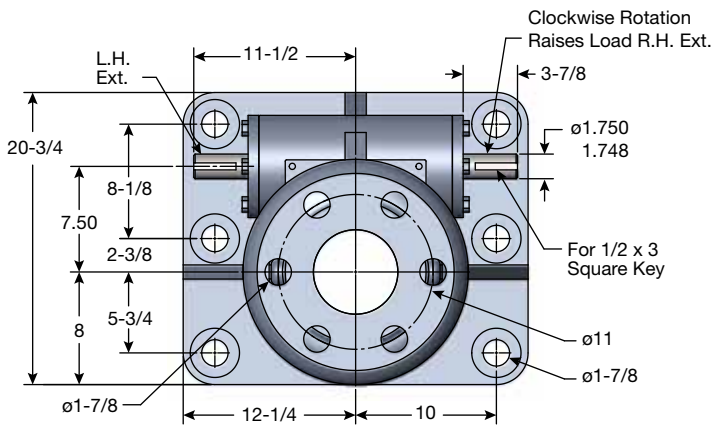


Inverted Rotating: DM-9076

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 148-149. Dimensions are subject to change without notice.

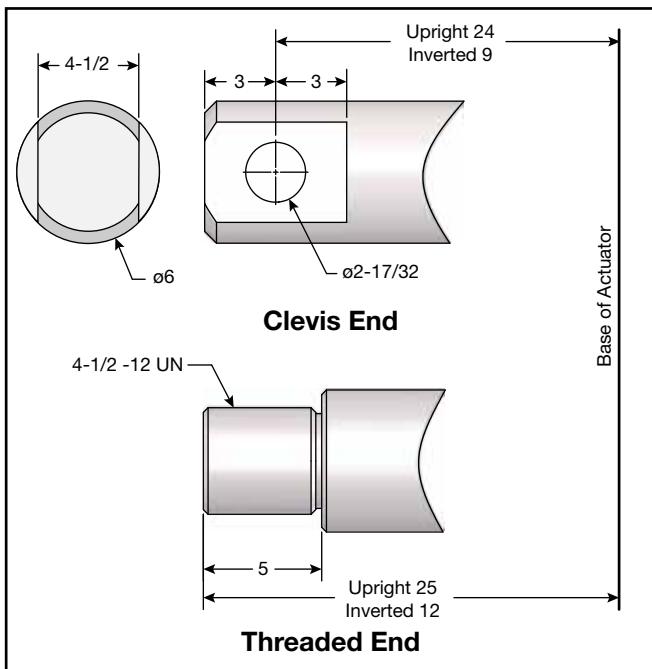
MACHINE SCREW ACTUATORS

100 TON CAPACITY

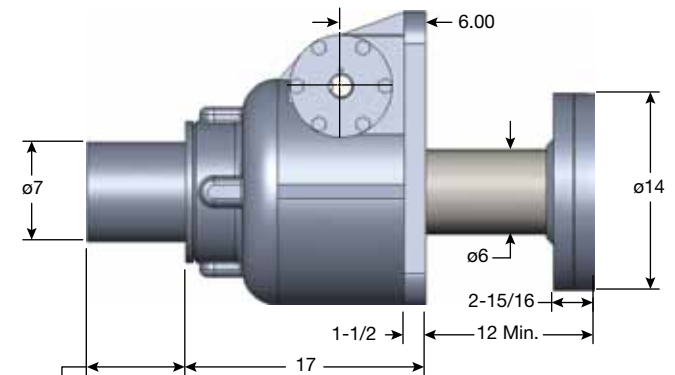


Upright: M-9099

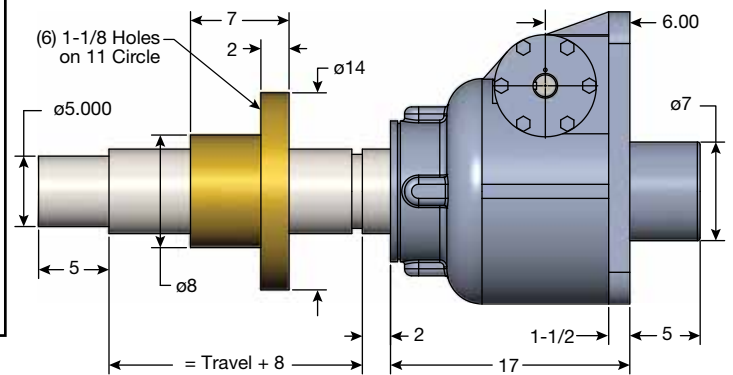
6" Diameter x .750 Lead Lifting Screws



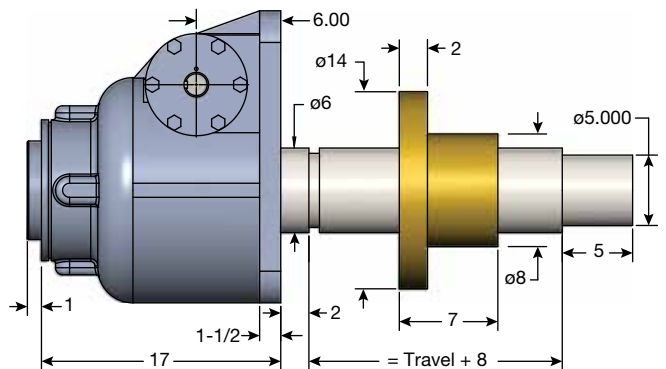
Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 148-149. Dimensions are subject to change without notice.



Inverted: M-9098

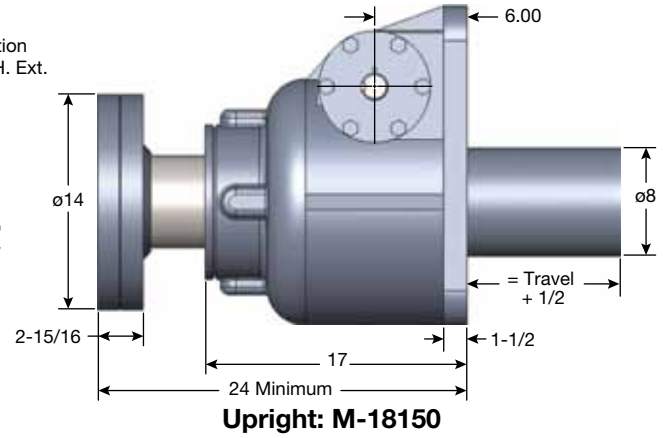
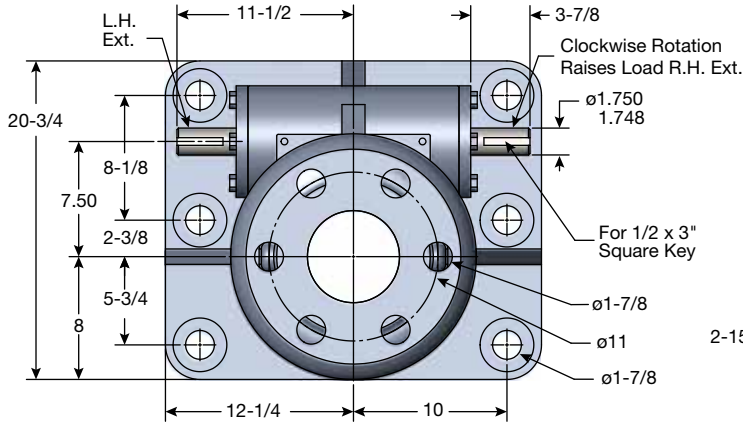


Upright Rotating: UM-9097

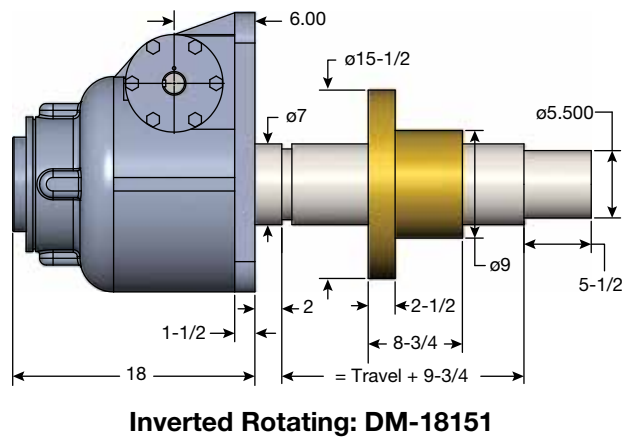
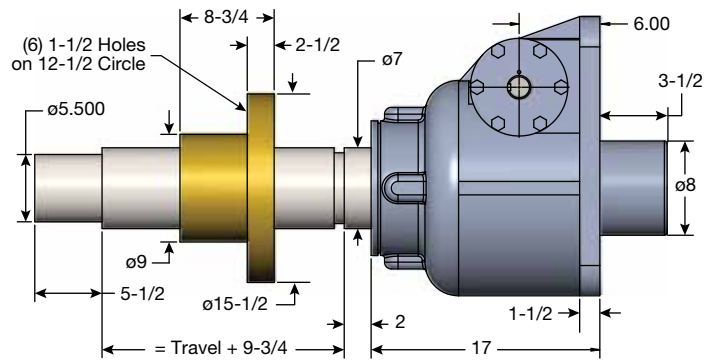
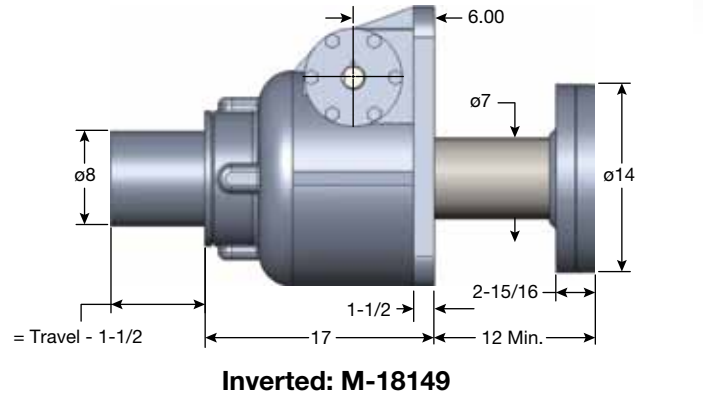
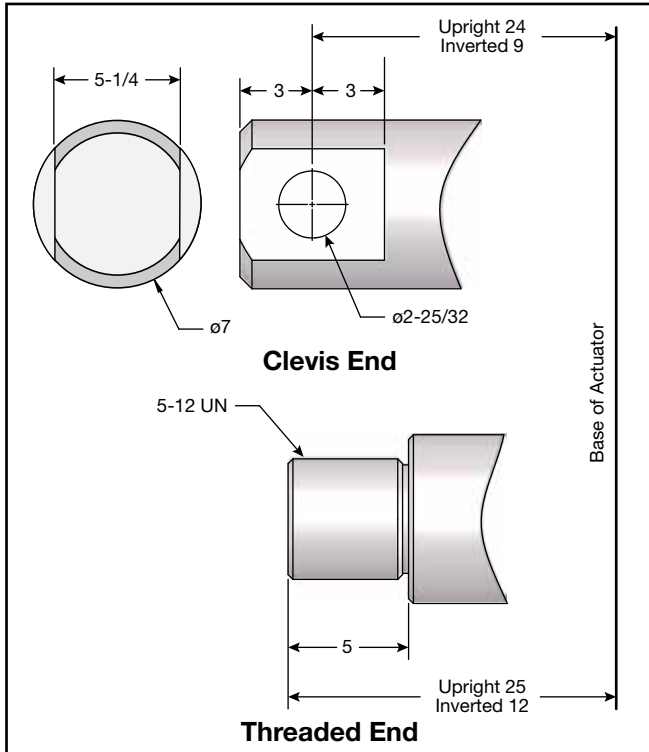


Inverted Rotating: DM-9097

MACHINE SCREW ACTUATORS 150 TON CAPACITY



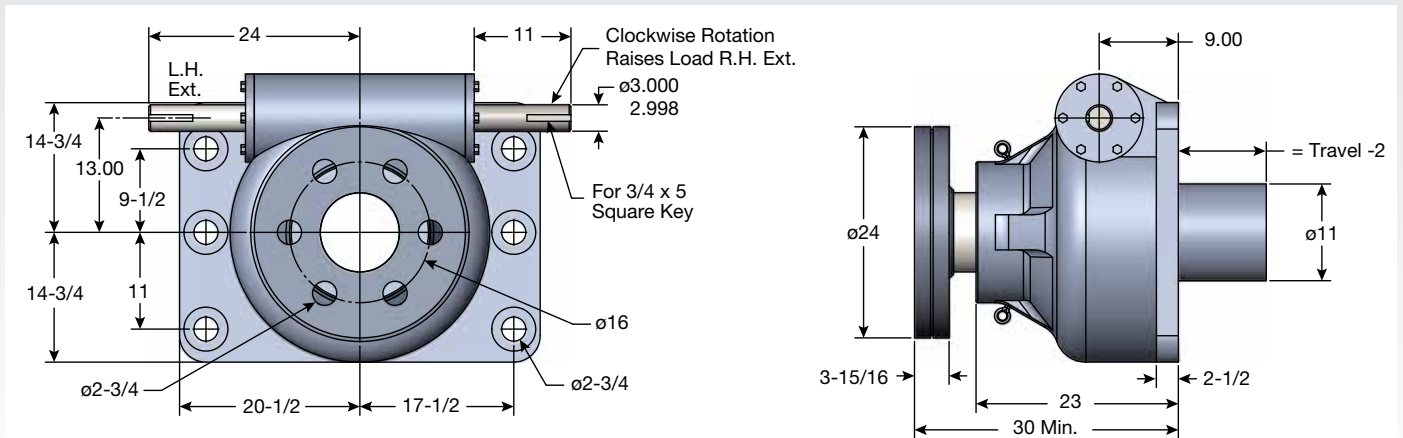
7" Diameter x 1.0" Lead Lifting Screws



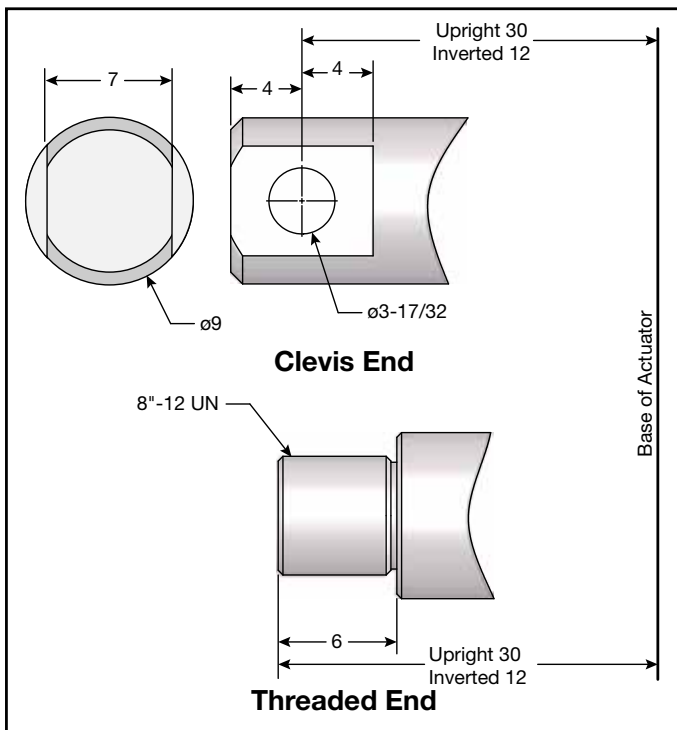
Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 148-149. Dimensions are subject to change without notice.

MACHINE SCREW ACTUATORS

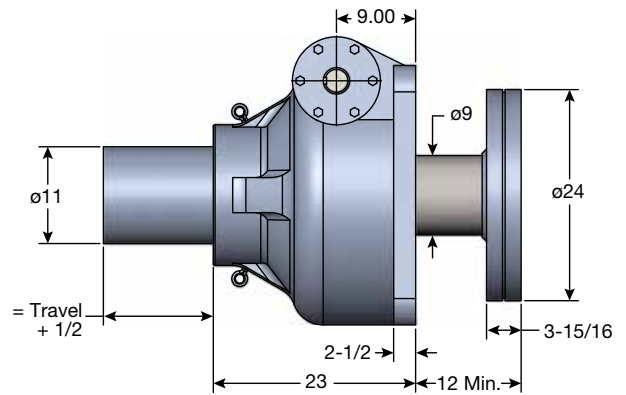
250 TON CAPACITY



9" Diameter x 1" Lead Lifting Screws



Upright: M-2250



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 148-149. Dimensions are subject to change without notice.

NOTE

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Actuators at these capacities are provided under specific Duff-Norton / customer agreement as to the actuator's performance parameters. These changes are internal to the housing and do not otherwise impact the envelope dimensions shown.

Please contact our Application Engineering group for more information.

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MACHINE SCREW ACTUATORS – STAINLESS STEEL

2 to 100 TONS

Top Plate

316 stainless steel. Must be bolted to lifting member to prevent rotation except when screw is keyed.

Lifting Screw

316 stainless steel. Also available as threaded end or clevis end.

Shell Cap

316 stainless steel. Locked into place by set screws.

Carbon Steel Load Bearings

Top and bottom to take full load in either direction.

Worm Bearings & Seals

Both ends of worm. 316 stainless steel case and spring.

Worm Gear

Wear resistant Bronze. Accurately hobbled for greater gear contact.

Worm

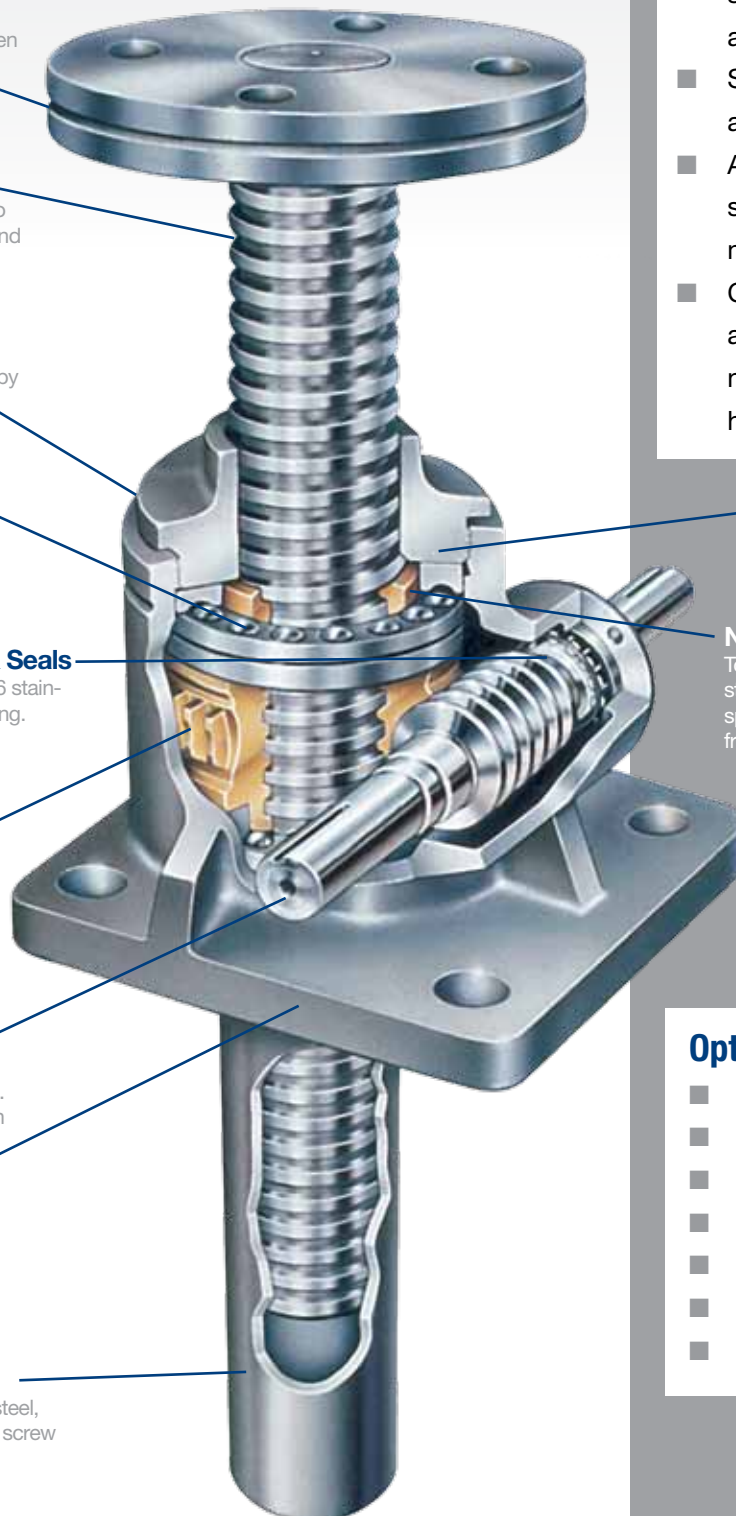
316 stainless steel. Standard. (17-4 Ph available)

Housing

316 stainless steel

Coverpipe

316 stainless steel, Protects lifting screw threads.



FEATURES

- Anti-backlash models available.
- Upright and inverted rotating screw models with traveling nut available.
- Sealed gear cavity keeps water and other contaminants out.
- Available with keyed lifting screws for translating screw models.
- Can be retrofitted into applications where Duff-Norton non-stainless steel actuators have been previously used.

Guide Bushing
Bronze

Nitrile Rubber Seals

Top and bottom with 316 stainless steel case and spring. Protects gearcase from contamination.

Optional Special Features:

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

MACHINE SCREW

ACTUATORS – STAINLESS STEEL

MODEL NUMBERING SYSTEM

FL - TSM - 9002 - 6 - 1R

Model Prefix

R - Reducer
F - C-face Adapter
H - Hand Wheel
L - Limit Switch
E - Encoder
J - Rotary Counter

Screw End & Configuration

T - Threaded End
C - Clevis End
M - Top Plate
P - Plain End

K - Keyed Screw
CC - Double Clevis

D - Inverted Rotating
U - Upright Rotating

Series & Capacity No.

Series:
 Machine Screw
 (90xx, 18xx, 70xx, 25xx)
 Special MS
 (100xx, 20xx, 80xx, 35xx)

 (1800 series base configurations
 are available only on 2 and 50
 Ton models)

Capacities:
 Upright model suffixes end with
 the capacity number.
 Inverted model suffixes lower the
 capacity number by one digit.
 Rotating model suffixes raise the
 capacity number by one digit.

SM - Base Model

Travel

1" increment travels are always represented using the exact travel amount.

Travels with fractional lengths are quoted using that length, but are serialized when the order is processed.

Serialized digits in this position may also be used for other models containing special features.

Model Suffix

B - Boot
L - Single End Worm Ext. Left
R - Single End Worm Ext. Right
1 - Optional Ratio #1
2 - Optional Ratio #2
X - Supplied without cover pipe

NOTE

Not sure if your application requires the full protection offered by our Stainless Steel actuators? Contact our Customer Service group to explore your options as there have been many instances where Duff-Norton has supplied actuators with Stainless Steel screws, worm shaft, and with actuator housings protected by our Epoxy / Polyurethane paint process.

MACHINE SCREW ACTUATORS – STAINLESS STEEL PERFORMANCE TABLE

Performance Table Instructions – pages 15, 39, 46, 52, 55, and 76

When reviewing any Duff-Norton Actuator Performance Specifications Table, as part of the process of selecting the best-suited actuator for your application, there are several important worm-gear ratios to consider.

Standard Ratio – is frequently chosen when higher speeds and efficiency ratings are desired.

Optional Ratio – is frequently chosen when the application requires higher lifting capacities, lower speeds, or to ease the use of a handwheel.

Numeric Ratio – is frequently chosen for applications requiring fine adjustments, higher lifting capacities, lower speeds, the easy use of a handwheel, self locking applications, and also offers the benefit of an even number of worm input turns per inch of stroke.

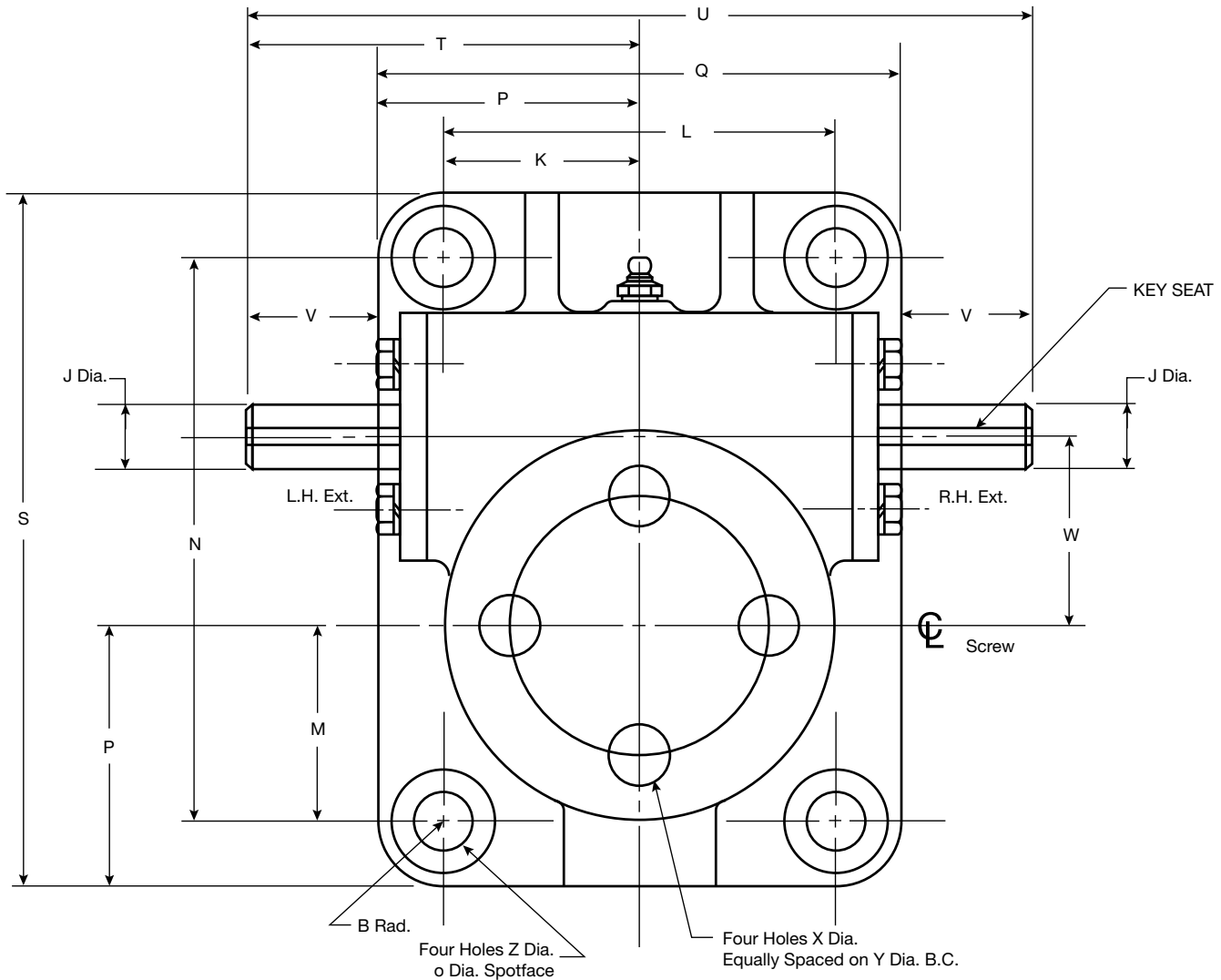
Performance Specifications - Machine Screw Actuator Stainless Steel											
Capacity (Tons) - 17-4PH Worm		2	5	10	15	20	25	30	35	50	100
Capacity (Tons) - 316 SS Worm		0.67	1.66	3.33	5.00	6.66	8.33	9.9	11.66	16.66	33.33
Lifting Screw	Diameter (in)	1	1-1/2	2	1-1/4	2-1/2	3	3	3-3/4	4-1/2	6
	Pitch (Std. & Opt.)	0.250	0.375	0.500	0.500	0.500	0.666	0.666	0.666	0.666	0.750
	Pitch (Numerical)	—	0.250	0.250	0.250	0.250	0.320	0.32	0.320	0.320	—
Worm Gear Ratios	Type	ACME	ACME	ACME	ACME	ACME	ACME	ACME	ACME	Mod, Sq.	Mod, Sq.
	Standard	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
	Optional No. 1	24:1	24:1	24:1	24:1	24:1	32:1	32:1	32:1	32:1	36:1
	Optional No. 2	12:1	12:1	—	—	—	—	—	—	—	—
Turns of Worm for 1 inch Stroke	Numeric Ratio	25:1	25:1	25:1	25:1	25:1	32:1	32:1	32:1	32:1	—
	Standard	24	16	16	16	16	16	16	16	16	16
	Optional No. 1	100	67	50	50	50	48	48	48	48	48
	Optional No. 2	50	33	—	—	—	—	—	—	—	—
Worm Torque at No Load (in-lb)	Numeric Ratio	100	100	100	100	100	100	100	100	100	100
	Standard	5	10	20	20	30	40	40	50	100	200
	Optional No. 1	5	10	20	20	30	40	40	50	100	200
	Optional No. 2	5	10	—	—	—	—	—	—	—	—
Maximum Horsepower per Actuator	Numeric Ratio	5	10	20	20	30	40	40	50	100	200
	Standard	2	4	5	5	5	8	8	8	15	25
	Optional No. 1	1/2	3/4	1-1/2	1-1/2	1-1/2	1-1/2	2-1/2	1-1/2	6	11
	Optional No. 2	3/4	2	—	—	—	—	—	—	—	—
Worm Torque at Full Load* (in-lb) 17-4PH Worm	Numeric Ratio	1/2	3/4	1-1/2	1-1/2	1-1/2	1-1/2	2-1/2	1-1/2	6	11
	Standard	120	450	750	1430	2050	2700	2640	4000	7500	16000
	Optional No. 1	50	185	400	820	1170	1700	1685	2400	4200	8600
	Optional No. 2	75	275	—	—	—	—	—	—	—	—
Worm Torque at Full Load* (in-lb) 316SS Worm	Numeric Ratio	48	175	370	640	925	1500	1800	2411	4040	—
	Standard	42	150	253	471	675	926	940	1366	2566	5466
	Optional No. 1	19	66	141	276	394	593	600	833	1466	3000
	Optional No. 2	27	95	—	—	—	—	—	—	—	—
Efficiency Rating (%) - 17-4PH Worm	Numeric Ratio	25	57	67	109	144	336	635	350	619	—
	Standard	22.1	22.1	26.5	20.9	22.0	22.4	22.4	17.4	13.3	12.4
	Optional No. 1	13.3	9.1	16.6	12.1	12.8	11.8	11.8	9.7	7.9	7.7
	Optional No. 2	17.7	18.1	—	—	—	—	—	—	—	—
Efficiency Rating (%) - 316SS Worm	Numeric Ratio	13.3	9.1	8.6	7.5	6.9	5.3	5.3	4.6	3.9	—
	Standard	20.3	21.1	25.1	20.3	18.8	17.9	17.9	17.0	12.9	12.1
	Optional No. 1	10.9	12.0	15.0	11.5	10.7	9.3	9.3	9.3	7.5	7.4
	Optional No. 2	15.5	16.8	—	—	—	—	—	—	—	—
Key Torque (in-lb) - 17-4PH Worm	Numeric	10.9	8.0	7.5	5.8	5.4	4.5	5.0	4.5	3.6	—
	Standard & Opt.	460	1750	4700	7580	10625	14000	16800	26500	47110	118200
Key Torque (in-lb) - 316SS Worm	Numeric	460	1599	4077	6645	9369	11474	13770	18561	30970	—
	Standard & Opt.	153	581	1565	2527	3538	4665	5600	8828	15697	39396
Weight with 6 inch Stroke (Raise) (lb)	Numeric	211	460	551	959	1199	2328	2800	2358	4087	—
	Standard & Opt.	17	35	52	66	93	160	160	240	410	1200
Weight per additional 1 inch Stroke (Raise) (lb)		0.3	0.9	1.4	1.5	2.6	2.5	2.5	3.7	5.5	9.0

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

Note: Contact Duff-Norton Customer Service for motorized performance.

MACHINE SCREW ACTUATORS – STAINLESS STEEL

2 TO 100 TON CAPACITY



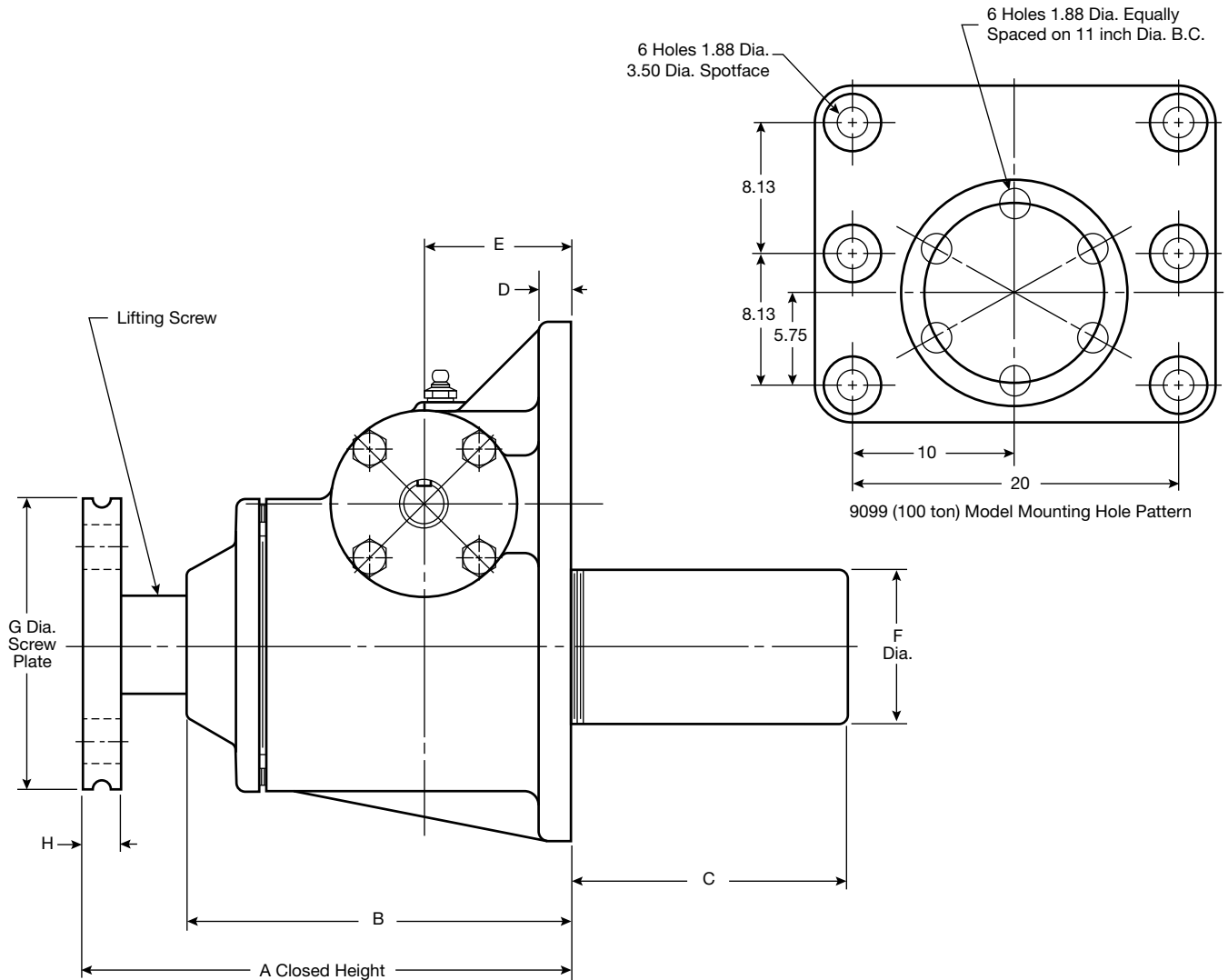
Product Specifications - Machine Screw Actuator Stainless Steel

17-4 PH Worm Capacity (Tons)	316SS Worm Capacity (Tons)		A	B	C	D	E (±.005)	F	G	H	J (+.000/ -.002)	K	L	M
	Sustaining	Operating												
2 (1800 Series)	2	.67	5.50	4.56	Travel	.50	1.750	1.66	4.25	.50	.500	3.00	6.00	1.00
2 (9000 Series)	2	.67	5.50	4.56	Travel	.50	1.750	1.66	4.25	.50	.500	1.56	3.13	1.93
5	5	1.66	7.50	5.88	Travel	.50	2.250	2.38	4.50	.60	.749	2.25	4.50	2.25
10	10	3.33	7.75	5.62	Travel + 3/8	.50	2.250	2.88	5.75	.94	1.000	2.88	5.75	2.00
15	15	5.00	8.00	6.31	Travel + 9/16	.63	2.750	2.88	5.75	.94	1.000	3.00	6.00	2.50
20	20	6.66	10.25	7.13	Travel + 1/2	.75	3.250	3.50	5.75	.94	1.000	3.00	6.00	3.00
25 & 30	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
35	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
50 (1800 Series)	50	16.66	13.50	11.38	Travel + 5/8	1.25	4.750	5.63	11.25	1.25	1.500	8.00	16.00	3.00
100	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

Dimensions are subject to change without notice.

MACHINE SCREW ACTUATORS – STAINLESS STEEL

2 TO 100 TON CAPACITY



Product Specifications - Machine Screw Actuator Stainless Steel

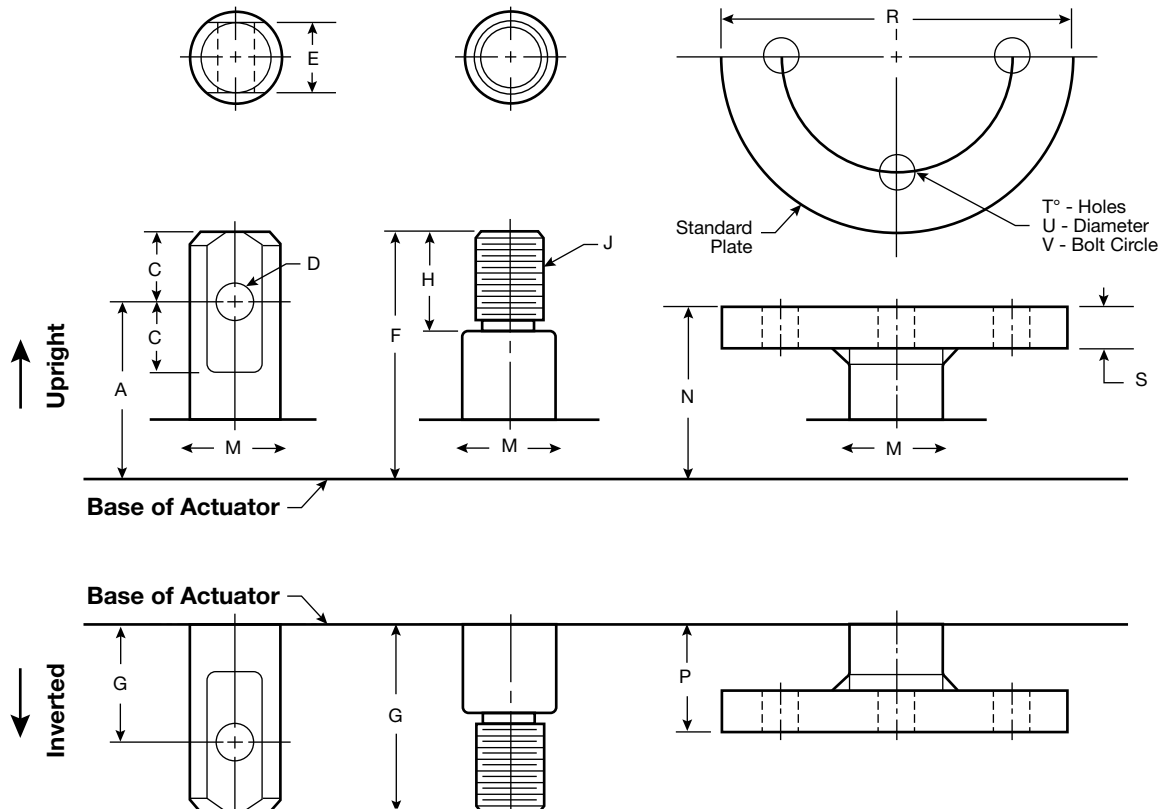
N	P	Q	R	S	T	U	V	W	X	Y	Z	a	b	Keyseat	Lifting Screw
															(Dia./Pitch)
2.00	3.50	7.00	1.75	3.50	3.50	7.00	1.12	1.702 +.003/-0.000	.41	3.00	.41	.75	.5	.125 x .060 x 1.00 LG.	1.00 x .250
5.25	2.06	4.13	2.42	6.25	3.50	7.00	1.12	1.702 +.003/-0.000	.41	3.00	.41	.88	.38	.125 x .060 x 1.00 LG.	1.00 x .250
6.50	3.00	6.00	3.00	8.00	4.50	9.00	1.50	2.188 +.002/-0.000	.69	3.00	.69	1.19	.75	.188 x .094 x 1.25 LG.	1.50 x .375
7.00	3.75	7.50	2.88	8.75	5.50	11.00	1.80	2.598 +.003/-0.000	.81	4.13	.81	1.31	.88	.250 x .125 x 1.50 LG.	2.00 x .500
7.50	3.88	7.75	3.38	9.25	5.50	11.00	1.80	2.598 +.003/-0.000	.81	4.13	.81	1.38	.88	.250 x .125 x 1.50 LG.	2.25 x .500
8.75	4.13	8.25	4.13	11.00	5.50	11.00	1.50	2.598 +.003/-0.000	.81	4.13	1.12	1.75	1.13	.250 x .125 x 1.50 LG.	2.50 x .500
11.00	5.13	10.25	5.13	13.75	7.00	14.00	2.30	3.750 +.006/-0.000	1.06	6.00	1.38	2.13	1.38	.313 x .156 x 2.00 LG.	3.00 x .666
12.50	5.13	10.25	6.00	15.50	7.00	14.00	2.10	3.750 +.006/-0.000	1.62	7.75	1.62	2.63	1.38	.313 x .156 x 2.00 LG.	3.75 x .666
6.00	9.88	19.75	4.88	9.75	11.00	22.00	4.40	5.313 +.003/-0.000	1.38	8.75	1.88	3.25	1.88	.375 x .188 x 2.25 LG.	4.50 x .666
16.26	12.25	24.50	8.00	20.75	11.50	23.00	3.40	7.500 +.003/-0.000	1.88	11.00	1.88	3.50	2.25	.500 x .250 x 3.00 LG.	6.00 x .750

Dimensions are subject to change without notice.

MACHINE SCREW

ACTUATORS – STAINLESS STEEL

STANDARD SCREW END DIMENSIONS



Dimensions - Machine Screw Actuator Stainless Steel Screw End																	
Capacity	A**	B**	C	D	E	F**	G**	H	J	M	N**	P**	R	S	T	U	V
2 Ton SMS	5-1/4	1-3/4	3/4	23/32	3/4	6	2-1/2	1-1/8	3/4"-10UNC-2A	1	5-1/4	1-3/4	4-1/4	7/16	4	13/32	3
5 Ton SMS	7	2-1/2	1	21/32	1	8	2-1/2	1-1/8	1"-8UNC-2A	1-1/2	7-1/2	2-1/2	4-1/2	5/8	4	11/16	3
10 Ton SMS	7-1/2	3	1-1/4	25/32	1-1/4	9-1/4	4-1/4	1-5/8	1-1/2"-6UNC-2A	2	7-3/4	2-3/4	5-3/4	15/16	4	13/16	4-1/8
15 Ton SMS	8-1/2	3	1-1/4	29/32	1-1/2	10-1/4	4-1/4	2	1-3/4"-5UNC-2A	2-1/4	8-1/2	2-3/4	5-3/4	15/16	4	13/16	4-1/8
20 Ton SMS	10	3-1/2	1-1/2	1-1/32	1-3/4	12-1/2	5	2-1/4	2"-4 1/2UNC-2A	2-1/2	10-1/4	3	5-3/4	15/16	4	13/16	4-1/8
25 & 30 Ton SMS	12	4	1-3/4	1-9/32	2-1/4	14-1/2	5-3/4	3-1/4	2-1/2"4-UNC-2A	3	11-3/4	3	8-1/2	15/16	4	1-1/16	6
35 Ton SMS	13	5	2	1-17/32	2-1/2	15-1/2	7	3-3/4	3-1/4"-4UNC-2A	3-3/4	12-1/2	4	10-1/2	1-5/16	4	1-5/8	7-3/4
50 Ton SMS	15	5-1/2	2-1/2	1-21/32	3-1/4	18	8	4-1/4	4" 4UNC-2A	4-1/2	13-1/2	3-1/2	11-1/4	1-1/4	4	1-3/8	8-3/4
100 Ton SMS	24	9	3	2-17/32	4-1/4	25	12	5	2-1/2"-12UNC-2A	6	24	12	14	2-15/16	6	1-7/8	11

**Closed dimensions may increase for actuator units supplied with bellows boots. Consult Customer Service.

Note: Lifting screws listed above are not keyed, and i.c. must be held to prevent rotation.

Keyed lifting screws and keyed anti-backlash models also available. Consult Customer Service.

ANTI-BACKLASH ACTUATORS

1/4 to 250 TONS



Why Anti-Backlash Control is Important

Even the best manufacturing processes produce clearances between a screw and a mating nut. In applications where loads may be in either direction, backlash can result from these clearances creating unacceptable movement in the controlled mechanism as loads change. These applications are common in the paper, plastic, film, sheet metal forming processes, satellite, or other load-reversing applications.

Such applications may be subjected to extreme vibrations. These vibrations can produce constant movement between the screw and lifting nut which can hammer the threads and cause premature wear.

To reduce this screw-to-nut backlash to an absolute minimum, Duff-Norton developed Anti-Backlash actuators. The design allows the backlash to be adjusted to a minimum value practical. As wear occurs, the actuator can be easily adjusted, without any disassembly, to return the backlash to its' original minimum value.

FEATURES

- The industry's best backlash control.
- A dual role as an internal safety nut.
- Available with standard, optional, & numeric ratios.
- Available in stainless steel for most capacities.
- Precise motion control.
- The ability to lock and hold a load, thereby eliminating the need for brake motors required for some applications.
- Available on 1/4 to 250 Ton models.

ANTI-BACKLASH ACTUATORS

MODEL NUMBERING SYSTEM

FL - TKM - 9402 - 6 - 1R

Model Prefix

R - Reducer
F - C-face Adapter
H - Hand Wheel
L - Limit Switch
E - Encoder
J - Rotary Counter

Screw End & Configuration

T - Threaded End
C - Clevis End
M - Top Plate
P - Plain End
K - Keyed Screw
CC - Double Clevis
D - Inverted Rotating
U - Upright Rotating
N - Numeric Ratio

Series & Capacity No.

Series:
 Anti-Backlash
 (94xx, 48xx, 74xx, 4501)
 Special AB
 (104xx, 58xx, 84xx, 5501)

 (1800 series base configurations are available only on 2 and 50 Ton models)

 Small Capacity AB (45xx, 4555, 4625)
 Special Small AB (55xx, 5555, 5625)

Capacities:
 Upright model suffixes end with the capacity number.
 Inverted model suffixes lower the capacity number by one digit. Rotating model suffixes raise the capacity number by one digit.

M - Base Model - Standard Material
SM - Base Model - Stainless Steel

Travel

1" increment travels are always represented using the exact travel amount.

Travels with fractional lengths are quoted using that length, but are serialized when the order is processed.

Serialized digits in this position may also be used for other models containing special features.

Model Suffix

B - Boot
L - Single End Worm Ext. Left
R - Single End Worm Ext. Right
1 - Optional Ratio #1
2 - Optional Ratio #2
X - Supplied without cover pipe

ANTI-BACKLASH ACTUATORS

MODEL NUMBERING SYSTEM

B9003A TV - 10.50 - LX2 - BFL

Capacity

B9225A - 500 Lbs
B9250A - 1000 Lbs
B9003A - 3 Ton

Screw End

C - Clevis End Screw
CC - Double Clevis Ends
M - Top Plate Screw
P - Plain End Screw
T - Threaded End Screw

Travel

1" Incremental travels are always represented using the exact travel amount. Fractional lengths are represented and processed to the nearest 100ths.

Base Model

None - Upright Translating
D - Inverted Rotating
K - Keyed, anti-rotation
U - Upright Rotating
V - Inverted Translating

Key Accessories

B - Boot
E - Encoder
F - C-face Adapter
H - Hand Wheel
J - Rotary Counter
L - Limit Switch
R - Reducer

Model Suffix

L - Single End Worm Extension Left
N - Numeric Gear Ratio – 100 turns/inch
R - Single End Worm Extension Right
X - Supplied without Cover Pipe
1 - Alternate Gear Ratio #1
2 - Alternate Gear Ratio #2

NOTE

Alphabet characters representing features and suffixes should always be used in alphabetic order to avoid questions of hierarchy.

Models for actuators with specialized features will have a serialized suffix such as B9225T-0001.

ANTI-BACKLASH ACTUATORS

PERFORMANCE TABLE - STANDARD MATERIALS

Specifications - Standard, Optional, and Numeric Ratios																		
Capacity (Tons)	1/4	1/2	1	2	3	5	10	15	20	25	30	35	50	75	100	150	250	
Max. Speed C-face Driven (in/min)** Pg. 118	—	—	—	72.0	72.0	108.0	108.0	108.0	108.0	107.0	107.5	107.0	—	—	—	—	—	
Max. Speed Reducer Driven (in/min)** Pg. 110	—	—	—	14.4	21.9	21.9	21.9	21.9	21.9	22.2	22.2	22.4	12.2	—	—	—	—	
Lifting Screw	Diameter (in)	1/2	5/8	3/4	1	1	1-1/2	2	2-1/4	2-1/2	3	3	3-3/4	4-1/2	5	6	7	9
	Pitch (Std. & Opt.)	0.250	0.125	0.200	0.250	0.250	0.375	0.500	0.500	0.500	0.666	0.666	0.666	0.666	0.666	0.750	1.000	1.000
	Pitch (Numerical)	—	—	—	—	—	0.250	0.250	0.250	0.250	0.320	0.32	0.320	0.320	—	—	—	—
	Type	ACME	ACME	ACME	ACME	ACME	ACME	ACME	ACME	ACME	ACME	ACME	ACME	ACME	Mod. Sq.	Mod. Sq.	Mod. Sq.	Mod. Sq.
Worm Gear Ratios	Standard	5:1	5:1	5:1	6:1	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	10-2/3:1	12:1	12:1	50:1
	Optional No. 1	—	—	20:1	24:1	24:1	24:1	24:1	24:1	24:1	32:1	32:1	32:1	32:1	32:1	36:1	36:1	—
	Optional No. 2	—	—	—	12:1	12:1	12:1	—	—	—	—	—	—	—	—	—	—	—
	Numeric Ratio	—	—	20:1	25:1	25:1	25:1	25:1	25:1	25:1	32:1	32:1	32:1	32:1	—	—	—	—
Turns of Worm for 1 inch Stroke	Standard	20	40	25	24	24	16	16	16	16	16	16	16	16	16	16	12	50
	Optional No. 1	—	—	100	96	96	64	48	48	48	48	48	48	48	48	48	36	—
	Optional No. 2	—	—	—	48	48	32	—	—	—	—	—	—	—	—	—	—	—
	Numeric Ratio	—	—	100	100	100	100	100	100	100	100	100	100	100	—	—	—	—
Worm Torque at No Load (in-lb)	Standard	2	2	5	5	5	10	20	20	30	40	40	50	100	150	200	250	200
	Optional No. 1	—	—	5	5	5	10	20	20	30	40	40	50	100	150	200	250	—
	Optional No. 2	—	—	—	5	5	10	—	—	—	—	—	—	—	—	—	—	—
	Numeric Ratio	—	—	5	5	5	10	20	20	30	40	40	50	100	—	—	—	—
Maximum Horsepower per Actuator	Standard	1/3	1/3	1/2	2	2	4	5	5	5	8	8	8	15	15	25	25	35
	Optional No. 1	—	—	1/4	1/2	3/4	3/4	1-1/2	1-1/2	1-1/2	2-1/2	2-1/2	2-1/2	6	6	11	11	—
	Optional No. 2	—	—	—	3/4	1-1/4	2	—	—	—	—	—	—	—	—	—	—	—
	Numeric Ratio	—	—	1/4	1/2	1/2	3/4	1-1/2	1-1/2	1-1/2	2-1/2	2-1/2	2-1/2	6	—	—	—	—
Worm Torque at Full Load* (in-lb)	Standard	13	21	55	120	165	450	750	1430	1811	2220	2640	4000	7500	12000	16000	28110	20000
	Optional No. 1	—	—	25	50	75	185	400	820	1035	1401	1685	2400	4200	6601	8600	15500	—
	Optional No. 2	—	—	—	75	105	275	—	—	—	—	—	—	—	—	—	—	—
	Numeric Ratio	—	—	25	48	72	175	370	640	925	1500	1800	2411	4040	—	—	—	—
Efficiency Rating (%)	Standard	30.6	18.9	23.1	22.1	24.2	22.1	26.5	20.9	22.0	22.4	22.4	17.4	13.3	12.4	12.4	14.2	8.0
	Optional No. 1	—	—	12.7	13.3	13.3	13.4	16.6	12.1	12.8	11.8	11.8	9.7	7.9	7.5	7.7	8.6	—
	Optional No. 2	—	—	—	17.7	19.0	18.1	—	—	—	—	—	—	—	—	—	—	—
	Numeric Ratio	—	—	12.7	13.3	13.2	9.1	8.6	7.5	6.9	5.3	5.3	4.6	3.9	—	—	—	—
Key Torque (in-lb)	Std. & Opt. 1 & 2	40	70	175	460	670	1750	4700	7580	10625	14000	16800	26500	47110	73000	118200	216000	423300
	Numeric Ratio	—	—	175	460	670	1599	4077	6645	9369	11474	13770	18561	30970	—	—	—	—
Maximum Worm Speed at Full Load (RPM)	Standard	1616	1000	573	1051	766	560	420	220	174	227	190	126	126	79	98	56	110
	Optional No. 1	—	—	630	630	631	278	236	115	91	112	94	66	90	57	81	45	—
	Optional No. 2	—	—	—	630	751	458	—	—	—	—	—	—	—	—	—	—	—
	Numeric Ratio	—	—	630	657	437	270	256	148	102	105	87	65	94	—	—	—	—
Maximum Load at Full Horsepower and 1750 RPM (lb)	Standard	455	527	520	2332	2521	3047	4386	3406	3370	5691	5691	4220	5949	4939	8865	7003	26780
	Optional No. 1	—	—	400	1156	1888	1064	1791	1276	956	1839	1839	1193	2831	1537	4670	2875	—
	Optional No. 2	—	—	—	1258	2402	2339	—	—	—	—	—	—	—	—	—	—	—
	Numeric Ratio	—	—	400	1210	1162	1031	1944	1646	1074	1714	1714	1187	2946	—	—	—	—
Weight with 6 inch Stroke (Raise) (lb)	2	2	5	17	17	35	52	66	93	160	160	240	410	650	1200	1350	2700	
Weight per Add.1 inch Stroke (Raise) (lb)	0.1	0.1	0.3	0.3	0.3	0.9	1.4	1.5	2.6	2.5	2.5	3.7	5.5	6.5	9.0	12.6	23.0	

All actuator units can be supplied with standard raises up to 24 inches. Special raises up to 20 feet are available upon request. Closed height dimensions may increase for actuators supplied with bellows boots. See page 148-149.

ANTI-BACKLASH ACTUATORS

PERFORMANCE TABLE - STAINLESS STEEL

Specifications - Standard, Optional, and Numeric Ratios											
Capacity (Tons) - 17-4PH Worm		2	5	10	15	20	25	30	35	50	100
Capacity (Tons) - 316 SS Worm		0.67	1.66	3.33	5.00	6.66	8.33	9.9	11.66	16.66	33.33
Lifting Screw	Diameter (in)	1	1-1/2	2	2-1/4	2-1/2	3	3	3-3/4	4-1/2	6
	Pitch (Std. & Opt.)	0.250	0.375	0.500	0.500	0.500	0.666	0.666	0.666	0.666	0.750
	Pitch (Numerical)	—	0.250	0.250	0.250	0.250	0.320	0.32	0.320	0.320	—
	Type	ACME	ACME	ACME	ACME	ACME	ACME	ACME	ACME	ACME	Mod. Sq.
Worm Gear Ratios	Standard	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
	Optional No. 1	24:1	24:1	24:1	24:1	24:1	32:1	32:1	32:1	32:1	36:1
	Optional No. 2	12:1	12:1	—	—	—	—	—	—	—	—
	Numeric Ratio	25:1	25:1	25:1	25:1	25:1	32:1	32:1	32:1	32:1	—
Turns of Worm for 1 inch Stroke	Standard	25	17	17	17	16	16	16	16	16	16
	Optional No. 1	100	67	50	50	48	48	48	48	48	48
	Optional No. 2	50	33	—	—	—	—	—	—	—	—
	Numeric Ratio	100	100	100	100	100	100	100	100	100	—
Worm Torque at No Load (in-lb)	Standard	5	10	20	20	30	40	40	50	100	200
	Optional No. 1	5	10	20	20	30	40	40	50	100	200
	Optional No. 2	5	10	—	—	—	—	—	—	—	—
	Numeric Ratio	5	10	20	20	30	40	40	50	100	200
Maximum Horsepower per Actuator	Standard	2	4	5	5	5	8	8	8	15	25
	Optional No. 1	1/2	3/4	1-1/2	1-1/2	1-1/2	2-1/2	2-1/2	2-1/2	6	11
	Optional No. 2	3/4	2	—	—	—	—	—	—	—	—
	Numeric Ratio	1/2	3/4	1-1/2	1-1/2	1-1/2	2-1/2	2-1/2	2-1/2	6	11
Worm Torque at Full Load* (in-lb) 17-4PH Worm	Standard	120	450	750	1430	2050	2700	2640	4000	7500	16000
	Optional No. 1	50	185	400	820	1170	1700	1685	2400	4200	8600
	Optional No. 2	75	275	—	—	—	—	—	—	—	—
	Numeric Ratio	48	175	370	640	925	1500	1800	2411	4040	—
Worm Torque at Full Load (in-lb) 316SS Worm	Standard	42	150	253	471	676	926	940	1366	2566	5466
	Optional No. 1	19	66	141	276	394	593	600	1466	1466	3000
	Optional No. 2	27	95	—	—	—	—	—	—	—	—
	Numeric Ratio	25	57	67	109	144	336	635	619	619	—
Efficiency Rating (%) - 17-4PH Worm	Standard	22.1	22.1	26.5	20.9	22.0	22.4	22.4	17.4	13.3	12.4
	Optional No. 1	13.3	13.4	16.6	12.1	12.8	11.8	11.8	9.7	7.9	7.7
	Optional No. 2	17.7	18.1	—	—	—	—	—	—	—	—
	Numeric Ratio	13.3	9.1	8.6	7.5	6.9	5.3	5.3	4.6	3.9	—
Efficiency Rating (%) - 316SS Worm	Standard	20.3	21.1	25.1	20.3	18.8	17.9	17.9	17.0	12.9	12.1
	Optional No. 1	10.9	12.0	15.0	11.5	10.7	9.3	9.3	9.3	7.5	7.4
	Optional No. 2	15.5	16.8	—	—	—	—	—	—	—	—
	Numeric Ratio	10.9	8.0	7.5	5.8	5.4	4.5	5.0	4.5	3.6	—
Key Torque (in-lb) - 17-4PH Worm	Std. & Opt.	460	1750	4700	7580	10625	14000	16800	26500	47110	118200
	Numeric Ratio	460	1599	4077	6645	9369	11474	13770	18561	30970	—
Key Torque (in-lb) - 316SS Worm	Std. & Opt.	153	581	1565	2527	3538	4665	5600	8828	15697	39396
	Numeric Ratio	211	460	551	959	1199	2328	2800	2358	4087	—
Weight with 6 inch Stroke (Raise) (lb)		17	35	52	66	93	160	160	240	410	1200
Weight per Additional 1 inch Stroke (Raise) (lb)		0.3	0.9	1.4	1.5	2.6	2.5	2.5	3.7	5.5	9.0

Note: For loads from 25% to 100% of actuator capacity, torque requirements are approximately proportional to the load.
 Note: Contact Duff-Norton Customer Service for motorized performance.

ANTI-BACKLASH ACTUATORS HOW IT WORKS

How Anti-Backlash 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). 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.

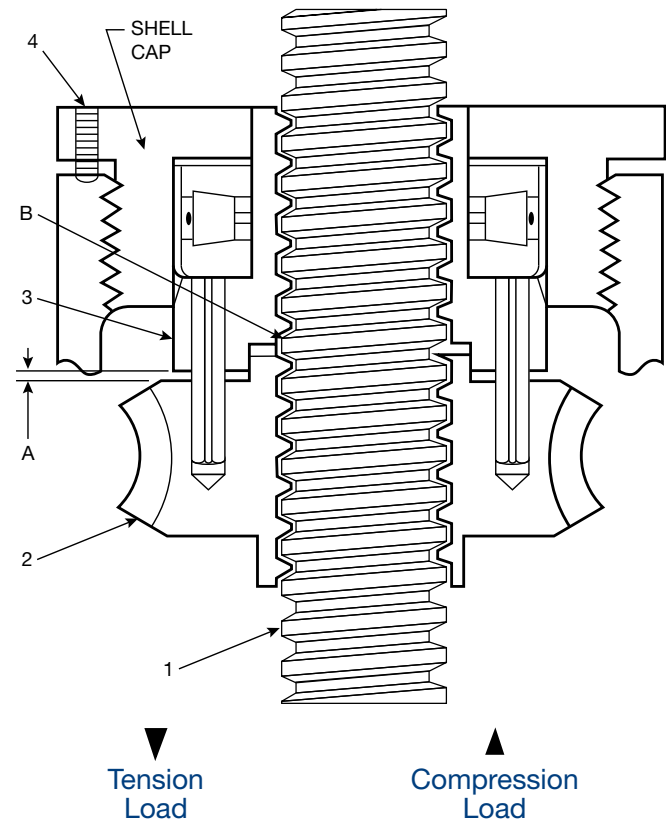
When wear occurs in the worm gear threads and the Anti-backlash nut thread, the load carrying thickness of the worm gear thread will be reduced. This wear will create a gap at point (B) and provide backlash equal to the wear on the threads.

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 reduction is achieved. This will reduce the separation (A) 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.

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

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

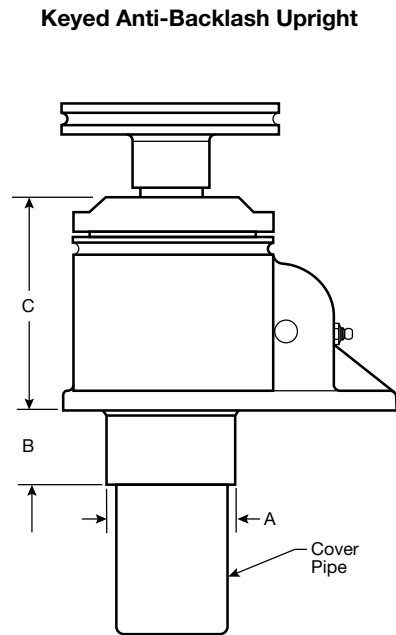
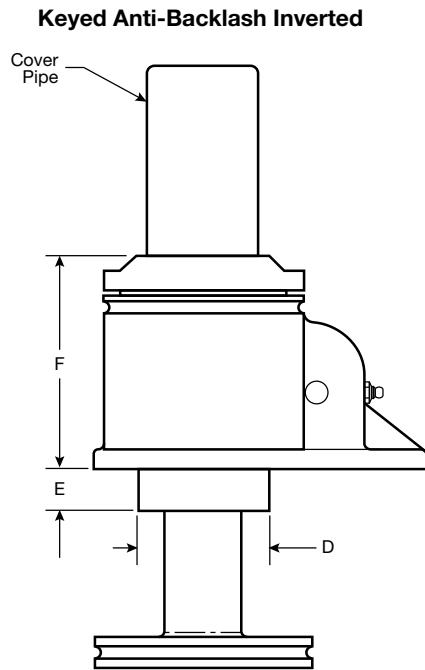


NOTE

Use anti-backlash as a safety device or to provide wear indication for critical applications. Keyed anti-backlash models may require (A) key adaptor, which projects below jack base. See pg. 49 for dimensions.

ANTI-BACKLASH ACTUATORS

KEY ADAPTOR DIMENSIONS



Key Adaptor Dimensions for Anti-Backlash Actuator

Actuator Capacity (Tons)	Upright A Diameter (in)	Upright B (in)	Upright C (in)	Inverted D Diameter (in)	Inverted E (in)	Inverted F (in)
1/4 & 1/2	1.66	Pipe Length	2.38	1.25	.81	2.88
1	1.66	.75	3.84	1.50	.38	3.38
2	2.25	1.25	3.88	2.25	.63	3.88
3	2.25	1.25	4.34	2.25	.63	4.34
5	2.75	1.75	5.44	2.75	.88	5.44
10	3.38	2.00	5.75	3.38	1.13	5.75
15	3.63	2.00	6.13	3.63	1.25	6.13
20	4.00	1.50	7.75	4.00	1.00	7.75
25 & 30	5.50	2.25	9.69	5.50	1.25	9.69
35	6.50	2.38	9.44	6.50	1.25	9.44
50	7.00	3.00	11.75	7.00	3.00	11.75

ANODE JACKS

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 alumina smelting process involves high temperatures and loads. The Duff-Norton anode jack is a heavy-duty version of our standard actuator, and has been modified for each smelting facility's specific application.

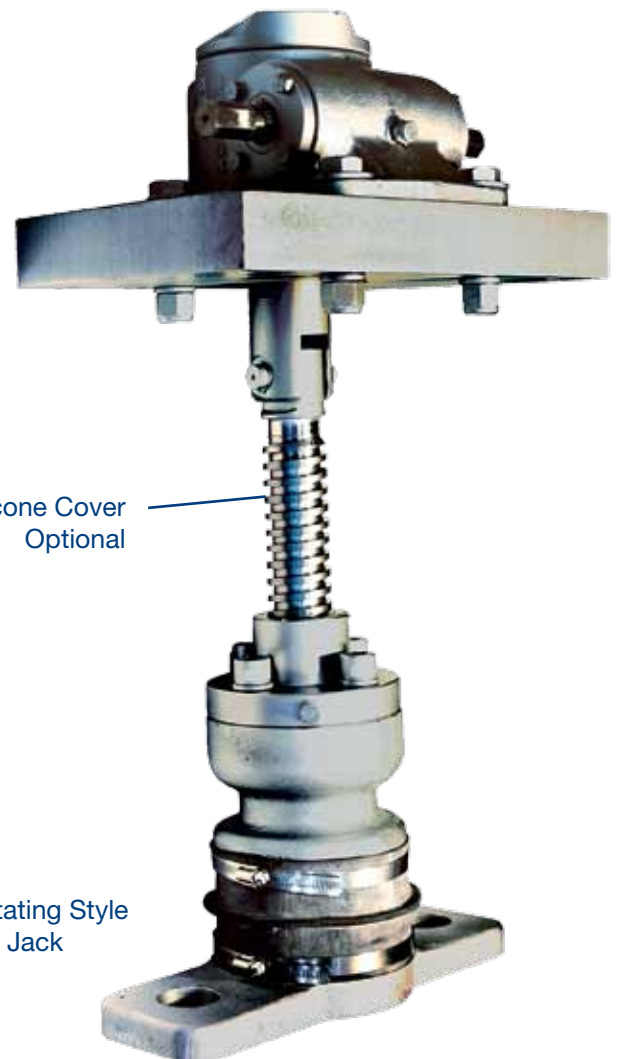
The Anode Jack's worm gears are made of wear resistant bronze and are up to 40% larger than our standard versions. Along with the larger worm gears are larger bearings and heavy-duty seals. Sealing is very important because the alumina dust is very abrasive. Anode jacks use only heat-treated alloy steel 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 highjacking of the frames and frozen pots.

FEATURES

- Oversized worm and gear set
- Heavy duty load bearing
- Heavy duty seals
- High temperature resistant grease
- Translating or rotating models available



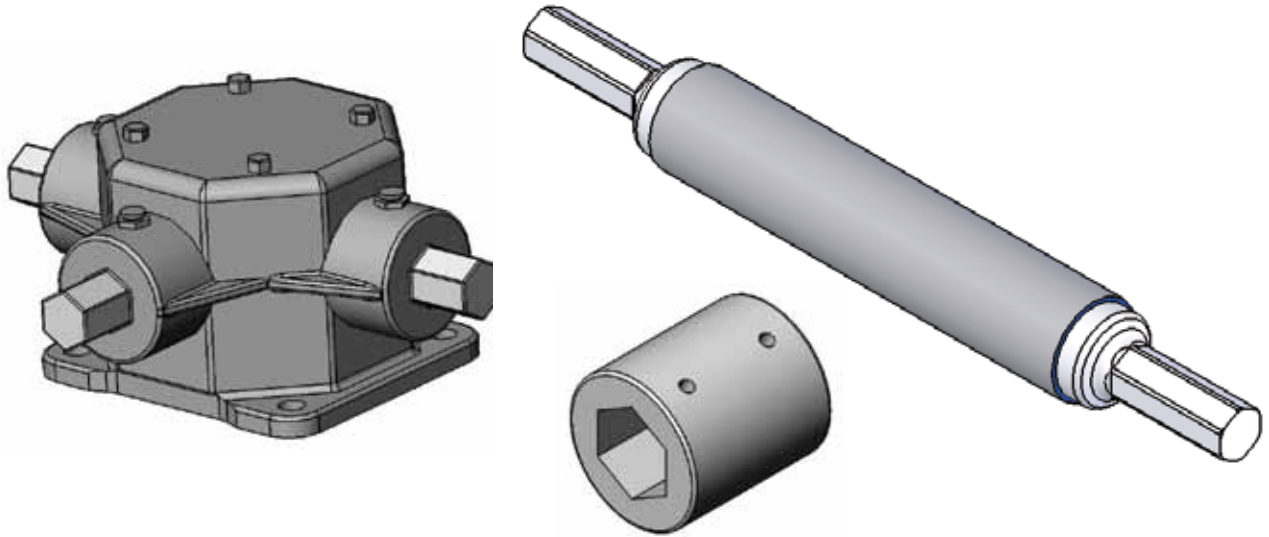
Inverted Translating Style Anode Jack



Elasticone Cover Optional

Inverted Rotating Style Anode Jack

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.



Oversized Clevis, Knurled Ring, & Cover Pipe



Heavy Duty Worm Seals & Grease Fittings



Trunnion Base & Upper Yoke



Cover Pipe with Heavy Duty Cap



Special Corrosion Resistant Paint



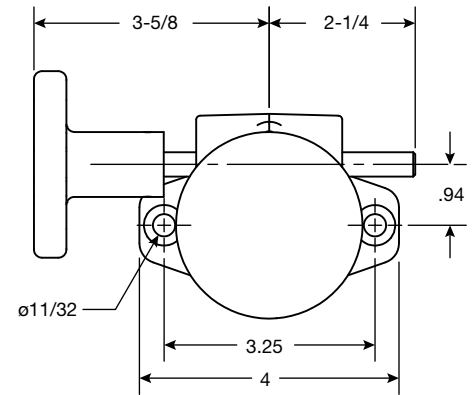
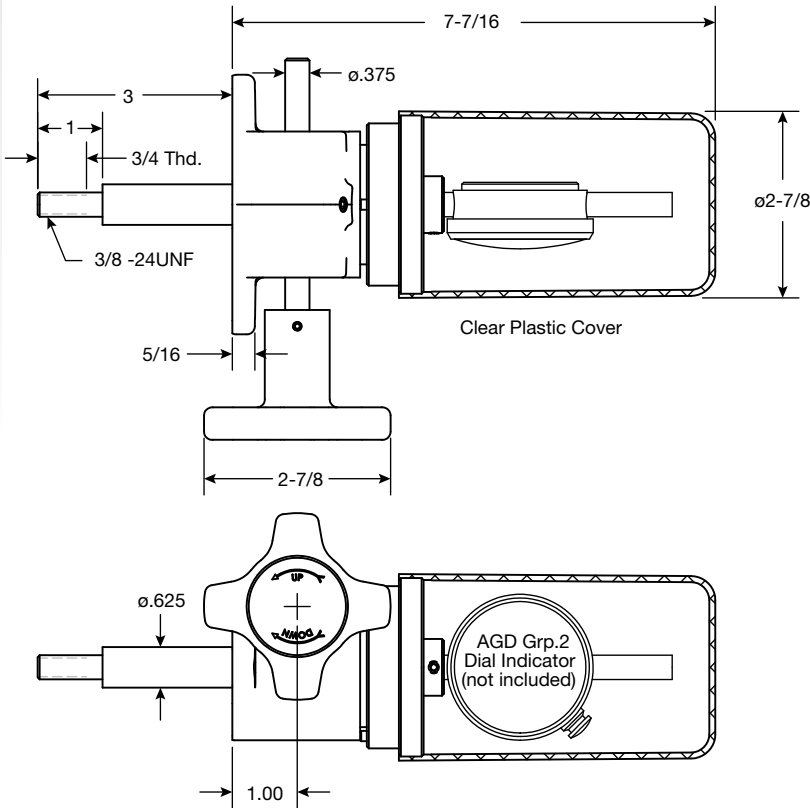
Hex Worm Shafts



Connecting Link, Clevis Pinned Screw, & Lifting Nut

MACHINE SCREW ACTUATORS MICRO-MINIATURE

Specifications



Specifications - Micro-Miniature Actuator

Model Number	Rated Capacity	Screw Diameter	Turns of Worm for 1/2 inch Raise	No Load Torque	Lifting Torque at Full Load	Worm Gear Ratio	Weight	Shell Cap and Housing
B9225MM-xxx	1000 lbs.	.625	500	2 inch - lbs.	18 inch - lbs	20:1	2 lbs	Aluminum
B9225MMS-xxx	1000 lbs.	.625	500	2 inch - lbs.	18 inch - lbs	20:1	3 lbs	Stainless Steel

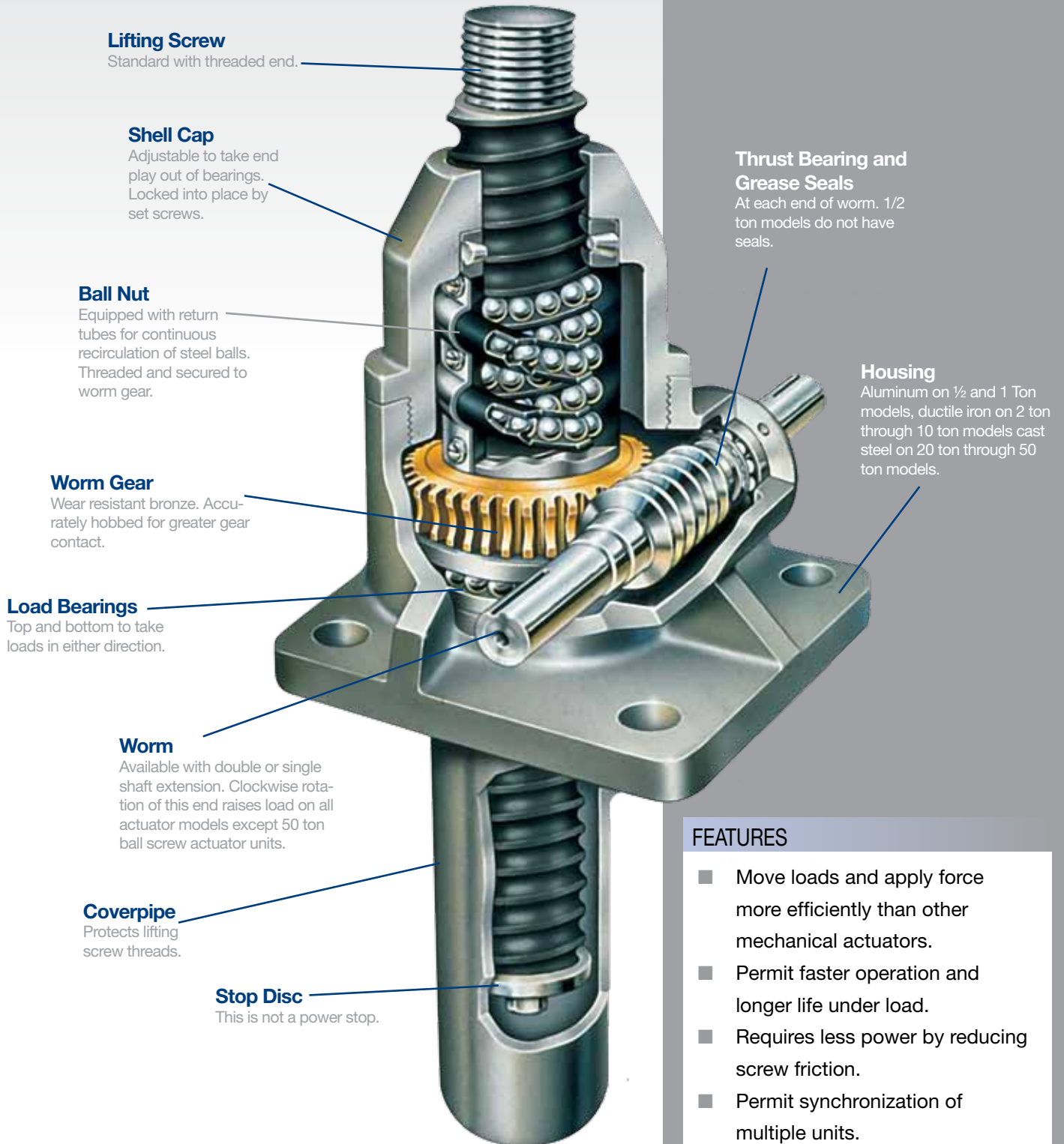
Note: The load bearings inside stainless steel actuators are not stainless steel. Dimensions are subject to change without notice

FEATURES

- Allows for extremely fine adjustment.
- Corrosion-resistant.
- Equipped with anti-backlash nuts to minimize vertical backlash between the screw and worm gear nut.
- Actuators up to 1,000 lbs.
- 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.
- 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-3554-83 - Continuous dial reading 0-100 in .001" graduations with revolution counter.

BALL SCREW ACTUATORS

1/2 to 50 TONS



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.

Worm Gear
Wear resistant bronze. Accurately hobbled 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.

Coverpipe
Protects lifting screw threads.

Stop Disc
This is not a power stop.

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

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

FEATURES

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

BALL SCREW ACTUATORS

MODEL NUMBERING SYSTEM

FL - TKM - 9802 - 6 - 1R

Model Prefix

- R - Reducer
- F - C-face Adapter
- L - Limit Switch
- E - Encoder
- J - Rotary Counter

Screw End & Configuration

- T - Threaded End
- C - Clevis End
- M - Top Plate
- P - Plain End
- K - Anti-rotation Screw
- CC - Double Clevis
- D - Inverted Rotating
- U - Upright Rotating

Series & Capacity No.

Series:

- Ball Screw (98xx, 28xx, 78xx)
- Special BS (108xx, 38xx, 88xx)

(2800 series base configurations are available only on 1/2, 1, 2, 3 and 50 Ton models)

Capacities:

Upright model suffixes end with the capacity number.
Inverted model suffixes lower the capacity number by one digit. Rotating model suffixes raise the capacity number by one digit.

1/2 & 1 Ton models use ball screw lead measurement in place of capacity information. These numbers change as described above based on actuator configuration.

M - Base Model

Travel

1" increment travels are always represented using the exact travel amount.

Travels with fractional lengths are quoted using that length, but are serialized when the order is processed.

Serialized digits in this position may also be used for other models containing special features

Model Suffix

- B - Boot
- L - Single End Worm Ext. Left
- R - Single End Worm Ext. Right
- 1 - Optional Ratio #1
- 2 - Optional Ratio #2
- X - Supplied without cover pipe

B9863A TV - 10.50 - LX2 - BFL

Capacity

B9863 - 1000 Lbs

Screw End

- C - Clevis End Screw
- CC - Double Clevis Ends
- M - Top Plate Screw
- P - Plain End Screw
- T - Threaded End Screw

Travel

1" Incremental travels are always represented using the exact travel amount. Fractional lengths are represented and processed to the nearest 100ths.

Base Model

- None - Upright Translating
- D - Inverted Rotating
- K - Keyed, anti-rotation
- U - Upright Rotating
- V - Inverted Translating

Key Accessories

- B - Boot
- E - Encoder
- F - C-face Adapter
- H - Hand Wheel
- J - Rotary Counter
- L - Limit Switch
- R - Reducer

Model Suffix

- L - Single End Worm Extension Left
- N - Numeric Gear Ratio - 100 turns/inch
- R - Single End Worm Extension Right
- X - Supplied without Cover Pipe
- 1 - Alternate Gear Ratio #1
- 2 - Alternate Gear Ratio #2

Alphabet characters representing features and suffixes should always be used in alphabetic order to avoid questions of hierarchy.

Models for actuators with specialized features will have a serialized suffix such as B9225T-0001.

BALL SCREW ACTUATORS

PERFORMANCE TABLE

Specifications - Ball Screw Actuator														
Capacity (Tons)	1/2	1	2 (HL)	2	3	5 (HL)	5	10 (HL)	10	20 (HL)	20	25	50 [†]	
Max. Speed Cface Driven (in/min)** Pg. 118	—	—	287.5	72.0	118.5	287.5	136.5	215.5	102.0	215.5	108.0	81.0	—	
Max. Speed Red. Driven (in/min)** Pg. 110	—	—	57.51	14.4	23.7	57.4	27.2	43	20.4	43.1	21.6	20.1	33.4	
Dimensional Information Pg. 115	56	57	58-61	62-63	64-65	66	67	68	69	70	70	71	72-73	
Lifting Screw	Diameter (in)	5/8	3/4	1	1	1-11/64	1-1/2	1-1/2	1-1/2	1-1/2	2-1/4	2-1/4	3	4
	Lead (in)	0.200	0.200	1.000	0.250	0.413	1.000	0.474	1.000	0.474	1.000	0.5000	0.660	1.000
Worm Gear Ratios	Standard	5:1	5:1	6:1	6:1	6:1	6:1	6:1	8:1	8:1	8:1	8:1	10-2/3:1	10-2/3:1
	Optional No. 1	20:1	20:1	24:1	24:1	24:1	24:1	24:1	24:1	24:1	24:1	24:1	32:1	32:1
	Optional No. 2	—	—	12:1	12:1	12:1	12:1	12:1	—	—	—	—	—	—
Turns of Worm for 1 inch Stroke	Standard	25	25	6	24	14.526	6	12.667	8	16.889	8	16	16.16	10.67
	Optional No. 1	100	100	24	96	58.106	24	50.667	24	50.667	24	48	48.48	32
	Optional No. 2	—	—	12	48	29.053	12	25.334	—	—	—	—	—	—
Worm Torque at No Load (in-lb)	Standard	0.5	2	10	3	5	20	10	20	15	50	40	40	40
	Optional No. 1	0.5	2	10	3	5	20	10	20	15	50	40	40	40
	Optional No. 2	—	—	10	3	5	20	10	—	—	—	—	—	—
Maximum Horsepower per Actuator	Standard	1/3	1/2	2	2	2	4	4	5	5	5	5	8	15
	Optional No. 1	1/6	1/4	1/2	1/2	1/2	3/4	3/4	1-1/2	1-1/2	1-1/2	1-1/2	2-1/2	6
	Optional No. 2	—	—	3/4	3/4	3/4	2	2	—	—	—	—	—	—
Starting Worm Torque at Full Load (in-lb)	Standard	10.5	22	180	50	110	500	220	800	350	1375	700	925	2700
	Optional No. 1	5.0	11	80	25	50	206	90	400	175	625	325	475	1500
	Optional No. 2	—	—	110	30	68	300	145	—	—	—	—	—	—
Running Worm Torque at Full Load (in-lb)	Standard	9.5	21	160	45	100	410	180	700	300	1270	650	825	2200
	Optional No. 1	4.0	10	70	20	45	183	80	290	150	570	300	425	1200
	Optional No. 2	—	—	100	25	60	270	125	—	—	—	—	—	—
Efficiency Rating (%)	Standard	67.0	60.6	66.3	58.9	65.7	64.7	69.8	56.8	62.8	62.7	61.2	59.7	67.8
	Optional No. 1	39.8	31.8	37.9	33.2	36.5	36.2	39.3	45.7	41.9	46.5	44.2	38.6	41.4
	Optional No. 2	—	—	53.0	53.1	54.8	49.1	50.3	—	—	—	—	—	—
Weight with 6 inch Stroke (Raise) (lb)	2.8	5	20	20	21	40	40	50	50	115	115	235	520	
Weight per Additional 1 inch Stroke (Raise) (lb)	0.1	0.3	0.3	0.3	0.4	0.9	0.9	0.9	0.9	1.5	1.5	2.9	5.0	
Hold Back Torque at Rated Load (ft-lb)	Standard	1	1	2	2	7	8	8	24	11	24	24	24	92
	Optional No. 1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	2	2	33
	Optional No. 2	—	—	1	1	2	2	2	—	—	—	—	—	—
Key Torque (in-lb)	35	70	100	175	440	1800	850	3500	1700	7000	3500	6000	17700	
Max Worm Speed at Full Load (rpm)	Standard	2001	1432	700	2521	1146	504	1146	394	900	229	450	545	350
	Optional No. 1	2101	1432	394	1261	630	229	252	236	540	151	291	332	252
	Optional No. 2	—	—	430	5875	695	420	869	—	—	—	—	—	—
Maximum Load at Full Horsepower and 170 rpm (lb)	Standard	1150	1601	1459	5875	3830	2585	6384	4104	9855	3927	8489	14018	17250
	Optional No. 1	1223	1556	458	2729	1734	377	2126	1791	4878	280	1968	5751	8942
	Optional No. 2	—	—	680	3557	2096	1858	4595	—	—	—	—	—	—

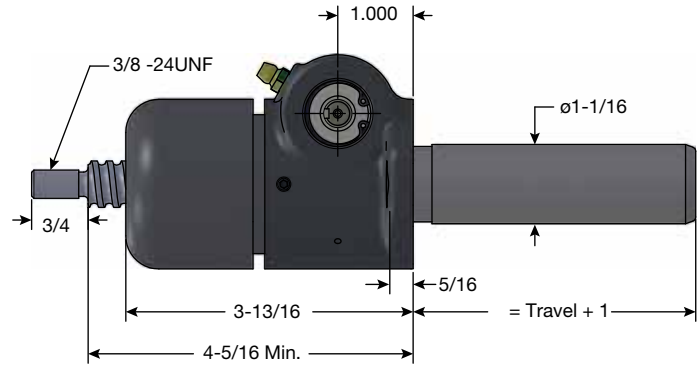
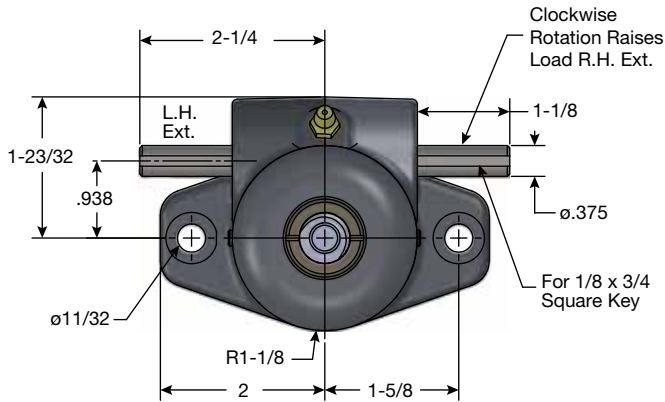
Notes:

- 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.
- See page 107 for Ball Screw and Nut Life Expectancy.
- All actuator units can be supplied with standard raises up to 24 inches. Special raises up to 20 feet are available upon request. Closed height dimensions may increase for actuators supplied with bellows boots. See page 148-149.

[†] Does your ball screw application require more than 50 tons? Please contact our Customer Service group to explore our specialty options for higher load ratings up to 100 tons.

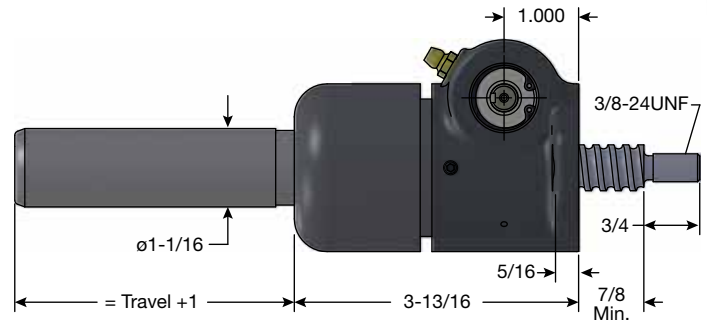
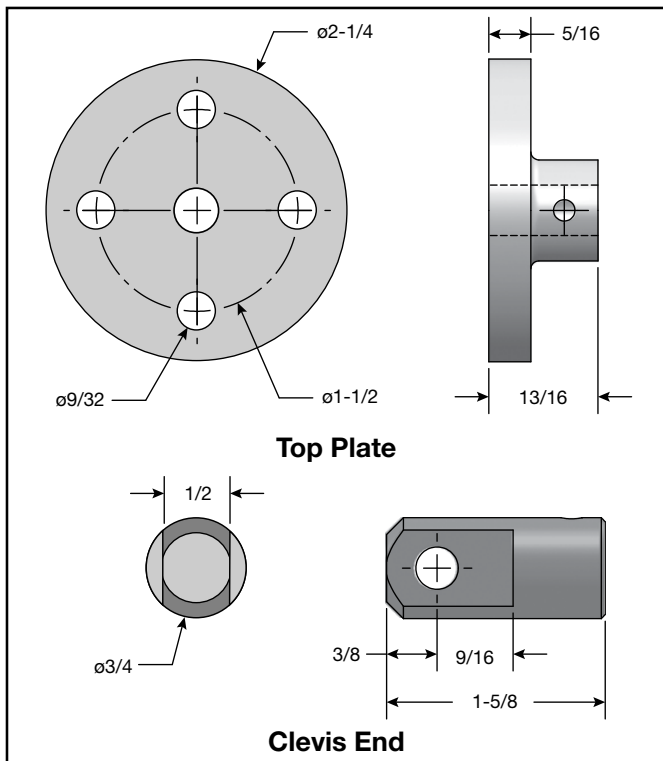
BALL SCREW ACTUATORS

1/2 TON CAPACITY

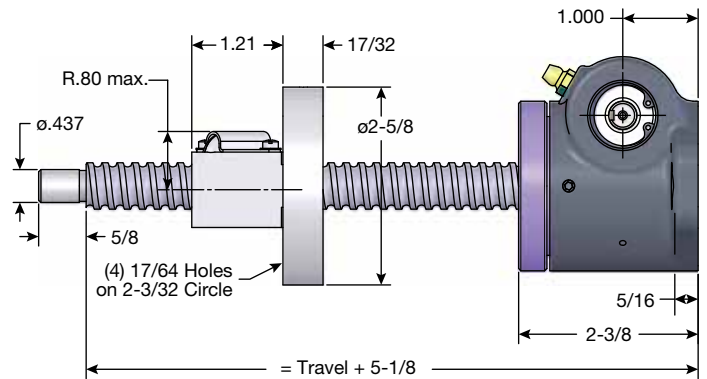


Upright: B9863T

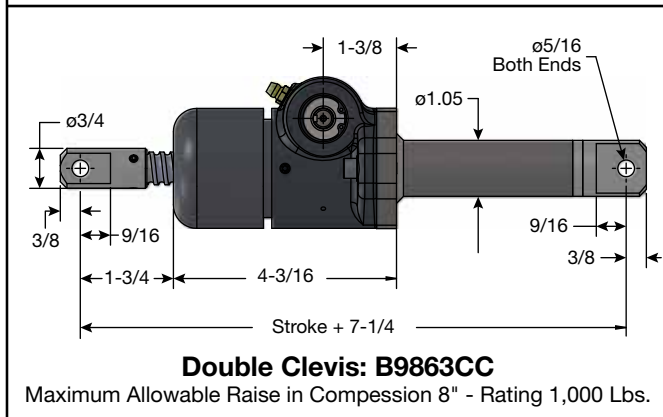
.631 Diameter x .200 Lead Lifting Screws



Inverted: B9863TV

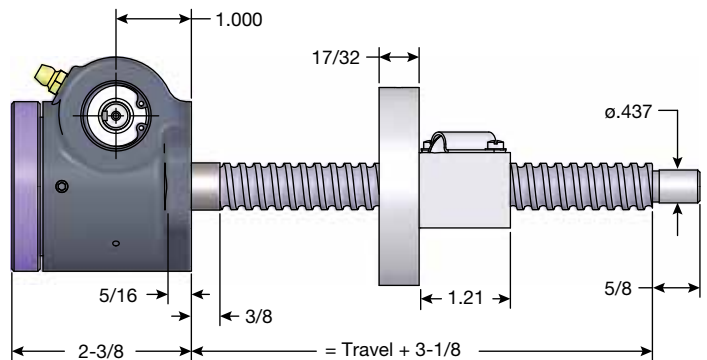


Upright Rotating: B9863U



Double Clevis: B9863CC

Maximum Allowable Raise in Compression 8" - Rating 1,000 Lbs.

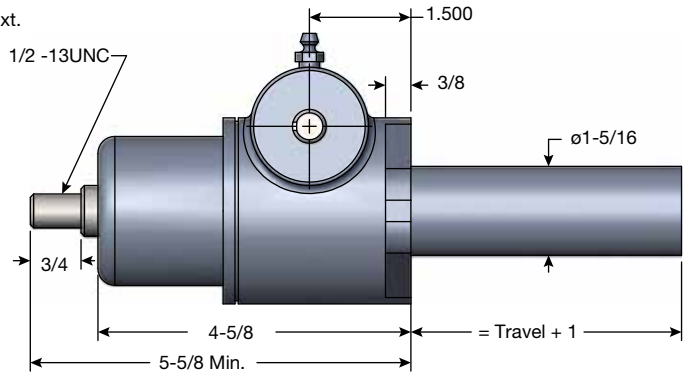
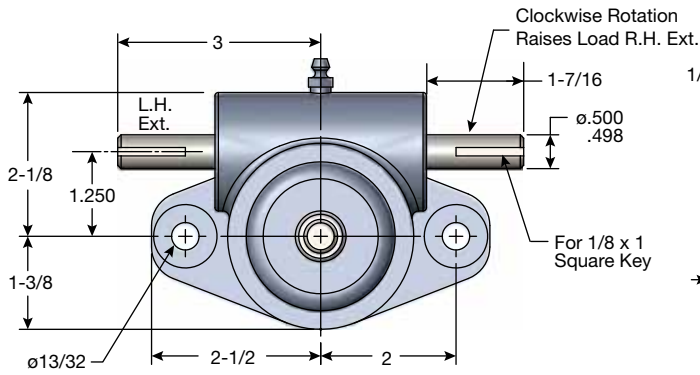


Inverted Rotating: B9863D

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 148-149. Dimensions are subject to change without notice.

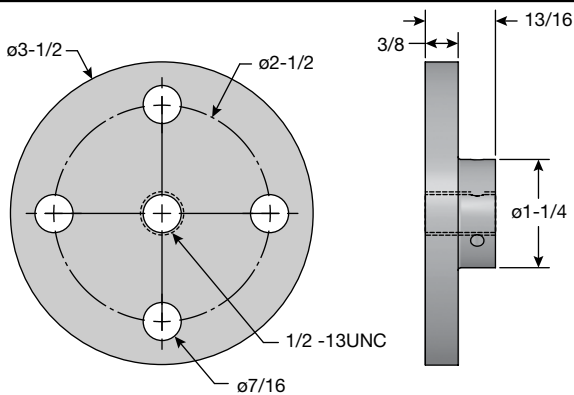
BALL SCREW ACTUATORS

1 TON CAPACITY

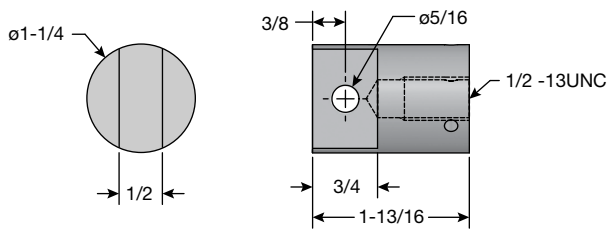


Upright: M-28750

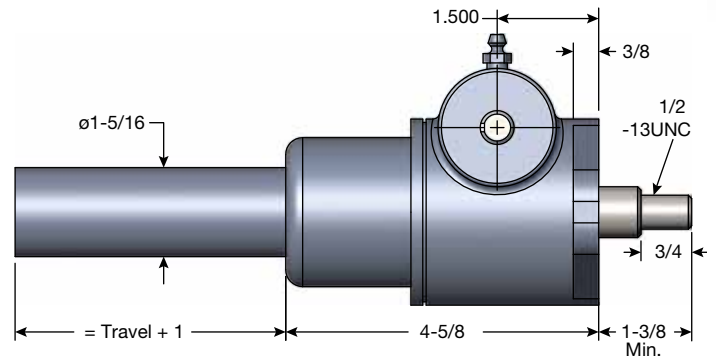
3/4" Diameter x .200 Lead Lifting Screws



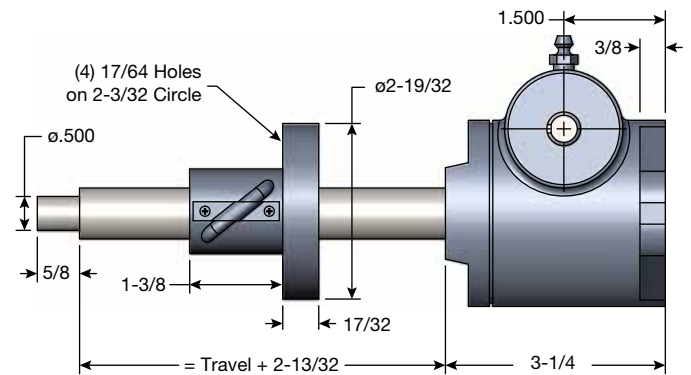
Top Plate



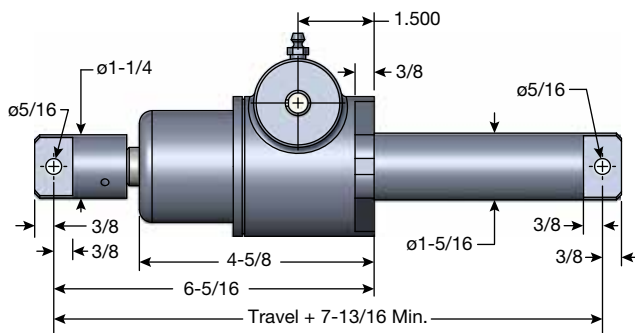
Clevis End



Inverted: M-28749

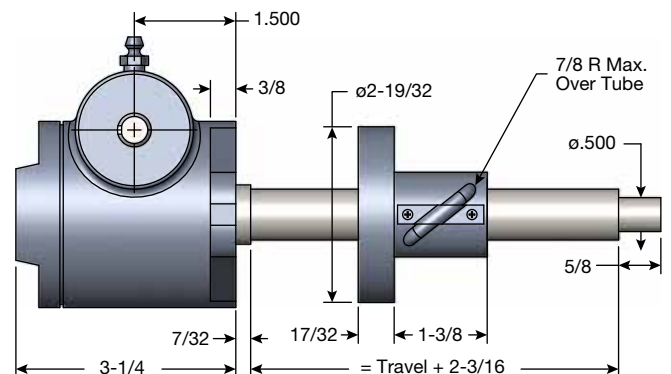


Upright Rotating: UM-28751



Double Clevis: CCM-28750

Maximum Allowable Raise in Compression 12" - Rating 2000 Lbs.

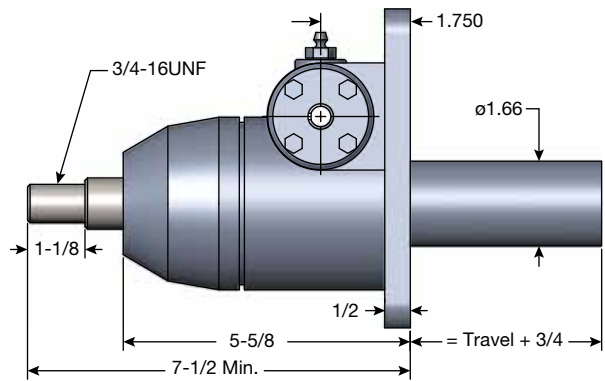
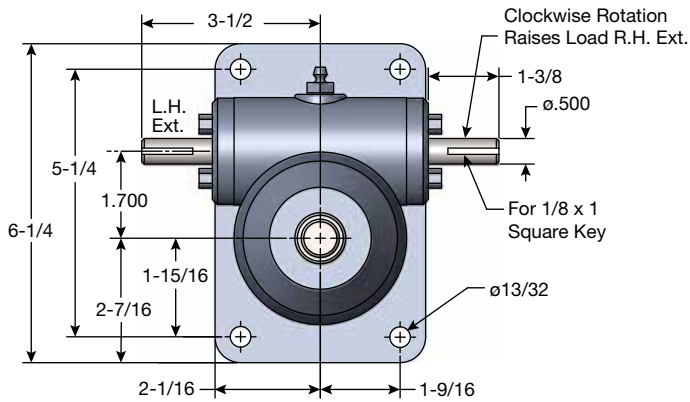


Inverted Rotating: DM-28751

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 148-149. Dimensions are subject to change without notice.

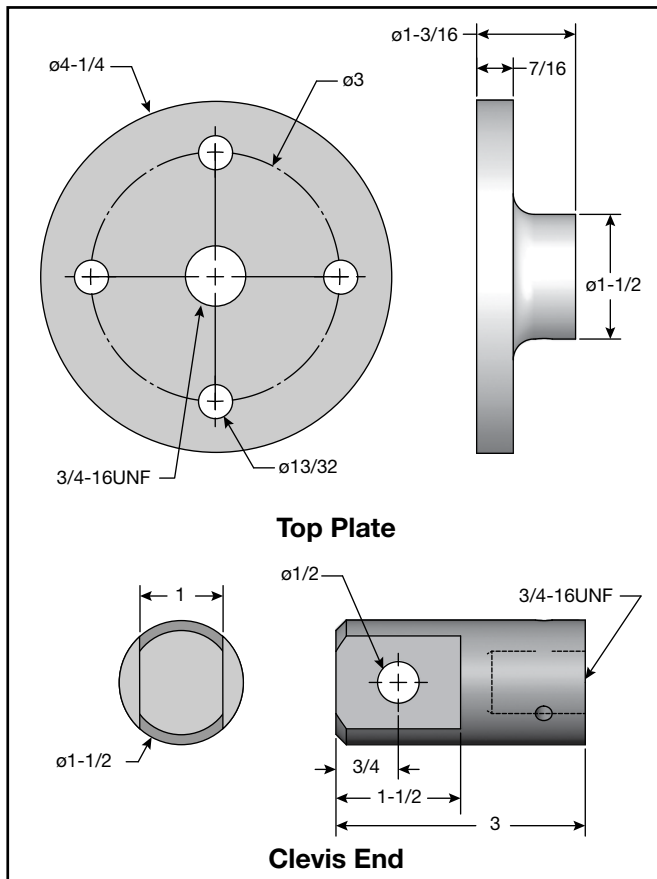
BALL SCREW ACTUATORS

2 TON CAPACITY - 1 INCH LEAD — 9800 SERIES

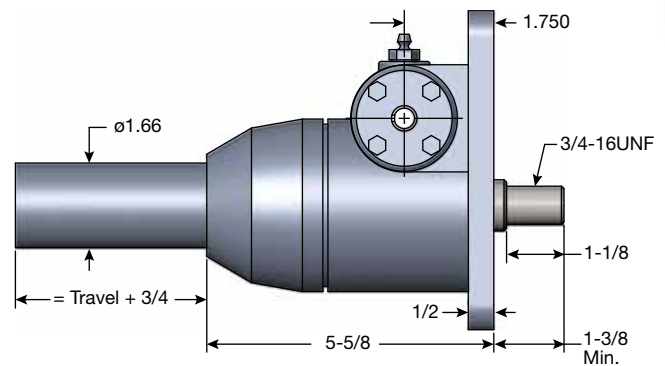


Upright: M-98021

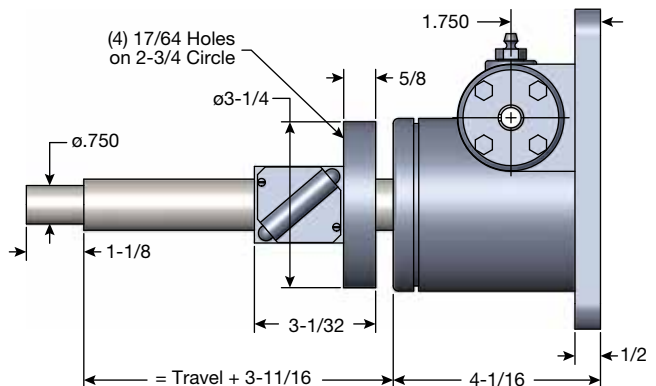
1" Diameter x 1.00 Lead Lifting Screws



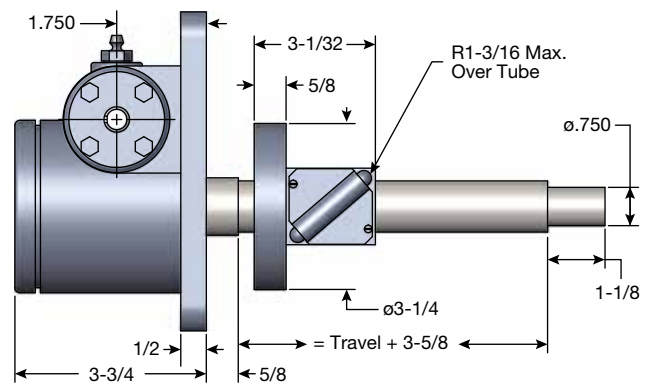
Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 148-149. Dimensions are subject to change without notice.



Inverted: M-98011



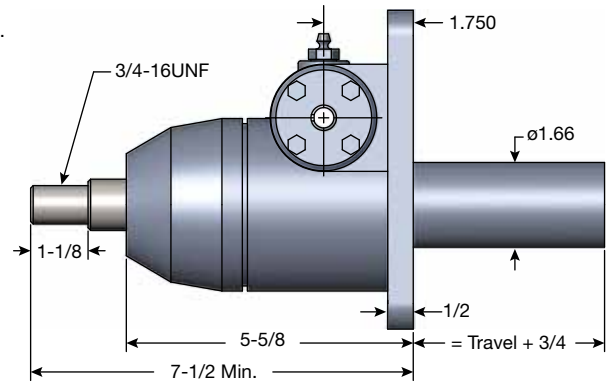
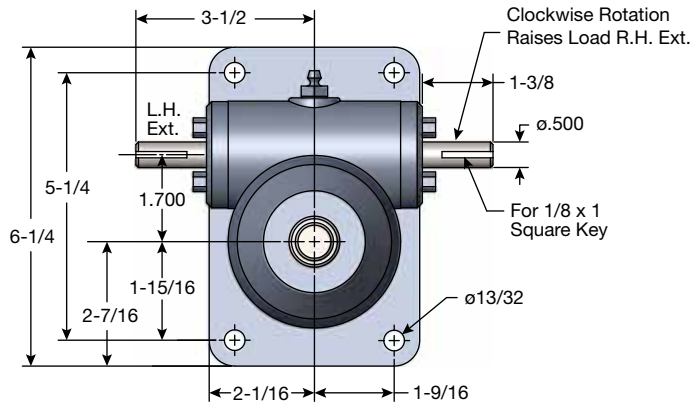
Upright Rotating: UM-98031



Inverted Rotating: DM-98031

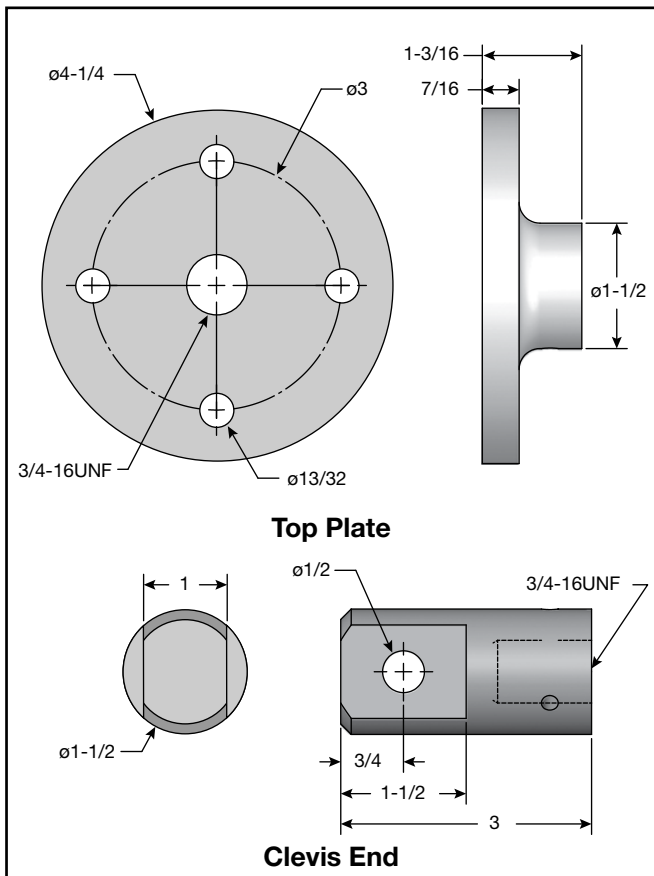
BALL SCREW ACTUATORS

2 TON CAPACITY — 9800 SERIES

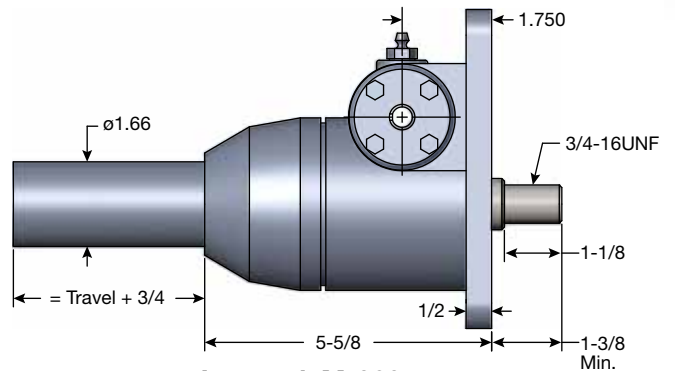


Upright: M-9802

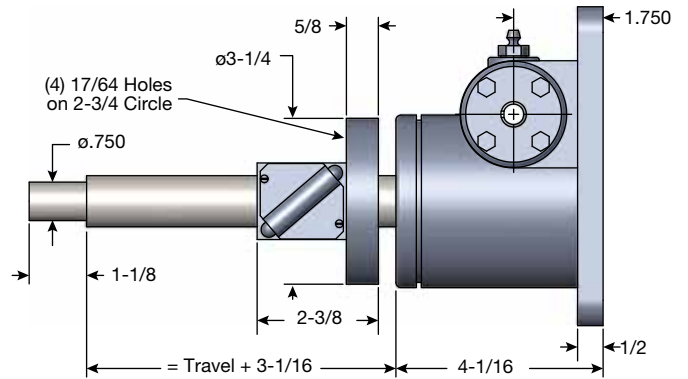
1" Diameter x .250 Lead Lifting Screws



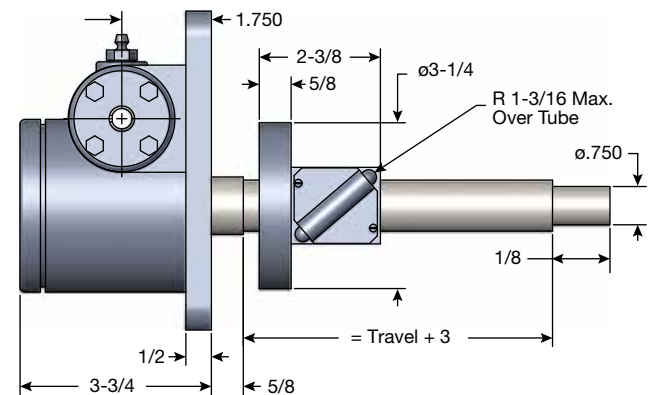
Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 148-149. Dimensions are subject to change without notice.



Inverted: M-9801



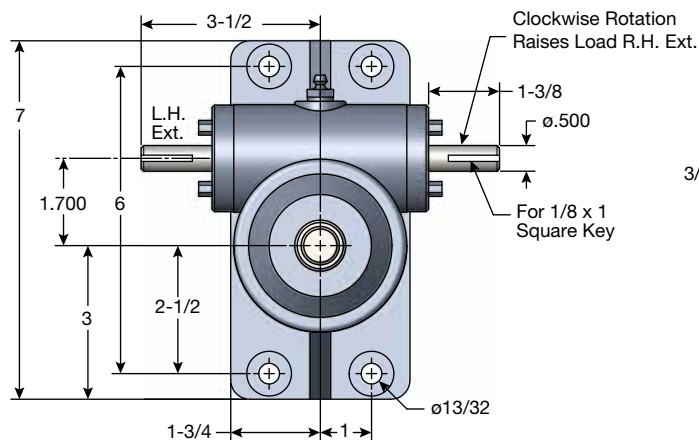
Upright Rotating: UM-9803



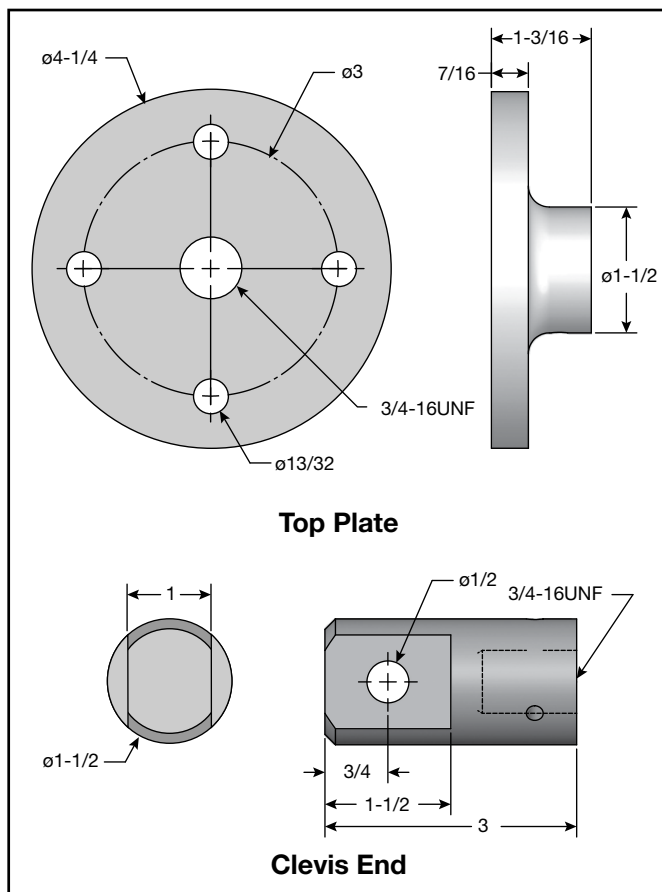
Inverted Rotating: DM-9803

BALL SCREW ACTUATORS

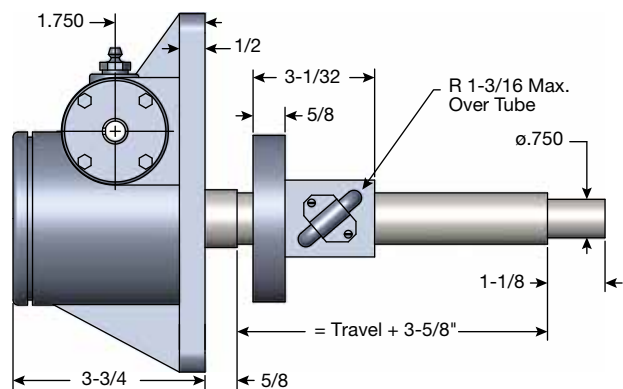
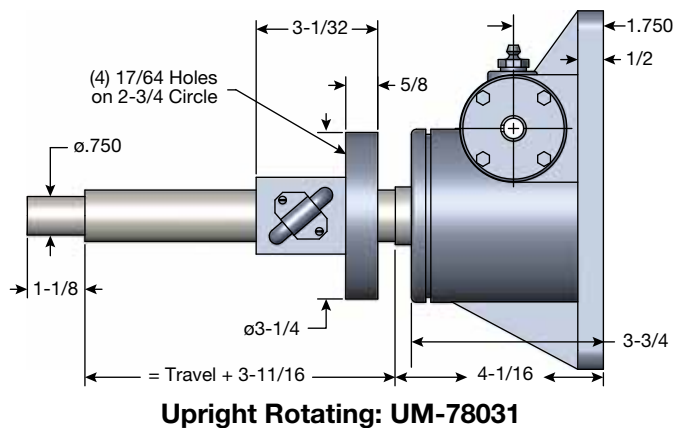
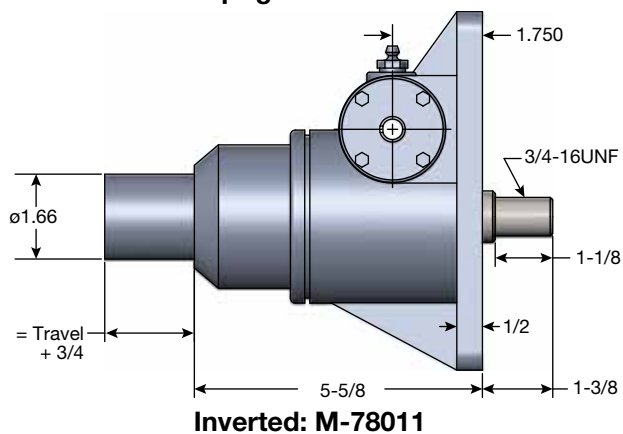
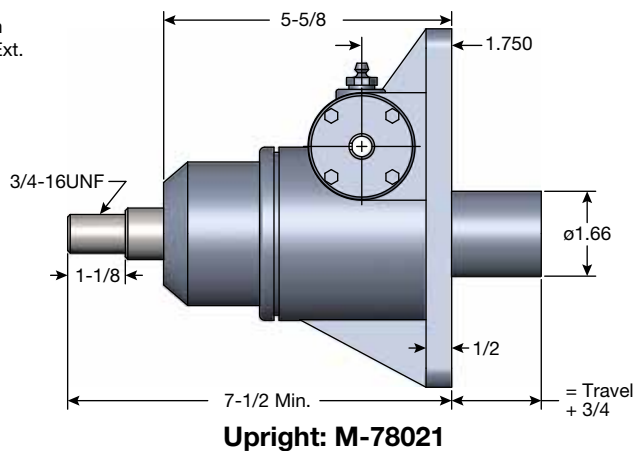
2 TON CAPACITY - 1 INCH LEAD — 7800 SERIES



1" Diameter x 1.000 Lead Lifting Screws

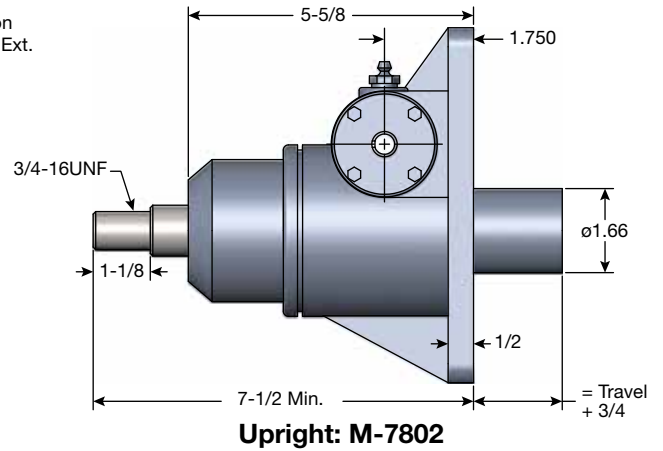
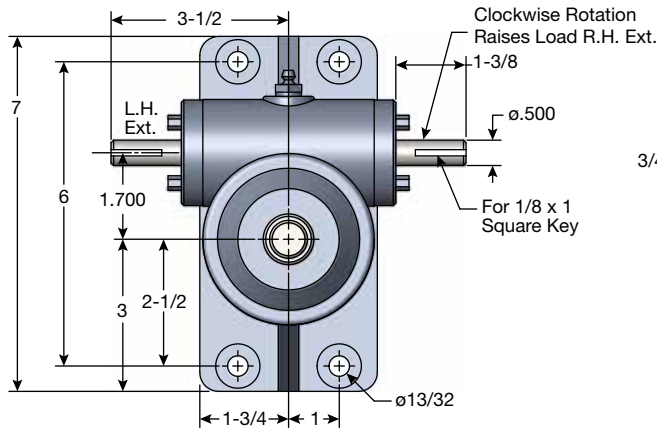


Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 148-149. Dimensions are subject to change without notice.

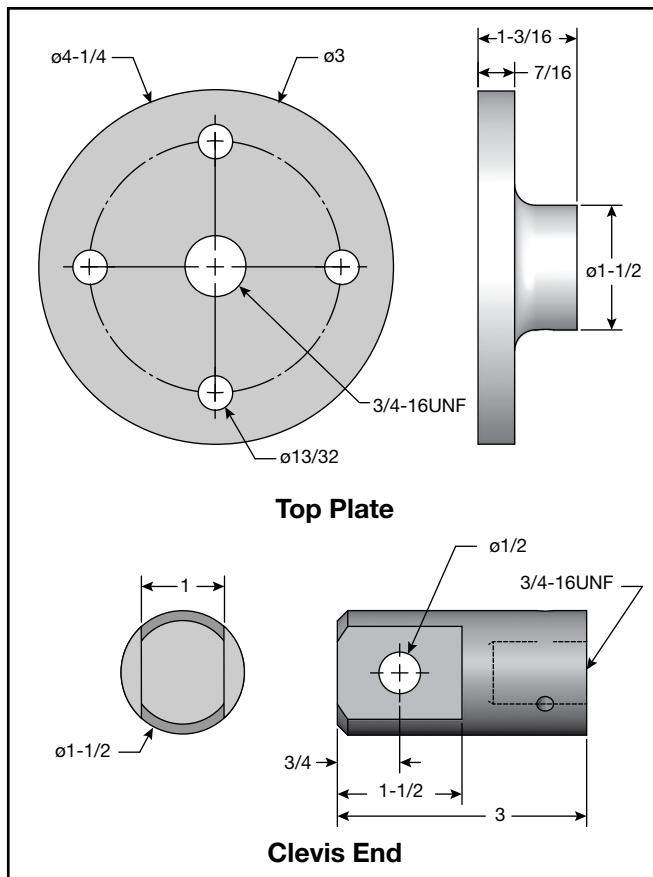


BALL SCREW ACTUATORS

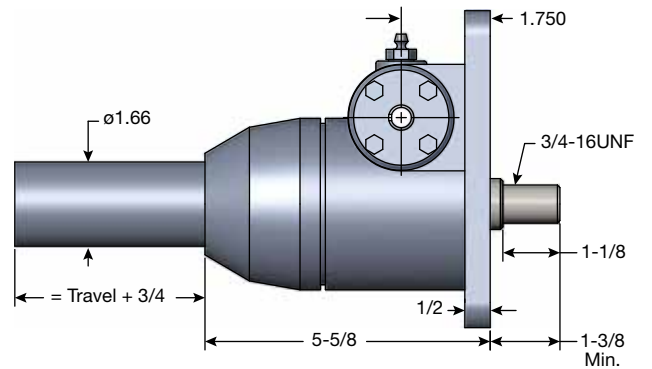
2 TON CAPACITY — 7800 SERIES



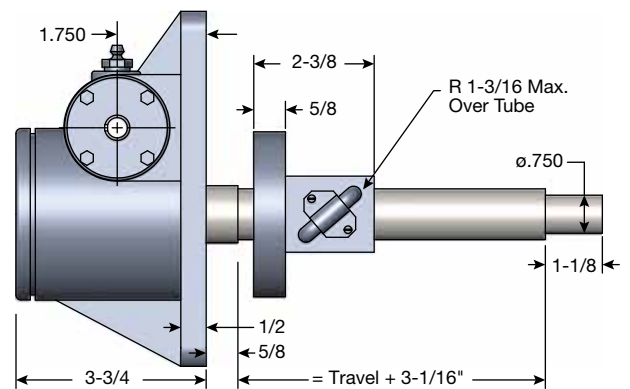
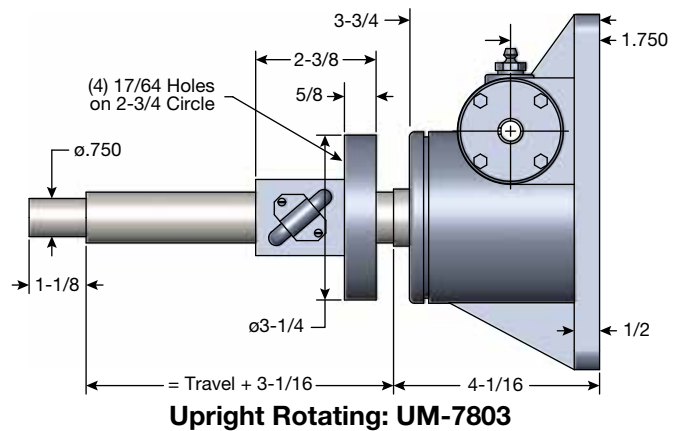
1" Diameter x .250 Lead Lifting Screws



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 148-149. Dimensions are subject to change without notice.



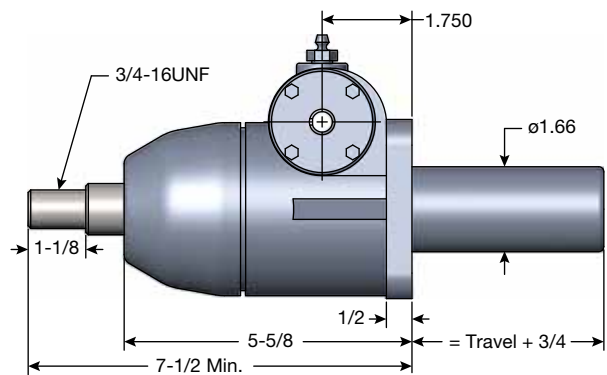
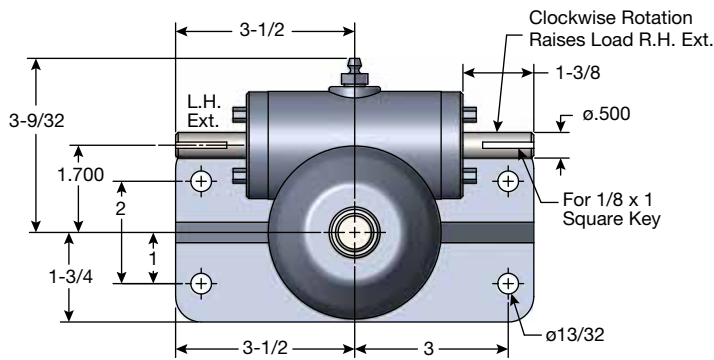
Inverted: M-7801



Inverted Rotating: DM-7803

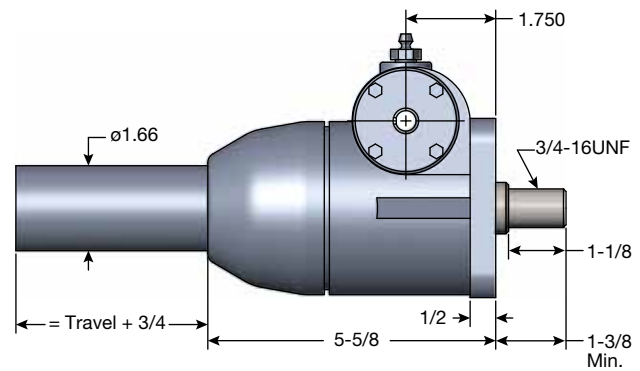
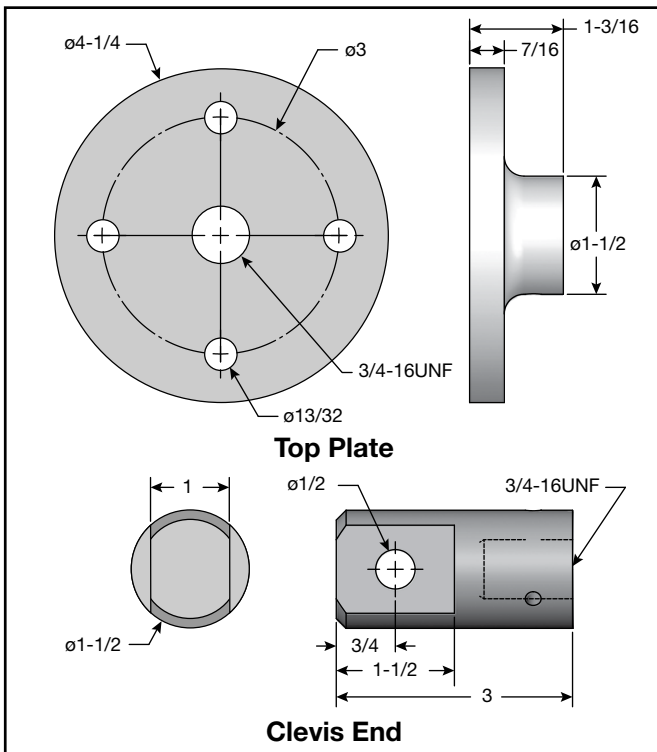
BALL SCREW ACTUATORS

2 TON CAPACITY - 1 INCH LEAD — 2800 SERIES

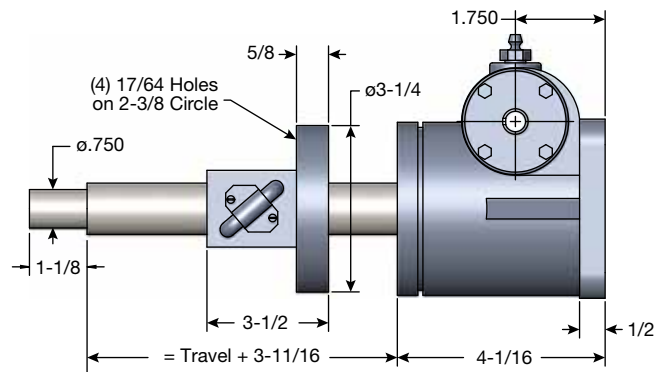
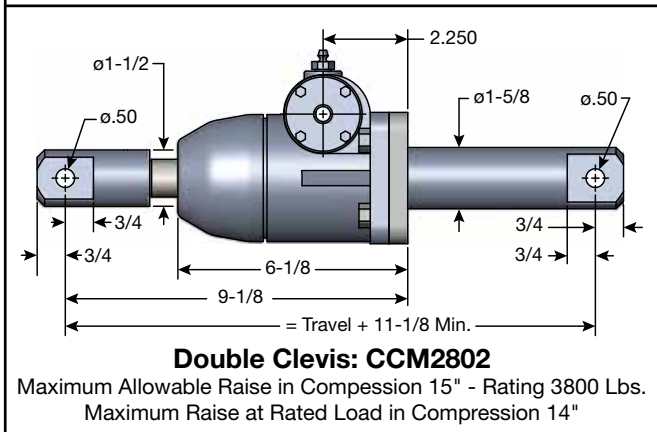


1" Diameter x 1.000 Lead Lifting Screws

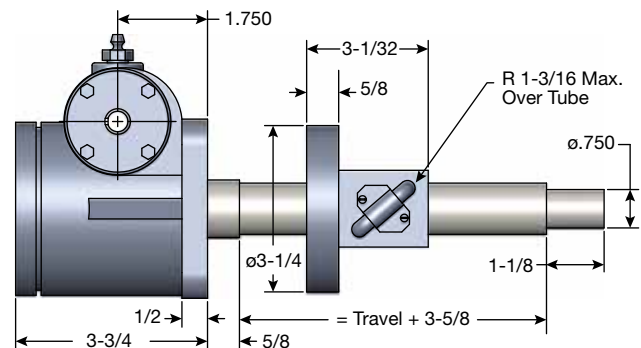
Upright: M-28021



Inverted: M-28011



Upright Rotating: KUM-28031

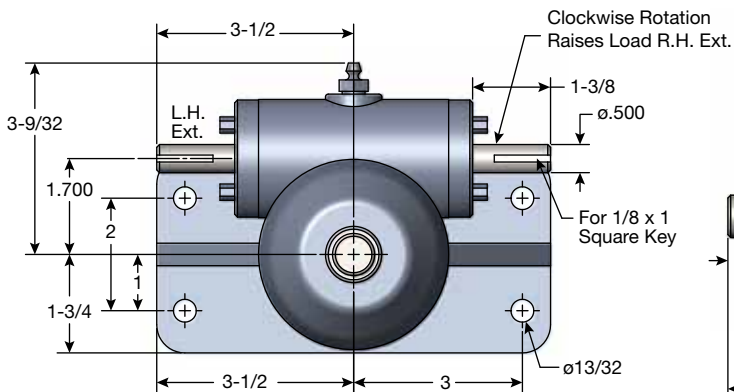


Inverted Rotating: KDM-28031

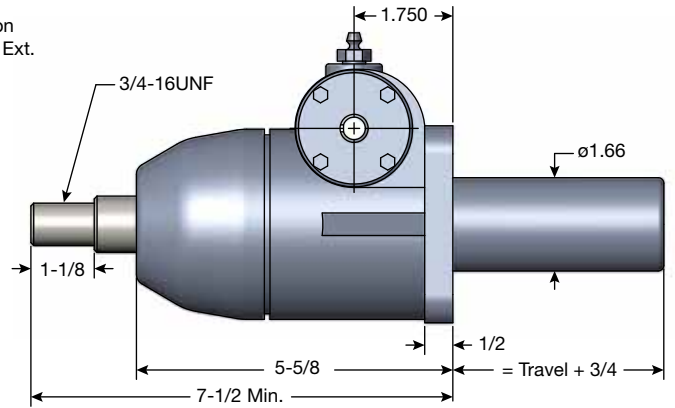
Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 148-149. Dimensions are subject to change without notice.

BALL SCREW ACTUATORS

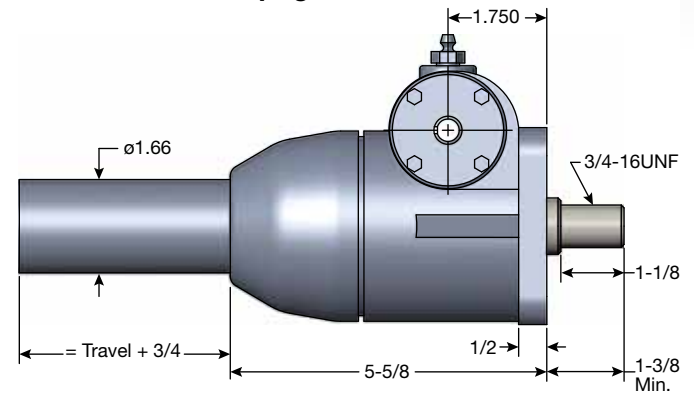
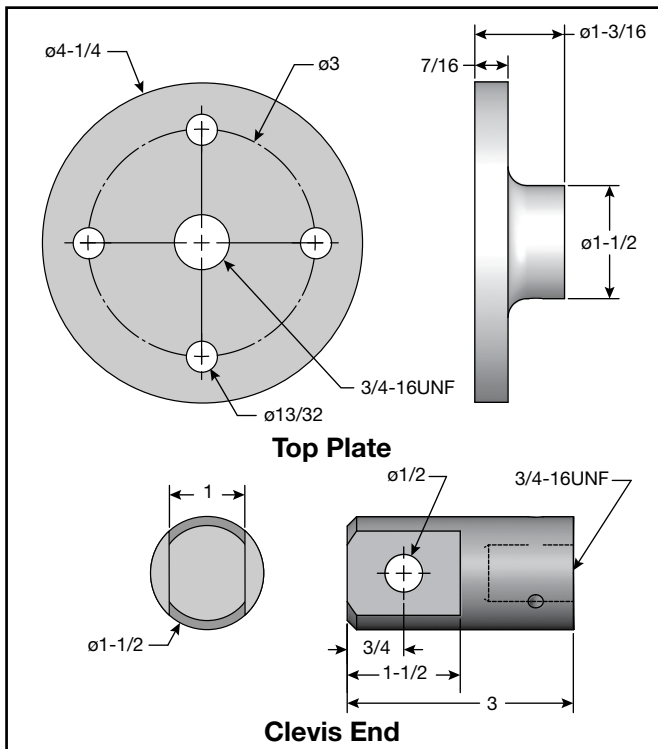
2 TON CAPACITY — 2800 SERIES



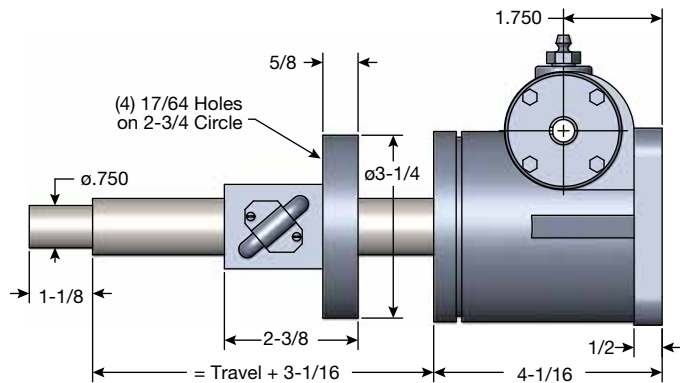
1" Diameter x .250 Lead Lifting Screws



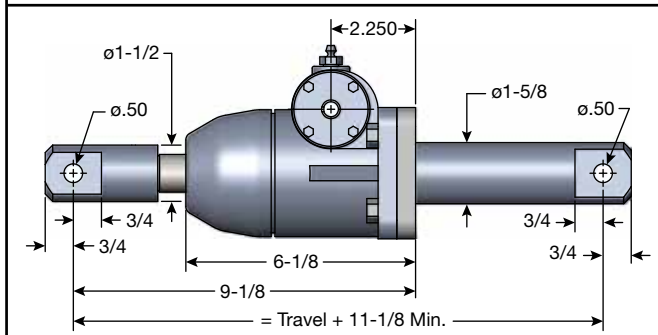
Upright: M-2802



Inverted: M-2801

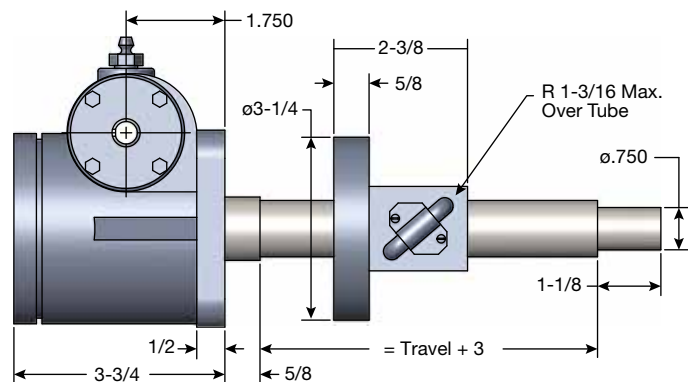


Upright Rotating: KUM-2803



Double Clevis: CCM2802

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

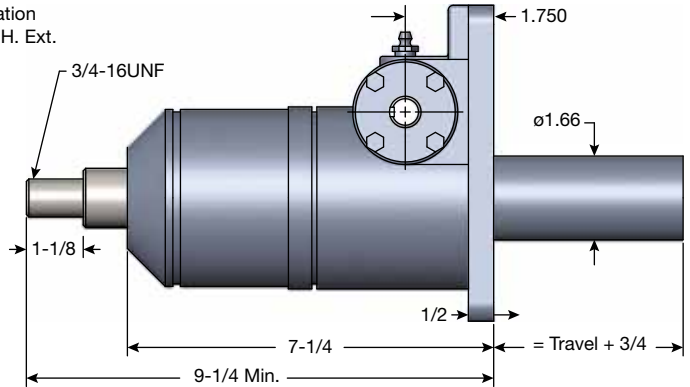
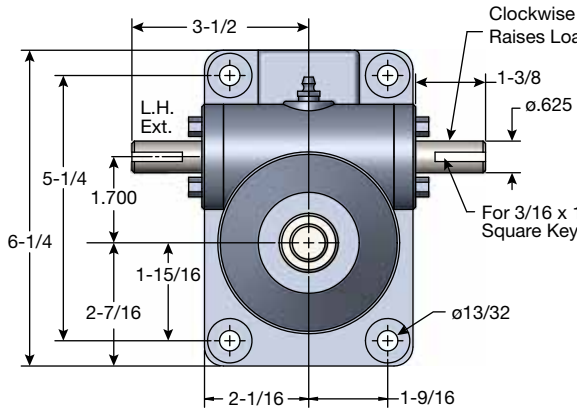


Inverted Rotating: KDM-2803

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 148-149. Dimensions are subject to change without notice.

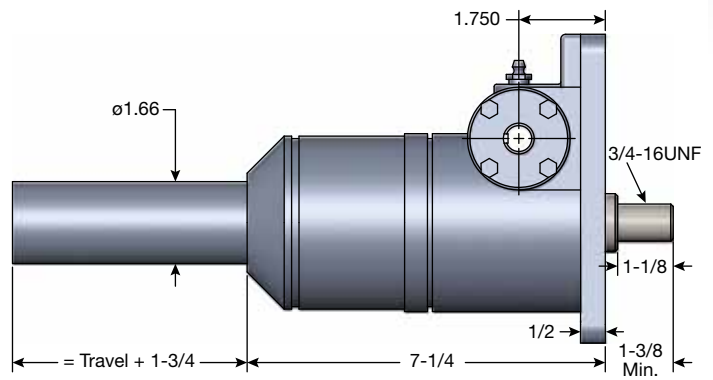
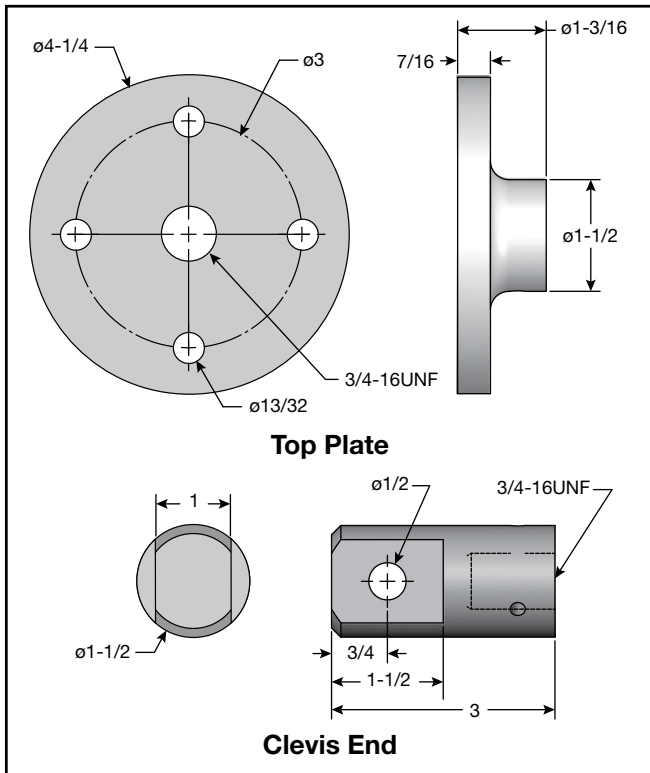
BALL SCREW ACTUATORS

3 TON CAPACITY — 9800 SERIES

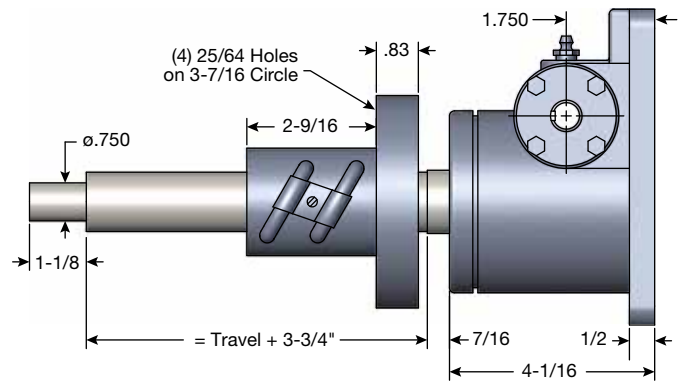


Upright: M-98003

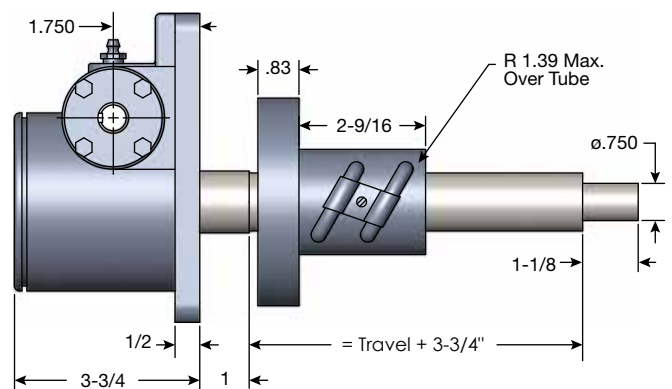
1-11/64" Diameter x .413 Lead Lifting Screws



Inverted: M-98002



Upright Rotating: UM-98004

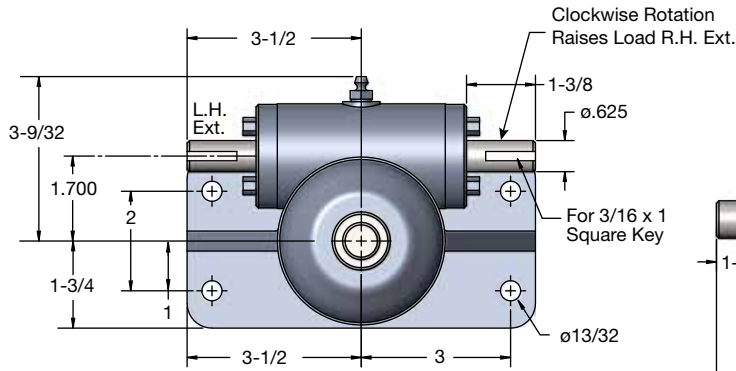


Inverted Rotating: DM-98004

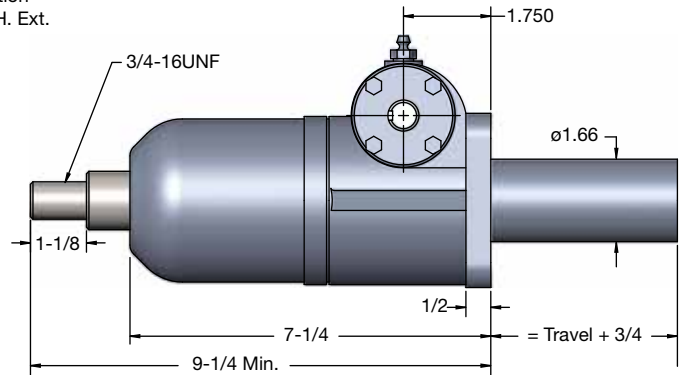
Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 148-149. Dimensions are subject to change without notice.

BALL SCREW ACTUATORS

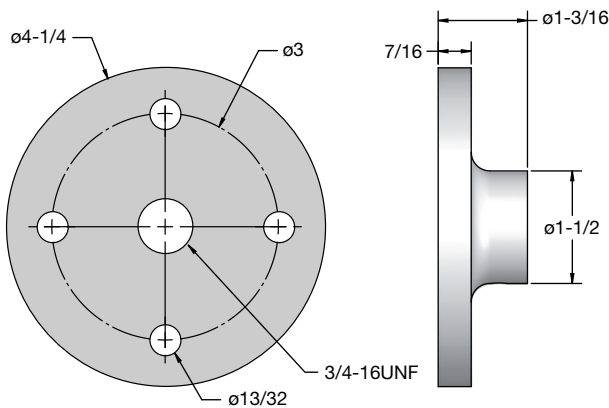
3 TON CAPACITY — 2800 SERIES



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

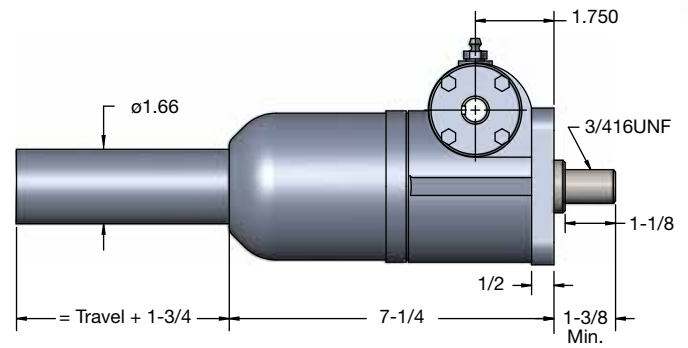


Upright: M-28003

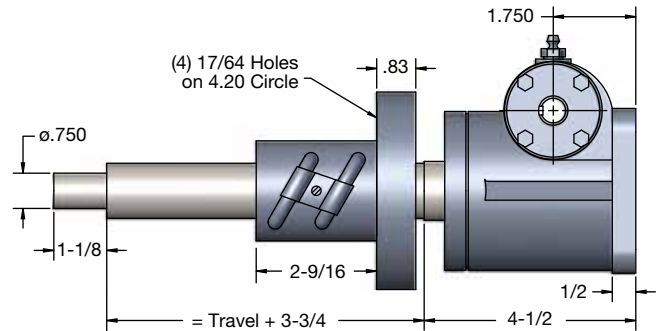


Top Plate

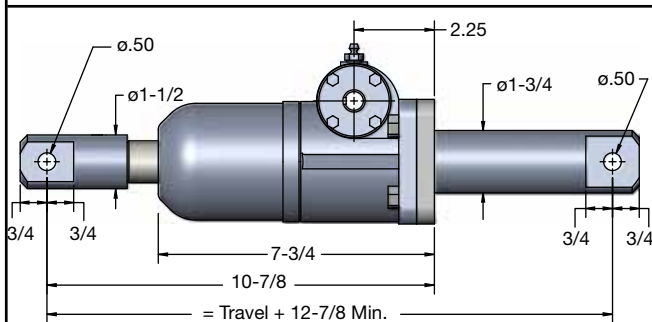
Clevis End



Inverted: M-28002

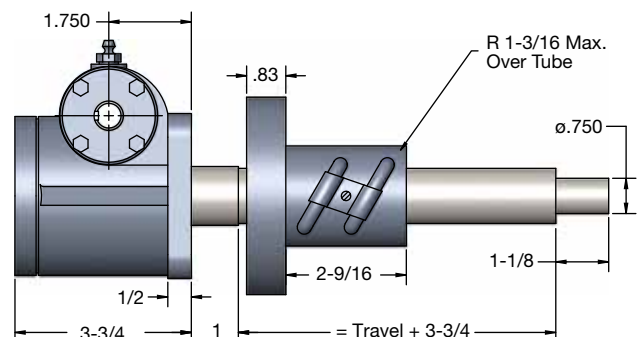


Upright Rotating: KUM-28004



Double Clevis: CCM-28003

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

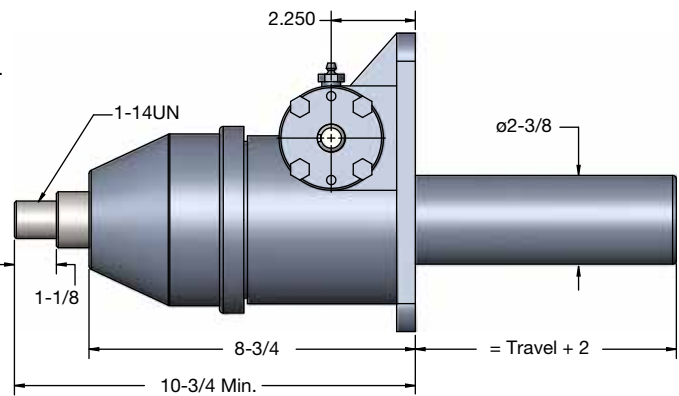
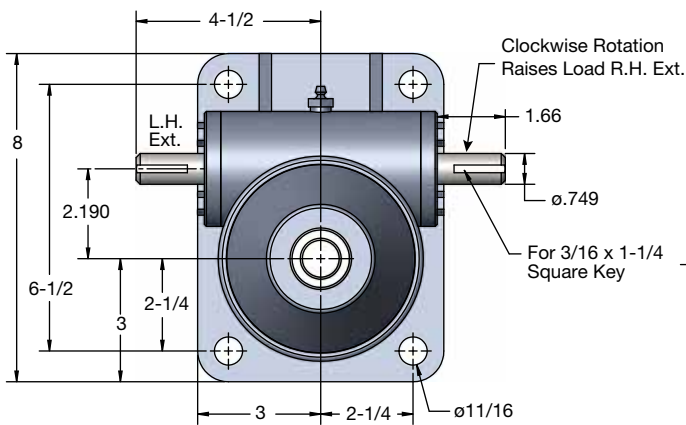


Inverted Rotating: KDM-28004

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 148-149. Dimensions are subject to change without notice.

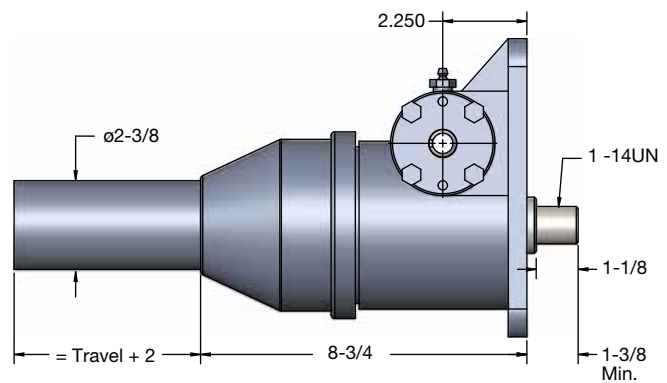
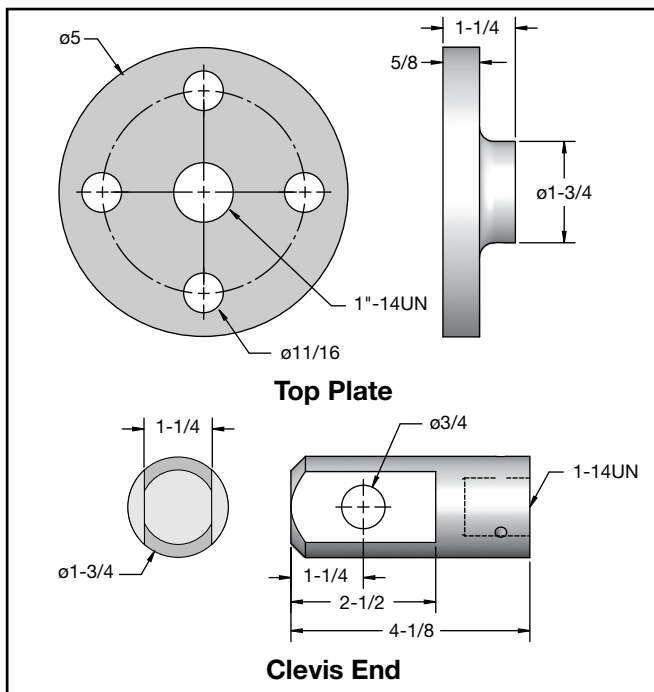
BALL SCREW ACTUATORS

5 TON CAPACITY - 1 INCH LEAD

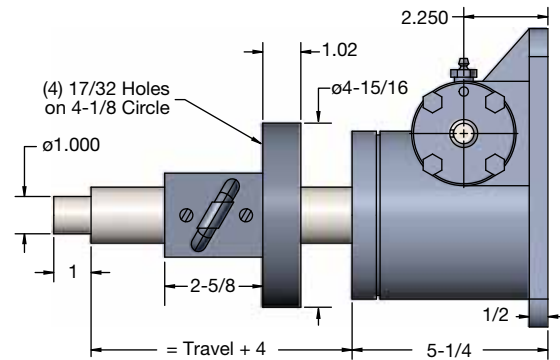


Upright: M-98051

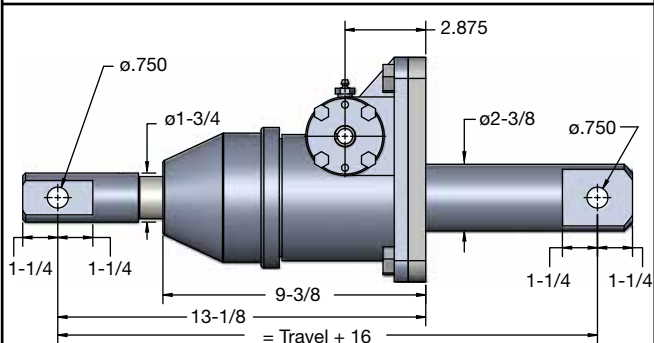
1-1/2" Diameter x 1.000 Lead Lifting Screws



Inverted: M-98041

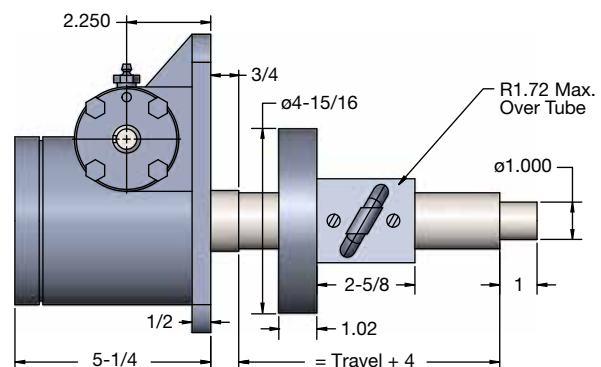


Upright Rotating: UM-98061



Double Clevis: CCM-9805

Maximum Allowable Raise in Compression 20" - Rating 7300 Lbs.
Maximum Raise at Rated Load in Compression 16"

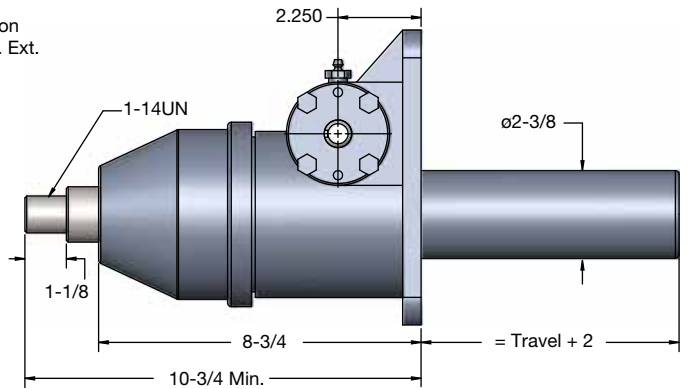
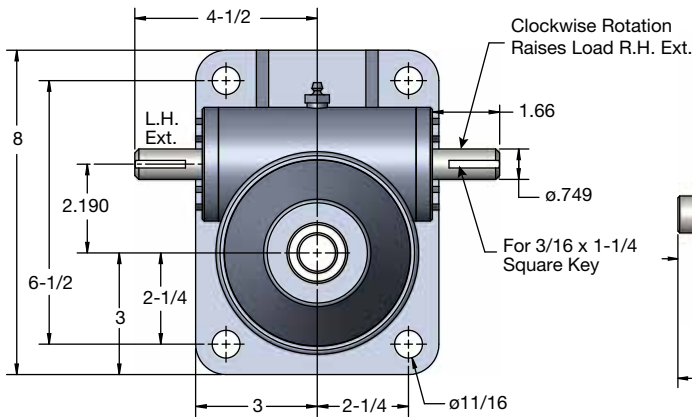


Inverted Rotating: DM-98061

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 148-149. Dimensions are subject to change without notice.

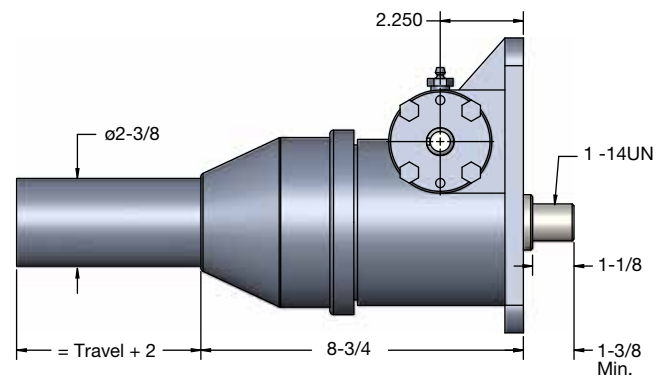
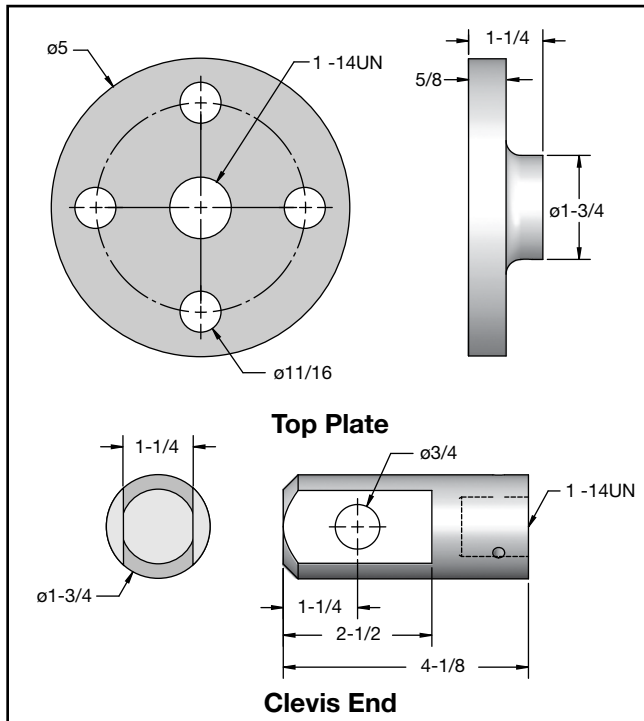
BALL SCREW ACTUATORS

5 TON CAPACITY

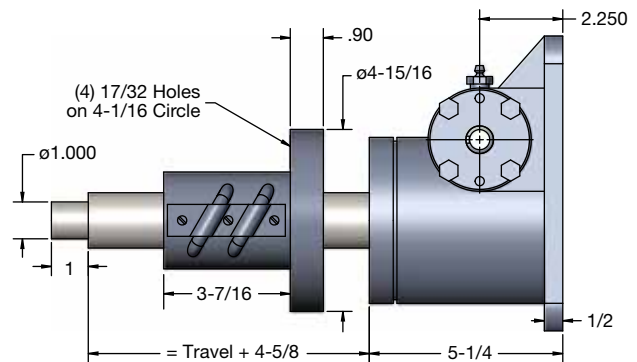


Upright: M-9805

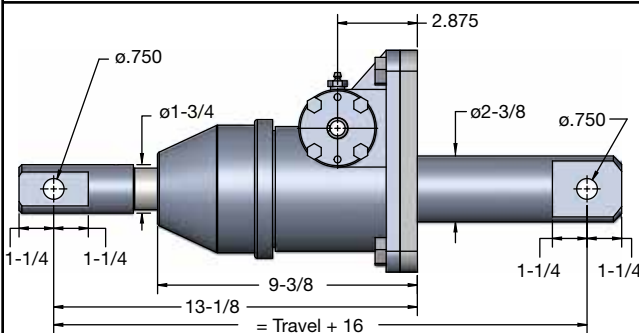
1-1/2" Diameter x .474 Lead Lifting Screws



Inverted: M-9804

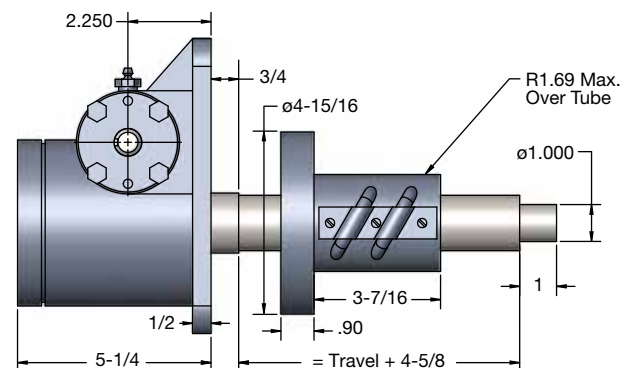


Upright Rotating: UM-9806



Double Clevis: CCM-9805

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

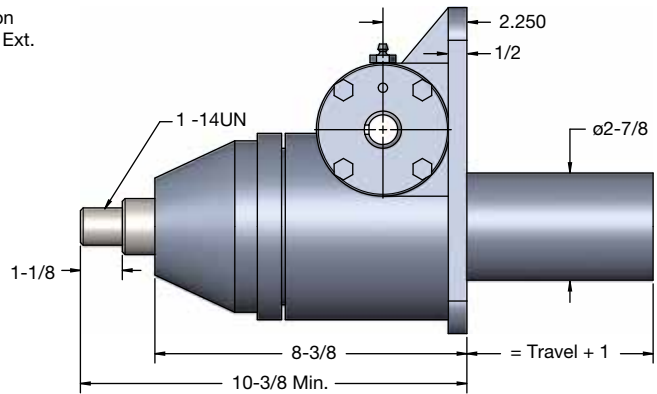
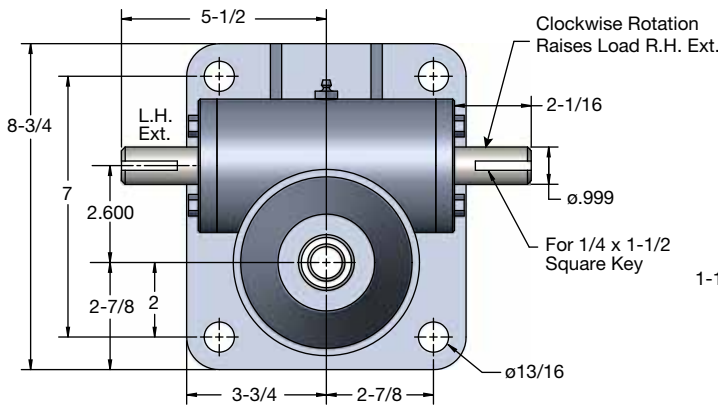


Inverted Rotating: DM-9806

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 148-149. Dimensions are subject to change without notice.

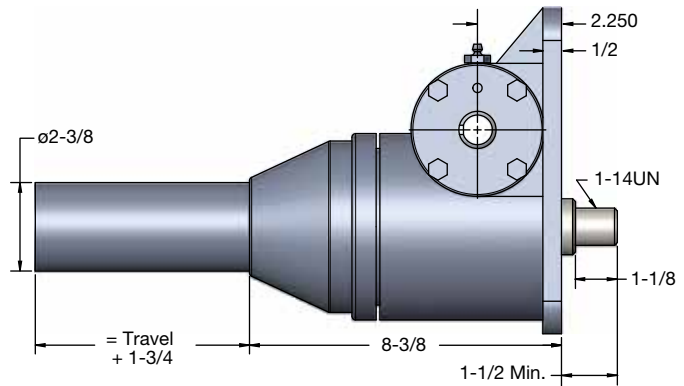
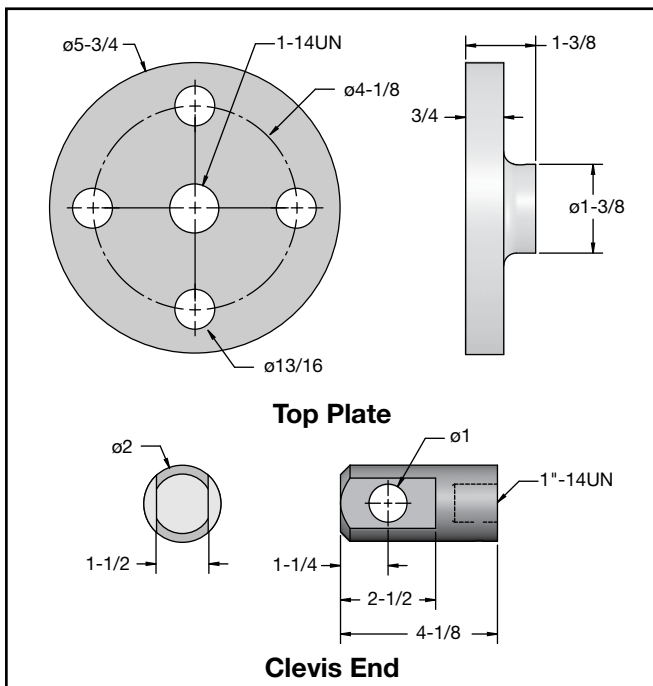
BALL SCREW ACTUATORS

10 TON CAPACITY - 1 INCH LEAD

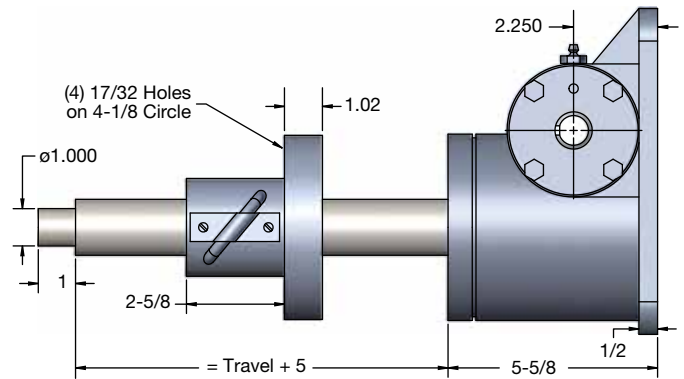


Upright: M-98101

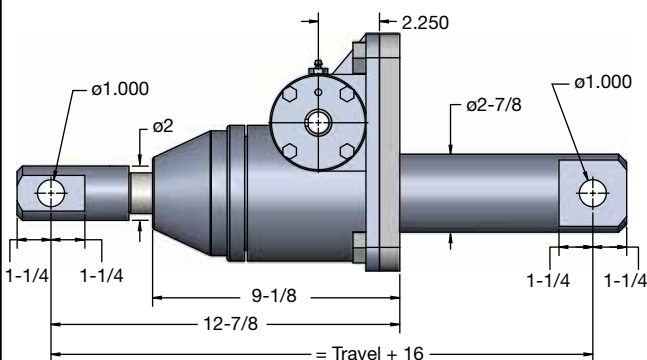
1-1/2" Diameter x 1.000 Lead Lifting Screws



Inverted: M-98091

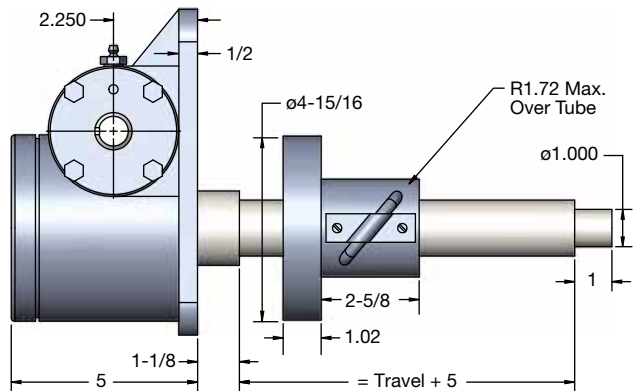


Upright Rotating: UM-98111



Double Clevis: CCM-9810

Maximum Allowable Raise in Compression 20" - Rating 7300 Lbs.
Maximum Raise at Rated Load in Compression 9"

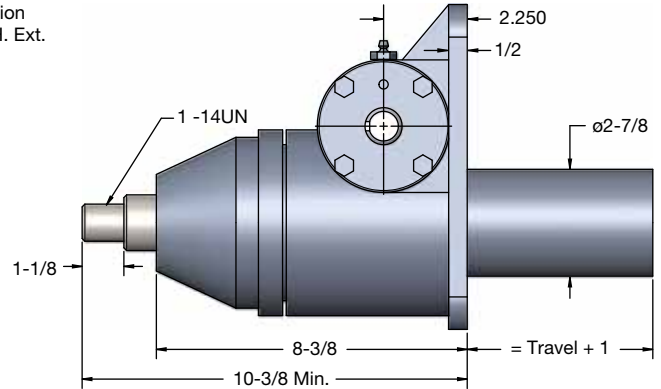
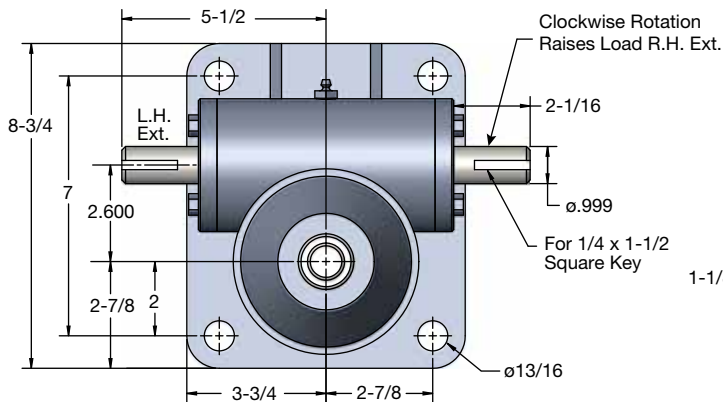


Inverted Rotating: DM-98111

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 148-149. Dimensions are subject to change without notice.

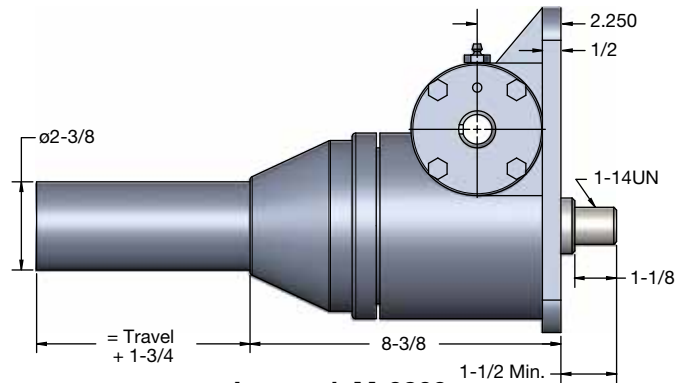
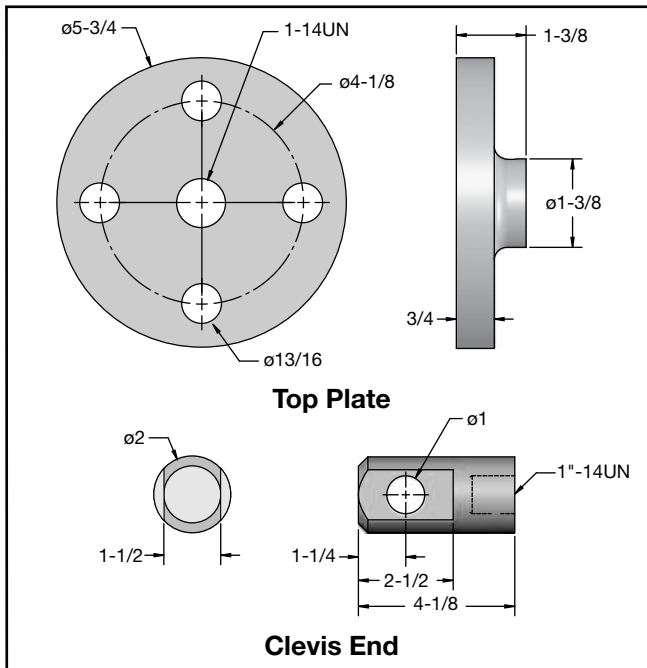
BALL SCREW ACTUATORS

10 TON CAPACITY

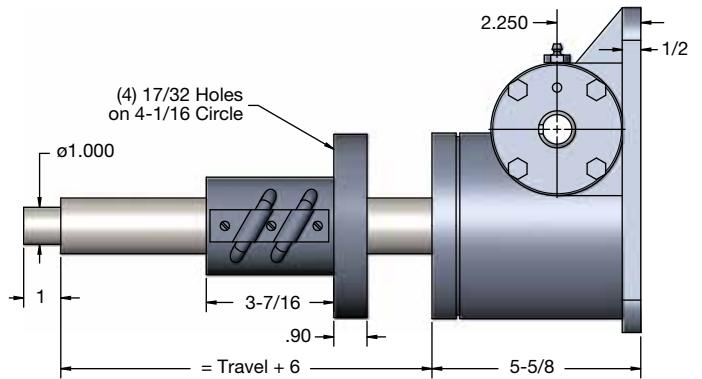


Upright: M-9810

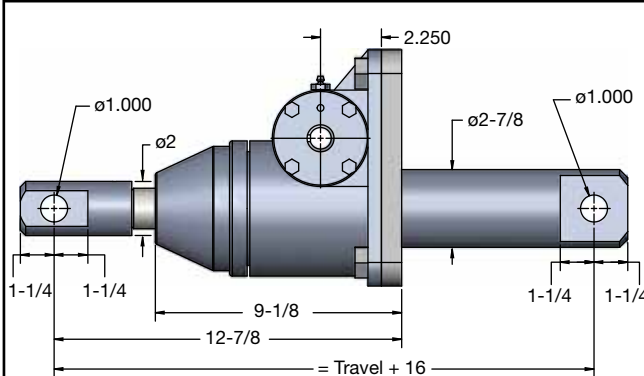
1-1/2" Diameter x .474 Lead Lifting Screws



Inverted: M-9809

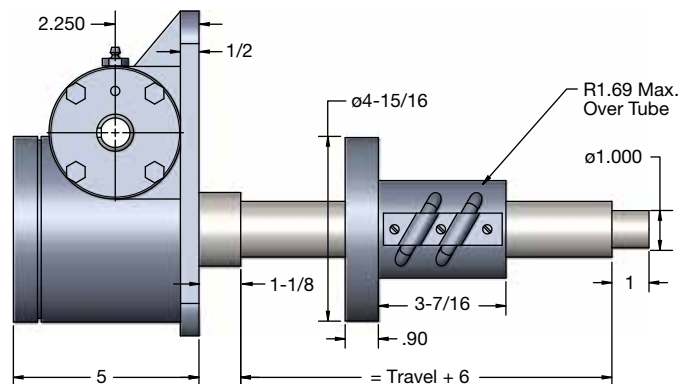


Upright Rotating: UM-9811



Double Clevis: CCM-9810

Maximum Allowable Raise in Compression 20" - Rating 7300 Lbs.
Maximum Raise at Rated Load in Compression 9"

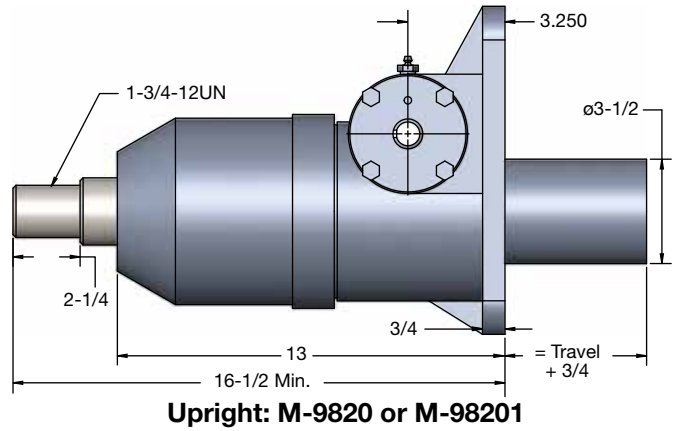
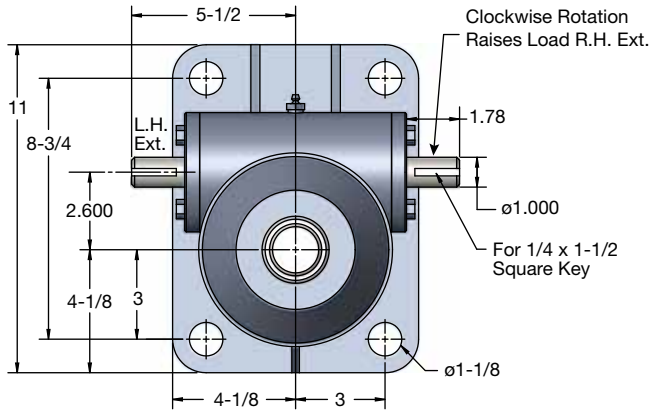


Inverted Rotating: DM-9811

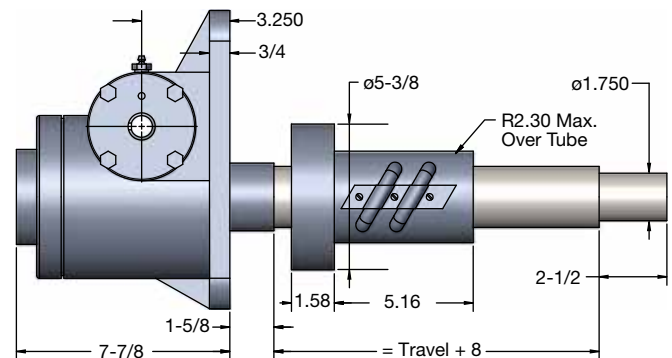
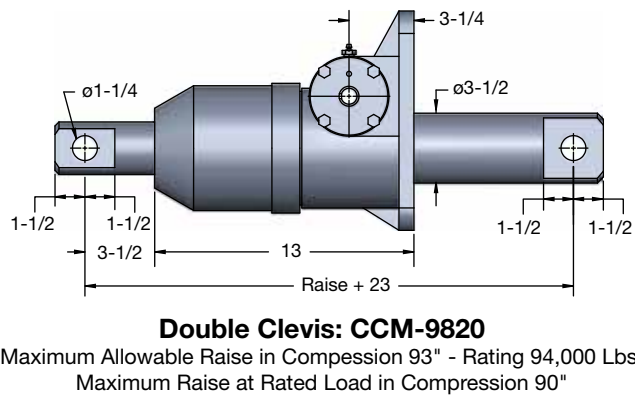
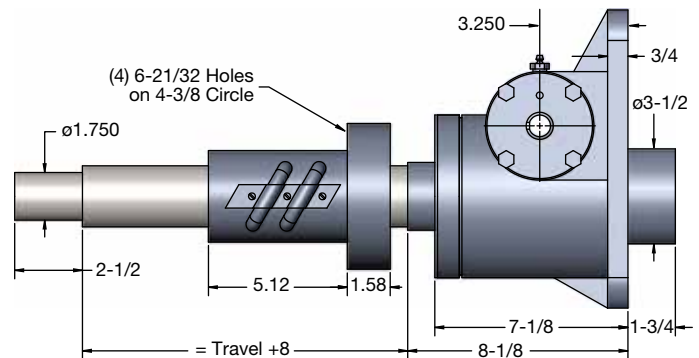
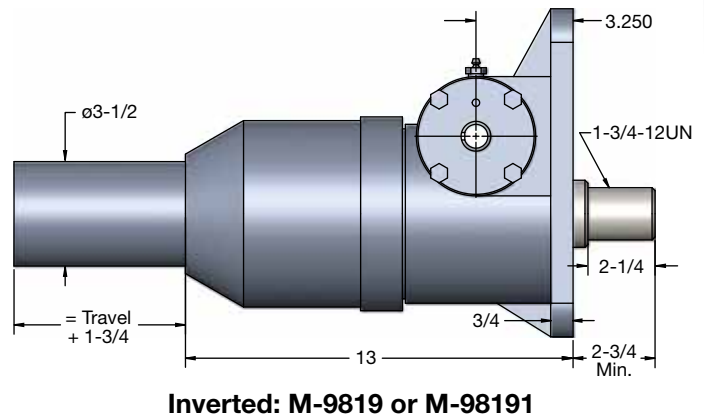
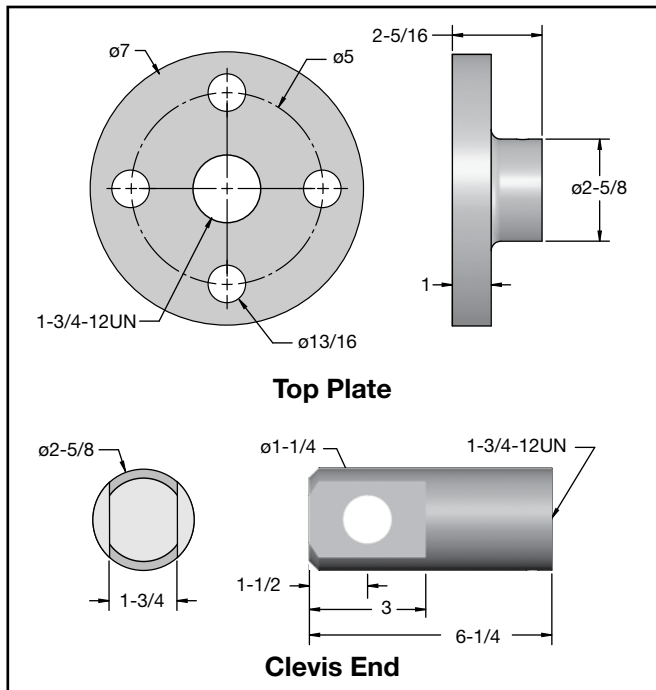
Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 148-149. Dimensions are subject to change without notice.

BALL SCREW ACTUATORS

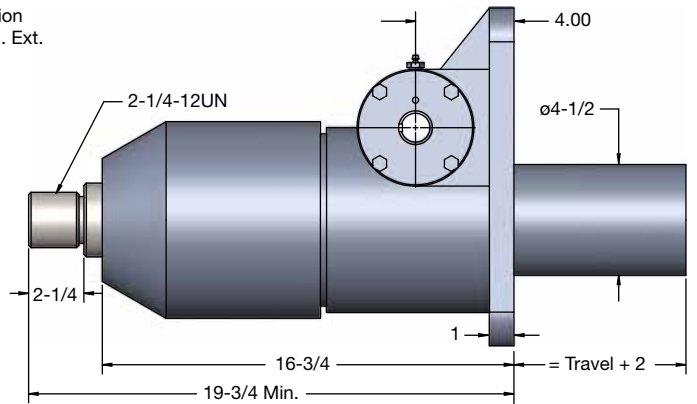
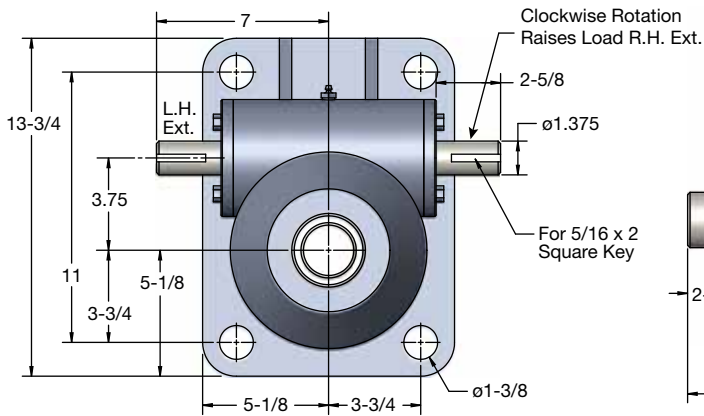
20 TON CAPACITY STANDARD AND 1 INCH LEAD



**2-1/4" Diameter x .500 Lead Lifting Screws
2-1/4" Diameter x 1.00 Lead Lifting Screws**

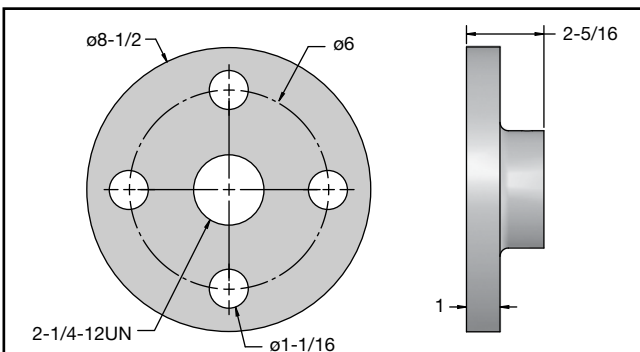


Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 148-149. Dimensions are subject to change without notice.

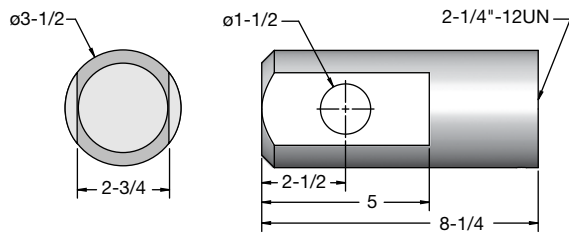


Upright: M-9825

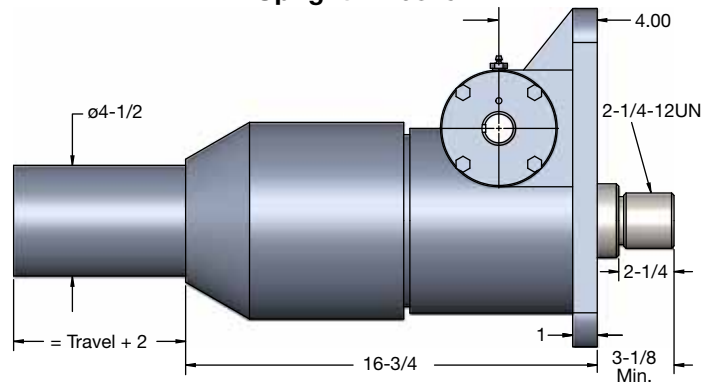
3" Diameter x .660 Lead Lifting Screws



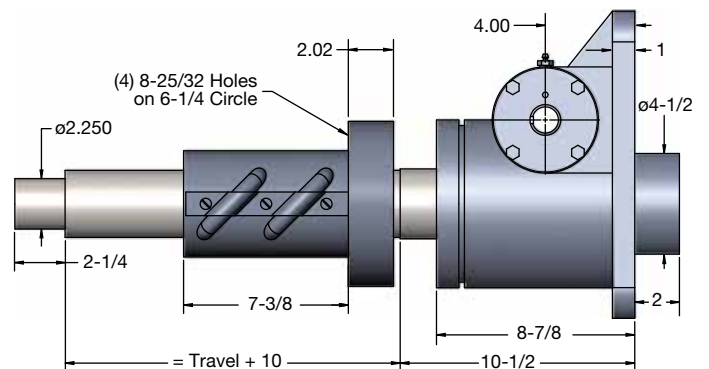
Top Plate



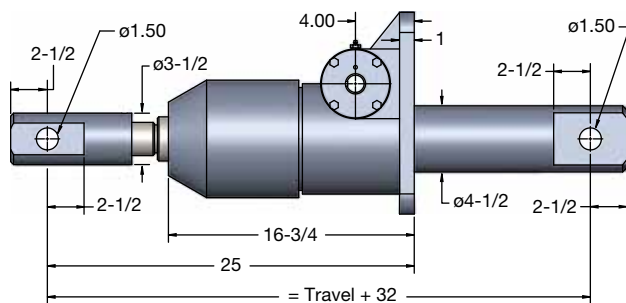
Clevis End



Inverted: M-9824



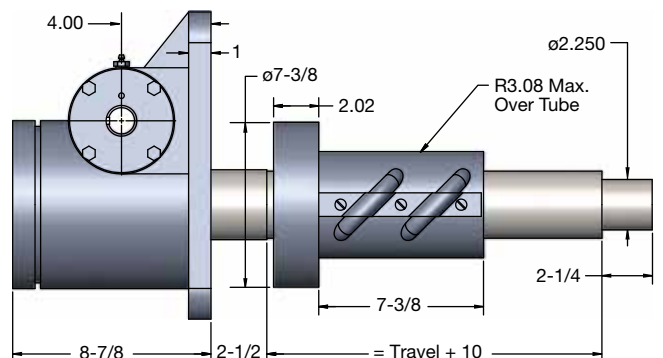
Upright Rotating: UM-9826



Double Clevis: CCM-9825

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

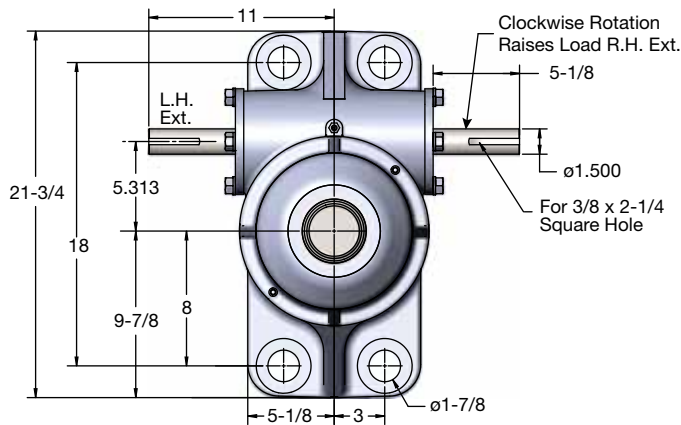
Note: Lifting screw is not keyed. Top should be secured to a lifting member to prevent rotation. When a Bellows Boot is required, see pages 148-149. Dimensions are subject to change without notice.



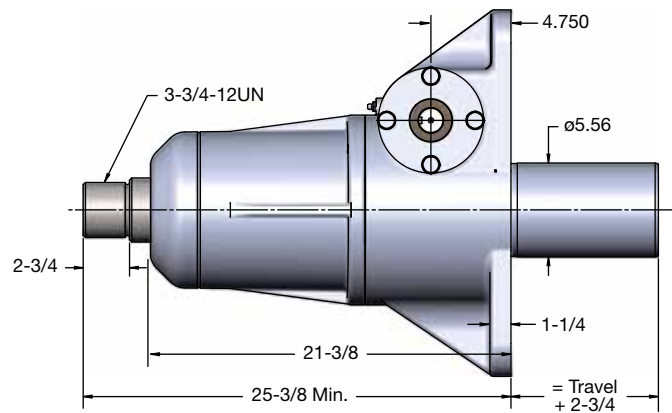
Inverted Rotating: DM-9826

BALL SCREW ACTUATORS

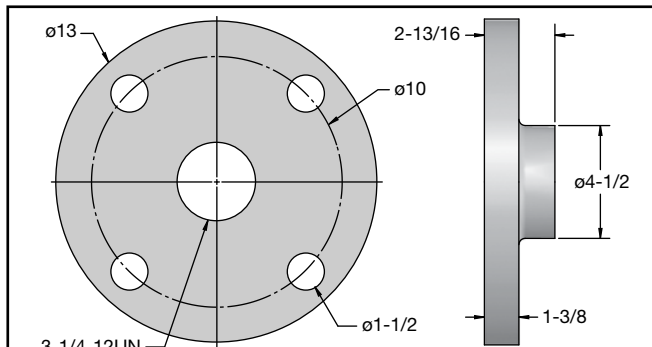
50 TON CAPACITY† — 9800 SERIES



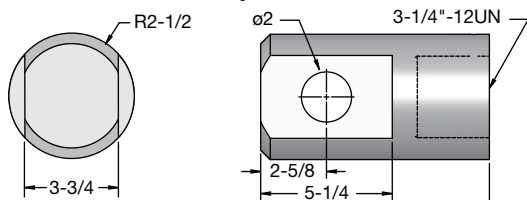
4" Diameter x 1.000 Lead Lifting Screws



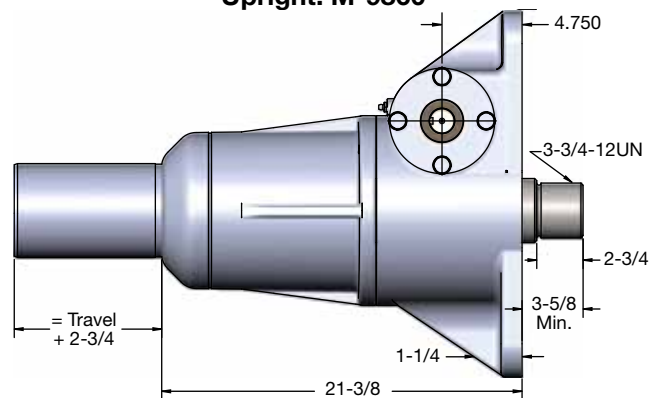
Upright: M-9860



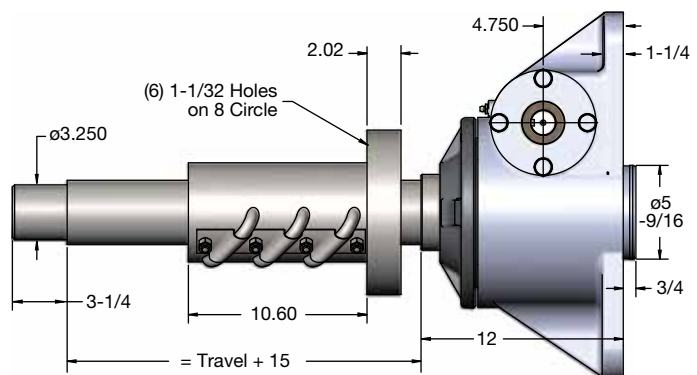
Top Plate



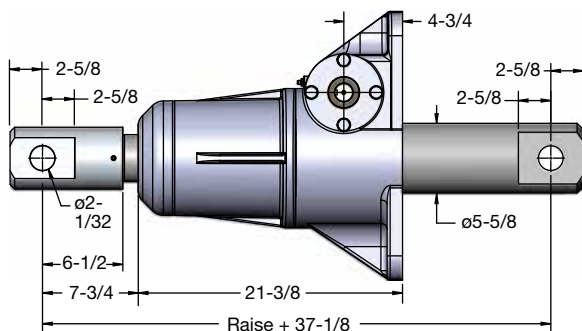
Clevis End



Inverted: M-9859

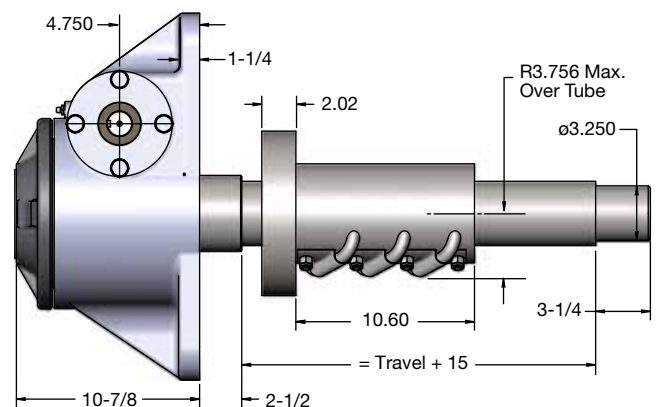


Upright Rotating: UM-9861



Double Clevis: CCM-9860

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



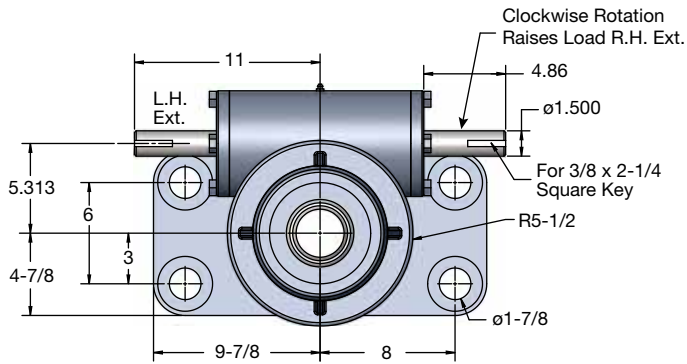
Inverted Rotating: DM-9861

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 148-149. Dimensions are subject to change without notice.

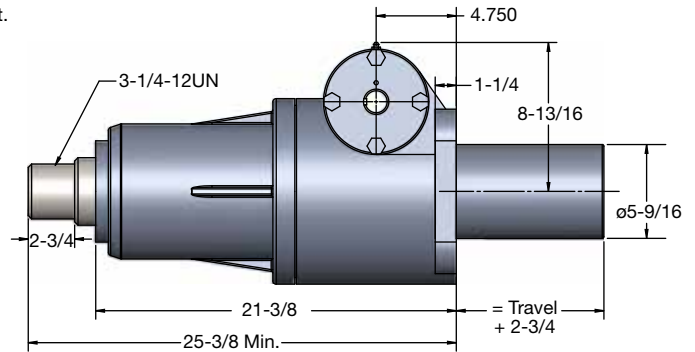
†Does your ball screw application require more than 50 tons? Please contact our Customer Service group to explore our specialty options for higher load ratings up to 100 tons.

BALL SCREW ACTUATORS

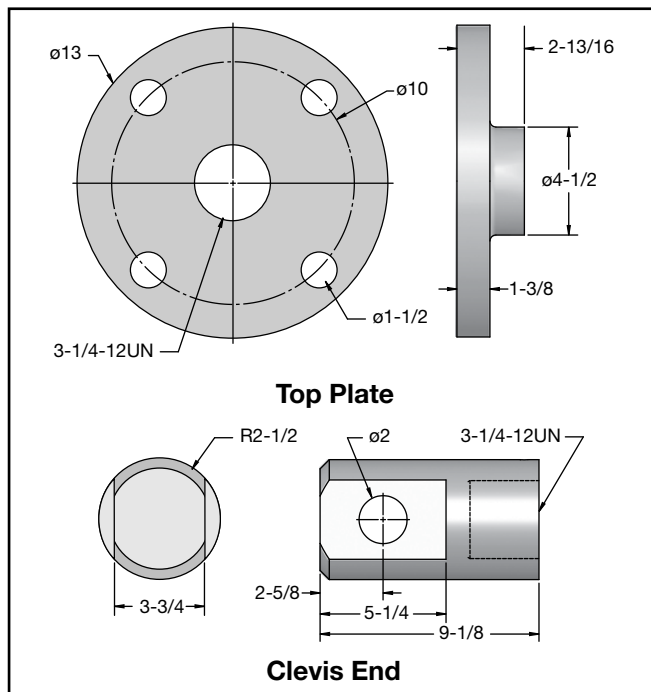
50 TON CAPACITY† — 2800 SERIES



4" Diameter x 1.000 Lead Lifting Screws

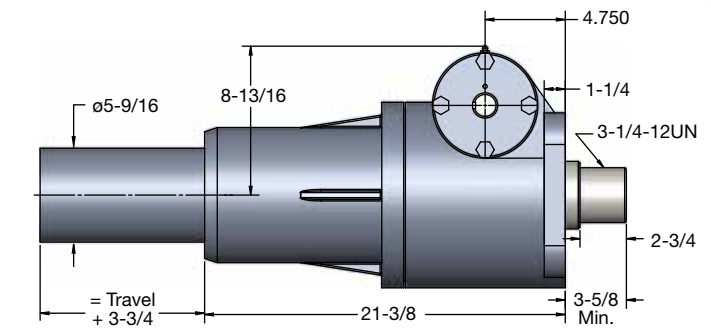


Upright: M-2860

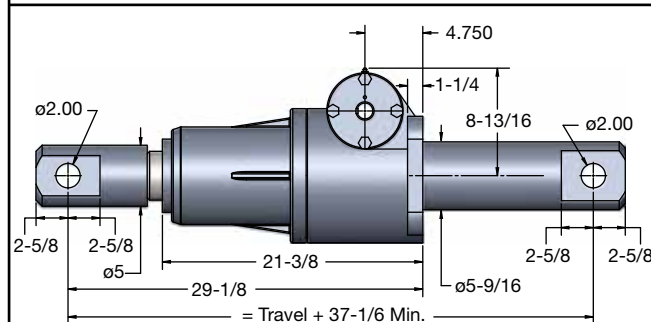


Top Plate

Clevis End



Inverted: M-2859

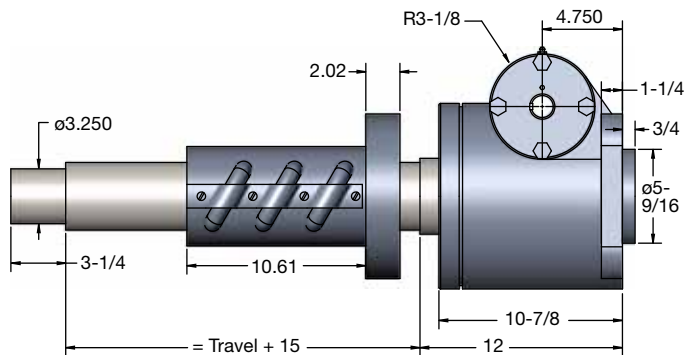


Double Clevis: CCM-2860

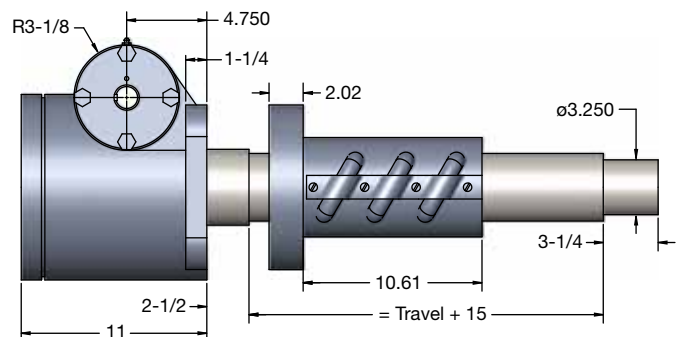
Maximum Allowable Raise in Compression 65" - Rating 62,000 Lbs.
Maximum Raise at Rated Load in Compression 47"

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 148-149. Dimensions are subject to change without notice.

† Does your ball screw application require more than 50 tons? Please contact our Customer Service group to explore our specialty options for higher load ratings up to 100 tons.



Upright Rotating: UM-2861

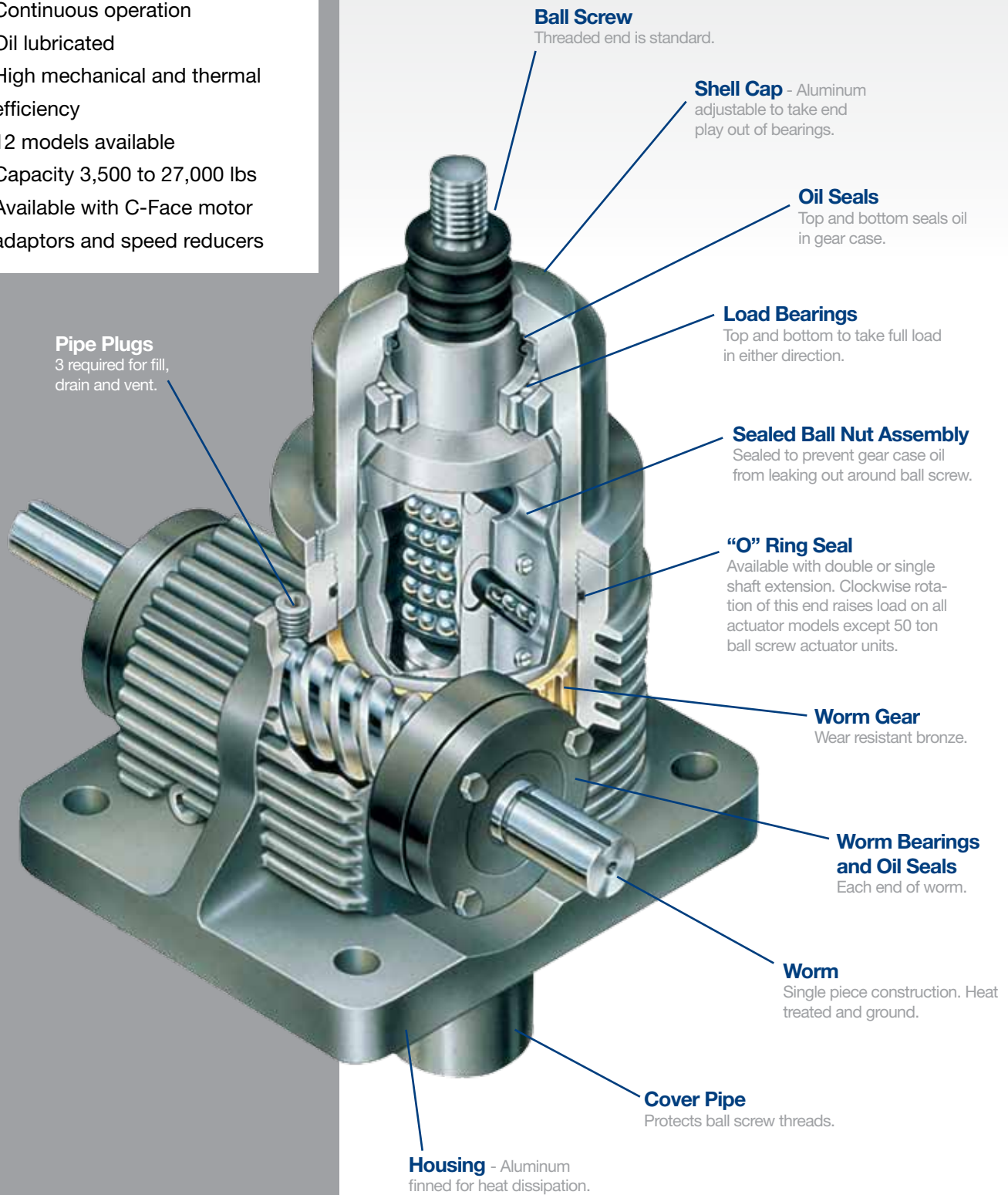


Inverted Rotating: DM-2861

CONTINUOUS DUTY CYCLE ACTUATORS

FEATURES

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



Ball Screw
Threaded end is standard.

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

Oil Seals
Top and bottom seals oil in gear case.

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

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

"O" Ring Seal
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.

Worm Gear
Wear resistant bronze.

Worm Bearings and Oil Seals
Each end of worm.

Worm
Single piece construction. Heat treated and ground.

Cover Pipe
Protects ball screw threads.

Housing - Aluminum finned for heat dissipation.

Pipe Plugs
3 required for fill, drain and vent.

CONTINUOUS DUTY CYCLE ACTUATORS MODEL NUMBERING SYSTEM

FL - TKM - 7515 - 6 - 1R

Model Prefix

R - Reducer
F - C-face Adapter
L - Limit Switch
E - Encoder
J - Rotary Counter

Screw End & Configuration

T - Threaded End
C - Clevis End
M - Top Plate
P - Plain End

K - Anti-Rotation Screw
CC - Double Clevis

D - Inverted Rotating
U - Upright Rotating

Series & Capacity No.

Series:

Standard Models (75xx,
7511, 7515, 7522)
Special Models (85xx,
8511, 8515, 8522)

Capacities:

Upright model suffixes
end as shown.
Inverted model suffixes lower the
capacity number by one digit.
Rotating model suffixes raise the
capacity number by one digit.

M - Base Model

Travel

1 inch increment travels are
always represented using the
exact travel amount.

Travels with fractional lengths
are quoted using that length,
but are serialized when the
order is processed.

Serialized digits in this
position may also be used
for other models containing
special features.

Model Suffix

B - Boot
L - Single End Worm Ext. Left
R - Single End Worm Ext. Right
1 - Optional Ratio #1
2 - Optional Ratio #2
X - Supplied without cover pipe

CONTINUOUS DUTY CYCLE ACTUATORS PERFORMANCE TABLE

FEATURES

- 25 configured models. Upright or inverted translating screw, rotating screw available and double clevis.
- Maximum load capacities range from 3,500 to 27,000 pounds.
- Rated load capacities (load at which actuator life is 1,000 hours) range from 2,000 to 13,000 lbs.
- High mechanical efficiency - The unit's mechanical efficiency (as high as 70%) is due to the heat-treated ball bearing screw and mating nut, hardened and ground alloy steel worm, wear resistant bronze worm gear and oil bath lubrication.
- High thermal efficiency - The continuous 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 up to 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.
- Worm gearing meets AGMA Standards.
- Sand-cast aluminum housings for added heat dissipation.
- Available with C-Face motor adaptors and reducers.

Duff-Norton 7500 Series high duty cycle actuators are specifically designed for continuous operation within certain load limitations (see Maximum Allowable Duty Cycle chart below). 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

Maximum Allowable Duty Cycle at 1750 RPM Input Speed			
Model Number	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.

operating life in terms of millions of inches of travel. This important feature allows optimum maintenance and replacement scheduling, so as to minimize downtime.

Specifications - Continuous Duty Cycle Actuator					
Model Number	7511	7515	75151 (HL)	7522	75221 (HL)
Maximum Speed Cface Driven (in/min)** (page 114)	118.5	102.0	215.5	81.0	215.5
Maximum Speed Reducer Driven (in/min)** (page 110)	23.0	20.0	43.0	16.0	32.0
Maximum Load Capacity (lbs)	3,500	12,000	5,500	27,000	13,500
Rated Load Capacity (lbs - 1000 hours life)	2,000	5,200	3,200	13,000	12,000
Lifting Screw (Diameter x Lead)	1.17 x .413	1.5 x .474	1.5 x 1.00	2.25 x .500	2.25 x 1.0
Worm Gear Ratio	6:1	8:1	8:1	10-2/3:1	10-2/3:1
Turns of Worm for 1 inch Raise	14.526	16.889	8.000	21.333	10.667
Horsepower per Actuator (Maximum at 1750 rpm)	2	5	5	10	10
Key Torque (in-lb)	260	1000	975	2400	2400
Starting Torque (in-lb at Maximum Load)	75	200	450	420	825
Running Torque (in-lb at Maximum Load)	60	170	392	350	685
Hold Back Torque* (lb-ft at Maximum Load)	4	9	9	12	12
Actuator Efficiency Rating (Percentage)	63.91	66.52	64.36	57.55	57.55
Weight with Base Raise of 6 inches (lbs)	19	43	43	95	95
Weight for Each Additional 1 inch Raise (lbs)	.4	.9	.9	1.5	1.5

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

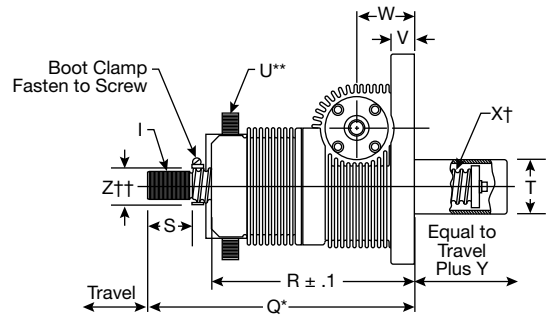
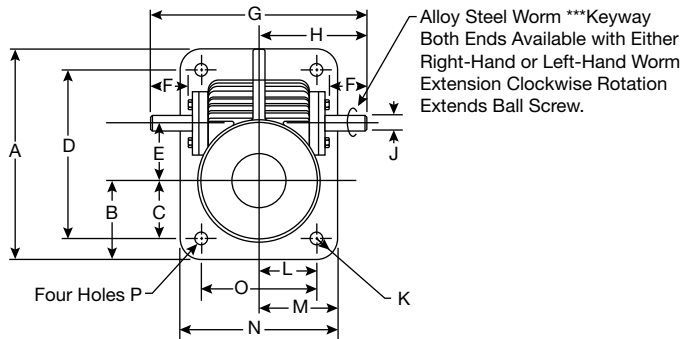
All actuator units can be supplied with standard raises up to 24 inches. Special raises up to 20 feet are available upon request. Standard inverted keyed models do not have a cover pipe (except for the 1 ton and 75 ton models). Closed height dimensions may increase for actuators supplied with bellows boots. See page 148-149.

Note: See page 107 for ball screw and nut life expectancy

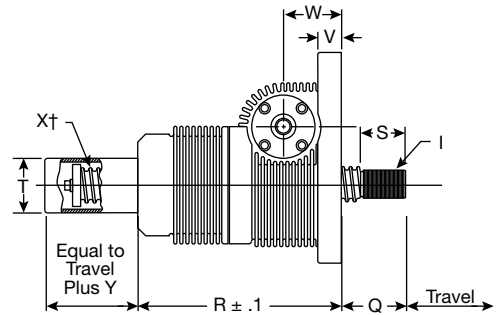
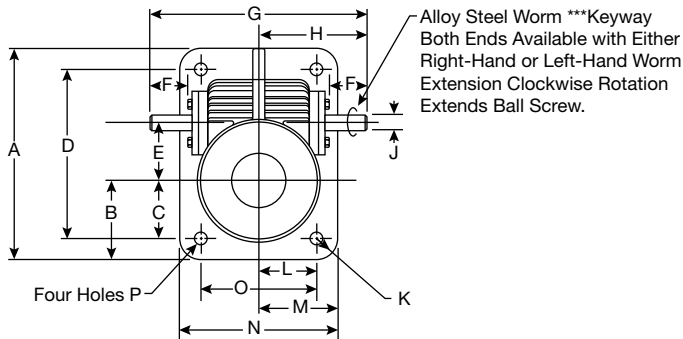
CONTINUOUS DUTY CYCLE ACTUATORS

7500 SERIES WITH TRANSLATING SCREW

Typical 7500 Series Actuator with Upright Translating Screw



Typical 7500 Series Actuator with Inverted Translating Screw



Specifications - Continuous Duty Cycle Actuators

Model Number	Dimensions (inches)					
	7511 Upright	7515 or 75151 Upright	7522 or 75221 Upright	7510 Inverted	7514 or 75141 Inverted	7521 or 75211 Inverted
A	7	8-3/4	13-3/4	7	8-3/4	13-3/4
B	2-3/4	2-7/8	5-1/8	2-3/4	2-7/8	5-1/8
C	2.20	2	3-3/4	2.20	2	3-3/4
D	6	7	11	6	7	11
E	+/- .001 1.703	+ .003 / - .000 2.598	+ .005 / - .000 3.750	+/- .001 1.703	+ .003 / - .000 2.598	+ .500 / - .001 3.750
F	1.12	1.68	2.38	1.12	1.68	2.38
G	8.6	11	14	8.6	11	14
H	4.3	5.5	7.0	4.3	5.5	7.0
I	3/4 16UNF -2A	1 14UNS -2A	1-3/4 12UN -2A	3/4 16UNF -2A	1 14UNS -2A	1-3/4 12UN -2A
J	+ .000 / - .002 .500	+ .000 / - .002 1.000	+ .001 / - .002 1.000	+ .000 / - .002 .500	+ .000 / - .002 1.000	+ .000 / - .002 1.000
K	1/2 R	7/8 R	1-3/8 R	1/2 R	7/8 R	1-3/8 R
L	2-1/4	2-7/8	3-3/4	2-1/4	2-7/8	3-3/4
M	2-3/4	3-3/4	5-1/8	2-3/4	3-3/4	5-1/8
N	5-1/2	7-1/2	10-1/4	5-1/2	7-1/2	10-1/4
O	4-1/2	5-3/4	7-1/2	4-1/2	5-3/4	7-1/2
P	13/32	11/16	13/16	13/32	11/16	13/16
Q*	+/- .06 10.4	+/- .10 11.2	+/- .10 16.6	+/- .06 10.4	+/- .10 11.2	+/- .10 16.6
R	+/- .06 8.4	+/- .10 9.2	+/- .10 13.2	+/- .06 8.4	+/- .10 9.2	+/- .10 13.2
S	1-1/8	1-1/8	2-1/4	1-1/8	1-1/8	2-1/4
T	1-21/32	2-3/8	3-1/2	1-21/32	2-3/8	3-1/2
U**	7 O.D. x 4 I.D.	7 O.D. x 4-3/4 I.D.	9.8 O.D. x 6.8 I.D.	7 O.D. x 4 I.D.	7 O.D. x 4-3/4 I.D.	9.8 O.D. x 6.8 I.D.
V	3/4	1	1-1/2	3/4	1	1-1/2
W	+/- .005 2.500	+/- .005 2.75	+/- .005 3.7500	+/- .005 2.500	+/- .005 2.750	+/- .005 3.7500
X†	1.171 Dia. 0.413 Lead	1.500 Dia. 0.474 Lead	2.25 Dia. 0.500 Lead	1.171 Dia. 0.413 Lead	1.50 Dia. 0.474 Lead	2.250 Dia. 0.500 Lead
Y	2	2	3	2	2	3
Z††	1.5	—	—	—	—	—

*Closed height

†Dimension includes diameter of ball screw with indicated lead for right-hand single thread.

**Bellows boot (optional)

††Hub Dia. for boot attachment

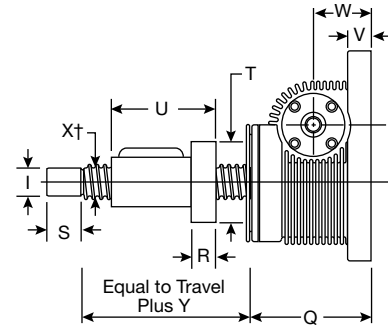
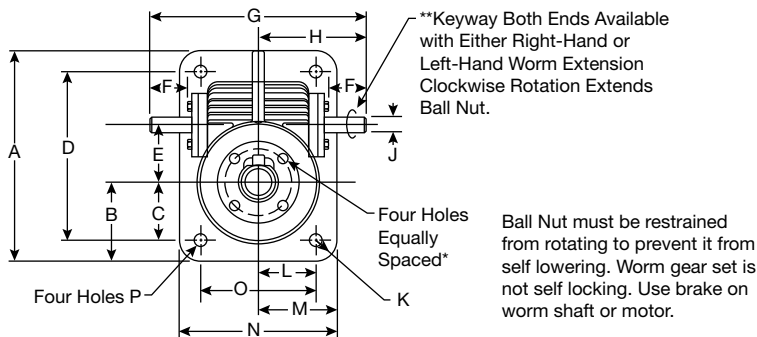
***Keyway for Model 7511 is 1/8 x 5/64 x 15/16 LG.

NOTE: When ordering, specify load and duty cycle. Keyway for Model 7515 & 7522 is 1/4 x 1/8 x 1 1/2

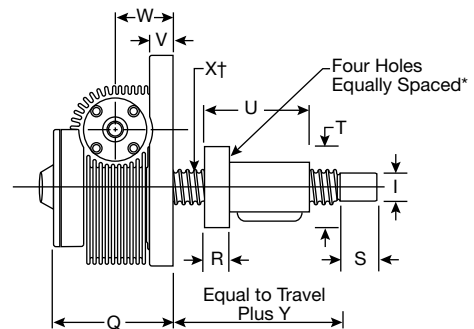
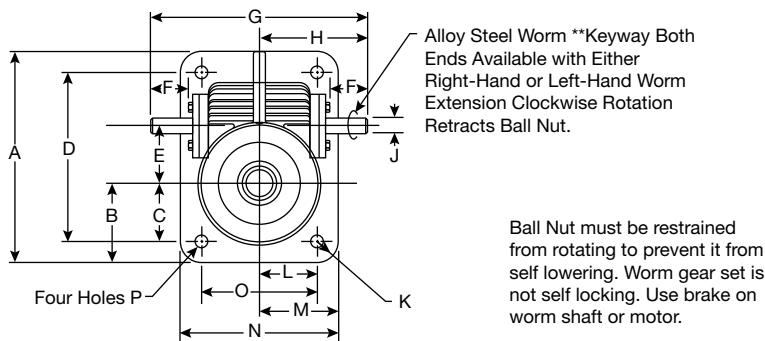
CONTINUOUS DUTY CYCLE ACTUATORS

7500 SERIES WITH ROTATING SCREW

Typical 7500 Series Actuator with Upright Rotating Screw



Typical 7500 Series Actuator with Inverted Rotating Screw



Specifications - Continuous Duty Cycle Actuator

Model Number	Dimensions (inches)					
	UM7512 Upright	UM7516 or UM75161 Upright	UM7523 or UM75231 Upright	DM7512 Inverted	DM7516 or DM75161 Inverted	DM7523 or DM75231 Inverted
A	7	8-3/4	13-3/4	7	8-3/4	13-3/4
B	2-3/4	2-7/8	5-1/8	2-3/4	2-7/8	5-1/8
C	2.20	2	3-3/4	2.20	2	3-3/4
D	6	7	11	6	7	11
E	+/- .001 1.703	+ .003 / - .000 2.598	+ .005 / - .000 3.750	+/- .001 1.703	+ .003 / - .000 2.598	+ .005 / - .000 3.750
F	1.12	1.68	2.38	1.12	1.68	2.38
G	8.6	11	14	8.6	11	14
H	4.3	5.5	7.0	4.3	5.5	7.0
I	+ .000 / - .002 0.750	+ .000 / - .002 1.000	+ .000 / - .002 1.750	+ .000 / - .002 0.750	+ .000 / - .002 1.000	+ .000 / - .002 1.750
J	+ .000 / - .002 0.500	+ .000 / - .002 1.000	+ .000 / - .002 1.000	+ .000 / - .002 0.500	+ .000 / - .002 1.000	+ .000 / - .002 1.000
K	1/2 R	7/8 R	1-3/8 R	1/2 R	7/8 R	1-3/8 R
L	2-1/4	2-7/8	3-3/4	2-1/4	2-7/8	3-3/4
M	2-3/4	3-3/4	5-1/8	2-3/4	3-3/4	5-1/8
N	5-1/2	7-1/2	10-1/4	5-1/2	7-1/2	10-1/4
O	4-1/2	5-3/4	7-1/2	4-1/2	5-3/4	7-1/2
P	13/32	11/16	13/16	13/32	11/16	13/16
Q*	+/- .1 5-1/4	+/- .1 5-3/4	+/- .1 7-3/4	+/- .1 5-1/4	+/- .1 5-3/4	+/- .1 7-3/4
R	.832	.985	+/- .10 1.582	.832	.895	+/- .10 1.582
S	1.13	1	2-1/4	1.13	1	2-1/4
T	4.250	4.937	5.375	4.250	4.937	5.375
U	3.395	4.33 Std. or 3.65 HL	6.706 Std. or 6.739 HL	3.395	4.33 Std. or 3.65 HL	6.706 Std. or 6.739 HL
V	3/4	1	1-1/2	3/4	1	1-1/2
W	+/- .005 2.500	+/- .005 2.750	+/- .005 3.7500	+/- .005 2.500	+/- .005 2.750	+/- .005 3.7500
X†	1.171 Dia. 0.413 Lead	1.500 Dia. 0.474 Lead	2.250 Dia. 0.500 Lead	1.171 Dia. 0.413 Lead	1.500 Dia. 0.474 Lead	2.250 Dia. 0.500 Lead
Y	3.75	4.75	8.0	3.75	4.75	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.

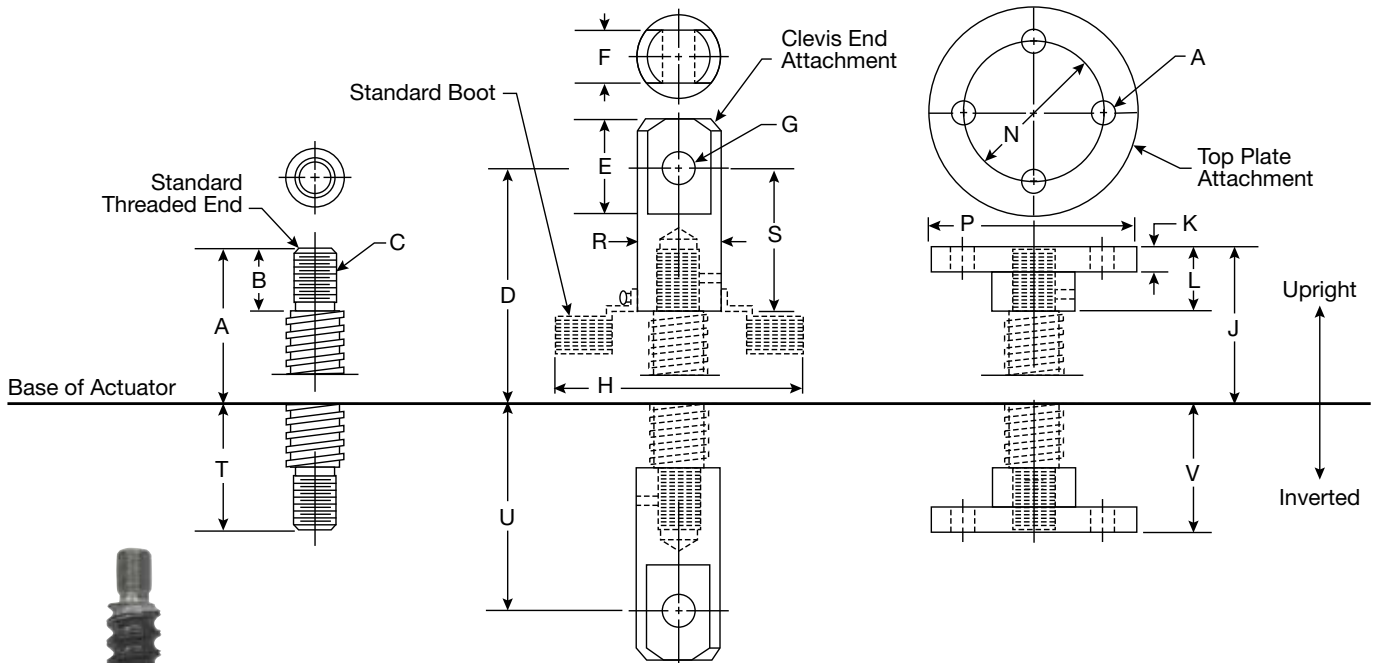
Keyway for Models UM-7516 & UM-7523 is 1/4 x 1/8 x 1 1/2.

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.

CONTINUOUS DUTY CYCLE ACTUATORS

7500 SERIES STANDARD SCREW ENDS



Model No.	Dimensions (inches)								
	A	B	C	D*	E	F	G	H	J*
7511	10-3/8	1-1/8	3/4"-16-UNF-2A	11-1/2	3/4	1	1/2" +.800/-0.000	7	10-7/16
7515	11-1/4	1-1/8	1"-14-UNS-2A	13	1-1/4	1-1/4	3/4" =.010/-0.000	7	11-1/4
7522	16-5/8	2-1/4	1-3/4"-12un-2A	19-1/8	1-3/4	1-3/4	1-1/4" +.010/-0.000	9-13/16	16-5/8

Model No.	Dimensions (inches)									
	K	L	M	N	P	R	S	T*	U*	V*
7511	7/16	1-3/16	13/32	3	4-1/4	1-1/2	2-1/4	2	3-1/8	2-1/6
7515	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	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 yet keyed. Must be held to prevent rotation.

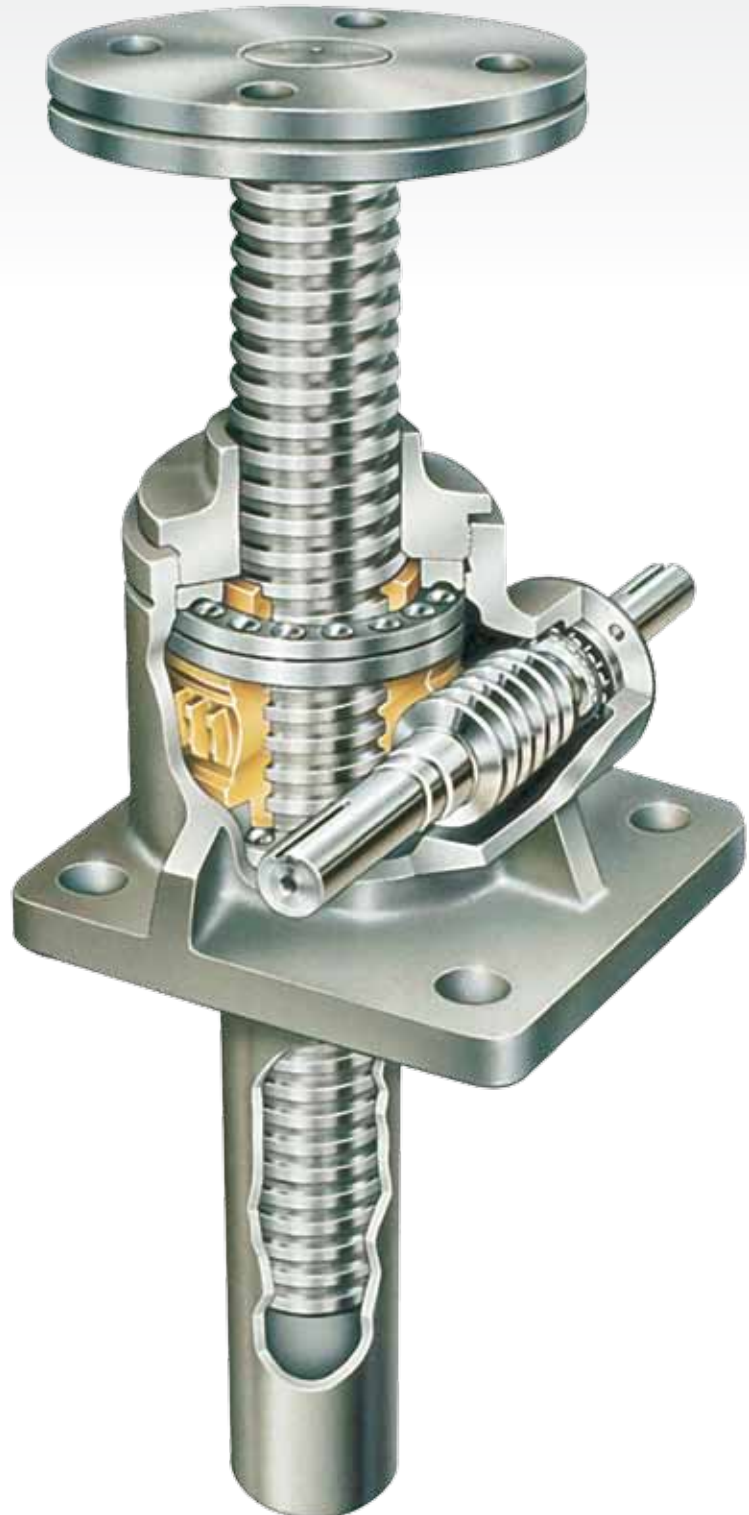
G SERIES METRIC MACHINE SCREW ACTUATORS

5 kN TO 500 kN

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

FEATURES

- Load Capacities in Tonnes.
- Mounting dimensions in millimeters.
- Metric screw diameters with trapezoidal threads. (Machine screw actuators)
- Metric shaft and keyway sizes per ISO recommended standards.
- All metric fasteners on machine screw units.
- Metric bolt centers.
- Other sizes and models available, contact Duff-Norton for more information.



METRIC MACHINE SCREW ACTUATORS

MODEL NUMBERING SYSTEM

G - 9002 - MV - 120 - 1R

G - Metric Base Model

Series & Capacity No.

Series:

50kN - 500kN
Machine Screw (90xx)
Special MS (100xx)

5kN - 25kN
Machine Screw (9225, 2501, 9002)
Special MS (3625, 3501, 10002)

Capacities:

Last two digits of model number indicate capacity

Travel

1 mm increment travels are always represented using the exact travel amount.

Serialized digits in this position may also be used for other models containing special features

Model Suffix

B - Boot
L - Single End Worm Ext. Left
R - Single End Worm Ext. Right
1 - Optional Ratio #1
2 - Optional Ratio #2
X - Supplied without cover pipe, but with guide bushing.

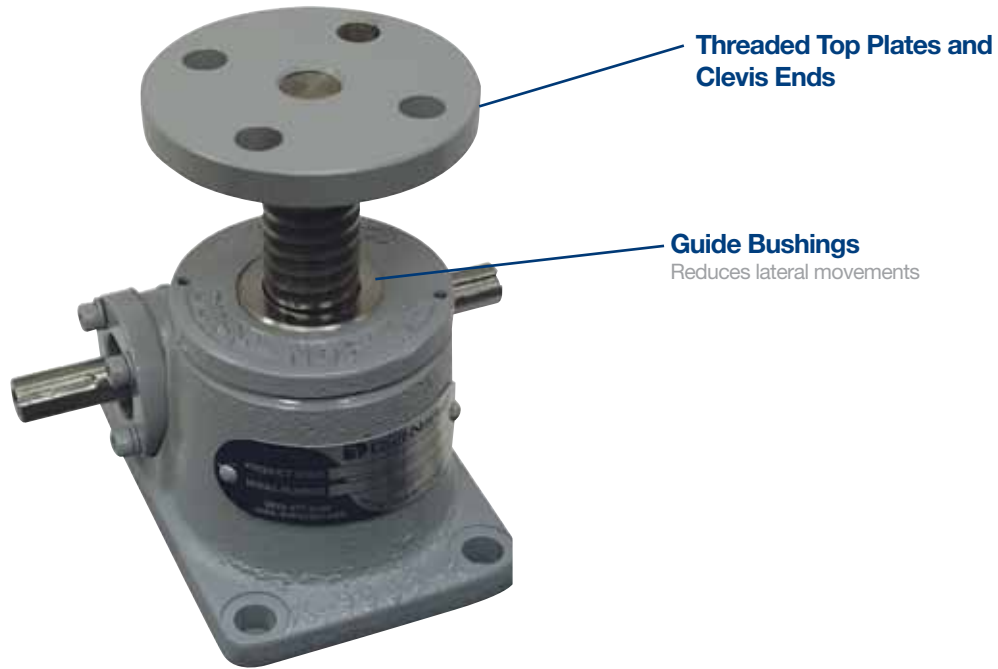
Screw End, Configuration, and Options. All that apply.

(none) - Upright translating
A - Anti-backlash
C - Clevis
CC - Double clevis
D - Inverted rotating
F - Flange for motor
K - Keyed screw
L - Limit switch
M - Top plate
P - Plain end
R - Gear reducer
S - Stainless
T - Threaded end
U - Upright rotating
V - Inverted

METRIC MACHINE SCREW

ACTUATORS

PERFORMANCE SPECIFICATIONS



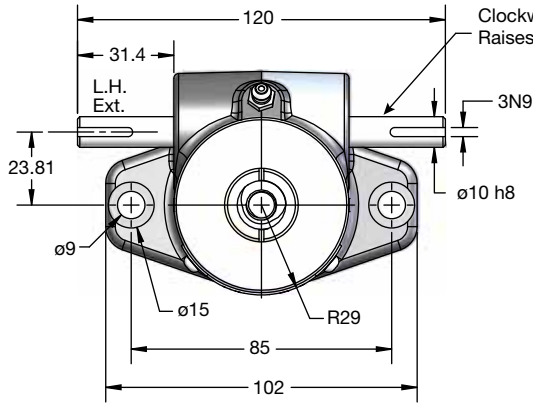
Specifications - Metric Machine Screw Actuator										
Capacity (kN)		5	10	25	50	100	150	200	300	500
Lifting Screw	Diameter (mm)	16	20	30	38	52	58	65	95	115
	Lead (mm)	3	5	6	9	12	12	12	16	16
	Type	Metric Trapezoidal	Metric Trapezoidal	Metric Trapezoidal	Metric Trapezoidal	Metric Trapezoidal	Metric Trapezoidal	Metric Trapezoidal	Metric Trapezoidal	Metric Trapezoidal
Worm Gear Ratios	Standard	5:1	5:1	6:1	6:1	8:1	8:1	8:1	10-2/3:1	10-2/3:1
	Optional No. 1	—	20:1	24:1	24:1	24:1	24:1	24:1	32:1	32:1
	Optional No. 2	—	—	12:1	12:1	—	—	—	—	—
Travel per Worm Turn (mm)	Standard	0.60	1.00	1.00	1.50	1.50	1.50	1.50	1.50	1.50
	Optional No. 1	—	0.25	0.25	0.38	0.50	0.50	0.50	0.50	0.50
	Optional No. 2	—	—	0.50	0.75	—	—	—	—	—
Worm Torque at No Load (N-m)	Standard	0.23	0.56	0.56	1.13	2.26	2.26	3.39	5.65	11.3
	Optional No. 1	—	0.56	0.56	1.13	2.26	2.26	3.39	5.65	11.3
	Optional No. 2	—	—	0.56	1.13	—	—	—	—	—
Maximum Input Power (kW)	Standard	0.25	0.37	1.49	2.98	3.73	3.73	3.73	6.00	11.2
	Optional No. 1	—	0.19	0.37	0.56	1.12	1.12	1.12	1.86	4.50
	Optional No. 2	—	—	0.56	1.49	—	—	—	—	—
Worm Torque at Full Load (N-m)	Standard	2.83	7.53	20.10	56.78	117.1	189.2	275.4	505.7	915.5
	Optional No. 1	—	3.69	9.34	27.06	63.2	101.4	147.7	305.3	520.5
	Optional No. 2	—	—	12.8	36.65	—	—	—	—	—
Efficiency Rating (%)	Standard	16.9	21.1	19.8	21.0	20.4	18.9	17.3	14.2	13.0
	Optional No. 1	—	10.8	10.7	11.0	12.6	11.8	10.8	7.8	7.6
	Optional No. 2	—	—	15.5	16.3	—	—	—	—	—
Weight with 25mm Raise (kg)		1.04	2.27	7.71	15.88	23.59	29.94	42.18	100	173
Weight per Additional 25mm Raise (kg)		0.04	0.13	0.13	0.40	0.63	0.67	1.16	1.65	2.46
Key Torque (N-m)		8.48	22.80	76.61	213.37	579.94	943.98	1374.01	2954.25	5746.55
Max Worm Speed at Full Load (rpm)	Standard	844	469	708	501	304	188	129	113	117
	Optional No. 1	—	491	378	198	169	105	72	58	83
	Optional No. 2	—	—	418	388	—	—	—	—	—
Maximum Load at Maximum Power and 1450 rpm (kN)	Standard	2.73	2.69	11.84	16.62	19.42	17.90	15.57	20.32	34.54
	Optional No. 1	—	2.21	5.34	4.93	8.40	7.74	5.52	6.61	18.01
	Optional No. 2	—	—	6.39	12.22	—	—	—	—	—

*For loads from 25% to 100% of actuator capacity, torque requirements are approximately proportional to the load. Raises, measured in increments of 25mm, are available up to 6.1 meters, depending on lifting screw diameter and available bar stock length.

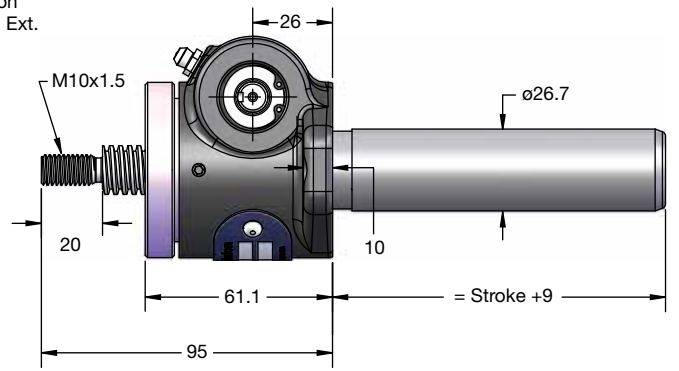
Note: Contact customer service for motorized performance.

METRIC MACHINE SCREW ACTUATORS

5 kN CAPACITY

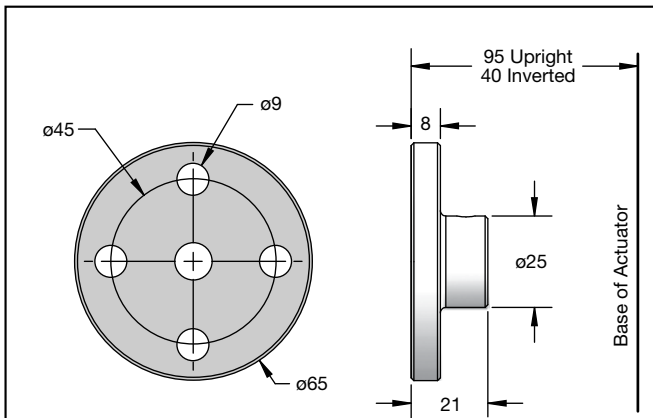


Top View: G9225T

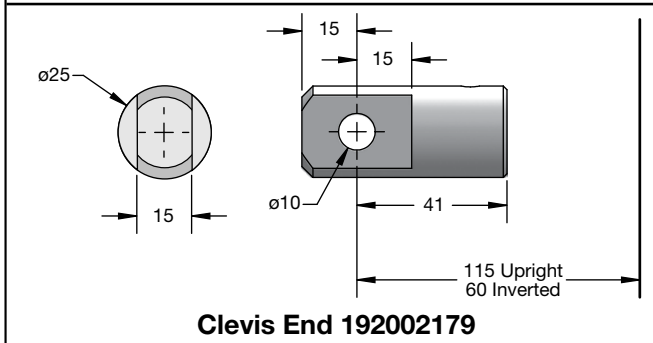


Upright: G9225T

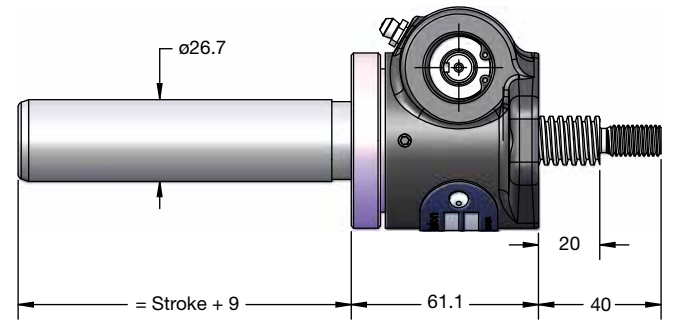
16mm O.D. x 3mm Lead Lifting Screws



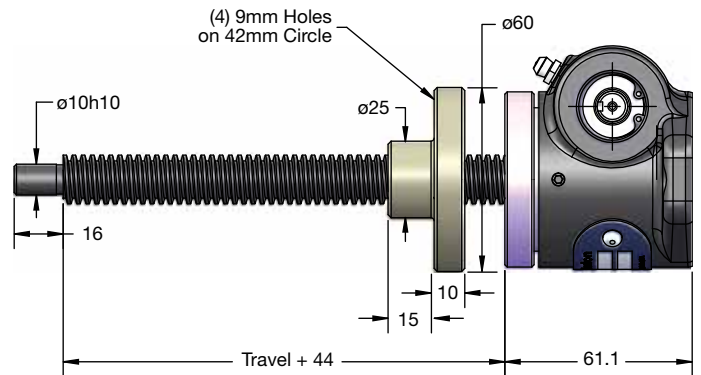
Top Plate 192002178



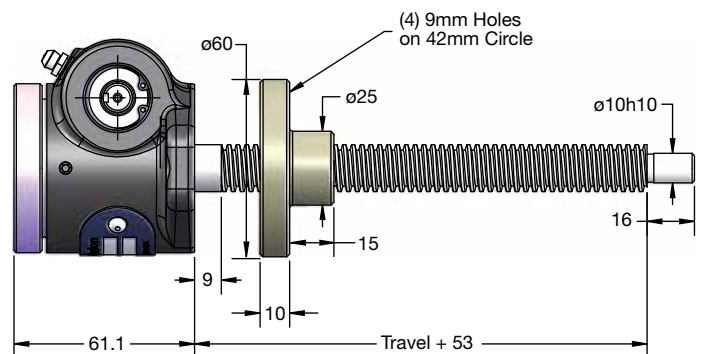
Clevis End 192002179



Inverted: G9225TV



Upright Rotating: G9225U

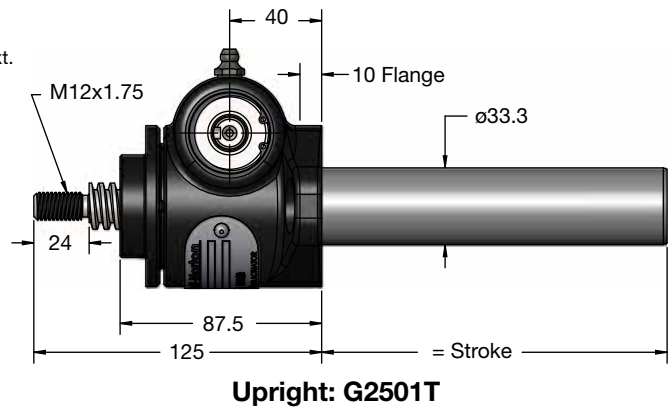
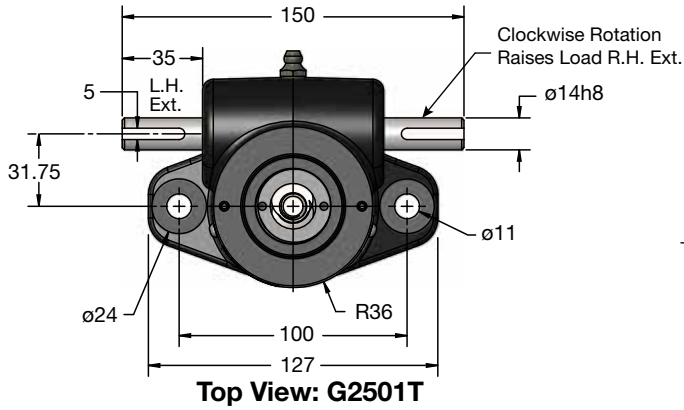


Inverted Rotating: G9225D

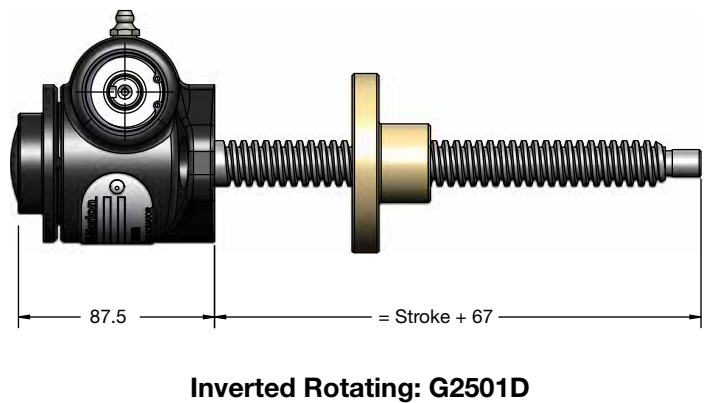
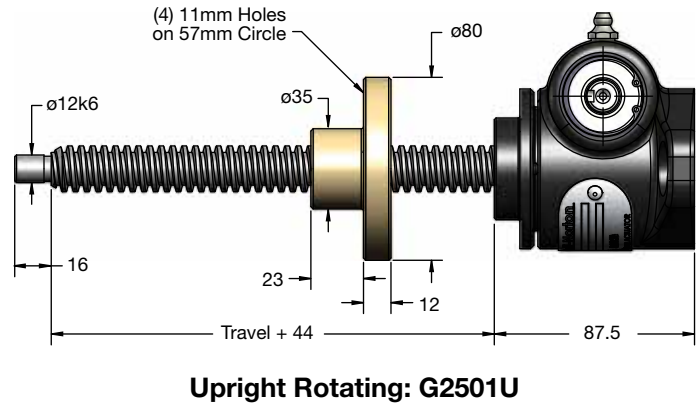
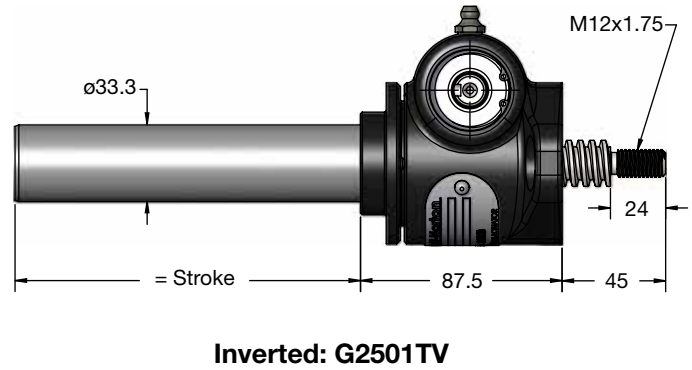
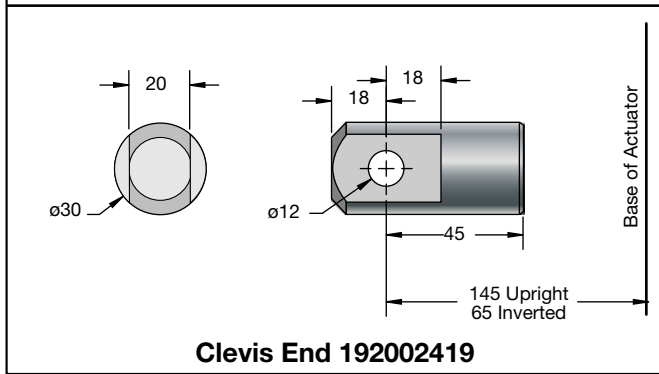
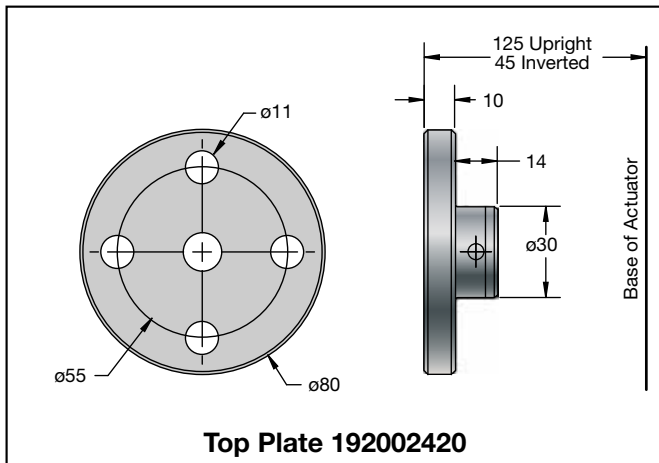
METRIC MACHINE SCREW

ACTUATORS

10 kN CAPACITY

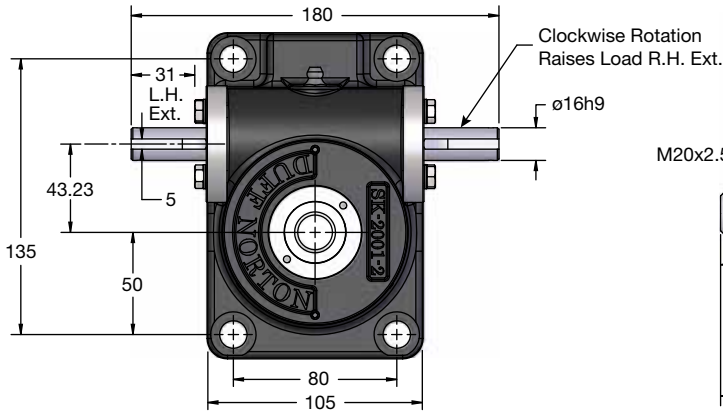


20mm O.D. 5mm Lead Lifting Screws

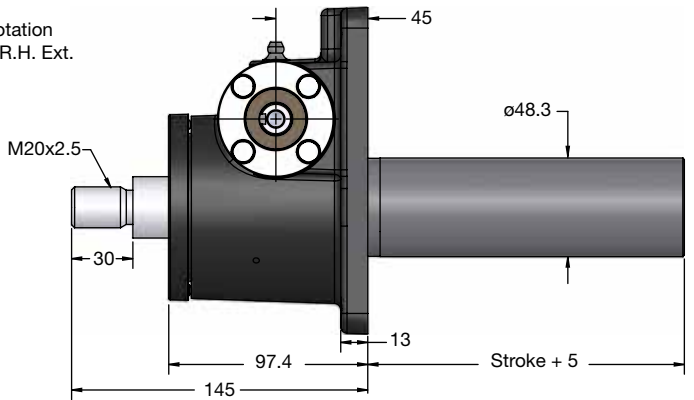


METRIC MACHINE SCREW ACTUATORS

25 kN CAPACITY

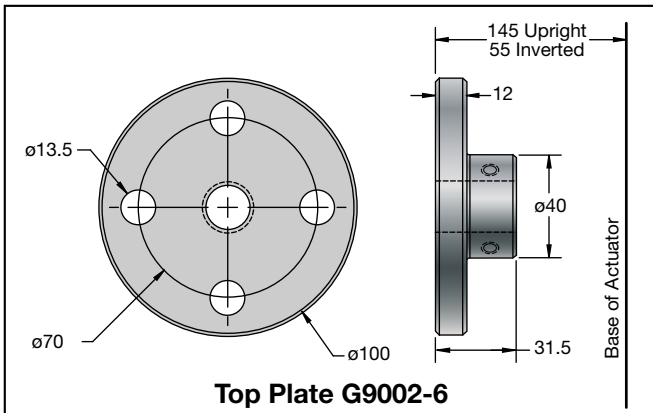


Top View: G9002T

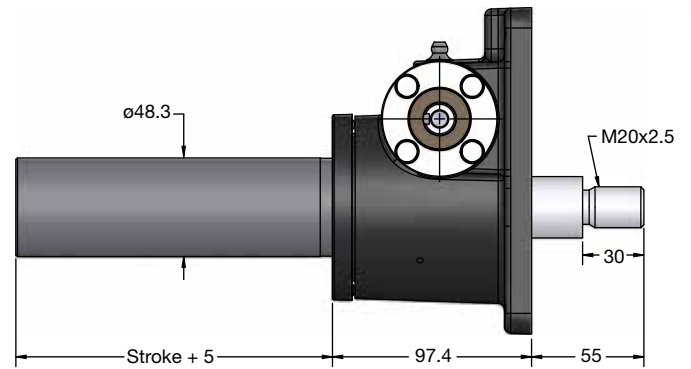


Upright: G9002T

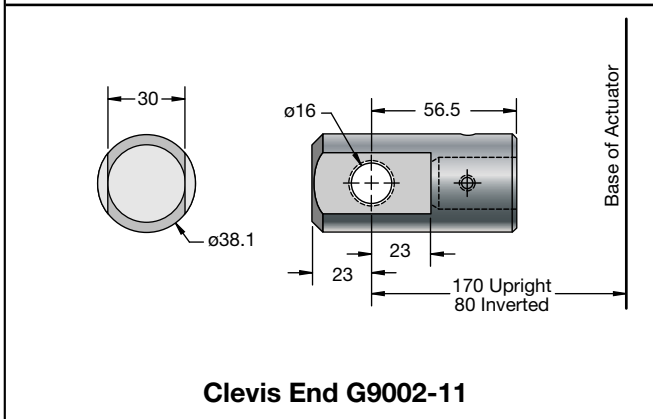
30mm O.D. 6mm Lead Lifting Screws



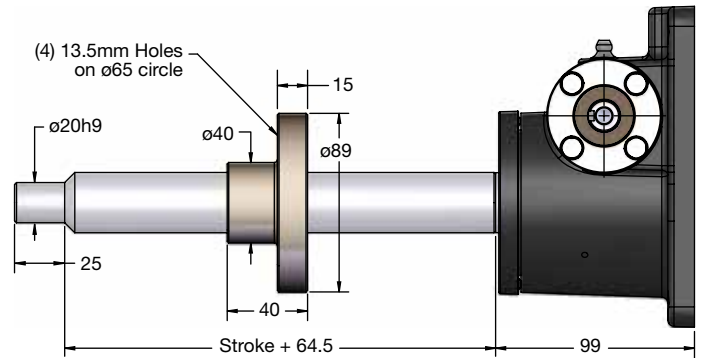
Top Plate G9002-6



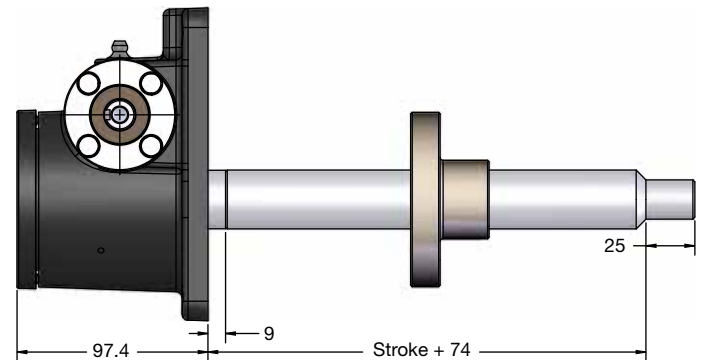
Inverted: G9002TV



Clevis End G9002-11



Upright Rotating: G9002U

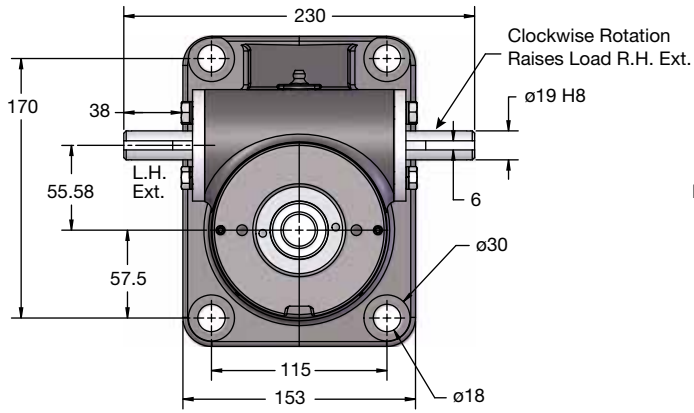


Inverted Rotating: G9002D

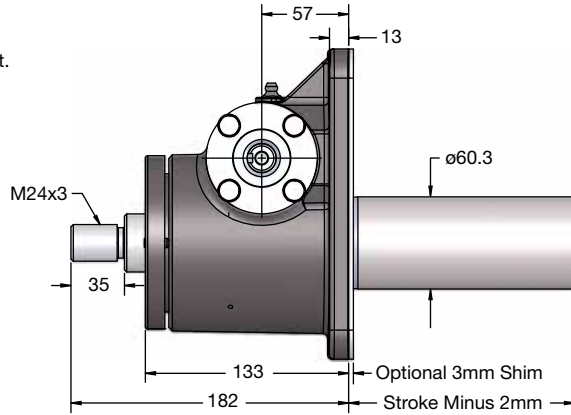
METRIC MACHINE SCREW

ACTUATORS

50 kN CAPACITY

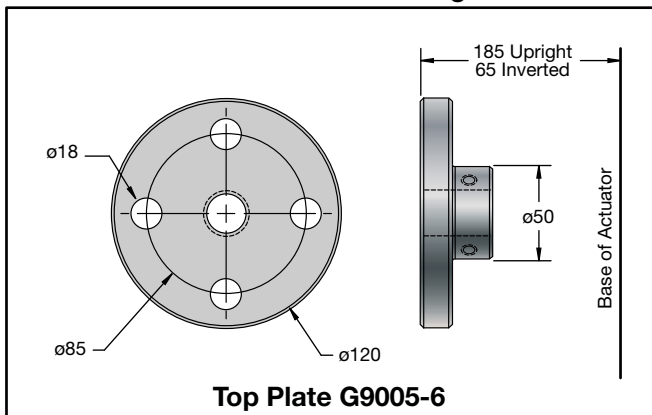


Top View: G9005T

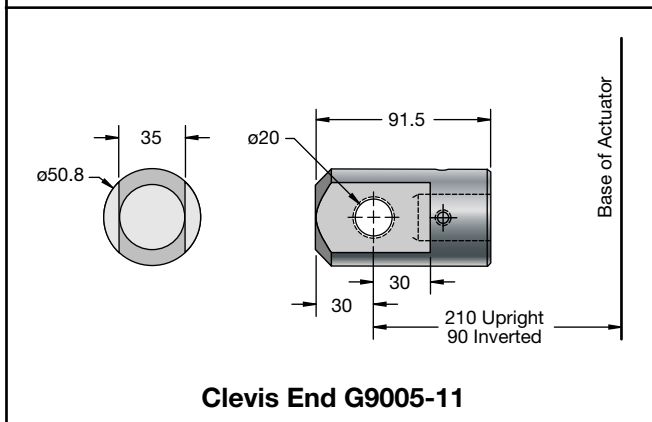


Upright: G9005T

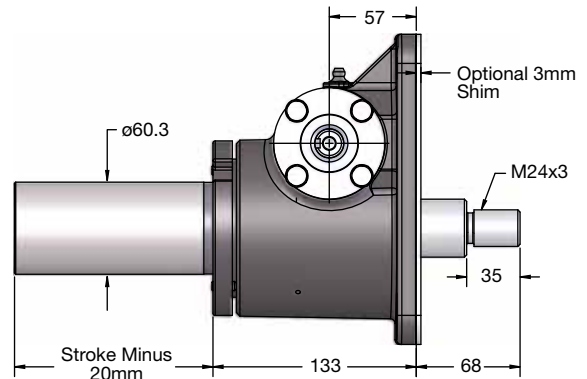
30mm O.D. 9mm Lead Lifting Screws



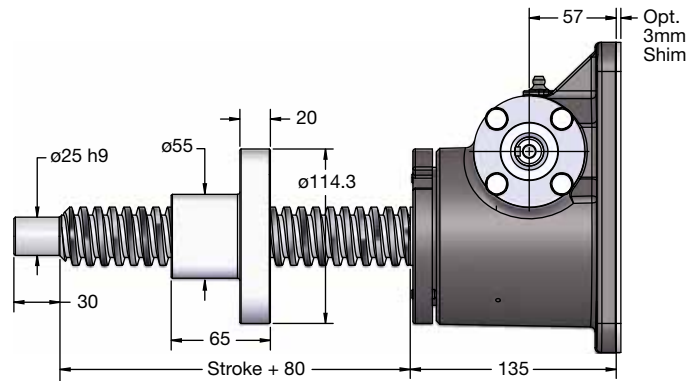
Top Plate G9005-6



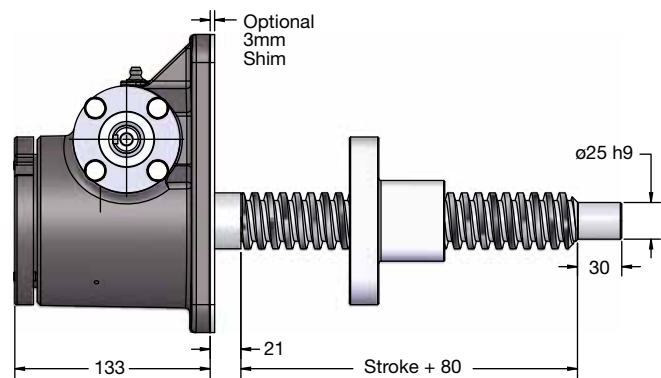
Clevis End G9005-11



Inverted: G9005TV



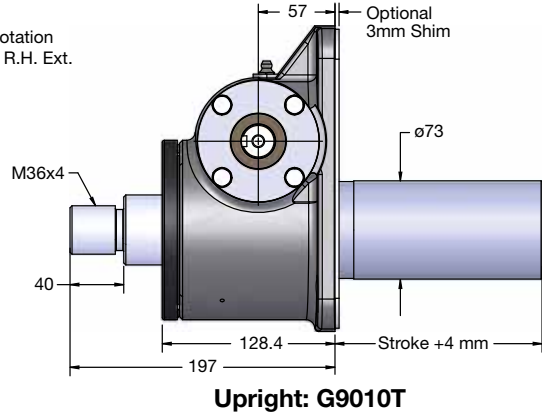
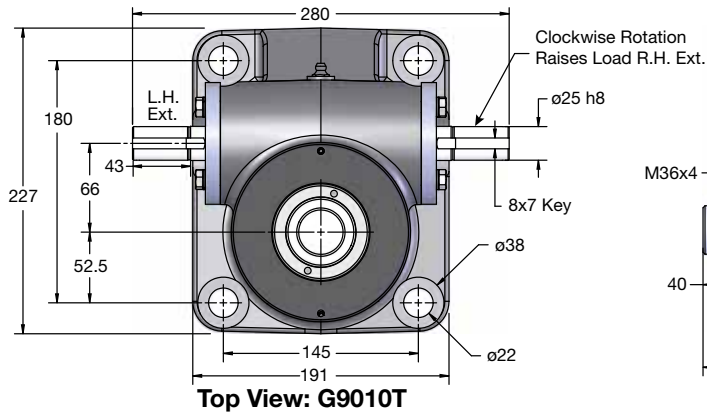
Upright Rotating: G9005U



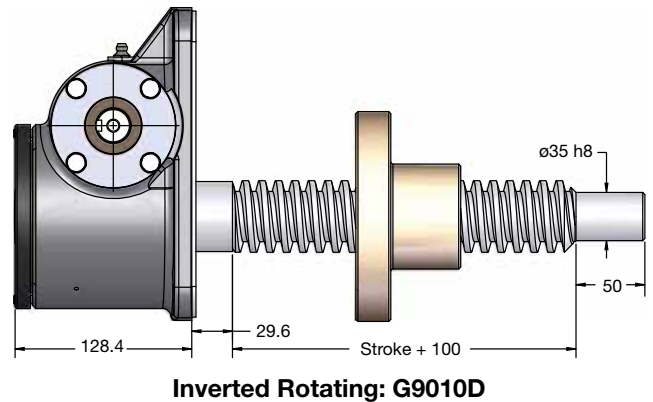
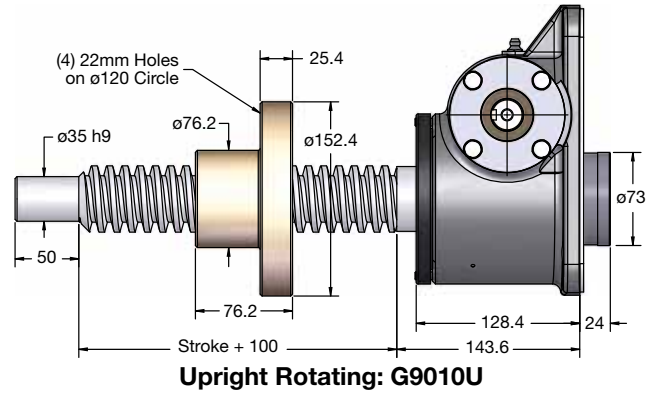
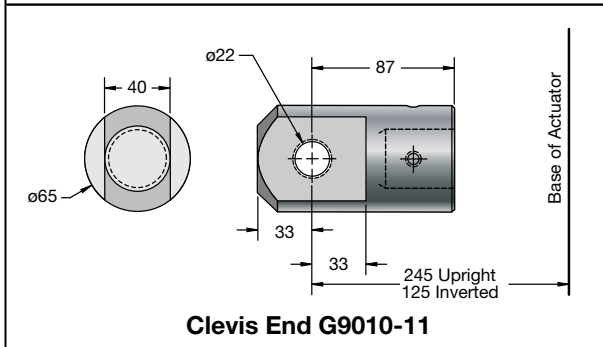
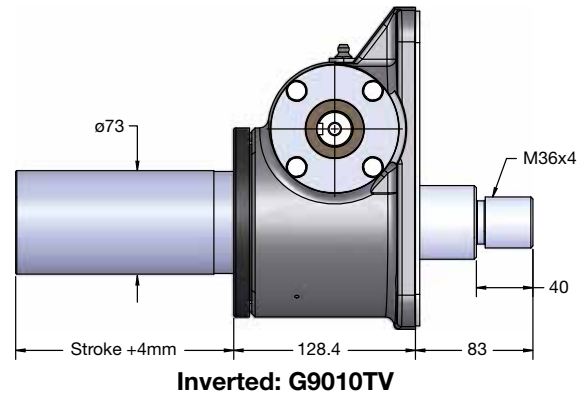
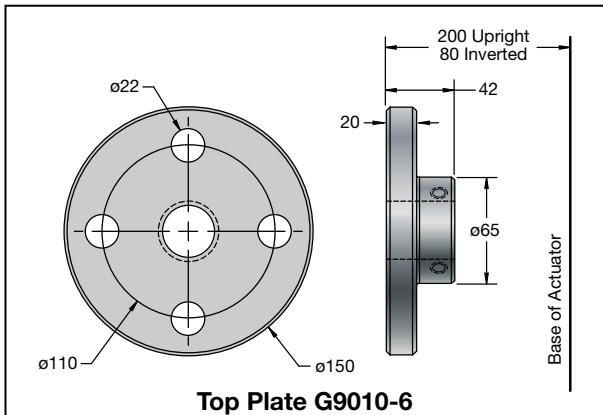
Inverted Rotating: G9005D

METRIC MACHINE SCREW ACTUATORS

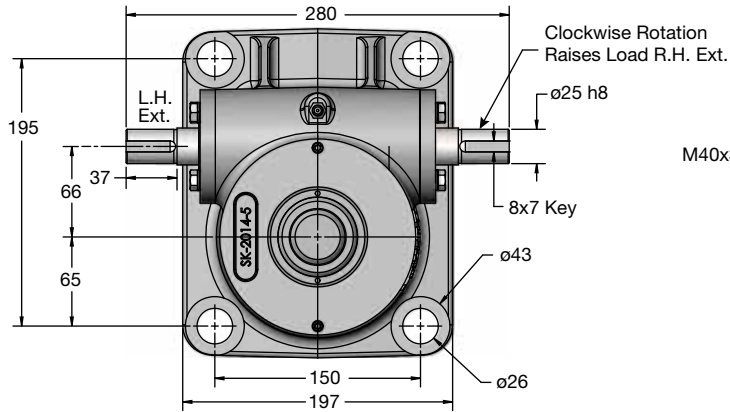
100 kN CAPACITY



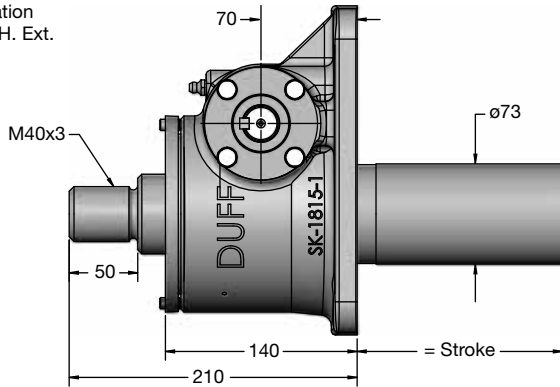
52mm O.D. x 912m Lead Lifting Screws



METRIC MACHINE SCREW ACTUATORS 150 kN CAPACITY

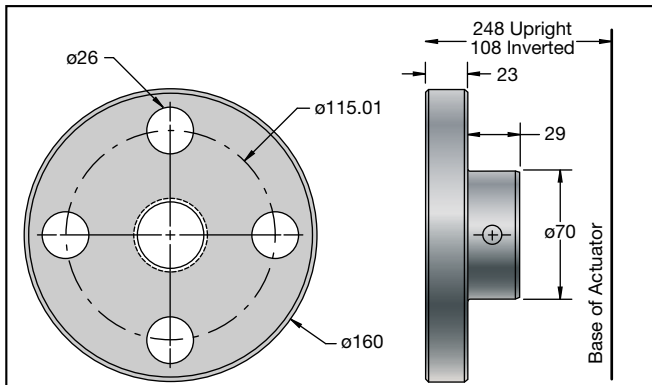


Top View: G9015T

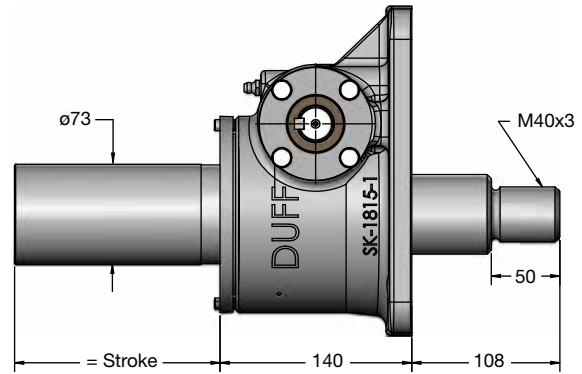


Upright: G9015T

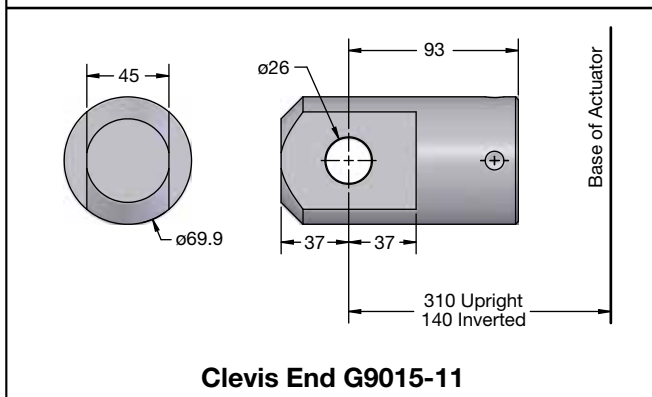
58mm O.D. x 12mm Lead Lifting Screws



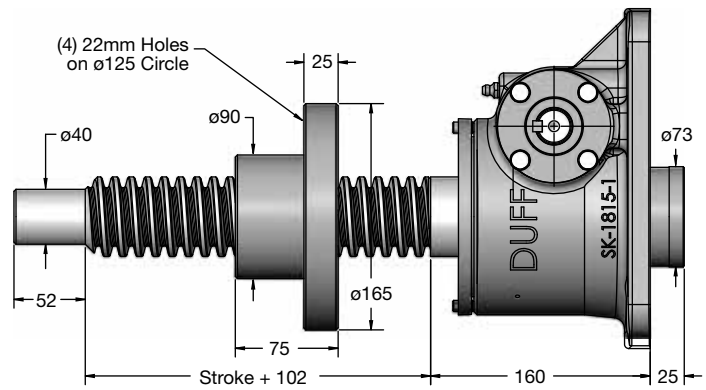
Top Plate G9015-6



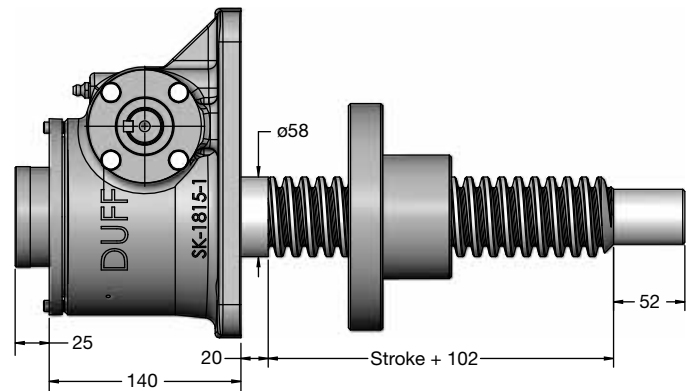
Inverted: G9015TV



Clevis End G9015-11



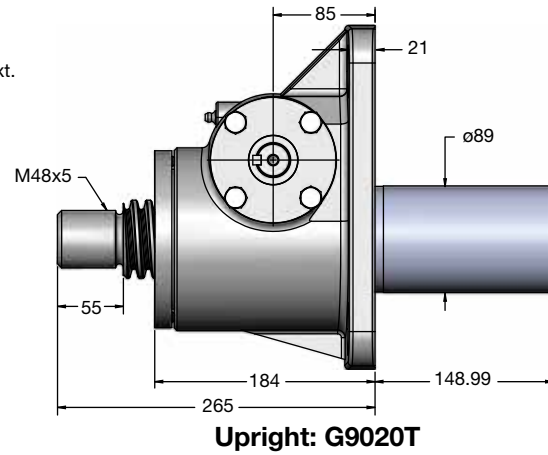
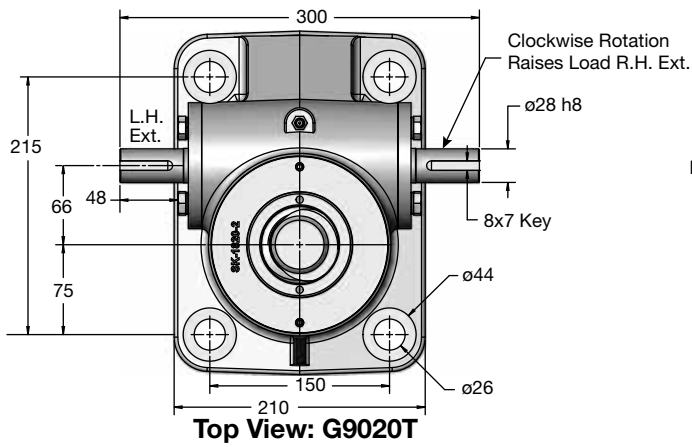
Upright Rotating: G9015U



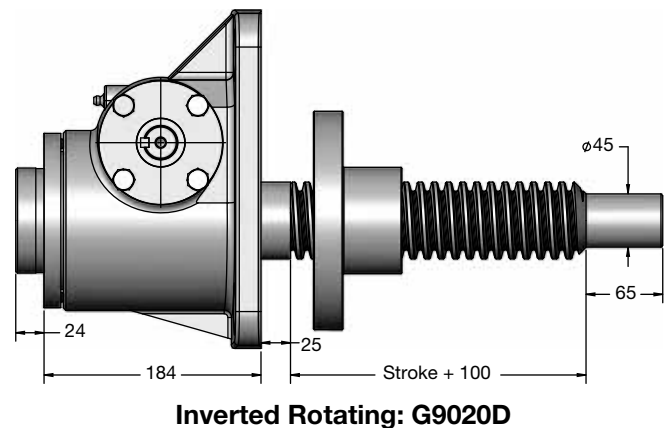
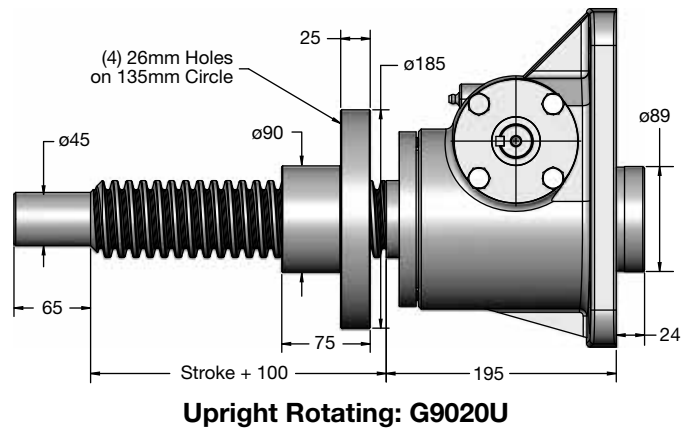
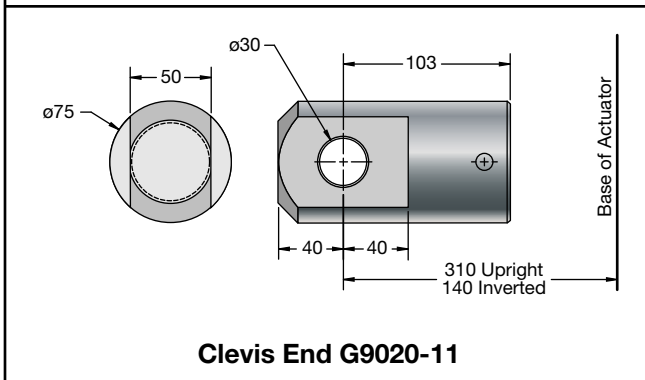
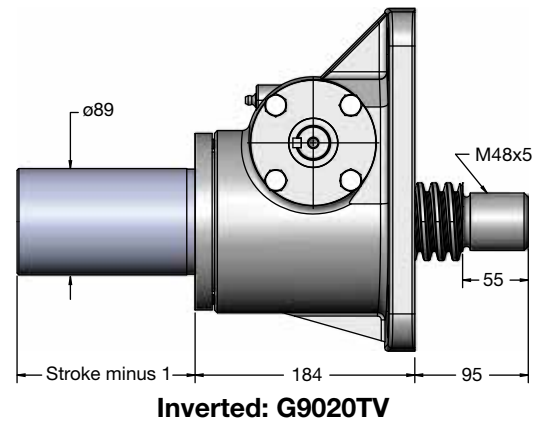
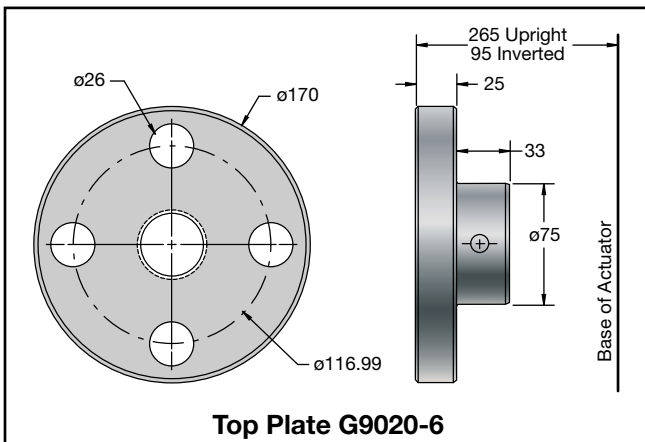
Inverted Rotating: G9015D

METRIC MACHINE SCREW ACTUATORS

200 kN CAPACITY



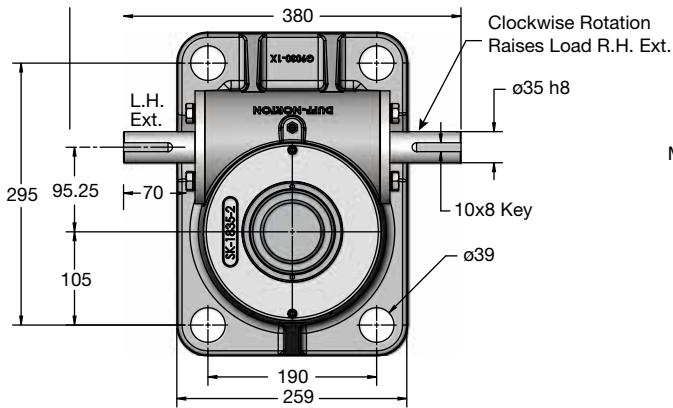
65mm O.D. x 12mm Lead Lifting Screws



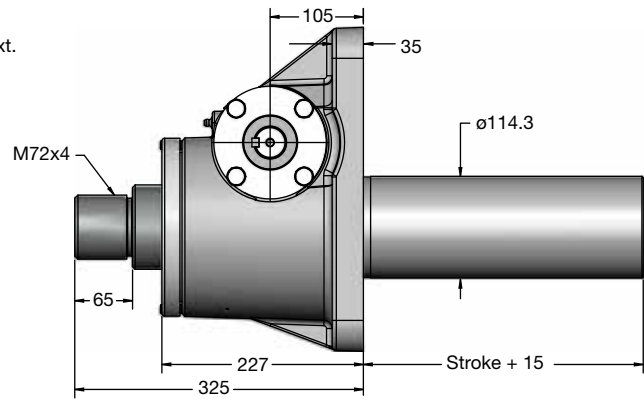
METRIC MACHINE SCREW

ACTUATORS

300 kN CAPACITY

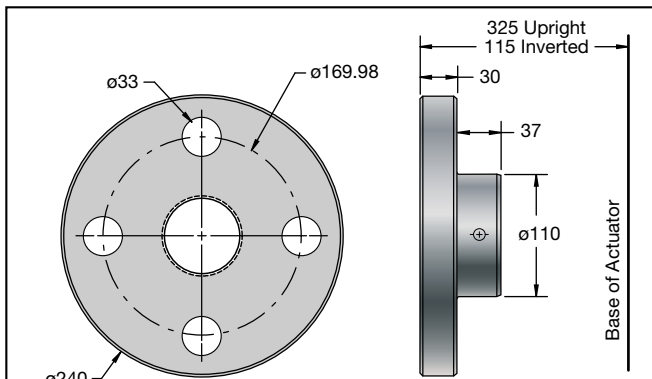


Top View: G9030T

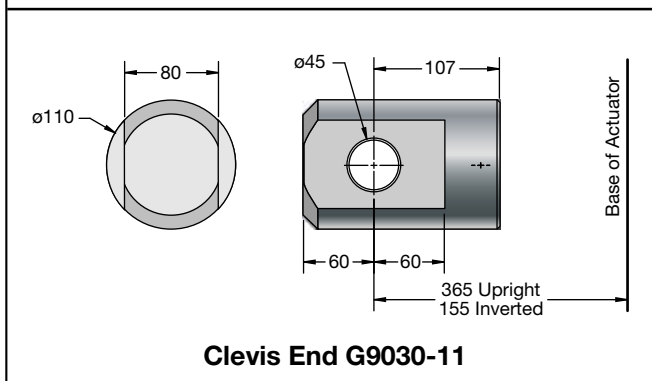


Upright: G9030T

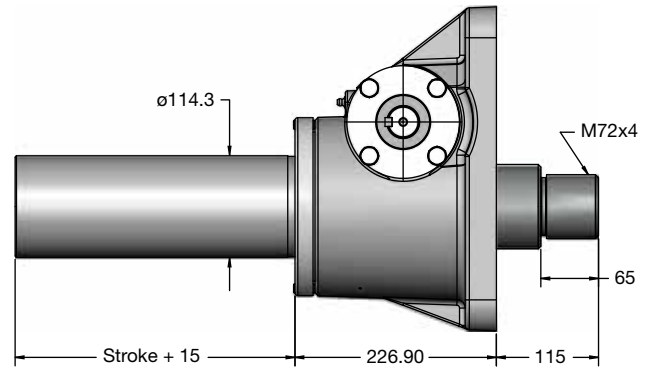
95mm O.D. x 16mm Lead Lifting Screws



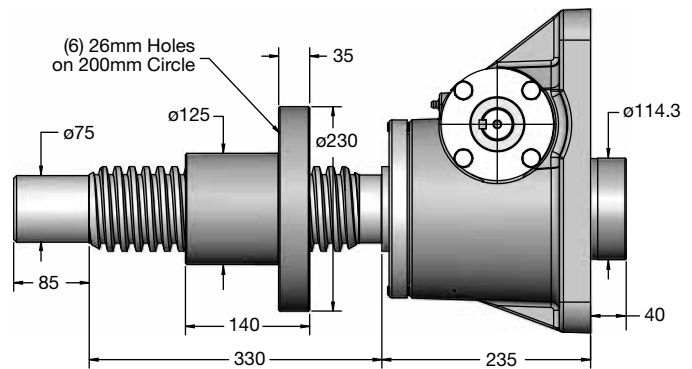
Top Plate G9030-6



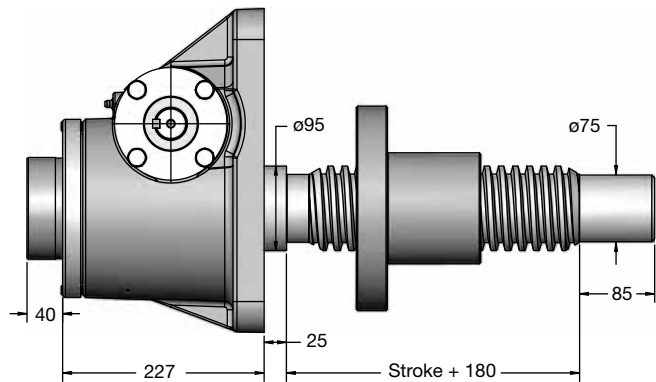
Clevis End G9030-11



Inverted: G9030TV



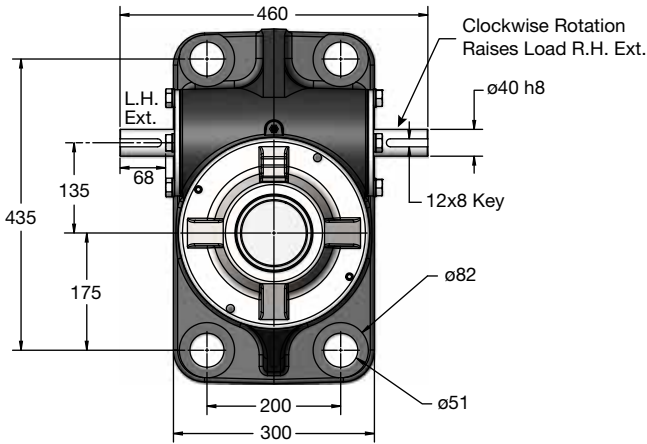
Upright Rotating: G9030U



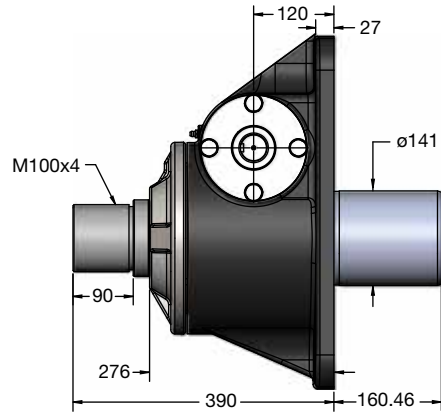
Inverted Rotating: G9030D

METRIC MACHINE SCREW ACTUATORS

500 kN CAPACITY

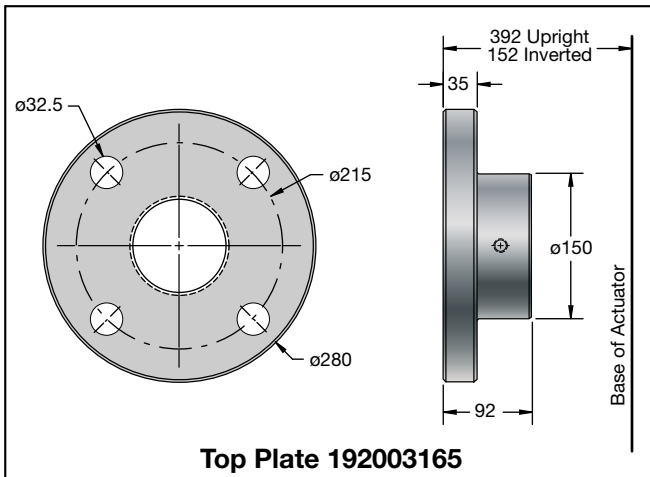


Top View: G9050T

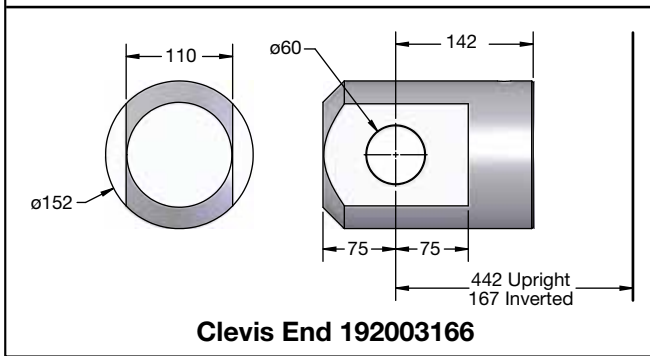


Upright: G9050T

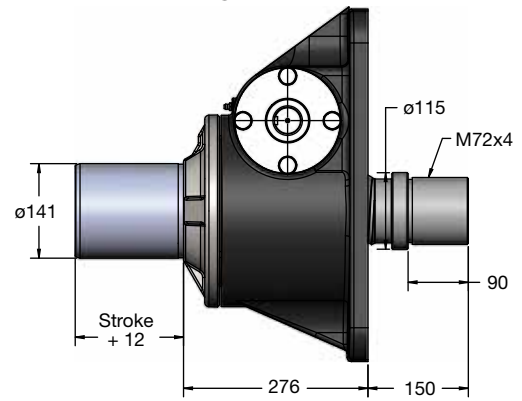
115mm O.D. x 16mm Lead Lifting Screws



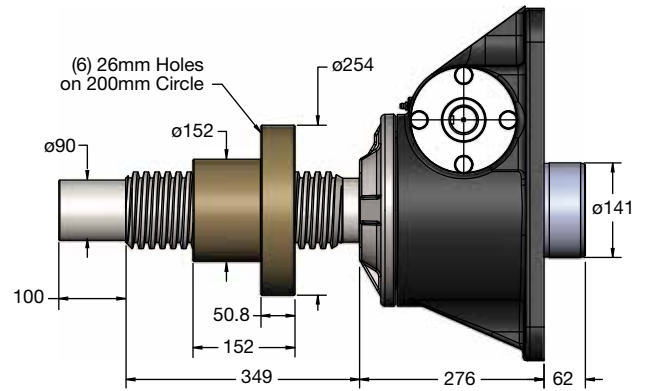
Top Plate 192003165



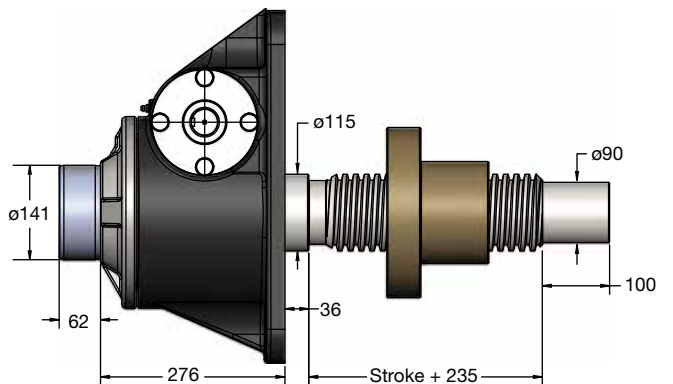
Clevis End 192003166



Inverted: G9050TV



Upright Rotating: G9050U



Inverted Rotating: G9050D

METRIC ANTI-BACKLASH ACTUATORS

MODEL NUMBERING SYSTEM

G - 9002 - AMV - 120 - 1R

G - Metric Base Model

Series & Capacity No.

Series:

50kN - 500kN
Machine Screw (90xx)
Special MS (100xx)

5kN - 25kN
Machine Screw (9225, 2501, 9002)
Special MS (3625, 3501, 10002)

Capacities:

Last two digits of model number indicate capacity

Travel

1 mm increment travels are always represented using the exact travel amount.

Serialized digits in this position may also be used for other models containing special features

Model Suffix

- B** - Boot
- L** - Single End Worm Ext. Left
- R** - Single End Worm Ext. Right
- 1** - Optional Ratio #1
- 2** - Optional Ratio #2
- X** - Supplied without cover pipe, but with guide bushing.

Screw End, Configuration, and Options. All that apply.

- (none)** - Upright translating
- A** - Anti-backlash
- C** - Clevis
- CC** - Double clevis
- D** - Inverted rotating
- F** - Flange for motor
- K** - Keyed screw
- L** - Limit switch
- M** - Top plate
- P** - Plain end
- R** - Gear reducer
- S** - Stainless
- T** - Threaded end
- U** - Upright rotating
- V** - Inverted

Specifications - Metric Machine Screw Actuator										
Capacity (kN)		5	10	25	50	100	150	200	300	500
Lifting Screw	Diameter (mm)	16	20	30	38	52	58	65	95	115
	Lead (mm)	3	5	6	9	12	12	12	16	16
	Type	Metric Trapezoidal	Metric Trapezoidal	Metric Trapezoidal	Metric Trapezoidal	Metric Trapezoidal	Metric Trapezoidal	Metric Trapezoidal	Metric Trapezoidal	Metric Trapezoidal
Worm Gear Ratios	Standard	5:1	5:1	6:1	6:1	8:1	8:1	8:1	10-2/3:1	10-2/3:1
	Optional No. 1	—	20:1	24:1	24:1	24:1	24:1	24:1	32:1	32:1
	Optional No. 2	—	—	12:1	12:1	—	—	—	—	—
Travel per Worm Turn (mm)	Standard	0.60	1.00	1.00	1.50	1.50	1.50	1.50	1.50	1.50
	Optional No. 1	—	0.25	0.25	0.38	0.50	0.50	0.50	0.50	0.50
	Optional No. 2	—	—	0.50	0.75	—	—	—	—	—
Worm Torque at No Load (N-m)	Standard	0.23	0.56	0.56	1.13	2.26	2.26	3.39	5.65	11.3
	Optional No. 1	—	0.56	0.56	1.13	2.26	2.26	3.39	5.65	11.3
	Optional No. 2	—	—	0.56	1.13	—	—	—	—	—
Maximum Input Power (kW)	Standard	0.25	0.37	1.49	2.98	3.73	3.73	3.73	6.00	11.2
	Optional No. 1	—	0.19	0.37	0.56	1.12	1.12	1.12	1.86	4.50
	Optional No. 2	—	—	0.56	1.49	—	—	—	—	—
Worm Torque at Full Load (N-m)	Standard	2.83	7.53	20.10	56.78	117.1	189.2	275.4	505.7	915.5
	Optional No. 1	—	3.69	9.34	27.06	63.2	101.4	147.7	305.3	520.5
	Optional No. 2	—	—	12.8	36.65	—	—	—	—	—
Efficiency Rating (%)	Standard	16.9	21.1	19.8	21.0	20.4	18.9	17.3	14.2	13.0
	Optional No. 1	—	10.8	10.7	11.0	12.6	11.8	10.8	7.8	7.6
	Optional No. 2	—	—	15.5	16.3	—	—	—	—	—
Weight with 25mm Raise (kg)		1.04	2.27	7.71	15.88	23.59	29.94	42.18	100	173
Weight per Additional 25mm Raise (kg)		0.04	0.13	0.13	0.40	0.63	0.67	1.16	1.65	2.46
Key Torque (N-m)		8.48	22.80	76.61	213.37	579.94	943.98	1374.01	2954.25	5746.55
Max Worm Speed at Full Load (rpm)	Standard	844	469	708	501	304	188	129	113	117
	Optional No. 1	—	491	378	198	169	105	72	58	83
	Optional No. 2	—	—	418	388	—	—	—	—	—
Maximum Load at Maximum Power and 1450 rpm (kN)	Standard	2.73	2.69	11.84	16.62	19.42	17.90	15.57	20.32	34.54
	Optional No. 1	—	2.21	5.34	4.93	8.4	7.74	5.52	6.61	18.01
	Optional No. 2	—	—	6.39	12.22	—	—	—	—	—

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

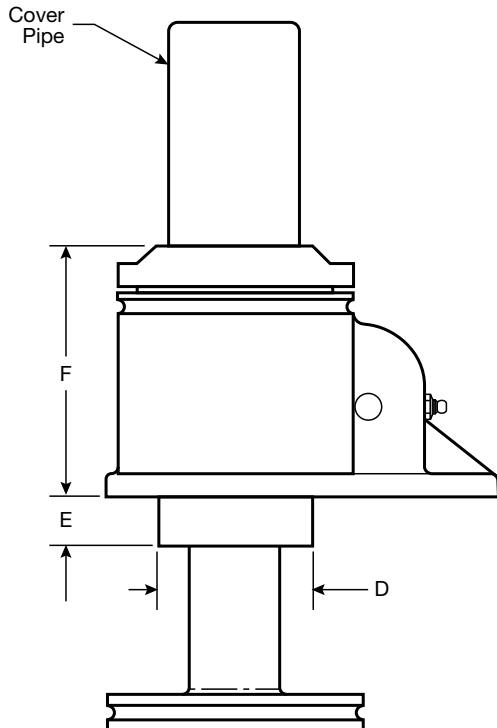
Raises, measured in increments of 25mm, are available up to 6.1 meters, depending on lifting screw diameter and available bar stock length.

Note: Contact customer service for motorized performance.

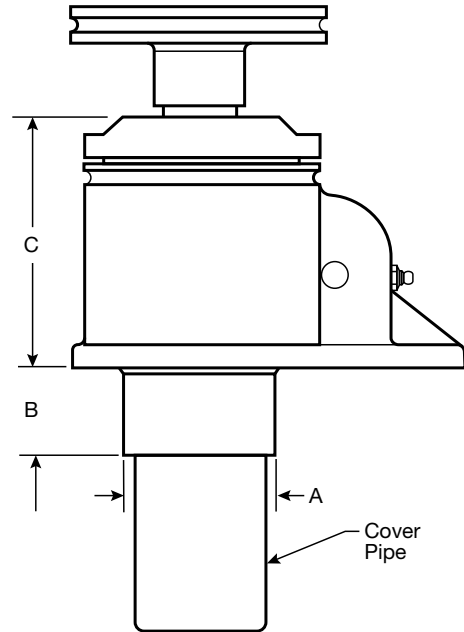
METRIC ANTI-BACKLASH ACTUATORS

KEY ADAPTOR DIMENSIONS

Keyed Anti-Backlash Inverted



Keyed Anti-Backlash Upright



Key Adaptor Dimensions for Metric Anti-backlash Actuators

Actuator Capacity (kN)	Upright Actuators			Inverted Actuators		
	A Diameter (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)
5	42.0	Pipe Length	64.0	31.8	20.6	73.0
10	42.0	Pipe Length	97.5	31.8	9.5	85.9
20	57.2	31.8	98.5	31.8	20.6	98.5
50	69.8	44.5	138.0	69.8	22.4	138.0
100	85.9	50.8	146.0	85.9	28.7	146.0
150	92.2	50.8	156.0	92.2	31.8	156.0
200	101.6	38.1	197.0	101.6	25.4	197.0
300	165.0	60.4	227.0	165.0	31.7	227.0
500	178.0	76.2	276.0	178.0	76.2	276.0

SCREW JACKS

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 15, 39, 46, 52, 55, 76 and 82) 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 starting on page 135.

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 for most machine screw models. 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.

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 15, 39, 46, 52, 55, 76 and 82. Where both starting and running torques are listed, use the running torque for hp calculations when using induction electric motors.

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

We use 98% 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 normal 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%

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, Continuous 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 ½ and ½ ton models and 18 inches on the 1 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:

- Side thrust on extended screw (see question 11)
- Column strength of screw (see question 12)
- 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 a side 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.

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 100.

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?

Yes, although the Duff-Norton SuperCylinder is recommended for these applications due to stroke limitations with the conventional double clevis configuration. Double clevis actuators are 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 (where we use a square nut on the end of the screw and a square tube to prevent

SCREW JACKS

FREQUENTLY ASKED QUESTIONS

CONTINUED

screw rotation); 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 also 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 pages 15, 39, 46, 52, 55, 76 & 82.

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 pages 148-149.)

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.

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 machine screw models, the load bearings should be replaced with heat-treated steel thrust rings which will increase the lifting torque approximately 100 percent. These rings are available as a special from Duff-Norton.

24. Is the actuator self - locking?

Only machine screw and anti-backlash models with 24:1 and 25:1 ratios are self-locking in most cases. Other machine screw and anti-backlash models with 12:1 lower ratios are not self-locking. All ball screw models are not self-locking. Units considered not self-locking will require a brake or other control device. 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. Most Machine Screw models require 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 proportion 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 0°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 machine screw, anti-backlash and Ball Screw models must be considered separately, as the normal backlash will vary due to different constructions.

For the machine screw models 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 an anti-backlash model should be considered.

Anti-backlash models: 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 this feature on page 40.

Ball screw models 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 machine screw models, this backlash will not be detrimental unless the load changes between compression and tension, or tension and compression.

SCREW JACKS

FREQUENTLY ASKED QUESTIONS

CONTINUED

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 46)

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

Machine screw and anti-backlash model lift screws may have lead error up to .0008 per inch. It is cumulative and not detrimental to the operation of the actuator model.

Ball screw models use heat treated rolled ball track with a lead error up to .003 per inch.

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 inch raise are shown in actuator specifications on pages 15, 39, 46, 52, 55, 76 and 82).

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 pages 110 thru 114).

$$\text{Worm shaft RPM} = \frac{\text{Desired Rate of Raise (in/min)}}{\text{Worm Turns for 1" Raise}}$$

For metric actuators:

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

34. How 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 ¼ to 1 ton actuator models.

35. 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 127-128 or on the inside cover of the limit switch, and use the following formula.

Max. Raise of Actuator Unit (inches) = Max. Input Revolutions of Limit Switch Turns of Actuator Unit Worm for 1 inch raise

36. 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.

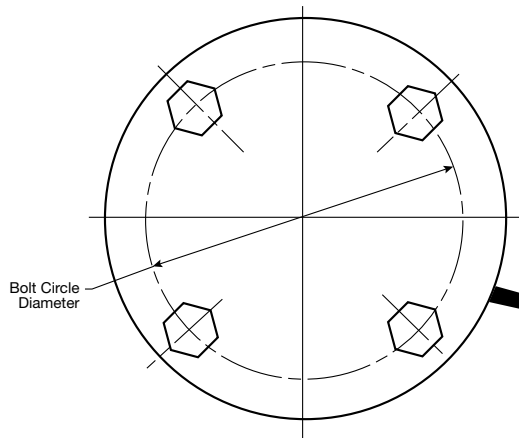
37. Can a multiple actuator unit arrangement be set up to visually indicate position of the lifting screw at any given point?

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

SCREW JACK

ENGINEERING GUIDE

FLANGE BOLT INFORMATION



Worm Flange



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

Flange Bolt Information		
Actuator Rating	B.C. Diameter	Bolt Information
1/4 Ton	N/A	No Flange Bolts
1/2 Ton	N/A	No Flange Bolts
1 Ton	N/A	No Flange Bolts
2 Ton	1-11/16 inch	Four 1/4-20 x 3/4 inch Lg. Equally Spaced at 90 Degrees
3 Ton BS	1-11/16 inch	Four 1/4-20 x 3/4 inch Lg. Equally Spaced at 90 Degrees
3 Ton MS	2-3/32 inch	Four 1/4-20 x 3/4 inch Lg. Equally Spaced at 90 Degrees
5 Ton	2-3/8 inch	Four 5/16-18 x 3/4 inch Lg. Equally Spaced at 90 Degrees
10 Ton	3 inch	Four 5/16-18 x 3/4 inch Lg. Equally Spaced at 90 Degrees
15 Ton	2-3/8 inch	Four 5/16-18 x 1 inch Lg. Equally Spaced at 90 Degrees
20 Ton	3-1/2 inch	Four 3/8-16 x 1 inch Lg. Equally Spaced at 90 Degrees
25 Ton	4-1/8 inch	Four 3/8-16 x 1-1/4 inch Lg. Equally Spaced at 90 Degrees
35 Ton	4-1/4 inch	Four 1/2-13 x 1-1/4 inch Lg. Equally Spaced at 90 Degrees
50 Ton	5-1/4 inch	Four 5/8-11 x 1-1/2 inch Lg. Equally Spaced at 90 Degrees
75 Ton	5-3/4 inch	Six 5/8-11 x 1-1/2 inch Lg. Equally Spaced at 60 Degrees
100 Ton	6-1/4 inch	Six 5/8-11 x 1-1/2 inch Lg. Equally Spaced at 60 Degrees
150 Ton	6-1/4 inch	Six 5/8-11 x 1-1/2 inch Lg. Equally Spaced at 60 Degrees
250 Ton	8-1/4 inch	Six 3/4-10 x 2 inch Lg. Equally Spaced at 60 Degrees

SCREW JACK ENGINEERING GUIDE

OVERHUNG LOAD CAPACITY OF ACTUATOR WORM SHAFT (LBS)



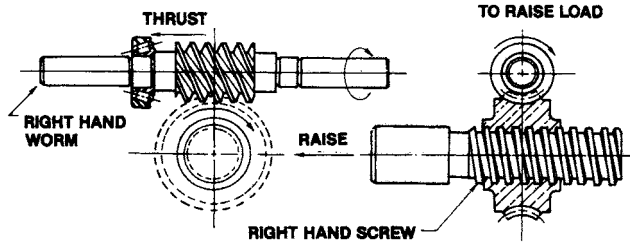
Actuator	Overhung Load
1/4 Ton MS	50
1/2 Ton MS	45
1/2 Ton BS	45
1 Ton MS & BS	55
2 Ton MS & BS	30
3 Ton MS	60
3 Ton BS	120
5 Ton MS & BS	105
10 Ton MS & BS	305
15 Ton MS	390
20 Ton MS & BS	325
25 Ton MS & BS	735
35 Ton MS	665
50 Ton MS & BS	350
75 Ton MS	630
100 Ton MS	650
150 Ton MS	350
250 Ton MS	1310

NOTE

- These ratings are based on use of roller chain and sprocket. For other conditions, divide ratings by following factors (must include bolt tension or gear separating forces):
 - 1.25 for overhung gear
 - 1.50 for overhung "V" belt
 - 2.50 for overhung flat belt
- 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.
- Above ratings apply to actuators carrying any load up to their rated capacity.

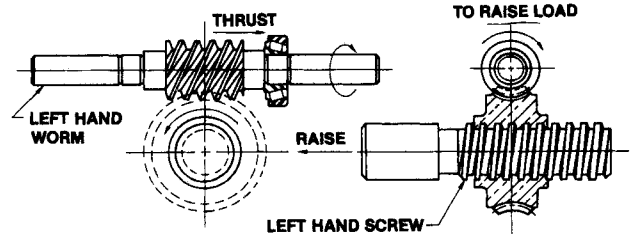
Worm Rotation Chart

Clockwise Rotation of Worm Raises Load



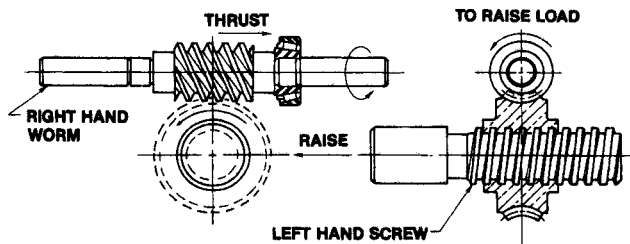
- Standard for All
- Except 50 and 75 ton MS, 50 ton BS

Clockwise Rotation of Worm Raises Load



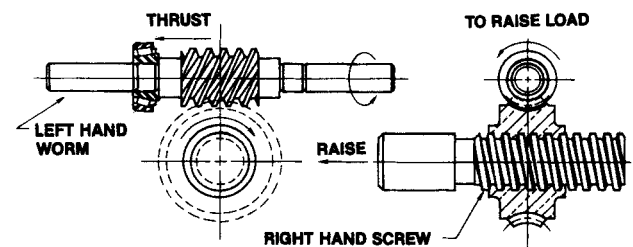
- Standard for 1850, 9050 & 9075
- Except 50 and 75 ton MS, 50 ton BS
- Special for all Other Actuators
- Unit at Extra Cost

Counter-Clockwise Rotation of Worm Raises Load



- Special for all Actuator Units

Counter-Clockwise Rotation of Worm Raises Load



- Standard for 50 ton BS
- Special for all Other Actuators
- Units at Extra Cost

Machine Screw Actuators Loads and Raises

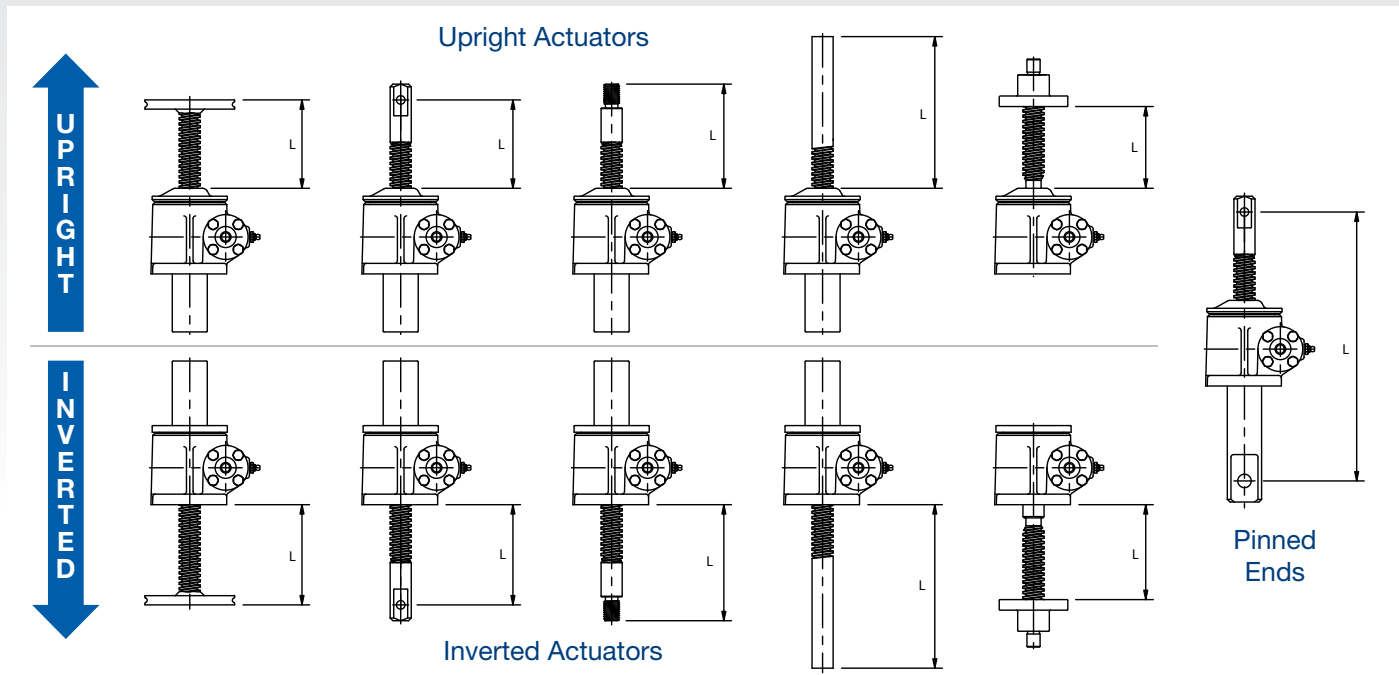
Raise (in)	1/4 Ton	1/2 Ton	1 Ton	2 Ton	3 Ton	5 Ton	10 Ton	15 Ton	20 Ton	25 Ton	35 Ton	50 Ton	75 Ton	100 Ton	150 Ton	250 Ton
3	.040	.050	.020	.020	.020	.030	.025	.030	.025	.035	.040	.060	.050	.050	.050	.090
6	.085	.075	.030	.035	.035	.050	.040	.045	.040	.060	.050	.090	.060	.060	.060	.100
9	.090	.105	.040	.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	.130	.170	.135	.150	.125	.200	.110	.275	.120	.120	.120	.160

NOTE

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 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.

SCREW JACK ENGINEERING GUIDE

LOAD SCREW COLUMN STRENGTH SPECIFICATIONS



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.

Capacity	Machine Screw		
	Max. Permissible Screw Length Regardless of Load (in)		Max. Pin-to-Pin Length Pinned Ends
	Fixed Free	Fixed Guided	
1/4 Ton MS	9	24	19
1/2 Ton MS	11	30	24
1 Ton MS	12	33	26
2 Ton MS	17	45	36
3 Ton MS	17	45	36
5 Ton MS	24	64	51
10 Ton MS	33	85	68
15 Ton MS	38	100	80
20 Ton MS	44	116	93
25 Ton MS	58	154	123
35 Ton MS	79	207	166
50 Ton MS	98	256	205
75 Ton MS	104	273	219
100 Ton MS	122	320	256
150 Ton MS	147	386	309
200 Ton MS	187	492	393

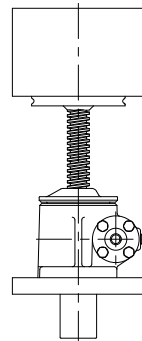
Capacity	Ball Screw		
	Max. Permissible Screw Length Regardless of Load (in)		Max. Pin-to-Pin Length Pinned Ends
	Fixed Free	Fixed Guided	
1/2 Ton BS	11	30	24
1 Ton BS	15	41	33
2 Ton BS	20	51	41
3 Ton BS	21	54	44
5 Ton BS	27	71	57
10 Ton BS	27	71	57
20 Ton BS	44	116	93
25 Ton BS	59	155	124
50 Ton BS	80	211	169

Capacity	Continuous Duty		
	Max. Permissible Screw Length Regardless of Load (in)		Max. Pin-to-Pin Length Pinned Ends
	Fixed Free	Fixed Guided	
7511 CD	21	54	44
7515 CD	27	71	57
7522 CD	44	116	93

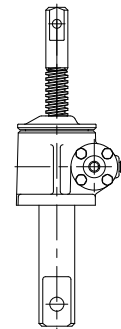
SCREW JACK ENGINEERING GUIDE

LOAD SCREW COLUMN STRENGTH SPECIFICATIONS

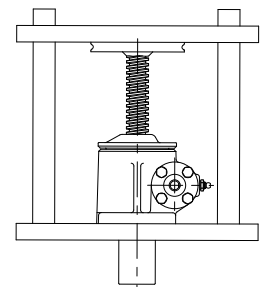
End Fixity Conditions - The horizontal axis of the strength curves has three screw length scales. The top scale is for the housing end of the screw fixed and the load end of the screw free from guiding. The middle scale is for trunnion or pin mounted actuators. The bottom scale is for the housing end 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.



One end fixed,
one end free



Pinned Ends



One end fixed,
one end guided

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.

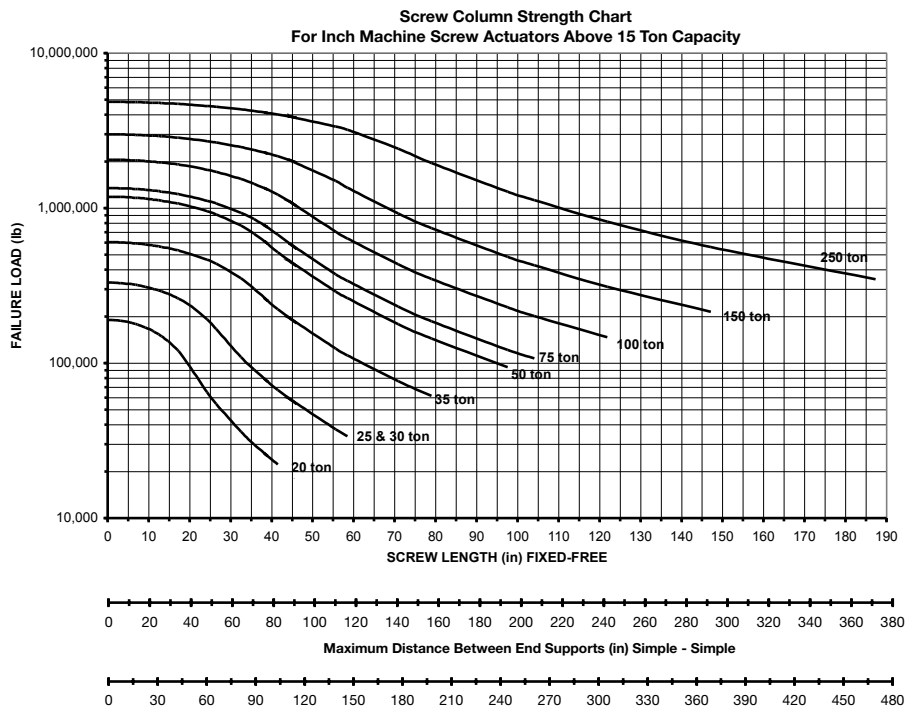
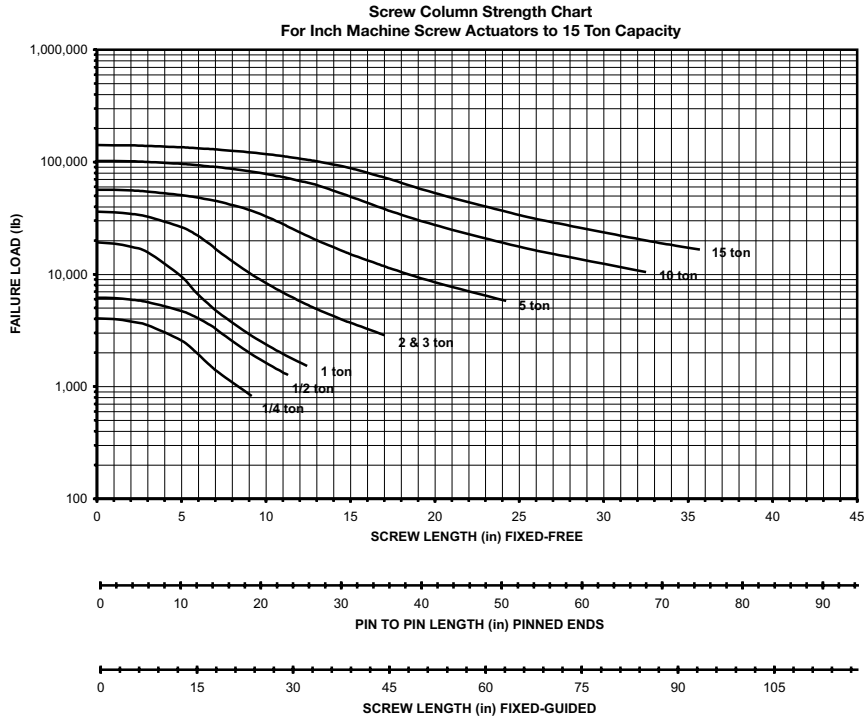
Example - Select a standard upright clevis end machine screw actuator for a 14,000 lb. unguided load and a 25 inch raise. For first approximation assume screw length equal raise.

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 inch screw length on upper horizontal axis scale.
5. Project horizontally right from 26,880 lb. load and vertically up from 25 inch 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 inch screw length is less than the 41 inch maximum permissible screw length.
 - 6a. Recheck actuator selection using true screw length.
 - 6b. Convert 25 inch actuator raise to true screw length.

8.50 inch	"A" dimension for clevis type screw end from screw end dimension diagram.
- 6.31 inch	Mounting face to top of shell cap from 9015 dimensional diagram.
2.19 inch	Screw length at no raise.
+ 25.00 inch	Raise.
27.19 inch	True screw length at 25 inch raise.
- 6c. Use failure load of 26,880 lb. and true screw length of 27.19 inches and re-enter chart to verify that 9015 is a safe selection.

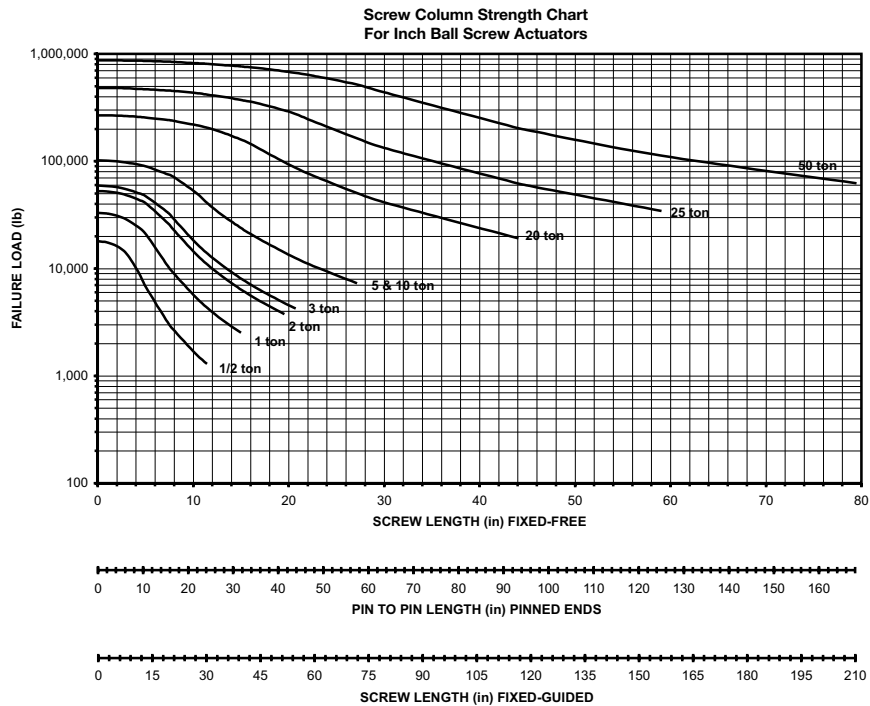
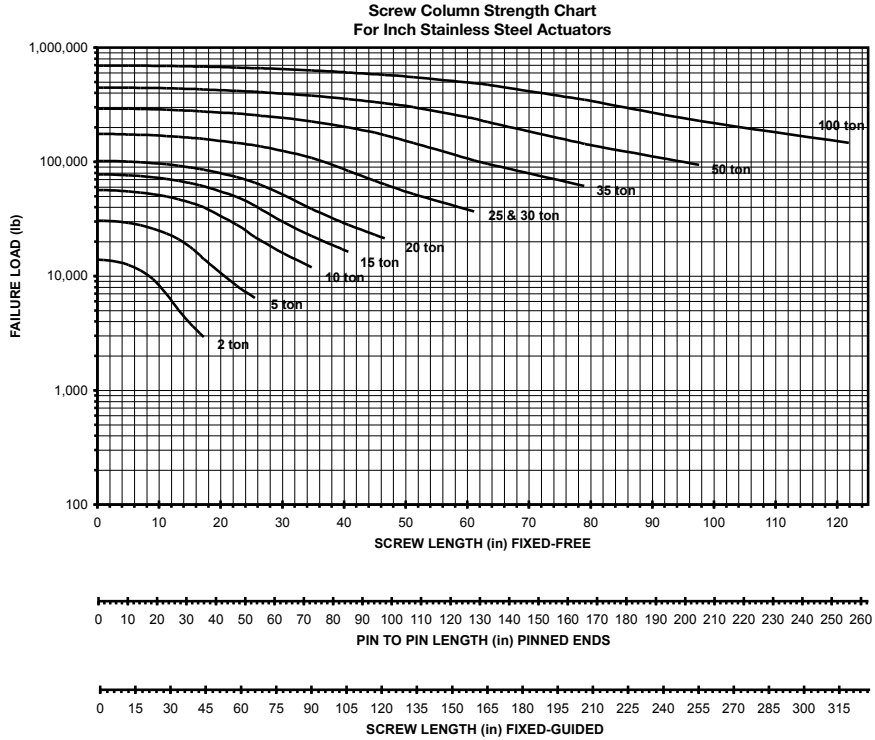
SCREW JACK ENGINEERING GUIDE

SCREW COLUMN STRENGTH CHART



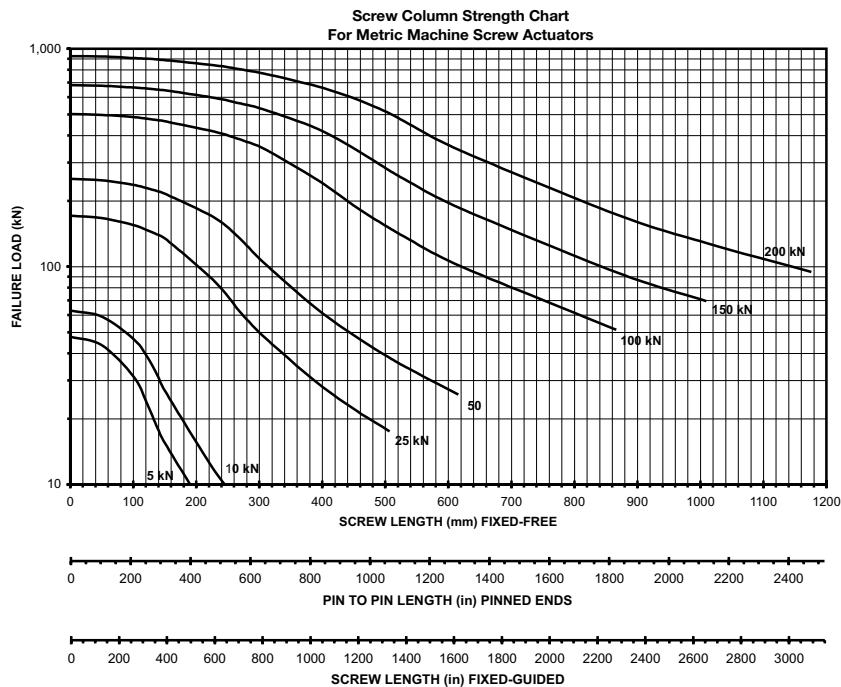
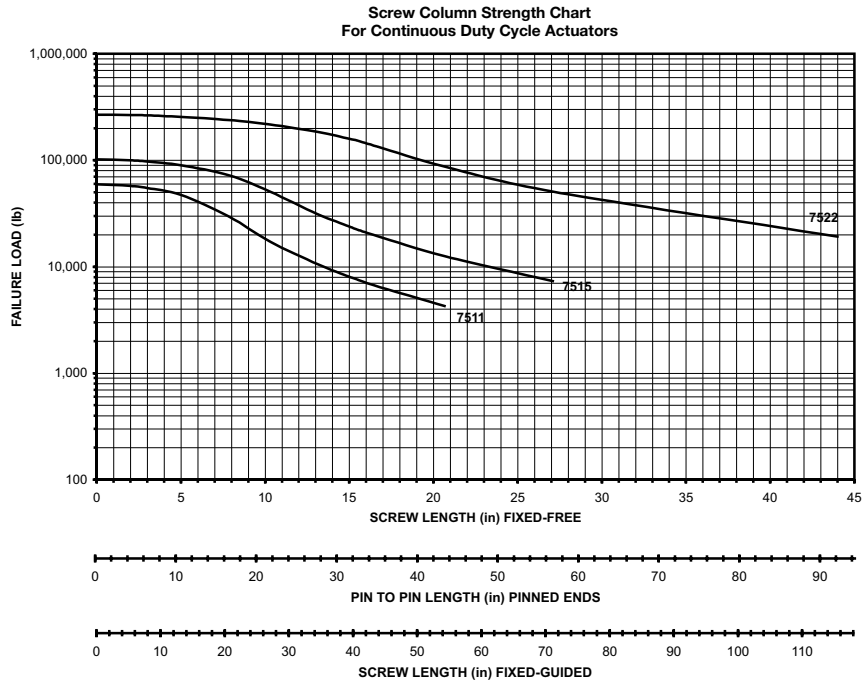
SCREW JACK ENGINEERING GUIDE

SCREW COLUMN STRENGTH CHART



SCREW JACK ENGINEERING GUIDE

SCREW COLUMN STRENGTH CHART



SCREW JACK POWERED ACTUATORS

EXTERNAL POWER SOURCE AND GEAR REDUCER



All actuators require an external power source. Whether this power source be an electric motor or hand wheel Duff-Norton has the required component.

Customers who choose to power their actuators with an electric motor may do so by connecting the motor to the actuator via a C-face adapter, right angle gear reducer, or by remotely connecting the motor and actuator worm shaft with a coupling and connecting shaft.

Some customers opt to manually power their actuators. In those cases hand wheels are usually the preferred drive component.

Gear Reducer Driven

Duff-Norton provides customers with the most comprehensive and easily implemented motorized gear reducer assortment. For the first time customers can easily select the gear reducer model best suited for their application.

FEATURES

- Available on 2 Ton through 50 Ton, machine screw or ball screw actuators.
- Largest selection of gear reducer ratios available.
- Easy mounting simplifies installation, eliminates drive alignment problems.
- Field retrofit possible on most existing non-motorized models.
- Modular assembly allows many different arrangements. Most models can have parts repositioned in the field to solve clearance problems.
- Properly sized motor and gear reducer mounted directly to side of actuator. (See pgs. 141-144 for shafts & couplings, etc.)
- One motorized actuator can shaft drive one or more additional actuators.
- Reducer's aluminum and finned housings yield better cooling properties.
- Eliminates exposed shafts and couplings; no need to design and source shafts or couplings.
- 725 rpm, 230/460 volt, 3 phase TEFC motors standard. Other voltages and special motor features available.

SCREW JACK POWERED ACTUATORS

HOW TO SIZE A MOTORIZED GEAR REDUCER

Determine whether machine screw or ball screw actuators are to be used.

Determine if it is a single actuator application, or multiple actuators, shaft driven from a common motorized reducer.

For a single actuator:

1. Determine actuator load.
2. Refer to the tables on pages 110-114. Select an actuator model with adequate nominal load rating. Ratings larger than actual load may be required due to column strength, life requirements, etc.
3. Select a reducer ratio to provide a suitable lifting speed.
4. Go along that line of the table to find a load capacity equal to or greater than applied load. Note the motor horsepower from the top of the column.

NOTE

Ratings in the shaded area of the chart exceed the safe load rating of a single actuator and are shown for designing multiple actuator systems. In no case should an actuator be used at a higher load or input horsepower than shown in the actuator specification charts on pages 15, 39, 46, 55, 76 and 82.



For multiple actuators, shaft driven from a single reducer:

1. Determine total system load and distribution of load between actuators.
2. Refer to the tables on pages 110-113. Select an actuator model with nominal load rating adequate for the most heavily loaded actuator in the system.
3. Select a reducer ratio to provide a suitable lifting speed.
4. Go along that line of the table to find a load capacity equal to or greater than total system load. Note the motor horsepower from the top of the column.

SCREW JACK POWERED ACTUATORS

MACHINE SCREW ACTUATORS - PERFORMANCE SPECIFICATIONS

The gear reducers shown in this section are sized with adequate power ratings to allow a single actuator to be used at its full load or horsepower rating. For multiple actuator applications, the reducers shown may not provide adequate power to operate several actuators at full rating. Oversized reducers are available. Contact Duff-Norton Customer Service for multiple actuator applications if the total capacity is greater than shown.

Actuator Model	Actuator Ratio	Reducer Model	Reducer Ratio	Lifting Speed (in/min)	Lifting Capacity (lbs) - See Notes Below, Motor Horsepower (1725 RPM) / Frame Size											
					1/4 - 56C	1/3 - 56C	1/2 - 56C	3/4 - 56C	1 - 56C	1.5 - 140TC	2 - 140TC	3 - 180TC	5 - 180TC	7.5 - 180TC		
2 Ton MS	6:1	31	5	14.4	1320	1750	2650	3980	5300						Note: 180TC flange!	
			7.5	9.6	1900	2500	3800	5720	7620							
			10	7.2	2430	3200	4860									
			15	4.8	3290	4340	6500									
			20	3.6	4120	5440	8200									
			25	2.9	4900	6490										
			30	2.4	5100	6740										
3 Ton MS	6:1	40	5	14.4	1450	1930	2900	4350	5800	8700	11600					
			7.5	9.6	2080	2770	4160	6250	8330	12500						
			10	7.2	2725	3630	5450	8175	10900							
			15	4.8	3725	4960	7450	11200	14900							
			20	3.6	4700	6260	9400	14100								
			25	2.9	5650	7500	11300									
			30	2.4	6000	8000	12000									
5 Ton MS	6:1	50	5	21.9	925	1230	1950	2775	3700	5550	7400	11100			Note: Model 50 reducer requires 140 Frame motor for 3 HP application	
			7.5	14.5	1340	1780	2680	4010	5350	8020	10700	16090				
			10	10.9	1750	2330	3500	5250	7000	10500	14000					
			15	7.3	2425	3230	4850	7270	9700	14500	18000					
			20	5.5	3100	4140	6220	9320	12430	18000						
			25	4.4	3750	5000	7500	11260	15000							
			30	3.6	4040	5400	8090	12100	16200							
10 Ton MS	8:1	63	5	21.9	1120	1500	2240	3360	4480	6720	8960	13400	22400			
			7.5	14.5	1650	2200	3300	4940	6600	10000	13200	19800	33700			
			10	10.9	2150	2860	4290	6430	8580	12860	17150	25730				
			15	7.3	3025	4030	6050	9070	12090	18100	24180	36200				
			20	5.5	3880	5175	7760	11640	15520	23300	31000					
			25	4.4	4700	6260	9400	14100	18800	28200	37600					
			30	3.6	5150	6860	10300	15450	20600	30900	37700					
15 Ton MS	8:1	75	5	21.9	890	1200	1780	2680	3570	5350	7140	10700	17850	26750		
			7.5	14.5	1310	1750	2620	3930	5240	7860	10480	15700	26200	39300		
			10	10.9	1725	2300	3450	5170	6900	10340	13800	20700	34500			
			15	7.3	2440	3250	4875	7310	9750	14600	19500	29250	46400			
			20	5.5	3160	4210	6320	9480	12640	18960	25300	37900				
			25	4.4	3880	5180	7760	11650	15500	23300	31000	46400				
			30	3.6	4050	5390	8100	12100	16200	24200	32300					
20 Ton MS	8:1	75	5	21.9	830	1100	1660	2490	3320	4980	6640	9960	16600	24900		
			7.5	14.5	1220	1620	2440	3650	4870	7300	9740	14600	24300	36500		
			10	10.9	1600	2140	3200	4800	6410	9600	12800	19200	32000	43200		
			15	7.3	2270	3020	4530	6800	9060	13600	18100	27200	45000			
			20	5.5	2930	3900	5850	8780	11700	17550	23400	35100				
			25	4.4	3600	4800	7200	10800	14400	21600	28800	43200				
			30	3.6	3780	5030	7550	11300	15100	22650	30200	43200				
40	2.7	4950	6600	9900	14850	19800	29700	39600								

Using Reducer-Horsepower Tables

1. Listed actuator capacities consider reducer efficiencies and maximum power ratings.
2. Capacities are based on available reducer output torque and apply to both single actuator and shaft-connected, multiple actuator configurations. Capacity is the total load for all actuators driven by the reducer.
3. Shaded capacities exceed the single actuator load rating or horsepower rating. In no case should any actuator be loaded beyond its nominal load rating, or at input powers greater than shown in the actuator specification chart on page 15.
4. For multiple actuator configurations with total capacity greater than shown, contact Duff-Norton Application Engineering.

SCREW JACK POWERED ACTUATORS

MACHINE SCREW ACTUATORS - PERFORMANCE SPECIFICATIONS

Actuator Model	Actuator Ratio	Reducer Model	Reducer Ratio	Lifting Speed (in/min)	Lifting Capacity (lbs), Motor Horsepower (1725 RPM) / Frame Size									
					1 - 80L	1.5 - 90S	2 - 90L	3 - 100L	5 - 100L	7.5 -132S	10 -132M	15 - 160M	20 - 160L	
25 & 30 Ton MS	10.67:1	92672.1	4.36	24.7		5330	7090	10510	17470	26080	34950			
			5.64	19.1	4570	6890	9160	13600	22610	33740	45250			
			6.68	16.1	N.A.	8170	10870	16120	26800	39980	53600			
			7.44	14.5	6030	9100	12090	17950	29810	44480	59640			
			8.33	12.9	6750	10200	13550	20110	33420	49840	66800			
			9.39	11.5	7610	11480	15290	22650	37650	N.A.				
			10.16	10.6	8240	12430	16530	24520	40740	60780				
			11.39	9.5	9230	13940	18530	27470	45670					
			12.84	8.4	10400	15720	20870	30960	51480					
			14.40	7.5	11690	17635	23420	34750	57740					
			15.56	6.9	12630	19050	25310	37540	62400					
			17.46	6.2	14160	21370	28400	42140	70020					
			18.21	5.9	N.A.	22270	29610	43920						
			20.00	5.4	16210	24480	32540	N.A.						
			24.88	4.3	N.A.	30450	40470	60020						
			27.33	3.9	22160	33440	44460							
			30.67	3.5	24860	37520	49890							
			33.71	3.2	27340	41260	54840							
			37.82	2.9	30675	46280	61530							
			43.28	2.5	35110	52950								
48.56	2.2	39390	59400											
35 Ton MS	10.67:1	92772.1	4.17	25.9						19350	25970			
			5.12	21.1		4860	6470	9590	15940	23780	31900			
			6.39	16.9		N.A.	N.A.	N.A.	N.A.	N.A.	29700	39800		
			7.18	15.0		6820	9080	13450	22360	33370	44730			
			8.85	12.2	5580	8410	11180	16590	27560	41100	55125			
			9.81	11.0	N.A.	9320	12400	18390	30570	45600	61140			
			11.28	9.6	7100	10720	14260	21150	35150	52430	70300			
			12.50	8.6	7870	11880	15800	23430	38930	58080	77890			
			13.79	7.8	8700	13100	17430	25840	42960	N.A.	N.A.			
			15.42	7.0	9710	14660	19490	28910	48030	71660	96075			
			17.08	6.3	10760	16240	21600	32025	53210	79400	106450			
			18.84	5.7	11880	17920	23800	35330	58710	89070				
			19.17	5.6	12075	18210	24230	35920	59710					
			21.14	5.1	13310	20100	26720	39630	65870					
			22.59	4.8	14220	21470	28560	42350	70380					
			24.64	4.4	15520	23430	31150	N.A.	N.A.					
			25.34	4.3	15980	24100	32040	47510	78960					
			27.65	3.9	17430	26280	34950	N.A.						
			31.85	3.4	N.A.	N.A.	N.A.	59710						
			35.04	3.1	N.A.	33320	44290	65700						
39.32	2.7	N.A.	37380	49700	73700									
43.44	2.5	27380	41300	54910										
46.92	2.3	29575	44600	59300										
52.64	2.0	33180	50050	66550										
59.68	1.8	37600	56730											
66.96	1.6	42190	63660											
50 Ton MS	10.67:1	9042	8.83	12.2							42800	63400	84500	
			9.39	11.5							45400	67400	89900	
			10.21	10.6							49400	73300	97700	
			11.40	9.5							55300	82000	109000	
			13.40	8.0						48800	65100	96300	128000	
			15.66	6.9						56800	75800	112000	150000	
			18.20	5.9						66300	88500	130000	173000	
			20.32	5.3						74200	99000	145000	193000	
			23.89	4.5						86400	115000	170000	227000	
			27.91	3.9						101000	135000	200000		
			31.70	3.4						114000	153000			
			34.39	3.1					84000	126000	168000			
			40.54	2.7					97700	146000	195000			
			47.67	2.3					116000	175000				
55.69	1.9				81300	135000	203000							

The 25 and 30 ton actuators use the same gear reducer. Cells shaded in light blue show capacities which are acceptable for the 30 ton actuator only. Cells shaded in dark blue show capacities not acceptable for either actuator.

Charts show available ratios and motors for close-coupled, IEC frame motors. Gear reducers with flange for NEMA C-face motor also available. Fitting of C-face motor will increase length of reducer-motor combination.

SCREW JACK POWERED ACTUATORS

BALL SCREW ACTUATORS - PERFORMANCE SPECIFICATIONS

Actuator Model	Actuator Ratio	Reducer Model	Reducer Ratio	Lifting Speed (in/min)	Lifting Capacity (lbs) - See Notes Below, Motor Horsepower (1725 RPM) / Frame Size										
					1/4 - 56C	1/3 - 56C	1/2 - 56C	3/4 - 56C	1 - 56C	1.5 - 140TC	2 - 140TC	3 - 180TC	5 - 180TC	7.5 - 180TC	
															Note: 180TC flange!
2 Ton BS	6:1	31	5	14.4	3490	4650	6970	10460	13950						
			7.5	9.6	5000	6680	10000	15000							
			10	7.2	6400	8500	12750	19000							
			15	4.8	8650	11500	17300								
			20	3.6	10800	14400	21600								
			25	2.9	11400	17000									
			30	2.4	11800	17700									
2 Ton BS High Lead	6:1	31	5	57.5	980	1300	1960	2940	3900						
			7.5	38.3	1400	1880	2800	4200	5600						
			10	28.8	1800	2400	3600	5390							
			15	19.2	2400	3200	4800								
			20	14.4	3000	4000	6000								
3 Ton BS	6:1	31	5	23.7	220	3100	4700	7000	9400						
			7.5	15.8	3380	4500	6750	10100	13500						
			10	11.9	4300	5700	8620	12900							
			15	7.9	5840	7700	11600								
			20	5.9	7300	9650	14600								
			25	4.7	8700	11500									
			30	4.0	9000	12000									
5 Ton BS	6:1	50	5	27.2	2280	3000	4550	6800	9100	13600	18200	27300*			
			7.5	18.2	3300	4400	6600	9900	13200	19800	26400				
			10	13.6	4300	5740	8600	12900	17200	25800	34500				
			15	9.1	5970	7950	11950	17900	23900	35800					
			20	6.8	7660	10200	15300	23000	30600						
			25	5.5	9250	12300	18500	27700	3700						
			30	4.5	9970	13300	19900	29900	39900						
5 Ton BS High Lead	6:1	50	5	57.4	1000	1330	2000	3000	4000	6000	8000	12000*			
			7.5	38.4	1450	1930	2900	4350	5800	8700	11600	17400*			
			10	28.7	1890	2520	3780	5670	7560	11300	15100				
			5	20.4	2750	3680	5500	8300	11000	16500	22100	33100	55200		
			7.5	13.6	4060	5400	8100	12200	16200	24300	32500	48700	81000		
			10	10.2	5300	7000	10570	15800	21100	31700	42300	63400			
			15	6.8	7450	9900	14900	22300	29800	44700	59500	89000			
10 Ton BS	8:1	63	20	5.1	9560	12750	19100	28700	38200	57400	76500				
			25	4.1	11600	15400	23100	34700	46300	69500					
			30	3.4	12700	16900	25400	38000	50750	76000					
			40	2.6	15700	20950	31400	47100	62800						
			5	43.0	1180	1575	2370	3550	4730	7100	9470	14200	23600		
			7.5	28.7	1740	2300	3480	5220	6960	10400	13900	20800	34800		
			10	21.5	2260	2990	4530	6800	9060	13600	18100	27200			
20 Ton BS	8:1	75	5	21.6	2500	3400	5150	7700	10300	15500	20600	30900	51500		
			7.5	14.4	3780	5040	7570	11300	15100	22700	30300	45400	75700		
			10	10.8	4980	6650	9970	14900	19900	29900	39900	59800	99700		
			15	7.2	7050	9400	14100	21100	28200	42300	56400	84500	140900		
			20	5.4	9140	12100	18200	27400	36500	54800	73100	109600			
			25	4.3	11400	15100	22750	34100	45500	68200	91000				
			30	3.6	11700	15600	23400	35000	46700	70000	93400				
20 Ton BS High Lead	8:1	75	5	43.1			2575	3850	5150	7750	10300	15450	25750	38650	
			7.5	28.7			2575	3850	5150	7750	10300	15450	25750	38650	

SCREW JACK POWERED ACTUATORS

BALL SCREW ACTUATORS - PERFORMANCE SPECIFICATIONS

Actuator Model	Actuator Ratio	Reducer Model	Reducer Ratio	Lifting Speed (in/min)	Lifting Capacity (lbs), Motor Horsepower (1725 RPM) / Frame Size								
					.50 - 71L	.75 - 80S	1 - 80L	1.5 - 90S	2 - 90L	3 - 100L	5 - 100L	7.5 - 132S	10 - 132M
25 Ton BS	10.67:1	92372.1	3.72	28.7				12240	16300	24120	40120		
			4.31	24.8			9390	14180	18850	27940	46480		
			5.13	20.8			11210	16900	22420	33270	55330		
			5.83	18.3		9750	12720	19210	25510	37880	62970		
			6.67	16.0		11150	14540	21940	29210	43270	71940		
			7.01	15.2		11760	15270	23090	30670	45510	75630		
			8.19	13.0		13760	17880	26970	35880	53210	88424		
			9.11	11.7		15270	19880	30000	39880	59150	98300		
			10.22	10.4		17150	22300	33630	44730	66360	110300		
			10.33	10.3		17333	22550	34000	45210	72720			
			11.20	9.5		18790	24420	36850	49030	81570			
			12.56	8.5		21030	27450	41390	55030				
			14.12	7.6		23630	30850	46480	61800				
			15.84	6.7		26540	34600	52180	69390				
			18.33	5.8		30730	40000	60360	80240				
			20.04	5.3		33575	43750	66000	87750				
			22.49	4.7		37700	49090	74060	98420				
			25.06	4.3		42000	54660	82480	109700				
			28.11	3.8		47090	61330	92540					
			32.80	3.3	36424	54970	71575	10800					
36.80	2.9	40850	61636	80300									
41.46	2.6	46060	69450	90480									
46.64	2.3	51760	78120										
49.46	2.2	54910											
55.49	1.9	61630											
50 Ton BS (Reverse base only)	10.67:1	92672.1	4.36	37.1								52640	70540
			5.64	28.7							45640	68090	91300
			6.68	24.2							54090	80680	108180
			7.44	21.7							60180	89780	120360
			8.33	19.4							67450	100590	134860
			9.39	17.2						45730	76000	N.A.	
			10.16	15.9						49500	82230	122680	
			11.39	14.2						55450	92180		
			12.84	12.6						62500	103900		
			14.40	11.2					47270	70130	116540		
			15.56	10.4					51090	75770	125950		
			17.46	9.3					57320	85040	141300		
			18.21	8.9					59770	88640			
			20.00	8.1				49400	65680	N.A.			
			24.88	6.5				61450	81680	121130			
			27.33	5.9				67500	89730				
			30.67	5.3			50180	75730	100680				
			33.71	4.8			55180	83270	110680				
37.82	4.3	47500	61900	93410	124180								
43.28	3.7	54300	70860	106860									
48.56	3.3	61000	79500	119900									

Using Reducer-Horsepower Tables

1. Listed actuator capacities consider reducer efficiencies and maximum power ratings.
2. Capacities are based on available reducer output torque and apply to both single actuator and shaft-connected, multiple actuator configurations. Capacity is the total load for all actuators driven by the reducer.
3. Capacities in italics exceed the single actuator load rating or horsepower rating. In no case should any actuator be loaded beyond its nominal load rating, or at input powers greater than shown in the actuator specification chart on page 55.
4. For multiple actuator configurations with total capacity greater than shown, contact Duff-Norton Application Engineering.

SCREW JACK POWERED ACTUATORS

CONTINUOUS DUTY ACTUATORS - PERFORMANCE SPECIFICATIONS

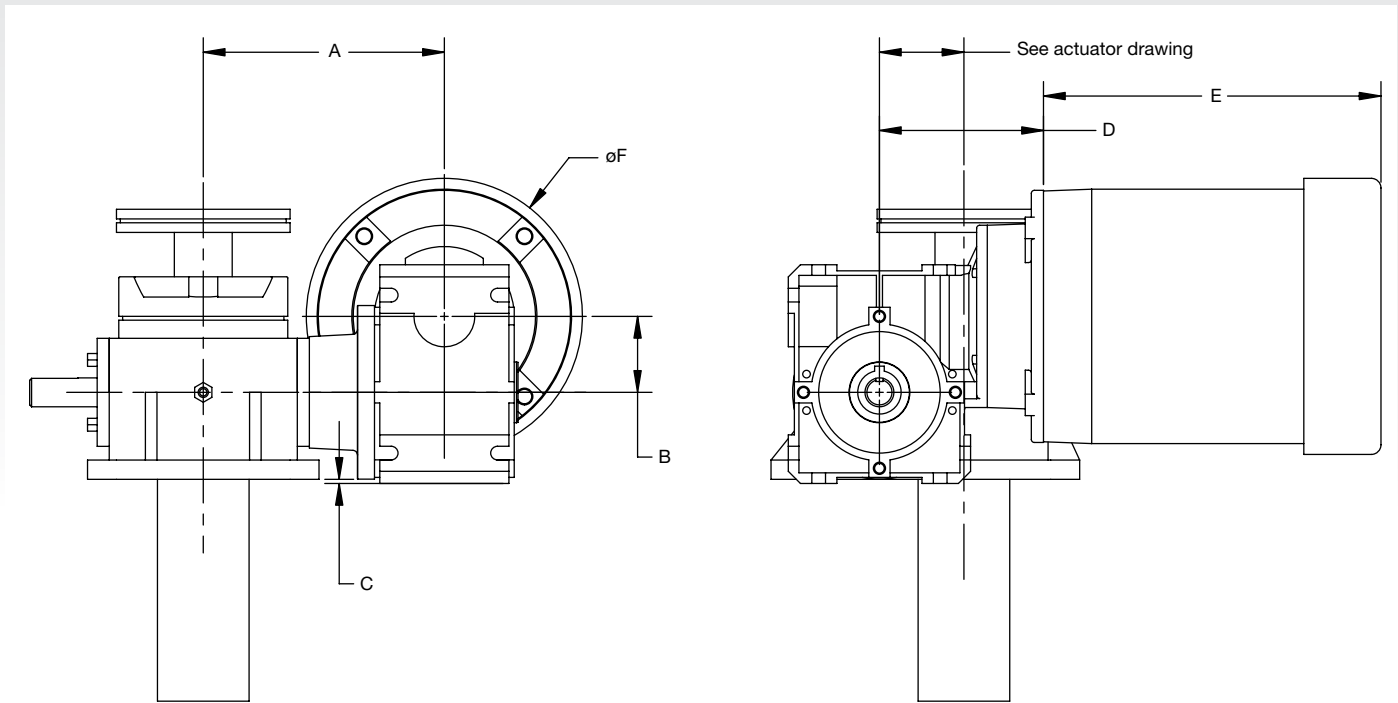
Actuator Model	Actuator Ratio	Reducer Model	Reducer Ratio	Lifting Speed (in/min)	Lifting Capacity (lbs) - See Previous Notes, Motor Horsepower (1725 rpm) / Frame Size								
					1/4 - 56C	1/3 - 56C	1/2 - 56C	3/4 - 56C	1 - 56C	1.5 - 140TC	2 - 140TC	3 - 180TC	5 - 180TC
7511 (3,500 lbs Max)	6:1	31	5	14.4	2200	3100	4700	7000	9400				
			7.5	9.6	3380	4500	6750	10100					
			10	7.2	4300	5700	8620						
			15	4.8	5840	7700							
			20	3.6	7300	9650							
7515 (12,000 lbs Max)	8:1	63	5	20.4	2880	3860	5770	8700	11500	17300	23200	34750	
			7.5	13.6	4260	5670	8500	12800	17000	25500	34125		
			10	10.2	5560	7350	11100	16590	22100	33280			
			15	6.8	7820	10400	15640	23400	31300				
			20	5.1	10000	13350	20000	30000					
75151 High Lead (5,500 lbs)	8:1	63	5	43.0	1240	1650	2480	3720	4960	7450	9940	14900	
			7.5	28.7	1820	2400	3650	5480	7300	10900	14600		
			10	21.5	2370	3140	4750	7140	9500	14250	19000		
7522 (27,000 lbs Max)	10.67:1	75	5	27.2	3200	4300	6460	9700	12930	19400	25860	38800	64650
			7.5	18.2	4750	6320	9500	14250	19000	28500	38000	57000	
			10	13.6	6250	8320	12500	18750	25000	37500	50000	75000	
			15	9.1	8800	11700	17590	26380	35180	52750	70360		
75221 High Lead (13,500 lbs)	10.67:1	75	5	57.4	1600	2150	3230	4850	6460	9700	12900	19400	
			7.5	38.4	2375	3160	4750	7120	9500	14250	19000	28500	
			10	28.7	3125	4160	6250	9370	12500	18750	25000	37500	



Does your application require mounting the limit switch or encoder on the reducer to allow another component to be mounted to the actuator's other side? No problem! Call our Customer Service team for assistance.

SCREW JACK POWERED ACTUATORS

MOTORIZED ACTUATOR - DIMENSIONS



Actuator Capacity (tons)	Reducer Model	Motor Frame	A (in)	B (in)	C (in)	D (in)
2	31	56C	6.75	1.22	.17 Above	1.14
3	40	56C	6.75	1.57	.22 Below	4.17
		140TC	6.75	1.57	.22 Below	4.64
5	50	56C	6.25	1.97	.11 Below	4.26
		140TC	6.25	1.97	.11 Below	4.73
10	63	56C	7.59	2.48	.59 Below	4.85
		140TC	7.59	2.48	.59 Below	5.32
		180TC	7.59	2.48	.59 Below	6.45
15	75	56-140TC	7.40	2.95	.40 Below	6.09
		180TC	7.40	2.95	.40 Below	6.96
20	75	56-140TC	7.68	2.95	.14 Below	6.09
		180TC	7.68	2.95	.14 Below	6.96
25 & 30	92672	80	7.40	2.68	.40 Above	7.08
		90-100	7.40	2.68	.40 Above	7.63
		132	7.40	2.68	.40 Above	7.95
35	92772	80	11.49	2.87	.92 Below	7.95
		90-100	11.49	2.87	.92 Below	8.50
		132	11.49	2.87	.92 Below	9.09
50	9042	100-160	11.64	1.42 Below	3.80 Below	9.72

Motor HP	Frame	Motor Without Brake		Motor With Brake	
		E (in)	F (in)	E (in)	F (in)
0.25	56C	7.50	7.16	11.50	7.16
0.33	56C	7.50	7.16	11.50	7.16
0.50	56C	8.00	7.16	13.00	7.16
0.75	56C	8.75	7.16	13.00	7.16
1	56C	9.25	7.16	13.50	7.16
1.5	140TC	9.75	7.16	15.00	7.16
2	140TC	10.75	7.16	16.00	7.16
3	180TC	11.37	9.22	16.12	9.22
5	180TC	11.87	9.22	16.62	9.22
7.5	210TC	16.50	10.81	22.25	10.81
10	210TC	22.87	10.81	25.00	10.81
0.25	63L	7.56	5.12	9.76	5.12
0.33	71S	8.43	5.71	10.71	5.71
0.50	71L	8.43	5.71	10.71	5.71
0.75	80S	9.29	6.50	11.81	6.50
1	80L	9.29	6.50	11.81	6.50
1.5	90S	10.87	7.20	13.82	7.20
2	90L	10.87	7.20	13.82	7.20
3	100L	12.05	7.91	15.63	7.91
5	100L	12.05	7.91	15.63	7.91
7.5	132S	12.83	8.89	16.49	8.98
10	132M	16.41	10.47	20.59	10.47
15	160M	18.83	12.60	25.40	12.60
20	160L	18.83	12.60	25.40	13.60

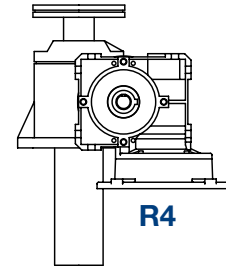
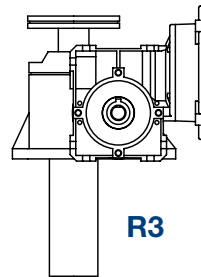
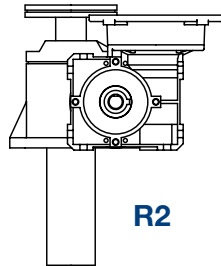
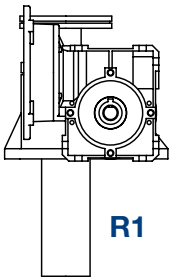
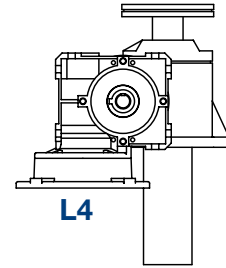
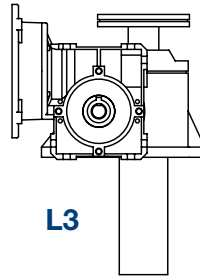
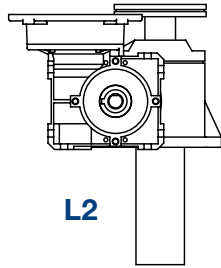
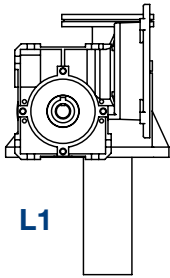
NOTE

- Motors in shaded portion of table are close-coupled, IEC frame, standard on 25 to 50 ton actuators with reducers.

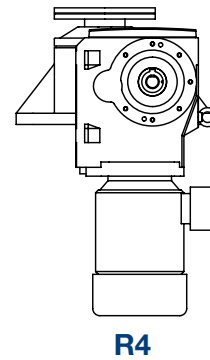
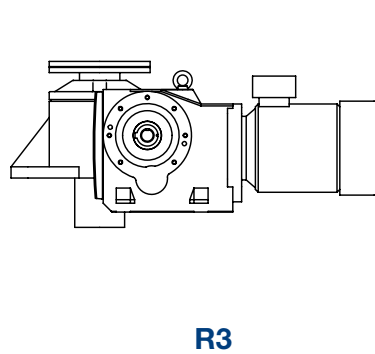
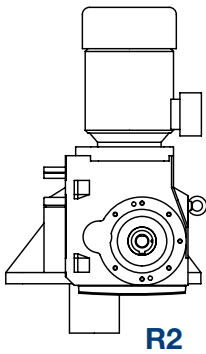
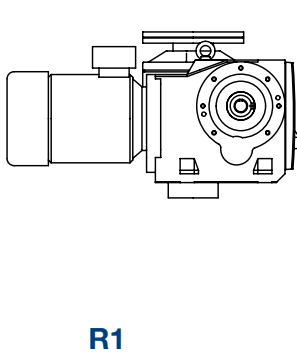
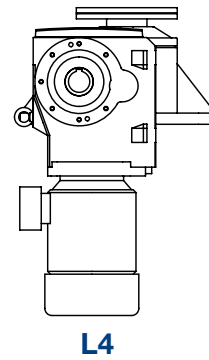
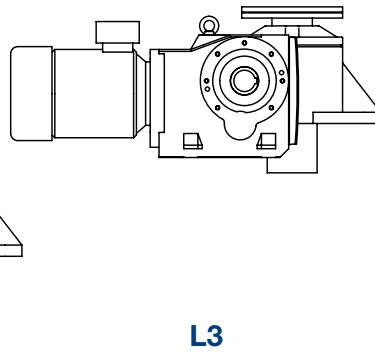
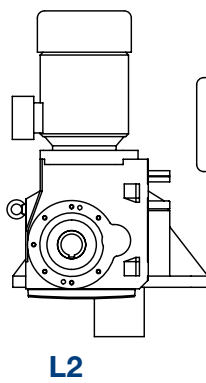
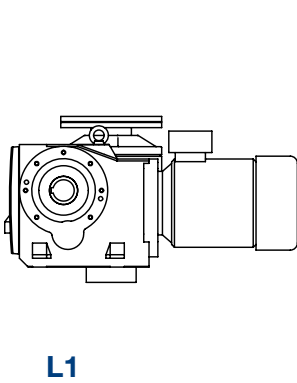
NEMA C-face motors can be fitted to 25-50 ton units, with some increase in length. IEC frame motors can also be fitted to all other reducers, to reduce motor envelope size.
- Dimensions for NEMA C-face motors are typical for 1725 rpm, 3-phase, TEFC motors. Dimensions may vary somewhat depending on manufacturer.

SCREW JACK POWERED ACTUATORS REDUCER POSITIONS

Reducer Positions 2-20 Tons



Reducer Positions 25-50 Tons



SCREW JACK POWERED ACTUATORS ACTUATOR MOTORS

Duff-Norton can competitively supply motors for any application from suppliers such as Baldor, Nord, US Electric, Leeson, and more.

Motors can be directly mounted to most Duff-Norton actuators using C-face adapters, directly mounted via speed reducers, or remotely mounted with shafting and couplings. IEC, servo, hydraulic, and air motors can also be supplied upon request.



FEATURES

Standard Motors Include:

- Brake and non-brake models
- Single and three phase models
- Explosion proof, washdown duty
- Wide variety of voltages and RPM's
- 50/60Hz models
- ¼ to 10 Horsepower ratings
- Common NEMA frame size

SCREW JACK POWERED ACTUATORS C-FACE MOTOR DRIVEN

Performance Specifications															
Actuator Capacity	Worm Gear Ratio	Lifting Speed (in/min)		Lifting Capacity (lbs)											
				Motor Horsepower											
		Motor RPM		1/2	1/2	3/4	3/4	1	1	1-1/2	1-1/2	2	2	3	5
		1725	1140	1725	1140	1725	1140	1725	1140	1725	1140	1725	1140	1725	1140
2 Ton MS	6:1	71.9	47.5	450	770	760	1240	1070	1710	1700	2660	2330	3600	—	—
	12:1	35.9	23.8	740	1260	1250	2040	—	—	—	—	—	—	—	—
	24:1	18.0	11.9	1150	1970	—	—	—	—	—	—	—	—	—	—
	25:1	17.3	11.4	1200	2060	2040	3320	—	—	—	—	—	—	—	—
3 Ton MS	6:1	71.9	47.5	480	830	820	1340	1160	1840	1830	2860	2510	3880	—	—
	12:1	35.9	23.8	780	1320	1320	2140	1860	2950	—	—	—	—	—	—
	24:1	18.0	11.9	1110	1890	1880	3060	—	—	—	—	—	—	—	—
	25:1	17.3	11.4	1160	1980	1970	3200	2770	4410	—	—	—	—	—	—
5 Ton MS	6:1	107.8	71.3	—	390	380	690	590	1000	1000	1620	1400	2240	2220	—
	12:1	53.9	35.6	300	640	640	1160	980	1670	1660	2690	2340	3720	—	—
	24:1	27.0	17.8	450	980	970	1750	—	—	—	—	—	—	—	—
	25:1	17.3	11.4	480	1040	1030	1860	—	—	—	—	—	—	—	—
10 Ton MS	8:1	107.8	71.3	—	190	190	560	430	940	930	1680	1420	2420	2410	4360
	24:1	35.9	23.8	—	370	360	1090	840	1800	1790	3230	—	—	—	—
	25:1	17.3	11.4	—	400	400	1180	910	1960	1940	3510	—	—	—	—
	8:1	107.8	71.3	—	150	140	440	340	730	720	1300	1100	1880	1870	3400
15 Ton MS	24:1	35.9	23.8	—	260	260	770	600	1280	1270	2300	—	—	—	—
	25:1	17.3	11.4	—	340	330	1000	770	1660	1640	2970	—	—	—	—
	8:1	107.8	71.3	—	—	—	240	130	540	530	1150	940	1760	1750	3370
	24:1	35.9	23.8	—	—	—	420	230	960	950	2040	—	—	—	—
20 Ton MS	25:1	17.3	11.4	—	—	—	480	260	1080	1070	2300	—	—	—	—
	10-2/3:1	107.7	71.2	—	—	—	—	—	320	320	950	730	1570	1560	3210
	32:1	17.3	11.4	—	—	—	—	—	520	510	1520	1170	2520	—	—
	32:1	13.5	8.9	—	—	—	—	—	490	480	1420	1090	2350	—	—
35 Ton MS	10-2/3:1	107.7	71.2	—	—	—	—	—	—	—	550	390	1030	1020	2300
	32:1	35.9	23.7	—	—	—	—	—	—	—	930	650	1740	—	—
	32:1	17.3	11.4	—	—	—	—	—	—	—	1100	760	2050	—	—
	6:1	71.9	47.5	1270	2050	2040	3210	2800	4360	4340	6680	5870	9880	—	—
2 Ton BS	24:1	18.0	11.9	2720	4390	—	—	—	—	—	—	—	—	—	—
	12:1	35.9	23.8	2220	3580	3550	—	—	—	—	—	—	—	—	—
	6:1	287.5	190.0	180	400	400	720	610	1040	1030	1680	1450	2320	—	—
	24:1	71.9	47.5	450	980	—	—	—	—	—	—	—	—	—	—
2 Ton BS High Lead	12:1	143.8	95.0	320	680	680	1220	—	—	—	—	—	—	—	—
	6:1	118.7	78.5	740	1260	1250	2040	1770	2810	2800	4370	3830	5920	—	—
	24:1	71.9	47.5	1730	2950	—	—	—	—	—	—	—	—	—	—
	12:1	59.4	39.2	1230	2110	—	—	—	—	—	—	—	—	—	—
5 Ton BS	6:1	136.0	89.9	380	810	810	1460	1230	2110	2090	3400	2950	4690	4660	—
	24:1	34.0	22.5	1000	2140	2120	3840	—	—	—	—	—	—	—	—
	12:1	68.0	44.9	590	1270	1260	2270	1920	3280	3260	5290	4590	7300	—	—
	6:1	287.5	190.0	—	140	140	430	330	710	700	1280	1080	1840	1830	—
5 Ton BS High Lead	24:1	71.9	47.5	—	380	370	1110	—	—	—	—	—	—	—	—
	12:1	143.8	95.0	—	250	250	740	570	1220	1210	2190	1850	3160	—	—
	8:1	102.0	67.4	170	720	710	1530	1250	2340	2350	4050	3450	5700	5600	10000
	24:1	34.0	22.5	370	1520	1500	3210	2620	4910	4950	8450	—	—	—	—
10 Ton BS	8:1	215.6	142.5	—	180	170	530	410	880	870	1570	1330	2270	2250	4100
	24:1	71.9	47.5	—	370	360	1090	840	1800	1790	3230	—	—	—	—
	8:1	107.8	71.3	—	—	—	40	—	860	850	2600	2000	4250	4200	8600
	24:1	35.9	23.8	—	—	—	100	—	2010	2050	6000	—	—	—	—
20 Ton BS	8:1	215.6	142.5	—	—	—	—	—	130	120	950	660	1770	1750	3920
	24:1	71.9	47.5	—	—	—	—	—	300	1000	2900	—	—	—	—
	10-2/3:1	106.7	70.5	—	—	—	40	—	800	790	2340	1800	3970	3840	7910
	32:1	35.6	23.5	—	—	—	80	—	1640	1610	4760	3680	7890	—	—
7511	6:1	118.7	78.5	650	1100	1100	1780	1550	2460	2450	3820	3350	5180	—	—
7515	8:1	102.0	67.4	500	1080	1070	1940	1640	2790	2780	4510	3910	6230	6190	10740
75151 HL	8:1	215.6	142.5	—	90	80	260	200	430	430	780	660	1130	1120	2040
7522	10-2/3:1	80.9	53.4	—	—	—	50	—	1010	990	2940	2270	4870	4830	9950
75221 HL	10-2/3:1	161.7	106.9	—	—	—	—	—	70	70	540	380	1020	1010	2260

FEATURES

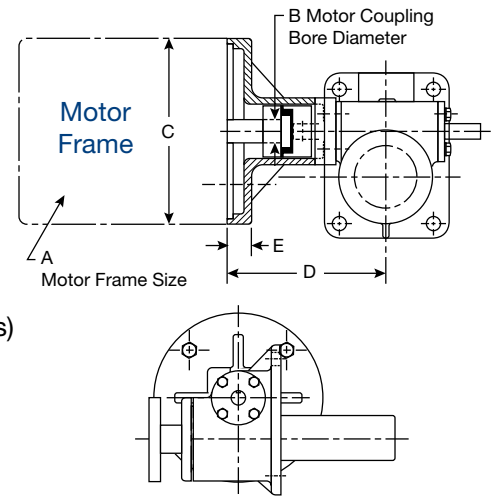
- Available for 2-35 Ton machine, 2-25 Ton ball screw, and all 7500 Series continuous duty cycle actuators.
- Designed with Standard NEMA C-face dimensions.
- Allows direct coupling of motor shaft with either the left or right side actuator input shaft.
- Comes with coupling, keys, and mounting hardware.

Motor Frame Sizes		
Motor HP	Motor RPM	
	1725	1140
1/2	56C	56C
3/4	56C, 143C	56C, 143C
1	56C, 143C	56C, 143C
1-1/2	56C, 143C	182C
2	56C, 143C	184C
3	—	182C
5	—	182C

SCREW JACK POWERED ACTUATORS C-FACE MOTOR DRIVEN

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



⚠ CAUTION

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 horsepower are shown in the table on the previous page. It is important that motors do not exceed the maximum horsepower shown.

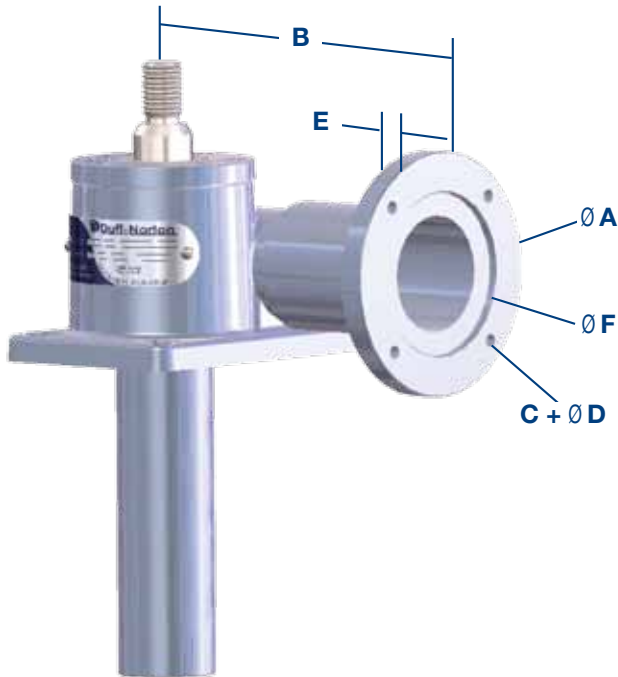
⚠ CAUTION

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.

Dimensions					
Capacity	A	B (+.001/-0.000)	C	D	E
2 Ton MS & BS, 3 Ton BS	56C	.625	6.75	6.16	.50
	143TC, 145TC	.875	6.75	6.16	.50
3 Ton MS	56C	.625	6.75	6.17	.50
	143TC, 145TC	.875	6.75	6.17	.50
5 Ton MS & BS	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
10 Ton MS & BS	56C	.625	6.75	8.13	.65
	143TC, 145TC	.875	6.75	8.13	.65
	182TC, 184TC	1.125	9.00	8.89	1.47
15 Ton MS	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
20 Ton MS & BS	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
25 & 30 Ton MS & BS	56C	.625	6.75	8.88	.74
	143TC, 145TC	.625	6.75	8.88	.74
	182TC, 184TC	1.125	9.00	9.63	1.49
35 Ton MS	56C	.625	6.75	8.88	.65
	143TC, 145TC	.875	6.75	8.88	.65
	182TC, 184TC	1.125	9.00	9.63	1.49
7511	56C	.625	6.75	6.98	.50
	143TC, 145TC	.875	6.75	6.98	.50
7515	56C	.625	6.75	8.06	.65
	143TC, 145TC	.875	6.75	8.06	.65
	182TC, 184TC	1.125	9.00	8.90	1.47
7522	56C	.625	6.75	9.62	.65
	143TC, 145TC	.875	6.75	9.62	.65
	182TC, 184TC	1.125	9.00	10.46	1.49

SCREW JACK POWERED ACTUATORS

IEC MOTOR DRIVEN - B-FACE MOTOR ADAPTOR



FEATURES

- Available for 25-200 kN G series screw jacks.
- Designed with Standard IEC B-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.
- NEMA motor adapters for our G series actuators are also available.

Dimensions							
Capacity	IEC/Servo Flanges	A Flange O.D.	B Flange Length**	C Mounting Holes B.C.	D Mounting Holes Diameter	E Mounting Hole Depth	F Counter Bore Diameter
25kN - G9002	G9002 - 63B14	90	126	75	6	12.7	60
	G9002 - 71B14	105	133	85	7	12.7	70
	G9002 - 80B14	120	143	100	7	12.7	80
	G9002 - 90B14	140	153	115	9	12.7	95
50kN - G9005	G9005 - 71B5	160	178	130	M8 Tap	12.4	110
	G9005 - 80B5	200	178	165	M10 Tap	12.4	130
	G9005 - 90B5	100	178	165	M10 Tap	12.4	130
	G9005 - 100B14	160	181	130	9	15.7	110
	G9005 - 112B14	160	181	130	9	15.7	110
100kN - G9010	G9010 - 80B5	200	203	165	M10 Tap	12.2	130
	G9010 - 90B5	200	203	165	M10 Tap	12.2	130
	G9010 - 100B14*	190	213	130	9	10.0	110
	G9010 - 112B14*	190	213	130	9	10.0	110
150kN - G9015	G9015 - 80B5	200	203	165	M10 Tap	12.2	130
	G9015 - 90B5	200	203	165	M10 Tap	12.2	130
	G9015 - 100B14*	190	213	130	9	10.0	110
	G9015 - 112B14*	190	213	130	9	10.0	110
200kN - G9020	G9020 - 80B5	200	213	165	M10 Tap	20.1	130
	G9020 - 90B5	200	213	165	M10 Tap	20.1	130
	G9020 - 100B14*	190	223	130	9	10.0	110
	G9020 - 112B14*	190	223	130	9	10.0	110
300kN - G9030	G9030 - 80B5	200	257	165	M10 Tap	20.1	130
	G9030 - 90B5	200	257	165	M10 Tap	20.1	130
	G9030 - 100B14*	190	267	130	9	10.0	110
	G9030 - 112B14*	190	267	130	9	10.0	110

Note: All dimensions are shown in millimeters. All couplings are purchased separately from the motor flange kit.

Use an adapter plate mounted to the G9010-80B5, G9015-80B5, G9020-80B5 and G9030-80B5 Flanges respectively.

Adapter plates should be mounted to the motor, and then to the motor flange

Mounts to the jacks' casting, and replaces the worm cover

SCREW JACK POWERED ACTUATORS

IEC MOTOR DRIVEN - B-FACE MOTOR ADAPTOR

Please provide the following information when ordering:

- Actuator model
- Worm gear ratio
- With or without anti-backlash feature (machine screw actuators)
- Motor horsepower
- Motor frame size
- Left or right motor adaptor position
- Other special requirements

Performance Specifications for 50 Hz Motor												
Actuator Capacity	Worm Gear Ratio	Speed (mm/min)	Lifting Capacity (Newtons)									
			Motor kW									
		RPM	0.12	0.18	0.25	0.37	0.55	0.75	1.10	1.50	2.20	3.70
			Motor RPM at 50 Hz									
		1450	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450
25 kN	6:1	1450	290	800	1380	2400	3910	5600	5490	7860	—	—
	12:1	725	650	1780	3090	5340	8710	—	—	—	—	—
	24:1	362.5	470	1270	2210	3830	—	—	—	—	—	—
50 kN	6:1	2175	—	—	460	1170	2230	3420	5490	7860	1200	—
	12:1	1087.5	—	—	990	2510	4800	7340	11780	16860	—	—
	24:1	543.75	—	—	720	1830	3500	—	—	—	—	—
100 kN	8:1	2175	—	—	—	—	1180	2330	4340	6630	10640	19240
	24:1	725	—	—	—	—	2230	4390	8170	—	—	—
150 kN	8:1	2175	—	—	—	—	1180	2140	3990	6110	9810	17730
	24:1	725	—	—	—	—	2230	4050	7540	—	—	—
200 kN	8:1	2175	—	—	—	—	170	1130	2830	4770	8160	15420
	24:1	725	—	—	—	—	320	2140	5340	—	—	—
300 kN	10-2/3:1	2175	—	—	—	—	—	—	950	2530	5300	11220
	32:1	725	—	—	—	—	—	—	1590	4230	—	—

Ratings with N.A. in their cells have either exceeded the B-face flange frame size, or the single screw jack kilowatt rating. In no case should any screw jack be loaded or have a power supply beyond its' rating or damage will likely result.

Performance Specifications for 60 Hz Motor												
Actuator Capacity	Worm Gear Ratio	Speed (mm/min)	Lifting Capacity (Newtons)									
			Motor kW									
		RPM	0.12	0.18	0.25	0.37	0.55	0.75	1.10	1.50	2.20	3.70
			Motor RPM at 60 Hz									
		1700	1700	1700	1700	1700	1700	1700	1700	1700	1700	1700
25 kN	6:1	1700	140	570	1080	1940	3230	4670	7180	—	—	—
	12:1	850	320	1280	2400	4320	7200	—	—	—	—	—
	24:1	425	230	920	1720	3100	—	—	—	—	—	—
50 kN	6:1	2550	—	—	240	850	1760	2760	4530	6550	10080	17650
	12:1	1275	—	—	520	1820	3770	5940	9730	14060	—	—
	24:1	637.5	—	—	380	1330	2750	—	—	—	—	—
100 kN	8:1	2550	—	—	—	—	720	1700	3410	5360	8790	16120
	24:1	850	—	—	—	—	1360	3200	6430	—	—	—
150 kN	8:1	2550	—	—	—	—	660	1560	3140	4940	8100	14860
	24:1	850	—	—	—	—	1250	2950	5920	—	—	—
200 kN	8:1	2550	—	—	—	—	—	600	2050	3700	6590	12780
	24:1	850	—	—	—	—	—	1140	3860	—	—	—
300 kN	10-2/3:1	2550	—	—	—	—	—	—	310	1660	4020	9070
	32:1	850	—	—	—	—	—	—	520	2770	—	—

Ratings with N.A. in their cells have either exceeded the B-face flange frame size, or the single screw jack kilowatt rating. In no case should any screw jack be loaded or have a power supply beyond its' rating or damage will likely result.

⚠ CAUTION

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 tables above. It is important that motors do not exceed the maximum horsepowers shown.

⚠ CAUTION

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.

SCREW JACK POWERED ACTUATORS ACTUATOR HAND WHEELS

The Duff-Norton hand wheel is for actuator customers who may require precise positioning, or may have loads which do not require motorized power to adjust.

NOTE

Hand wheels are not recommended for use with ball screw actuators as they contain no braking system. Also, for models with 12:1 ratios and lower, an additional locking mechanism to prevent back driving is recommended.

FEATURES

- Easy installation to existing actuators. All hand wheels are bored, keyed, and set-screw drilled to the proper dimensions.
- Revolving handle design for rotational ease.
- Recessed hub and spoke design.
- Cast iron material with chrome plating.



The table below presents dimensional information for all Duff-Norton Hand Wheels. To properly select the best hand wheel for your application, please review the provided information, or contact our customer service team.

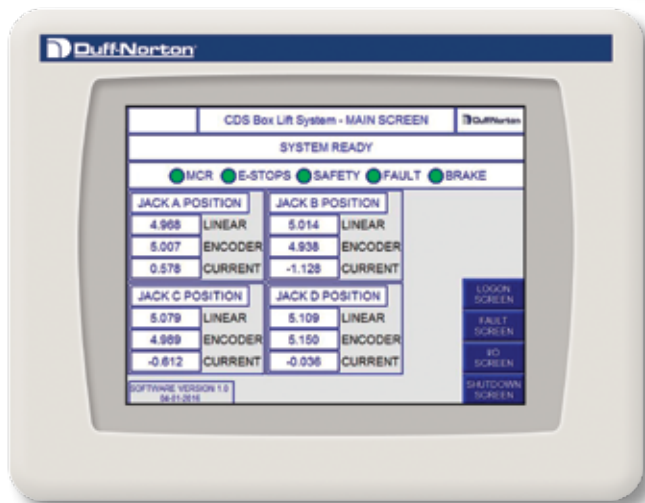
Model Number	Capacity	Diameter	Width*	Bore Size	Keyway Size
HW04-.375	1/4 and 1/2 Ton MS and BS	4"	3-3/8"	0.375	1/8 x 1/16 x 1
HW06-.375	1/4 and 1/2 Ton MS and BS	6"	4"	0.375	1/8 x 1/16 x 1
HW04-.500	1 and 2 Ton MS and BS	4"	3-3/8"	0.500	1/8 x 1/16 x 1
HW06-.500	1 and 2 Ton MS and BS	6"	4"	0.500	1/8 x 1/16 x 1
HW04-.625	3 Ton MS and BS	4"	3-3/8"	0.625	3/16 x 3/32 x 1
HW06-.625	3 Ton MS and BS	6"	4"	0.625	3/16 x 3/32 x 1
HW06-.750	5 Ton MS and BS	6"	4"	0.750	3/16 x 3/32 x 1-1/4
HW08-.750	5 Ton MS and BS	8"	6-3/16"	0.750	3/16 x 3/32 x 1-1/4
HW10-.750	5 Ton MS and BS	10"	5-3/4"	0.750	3/16 x 3/32 x 1-1/4
HW08-1.00	10-20 Ton MS and BS	8"	6-3/16"	1.000	1/4 x 1/8 x 1-1/2
HW10-1.00	10-20 Ton MS and BS	10"	5-3/4"	1.000	1/4 x 1/8 x 1-1/2
HW12-1.00	10-20 Ton MS and BS	12"	6-1/2"	1.000	1/4 x 1/8 x 1-1/2

*From the end of the handle to the end of the hub

DUFF-NORTON

CONTROL SYSTEMS

PRECISION MOTION TECHNOLOGY



FEATURES

Duff-Norton control systems provide

- Fewer interfaces
- Better performance
- One integrated system
- Automated machine cycling
- Scalable software, stops, and limits

Whether you need a custom turnkey solution, a standalone, or an integration into a legacy system, our automated motion control solutions bring together the products and technology that improve your processes and move you into the future through each stage of production.

Why use Duff-Norton Controls?

We are linear motion experts. We know our linear motion products better than anyone and understand the challenges you face – navigating a dynamic marketplace that demands innovative technologies and the agility to contend with a greater need for increased productivity.

Our industrial experience combined with the latest controls technologies and our broad assortment of linear motion products make us the ideal partner to work closely with you to design and implement your system solutions.

We know how to get the highest performance out of our linear motion products. Through our control solutions we can meet the most advanced industrial lifting, positioning, and transfer demands needed to help you gain a competitive advantage in the global marketplace.

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DUFF-NORTON

CONTROL SYSTEMS

FEATURES & BENEFITS

Electric control systems support a wide range of applications

Duff-Norton engineers a wide range of controls systems, and can provide turnkey solutions for applications ranging from jogging controls to complex automated systems. We offer systems from fractional horsepower sizes up to 200 HP.

STANDARD FEATURES

- All Duff-Norton controls are designed to meet UL508A
- NEMA enclosures provided for all applications
- Labeled terminal strip for ease of field connections
- Motor overload protection
- Short circuit protection for all control voltages
- External Main Disconnect Switch (MDS)
- All wires labeled for quick troubleshooting
- Electrical schematics provided for all applications

BENEFITS

- Fewer interfaces
- Turnkey solutions
- Better performance
- Reduced downtime
- One integrated system
- Increased productivity

STANDARD SOFTWARE PROGRAMMING

- PLC
- VFD
- HMI
- SERVO

INDUSTRY EXPERTISE

- Synchronization controls
- Variable speed controls
- Positioning controls
- Jog controls

STANDARD HARDWARE

- PLCs
- Encoders
- HMIs
- Motor protection
- VFDs
- Linear sensors
- SERVOS
- E-Stops

AVAILABLE CONTROL SYSTEMS

- Custom controls (Duff-Norton control packages can be highly customized to meet your needs)
- Synchronization controls
- Variable speed controls
- Positioning controls
- Pendant controls
- Digital display controls
- Three phase jog controls
- Single phase jog controls

For additional information on Duff-Norton control systems please see the brochure Control Systems Solutions for Precision Motion Technology (PB-CNTL-01)

SCREW JACK ACTUATOR CONTROLS

TURNKEY SOLUTIONS FOR APPLICATIONS IN THE FOLLOWING MARKETS



Rail Maintenance Equipment

Duff-Norton designs and manufactures Rail Shop Equipment for performing maintenance and inspection work on locomotive and rail car transport vehicles. Our Rail Shop Equipment products support a broad range of lifting heights, weights and vehicle dimensions.

- In-ground lifting systems
- Mobile and fixed lifting jacks
- Drop tables
- Car hoists
- Turntables
- Workshop equipment

We can design and install a custom system tailored to fit your lifting needs.

Motion Solutions

Duff-Norton is a designer and manufacturer of complete turnkey solutions for a variety of industries such as aluminum, steel, agriculture, construction, communications, energy, food & beverage and industrial machinery. If you want to tilt an object fixed at one end, lift, lower, roll, slide, open or close an object or if you have an application that requires periodic adjustment, Duff-Norton can use linear actuators and electrical cylinders to design a custom solution that's tailored to your specific needs.



Stage & Theatre

Duff-Norton designs and manufactures equipment for stage and theatre applications. Our actuators and lifting elements are fast, efficient, reliable and safe.

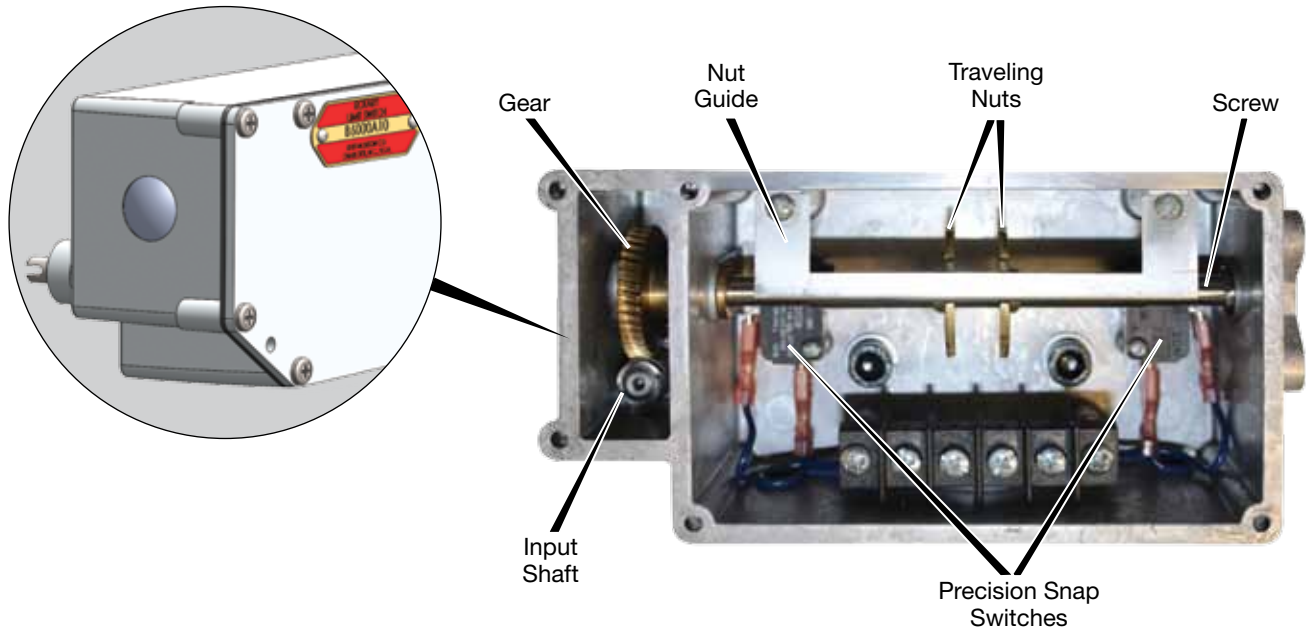
- Custom designs combine acme screws, winches, and hoists
- Stage and theatre lifts
- Moveable props, podiums or shifting floors
- A total solution that conforms perfectly with your demands and requirements
- Minimal yearly routine maintenance, which can be scheduled for facility downtime



SCREW JACK ACTUATOR CONTROLS

B6000 SERIES ROTARY LIMIT SWITCH

When you need precise control of your mechanical actuator Duff-Norton's newest B6000 Series Rotary Union Limit Switch design provides the ultimate in adjustability with even higher accuracy than a cam switch. By eliminating plastic mechanical components we also ensure robust durability.



FEATURES

- Switches rated 15 amps, 125-277 VAC; 1/2 amp, 125 VDC; 1/4 amp, 250 VDC.
- Switches SPST-N.C. SPDT available.
- Adaptable to all Duff-Norton mechanical actuators 2 ton and larger.
- Sturdy and compact, corrosion-resistant aluminum housing and cover, NEMA 4 enclosure rating, threaded 1/2 inch NPT conduit opening, brass nuts travel on stainless steel shaft.
- Easy to adjust, slotted traveling nuts allow precise fine-adjustment without the trial and error of cam type switches.
- Three available ratios to serve different travel requirements, while optimizing repeatability.
- Operating temperature, -20° to 150°F. Lifetime lubricated with synthetic grease.
- Can be mounted on either side of actuator, in four 90° orientations.
- May be ordered on actuators close-mounted to shortened worms, reducing actuator width.
- Additional rotary limit switches available with 4 positions, or for hazardous locations, consult factory.

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

$$\text{Required worm revolutions} = (\text{Inches of Actuator Travel}) \times (\text{Actuator Turns per Inch})$$

NOTE

Need a specialty Limit Switch not shown above with options such as 4 Pole, or Explosion Proof capabilities? Contact our Customer Service group for more information.

SCREW JACK ACTUATOR CONTROLS ROTARY LIMIT SWITCHES

Performance Specifications

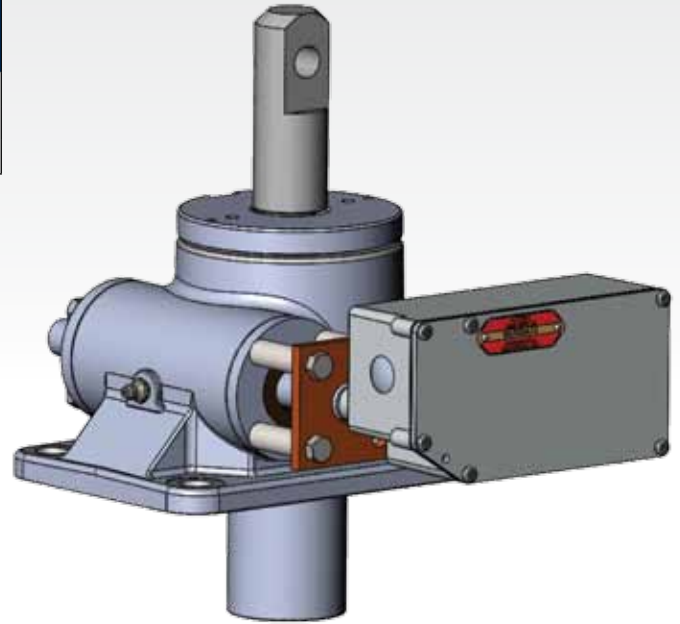
Rotary Limit Switch Performance Specifications					
Model Number	Gear Ratio	Maximum Worm Revolution	Maximum Actuator Raise	Maximum Over-travel	Switch Reset Dist.
B6000A10	10:1	1200	1200/TPI	24/TPI	5/TPI
B6000A20	20:1	2400	2400/TPI	48/TPI	10/TPI
B6000A40	40:1	4800	4800/TPI	96/TPI	20/TPI

Mounting and Adjustment

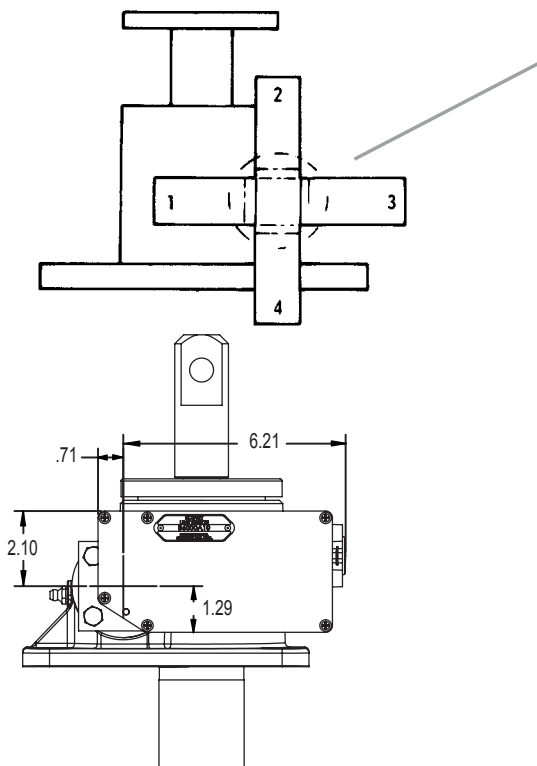
Mounting and Adjustment Chart		
Actuator Model, Tons	Width, "W", inches	
	Extended Mount Switch	Close Mount Switch
2	6.50	5.19*
5	7.50	6.00
10	8.50	6.63
15	8.50	6.63
20	8.50	6.87
25	10.00	7.56
35	10.00	7.56
50	14.00	9.81
75	15.00	10.38
100	14.50	10.75
150	14.50	10.75

* M1802: Pos. 2 & 3 only.

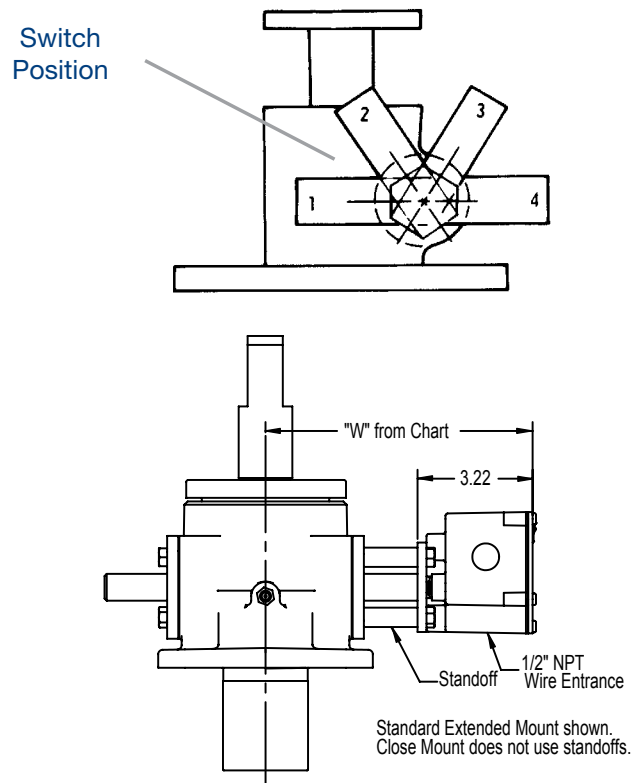
M9002: Pos. 1,2,&3 only.



All models except 75, 100, and 150 Ton

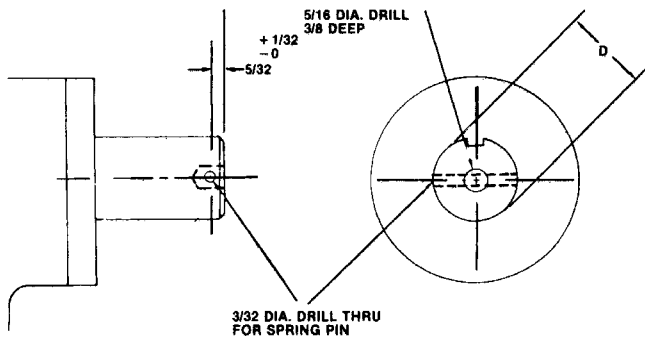


75, 100, and 150 Ton only

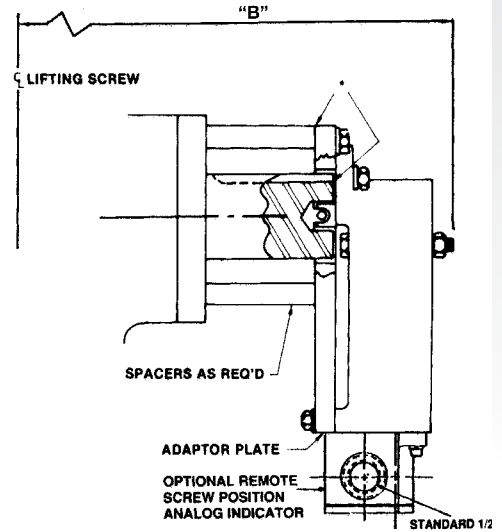
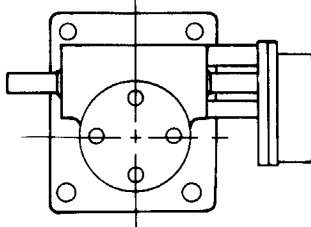


SCREW JACK ACTUATOR CONTROLS ROTARY LIMIT SWITCHES

Limit Switch Field Installation Dimensions

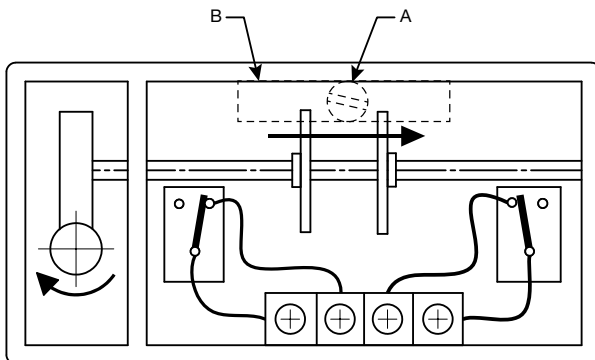


*NOTE: SHIM OUT ON LIMIT SWITCH IF NECESSARY.
WORM SHAFT END MUST NOT RUB SWITCH HOUSING.



Rotary Limit Switch Electrical Wiring Diagram and Setting Instructions

- ▲ CAUTION: Disconnect power before making any adjustment.
- Check drift before adjusting limits.
- Remove screw "A" and nut guide keeper "B" to adjust limits.
- Run actuator unit to desired limit.
- Rotate appropriate nut until switch clicks, then turn 1/2 turn more.
- Replace "A" and "B."
- Run actuator unit to other limit.
- Repeat steps 2, 4 and 5 to adjust this nut.



Note: N.C. = Normally Closed

N.C. N.C.

Wiring Diagram A & B Models

NOTE

Limit switch cannot be fitted directly to 1/4, 1/2 and 1 ton series. Anti-backlash mounting is the same as machine screw actuators. Dimensions are subject to change without notice.

Worm Shaft Dimensions

Capacity	MS	BS	Mounting Dimensions	Worm Shaft Diameter
2 and 3 Ton	X		6-3/4	.500
3 Ton		X	6-3/4	.500
5 Ton	X	X	7-3/4	.750
10 and 15 Ton	X	X	8-3/4	1.000
20 Ton	X	X	8-3/4	1.000
25 Ton	X	X	10-1/4	1.375
30 Ton	X		10-1/4	1.375
35 Ton	X		10-1/4	1.375
50 Ton	X	X	14-1/4	1.375
75 Ton	X		15-1/4	1.500
100 Ton	X		14-3/4	1.750
150 Ton	X		14-3/4	1.875

NOTE

Slight adjustments may be necessary. See Performance Specification Chart on the previous page for notch adjustment value.

SCREW JACK ACTUATOR CONTROLS POTENTIOMETER / TRANSDUCER

The Duff-Norton SKA6205 Series Position Feedback Potentiometer/Transducer is designed to mount on the end of any SKA6000T limit switch. Its active component is a precision potentiometer which may be used as voltage divider to provide a feedback voltage that is proportional to actuator position.

FEATURES

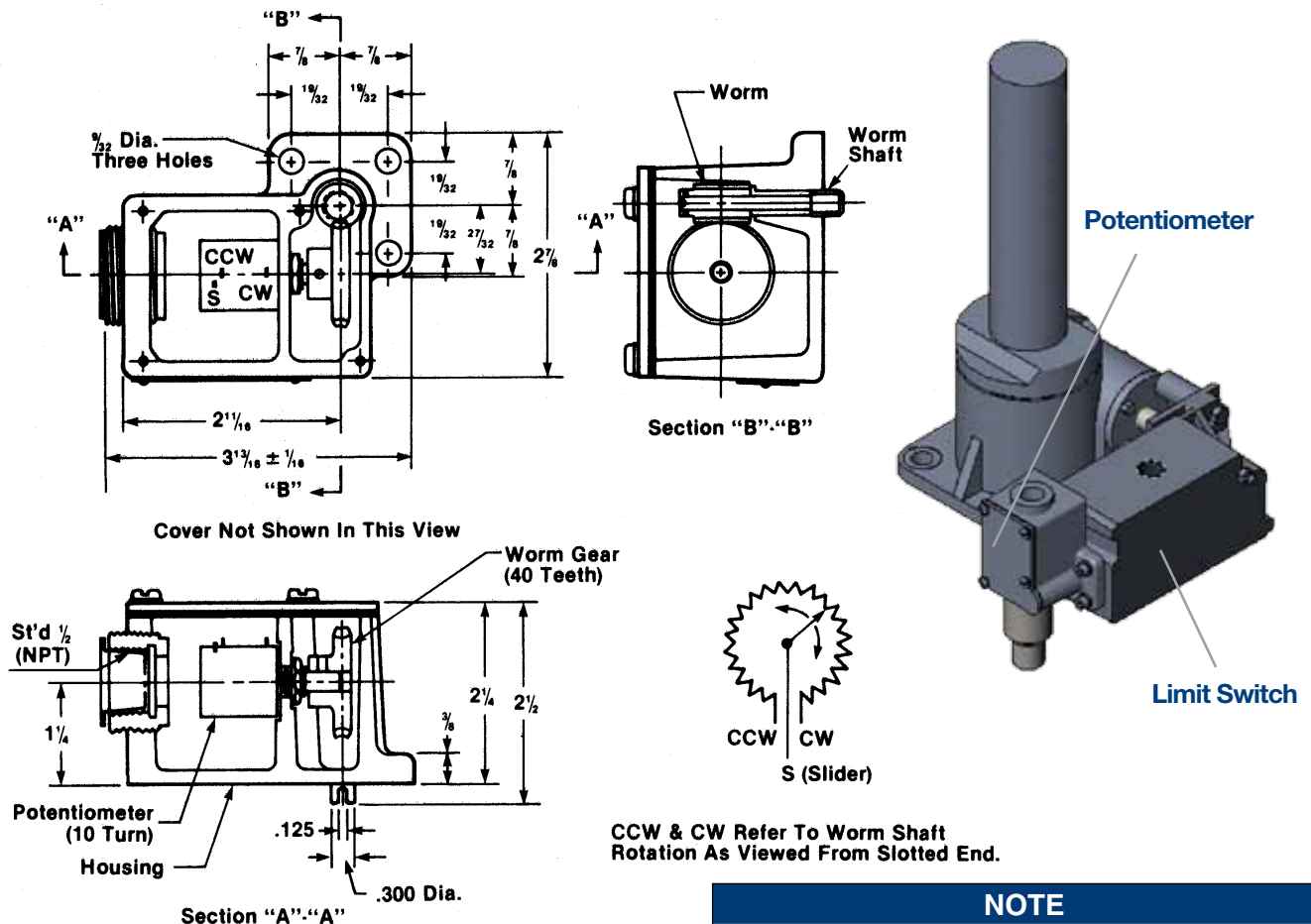
- Multiple gear ratios allow for a wide range of raises.
- Standard resistance is 5000 ohms. Other resistances are available on special order.
- Power rating: 2 watts at 40°C
- Maximum service temperature: 85°C
- Interface directly with the Model SK6300-4K Digital Position Indicator to provide a scalable readout of position. The SKA6205 series models can also be used with most motor controls that have provision for potentiometer feedback signal.
- Transducer supplied with black anodized finish as standard.

Potentiometer Performance Specifications

Model Number	Maximum Turns Potentiometer Worm Shaft
SKA6205-30	30
SKA6205-50	50
SKA6205-60	60
SKA6205-100	100
SKA6205-200	200
SKA6205-400	400

Note: When used with Duff-Norton actuators and limit switched the potentiometer selection should be:

$$\text{Desired potentiometer turns} = \frac{\text{Total stroke} \times \text{Worm turns per inch}}{\text{L.S. gear ratio}}$$



NOTE

Transducer shipped unattached, to be installed at site. Includes required mounting hardware; soldering to potentiometer required.

SCREW JACK ACTUATOR CONTROLS

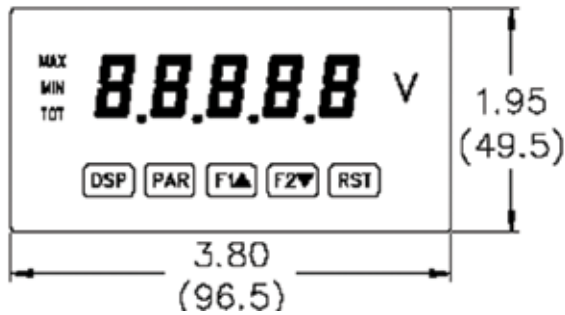
DIGITAL POSITION INDICATOR FOR DUFF-NORTON POTENTIOMETERS

The Duff-Norton model SK6300-4K Digital Position Indicator processes a feedback signal from a the SKA6205 series potentiometers to provide position readout with user selectable scaling factor. By running the actuator to two positions in its stroke and keying in the desired readout at each point, the indicator automatically scales the input signal to provide linear readout over the full travel of the actuator.

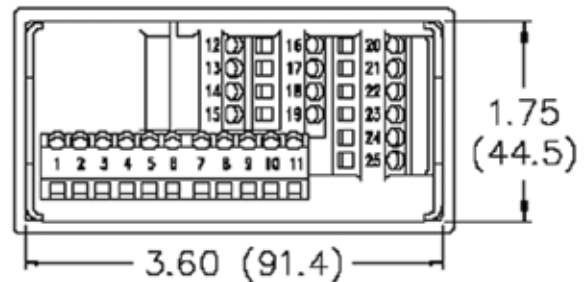
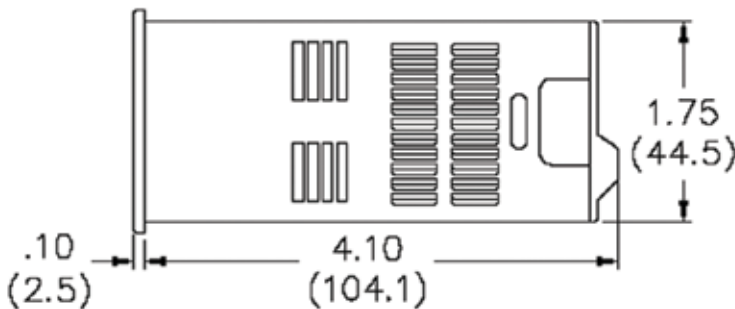
The SK6300-4K has a universal, 85-250 VAC power input and generates a regulated 24 VDC excitation signal to the potentiometer. The SK6300-4K operates seamlessly with any potentiometer equipped Duff-Norton actuator.

FEATURES

- Self scaling by inputting minimum and maximum readings – either by key stroke or input signal.
- Two adjustable up / down limits with 0 to +/- 99999.
- Accepts 1K to 10K potentiometer inputs.
- Programmable decimal point location.
- Input power requirement from 85 – 250 VAC.
- Programmable front panel functions.
- For use with Duff-Norton 2 through 150 ton machine or ball screw actuators.

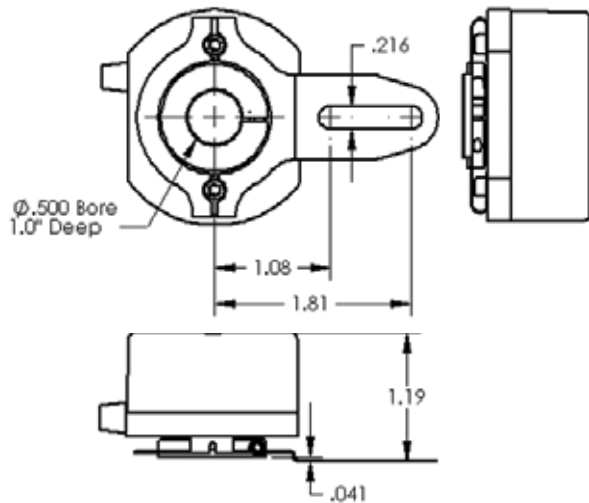


NOTE: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5.0" (127) W
Dimension in inches (mm)



Incremental Encoders

Incremental encoders provide pulses or counts back to a PLC or VFD. A PLC can be programmed to use encoder pulses to synchronize, position, or vary the speed of an electric motor. They can be mounted on limit switches, reducers, or electric motors and can offer a variety of different pulses per revolution (PPR). Incremental encoders can provide as little as one pulse per revolution up to several thousand pulses per revolution.

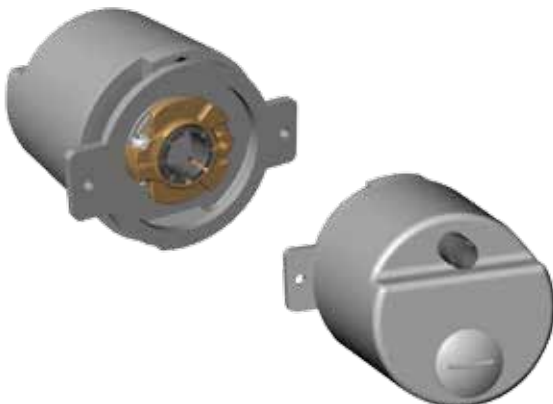


FEATURES

- Up to 10000 pulses per revolution (60 ppr standard)
- Input voltage 4.75 to +28VDC
- Operating temperature (-0° to +70°C)
- M12 cable connector or prewired cable options

Absolute Encoders

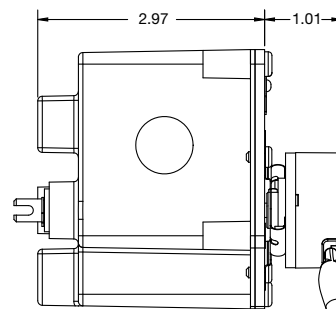
Absolute encoders work similarly to incremental encoders. Pulses or counts are monitored by a PLC or VFD. Ethernet/IP encoders communicate with a PLC over an Ethernet cable. Unlike incremental encoders, absolute encoders retain position through a power cycle. There is no need to reference or home absolute encoders after a power cycle.



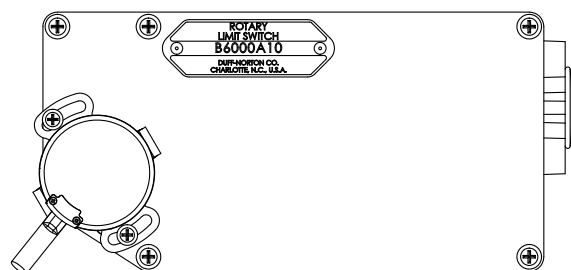
Ethernet/IP Absolute Encoder

Mounted Encoders

Try this new innovation from Duff-Norton! Customers can now choose to expand their controls capabilities with encoders mounted on our Duff-Norton B Series limit switches.



Mounted Encoder

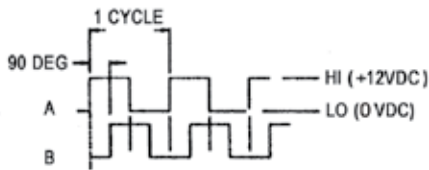
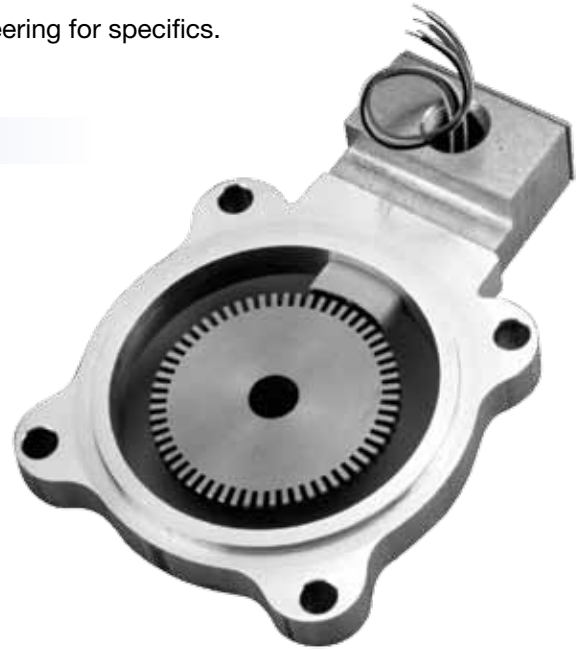


SCREW JACK ACTUATOR CONTROLS RING KIT ENCODER

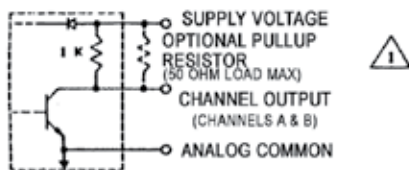
The Ring Kit Encoder counts motor revolutions and is mounted between the C-face motor and motor mounting flange. This mounting allows the actuator worm opposite the motor to be available for mounting a limit switch or driving another actuator. With 60 pulses per motor revolution, the ring kit offers a high pulse count relative to actuator travel. A small junction box with NPT opening is attached to the ring, allowing easy, protected electrical connections. Available for all sizes of NEMA C flanges used on Duff-Norton actuators. Additional output types available. Contact Duff-Norton Application Engineering for specifics.

SPECIFICATIONS

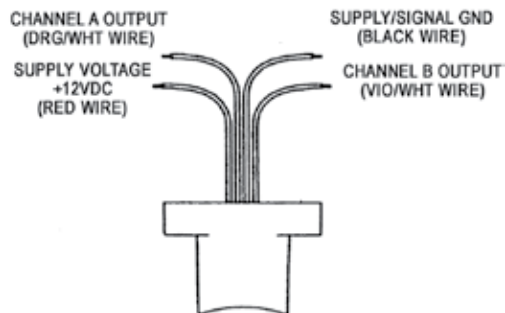
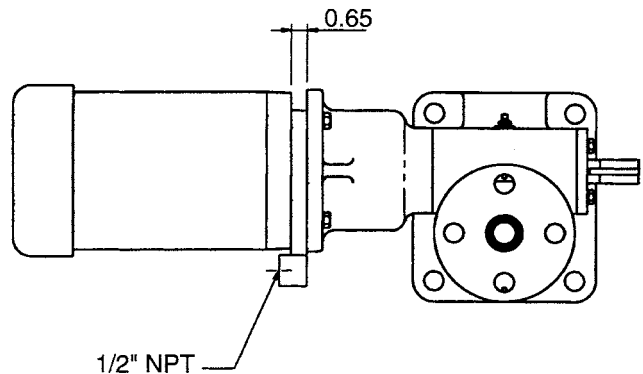
- Sensor Type.....Bidirectional shaft speed sensor
- Pulse Per Revolution 60 cycles each channel
- Supply Voltage.....5 - 24VDC
- Supply Current.....60 mA typical (115 mA maximum)
- Output Drive Capability ..250 mA per channel continuous
- Maximum Load.....50 ohms per channel



Output Channel Waveforms



Output Channel Schematic (Channels A & B)



Electrical Connections

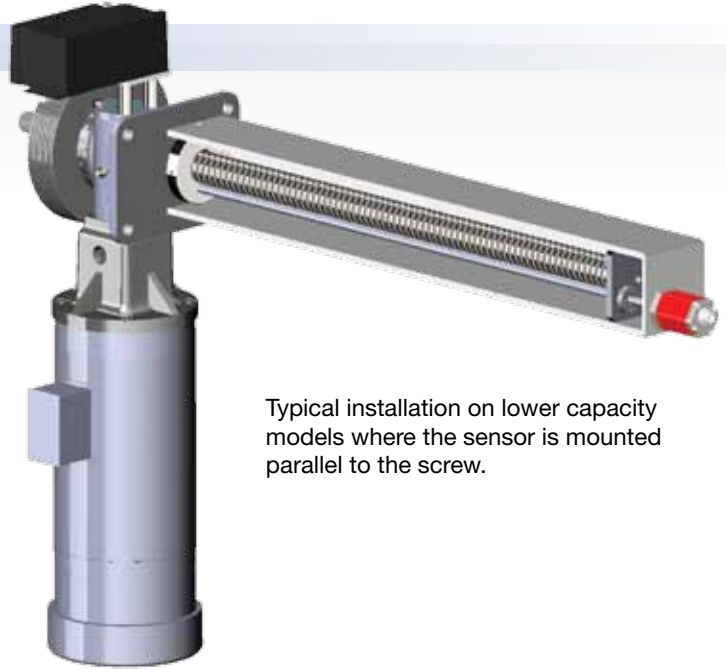
SCREW JACK ACTUATOR CONTROLS MAGNETOSTRICTIVE POSITION SENSOR

Duff-Norton offers 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 (1525mm)
- 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



Typical installation on lower capacity models where the sensor is mounted parallel to the screw.

Typical installation on higher capacity models where the screw is "gun drilled" with the sensor mounted inside the screw.



SPECIFICATIONS

- Supply Voltage..... +15 to 26 VDC
- Non-Linearity $\pm 0.02\%$ of full scale on 0.002 inch whichever is greater
(± 0.05 mm) whichever is greater
- Repeatability..... $\pm 0.001\%$ 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 inch (0.1 inch increments)
Metric: 50 to 1500 mm (5 mm increments)

SCREW JACK ACTUATOR CONTROLS ROTARY COUNTERS

The Duff-Norton Rotary Counter is for actuator customers who are looking for a more economical and easy way to determine an actuator's position. Our counters have been designed to match our most common actuator ratios. An operator viewing the reading in the display window will know his actuator's exact position because the counter's display shows stroke to the nearest Thousandths of an inch up to 99 inches of travel. Custom numeric displays are also available.

FEATURES

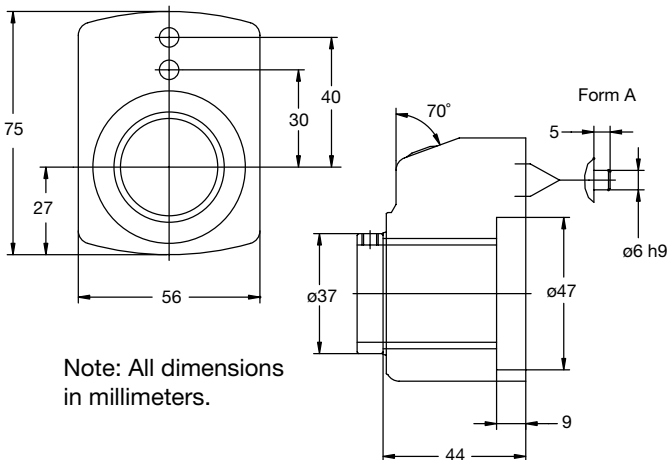
- Display readings have been pre-matched to the actuator's ratios.
- Display reading has been extended to the nearest Thousandths of an inch.
- Clockwise and counter clockwise models available.
- Easy mounting kits available for installation to existing field actuators.



Model Number	Turns of Worm for 1 Inch Raise	MS Actuator Capacity and Ratio				Approx. Width
		Standard	Optional 1	Optional 2	Numeric	
Clockwise Rotation						
RC16R	16	5-100 Tons				2 inch
RC24R	24	2-3 Tons				2 inch
RC32R	32			5 Ton		2 inch
RC48R	48		10-100 Ton	2-3 Ton		2 inch
RC64R	64		5 Ton			2 inch
RC96R	96		2-3 Ton			2 inch
RC100R	100				2-25 Ton	2 inch
Counter Clockwise Rotation						
RC16L	16	5-100 Tons				2 inch
RC24L	24	2-3 Tons				2 inch
RC32L	32			5 Ton		2 inch
RC48L	48		10-100 Ton	2-3 Ton		2 inch
RC64L	64		5 Ton			2 inch
RC96L	96		2-3 Ton			2 inch
RC100L	100				2-25 Ton	2 inch

Note: counter models with either 24 or 96 turns will be short .002 inch per inch. For those models, instead of a 1.000 inch reading, one would have a .998 inch reading.

Rotary Counter Installation



Rotary Counters - Mounting Information

The Duff-Norton Rotary Counter fits over the actuator's worm shaft. A special worm bushing fills dimensional difference between the counter's bore and the worms' diameter (see table). An anti-rotation pin from the counter's rear into the actuators' worm flange holds the counter steady.

Model Number	Bore Size	Capacity
SK8001-6	.500"	2 Ton MS
BU10-.625	.625"	3 Ton MS
BU10-.750	.750"	5 Ton MS
BU10-1.00	1.00"	10 - 20 Ton MS

Note: Capacities greater than 20 Tons have their worm diameters turned down to size.

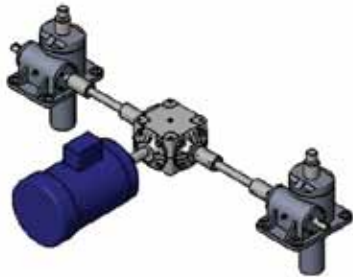
SCREW JACK POWER TRANSMISSION COMPONENTS TYPICAL SYSTEM ARRANGEMENTS

Duff-Norton offers all of the components necessary to complete your power transmission system, whether it consists of a single actuator or a multiple actuator arrangement. We offer a complete line of accessories to interconnect two or more actuators and provide permanent synchronization. Duff-Norton's Application Engineers can specify shafts, couplings, pillow blocks, and right-angle miter gearboxes to accommodate any layout. Bellows boots to protect actuator screws from dirt and other contaminants are available for all actuators, to increase life and reduce maintenance requirements.

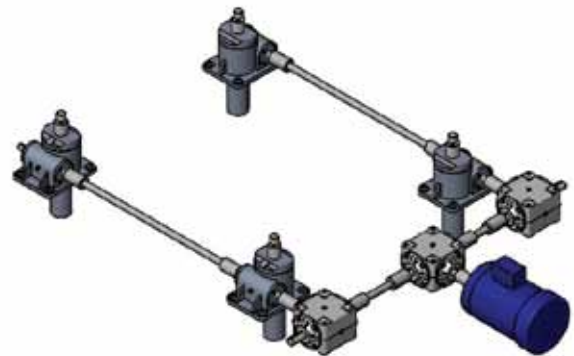
The following pages outline the basic selection of power transmission components that can be utilized to assemble a system. The tables match the parts to their respective actuator sizes to assist selection.

By letting Duff-Norton be your sole source for actuator system components, you can consolidate your needs on one purchase order, reducing time spent sourcing, pricing, and receiving parts. Should you have questions, contact our customer service representatives. Duff-Norton's extensive experience in actuator systems can provide you with suggestions for the most economical and reliable method to complete your lifting system.

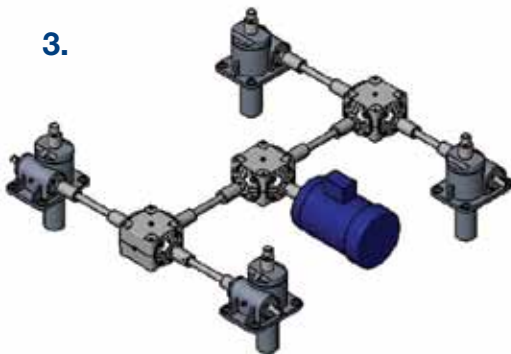
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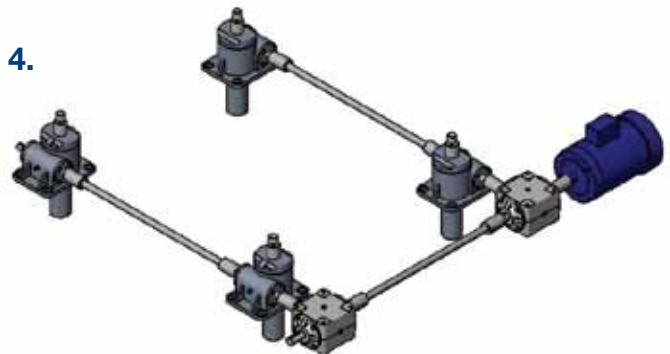
2.



3.



4.



SCREW JACK POWER TRANSMISSION COMPONENTS

Machine Screw Power Transmission Components								
Actuator Model	Coupling Part Number	Bore Size and Description	Connecting Shaft Part Number	Pillow Block Part Number	Mitre Box Part Number	Mitre Box Description	Mitre Box Part Number	Mitre Box Description
MS 1/4 Ton	SK2555-29	3/8" Bore - Jaw	SH50	PB50	MB-4	3 way		
MS 1/2 Ton	SK2555-29	3/8" Bore - Jaw	SH63	PB63	MB-4	3 way		
MS 1 Ton	SK2402J	1/2" Bore - Jaw	SH75	PB75	MB-7	3 way		
MS 2 Ton	SK2402J	1/2" Bore - Jaw	SH100	PB100	MB-16	3 way		
MS 3 Ton	CP03-500500	1/2" Bore - Chain	SH100	PB100	MB-16	3 way		
MS 5 Ton	CP05-750750	3/4" Bore - Chain	SH150	PB150	MB-19	3 way	MB-19G	4 way
MS 10 Ton	CP20-10001000	1" Bore - Chain	SH163	PB168	MB-19	3 way	MB-19G	4 way
MS 15 Ton	CP20-10001000	1" Bore - Chain	SH200	PB200	MB-20	3 way	MB-20G	4 way
MS 20 Ton	CP20-10001000	1" Bore - Chain	SH200	PB200	MB-20	3 way	MB-20G	4 way
MS 25 Ton	CP35-13751375	1-3/8" Bore - Chain	SH225	PB225	MB-20	3 way	MB-20G	4 way
MS 30 Ton	CP35-13751375	1-3/8" Bore - Chain	SH225	PB225	MB-20	3 way	MB-20G	4 way
MS 35 Ton	CP35-13751375	1-3/8" Bore - Chain	SH250		MB-22	3 way	MB-22G	4 way
MS 50 Ton	CP50-15001500	1-1/2" Bore - Chain	• Please contact our customer service team •					

Anti-Backlash Power Transmission Components								
Actuator Model	Coupling Part Number	Bore Size and Description	Connecting Shaft Part Number	Pillow Block Part Number	Mitre Box Part Number	Mitre Box Description	Mitre Box Part Number	Mitre Box Description
AB 1/4 Ton	SK2555-29	3/8" Bore - Jaw	SH50	PB50	MB-4	3 way		
AB 1/2 Ton	SK2555-29	3/8" Bore - Jaw	SH63	PB63	MB-4	3 way		
AB 1 Ton	SK2402J	1/2" Bore - Jaw	SH100	PB75	MB-7	3 way		
AB 2 Ton	SK2402J	1/2" Bore - Jaw	SH100	PB100	MB-16	3 way		
AB 3 Ton	CP03-500500	1/2" Bore - Chain	SH100	PB100	MB-16	3 way		
AB 5 Ton	CP05-750750	3/4" Bore - Chain	SH150	PB150	MB-19	3 way	MB-19G	4 way
AB 10 Ton	CP20-10001000	1" Bore - Chain	SH163	PB168	MB-19	3 way	MB-19G	4 way
AB 15 Ton	CP20-10001000	1" Bore - Chain	SH200	PB200	MB-20	3 way	MB-20G	4 way
AB 20 Ton	CP20-10001000	1" Bore - Chain	SH225	PB200	MB-20	3 way	MB-20G	4 way
AB 25 Ton	CP35-13751375	1-3/8" Bore - Chain	SH225	PB225	MB-20	3 way	MB-20G	4 way
AB 30 Ton	CP35-13751375	1-3/8" Bore - Chain	SH225	PB225	MB-20	3 way	MB-20G	4 way
AB 35 Ton	CP35-13751375	1-3/8" Bore - Chain	SH250		MB-22	3 way	MB-22G	4 way
AB 50 Ton	CP50-15001500	1-1/2" Bore - Chain	• Please contact our customer service team •					

Ball Screw Power Transmission Components								
Actuator Model	Coupling Part Number	Bore Size and Description	Connecting Shaft Part Number	Pillow Block Part Number	Mitre Box Part Number	Mitre Box Description	Mitre Box Part Number	Mitre Box Description
BS 1/2 Ton	SK2555-29	3/8" Bore - Jaw	SH50	PB50	MB-4	3 way		
BS 1 Ton	SK2402J	1/2" Bore - Jaw	SH63	PB63	MB-4	3 way		
BS 2 Ton	SK2402J	1/2" Bore - Jaw	SH100	PB100	MB-16	3 way		
BS 2 Ton*	SK2402J	1/2" Bore - Jaw	SH100	PB100	MB-16	3 way		
BS 3 Ton	CP03-500500	1/2" Bore - Chain	SH100	PB100	MB-16	3 way		
BS 5 Ton	CP05-750750	3/4" Bore - Chain	SH125	PB125	MB-19	3 way	MB-19G	4 way
BS 5 Ton*	CP05-750750	3/4" Bore - Chain	SH150	PB150	MB-19	3 way	MB-19G	4 way
BS 10 Ton	CP20-10001000	1" Bore - Chain	SH125	PB125	MB-19	3 way	MB-19G	4 way
BS 10 Ton*	CP20-10001000	1" Bore - Chain	SH163	PB168	MB-19	3 way	MB-19G	4 way
BS 20 Ton	CP20-10001000	1" Bore - Chain	SH163	PB168	MB-20	3 way	MB-20G	4 way
BS 20 Ton*	CP20-10001000	1" Bore - Chain	SH200	PB200	MB-20	3 way	MB-20G	4 way
BS 25 Ton	CP35-13751375	1-3/8" Bore - Chain	SH163	PB168	MB-22	3 way	MB-22G	4 way
BS 50 Ton	CP50-15001500	1-1/2" Bore - Chain	• Please contact our customer service team •					

*High Lead Option

NOTE

All selections are based on the actuator's worm input torque at full load. As the application and load changes, the power transmission components best suited for the application may change as well. In particular, connecting shaft sizes could change depending on the shaft length required, which may also result in changes to the pillow blocks and couplings.

SCREW JACK POWER TRANSMISSION COMPONENTS

Stainless Steel Machine Screw Power Transmission Components								
Actuator Model	Coupling Part Number	Bore Size and Description	Connecting Shaft Part Number	Pillow Block Part Number	Mitre Box Part Number	Mitre Box Description	Mitre Box Part Number	Mitre Box Description
SMS 2 Ton	SK2402J	1/2" Bore - Jaw	SH100	PB100	MB-7	3 way		
SMS 3 Ton	CP03-500500	1/2" Bore - Chain	SH100	PB100	MB-16	3 way		
SMS 5 Ton	CP05-750750	3/4" Bore - Chain	SH150	PB150	MB-16	3 way		
SMS 10 Ton	CP20-10001000	1" Bore - Chain	SH150	PB150	MB-19	3 way	MB-19G	4 way
SMS 15 Ton	CP20-10001000	1" Bore - Chain	SH175	PB175	MB-20	3 way	MB-20G	4 way
SMS 20 Ton	CP20-10001000	1" Bore - Chain	SH175	PB175	MB-20	3 way	MB-20G	4 way
SMS 25 Ton	CP35-13751375	1-3/8" Bore - Chain	SH225	PB225	MB-19	3 way	MB-19G	4 way
SMS 30 Ton	CP35-13751375	1-3/8" Bore - Chain	SH225	PB225	MB-19	3 way	MB-19G	4 way
SMS 35 Ton	CP35-13751375	1-3/8" Bore - Chain	SH2250	PB225	MB-22	3 way	MB-22G	4 way
SMS 50 Ton	CP50-15001500	1-3/8" Bore - Chain	• Please contact our customer service team •					

Continuous Duty Power Transmission Components								
Actuator Model	Coupling Part Number	Bore Size and Description	Connecting Shaft Part No.	Pillow Block Part Number	Mitre Box Part Number	Mitre Box Description	Mitre Box Part Number	Mitre Box Description
CD 7511	SK2402J	1/2" Bore - Jaw	SH100	PB100	MB-7	3 way		
CD 7515	CP20-10001000	1" Bore - Chain	SH100	PB100	MB-16	3 way		
CD 75151*	CP20-10001000	1" Bore - Chain	SH100	PB100	MB-16	3 way		
CD 7522	CP20-10001000	1" Bore - Chain	SH125	PB125	MB-19	3 way	MB-19G	4 way
CD 75221*	CP20-10001000	1" Bore - Chain	SH150	PB150	MB-19	3 way	MB-19G	4 way

* High Lead Option*

NOTE

All selections are based on the actuator's worm input torque at full load. As the application and load changes, the power transmission components best suited for the application may change as well. In particular, connecting shaft sizes could change depending on the shaft length required, which may also result in changes to the pillow blocks and couplings.



SCREW JACK

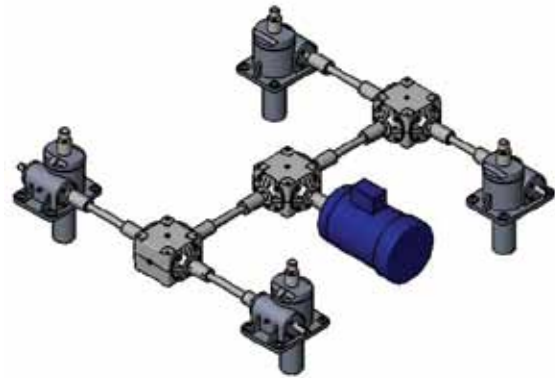
POWER TRANSMISSION COMPONENTS

MITRE BOXES

Power transmission systems frequently use multiple actuator arrangements. Such systems commonly use mitre boxes to effectively position and equally distribute loads. As the mitre boxes are supplied with 1:1 gear ratios as standard, all motion is synchronous upon system actuation through the main drive shaft.

FEATURES

- 98% average efficiency ratings.
- Carburized and case hardened bevel gears.
- Alloy steel input/output shafts for greater strength.
- Anti-friction bearings on all shafts.
- MB-4 and MB-8 models come with lifetime lubrication, stainless steel shafts and aluminum housings.



Mitre Box Performance Specifications			
Part Number	Type	Capacity (in/lbs)	Shaft Diameter
MB-4	3-Way	23	.375"
MB-8	3-Way	97	.75"
MB-16	3-Way	344	.625"
MB-19	3-Way	1400	1.0"
MB-19G	4-Way	1400	1.0"
MB-20	3-Way	3000	1.25"
MB-20G	4-Way	3000	1.25"
MB-22	3-Way	5000	1.375"
MB-22G	4-Way	5000	1.375"

Our mitre boxes feature a compact design, which eliminates the need for an extended hub. With this design feature the bevel gear is supported by tapered roller bearings on both sides. The result is a higher horsepower rating, increased service-life, improved lubrication, and more flexible mounting compared to other brands.

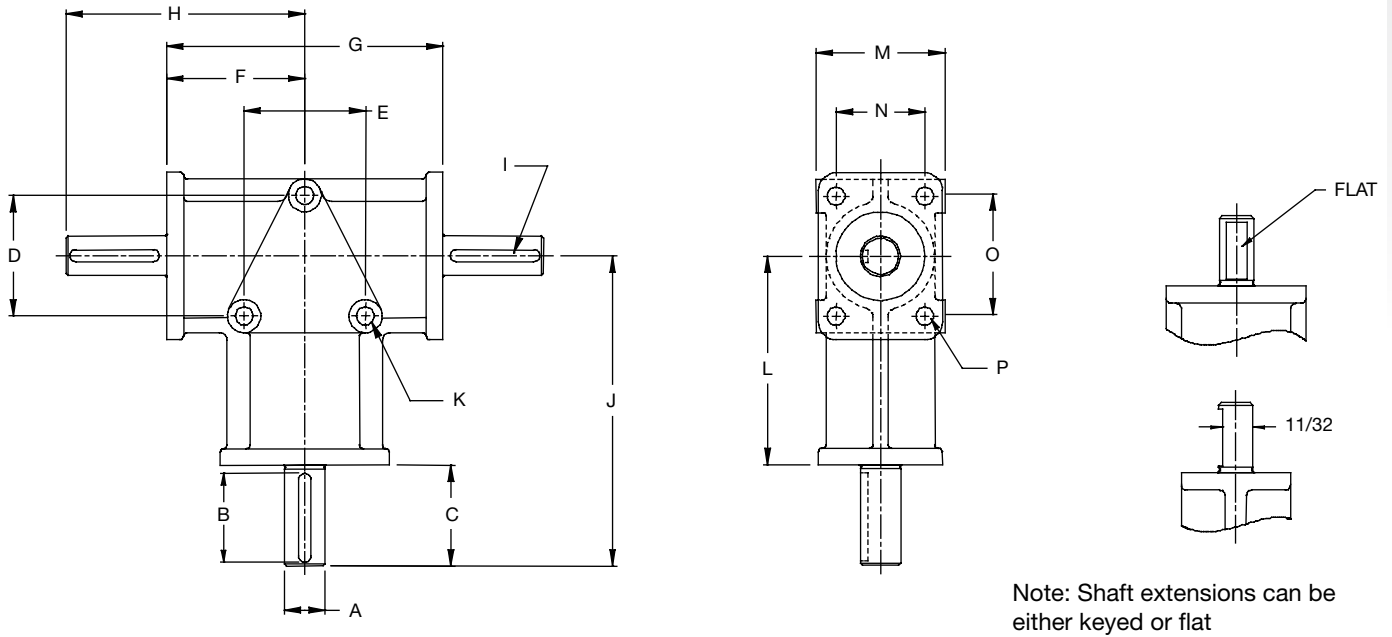


SCREW JACK

POWER TRANSMISSION COMPONENTS

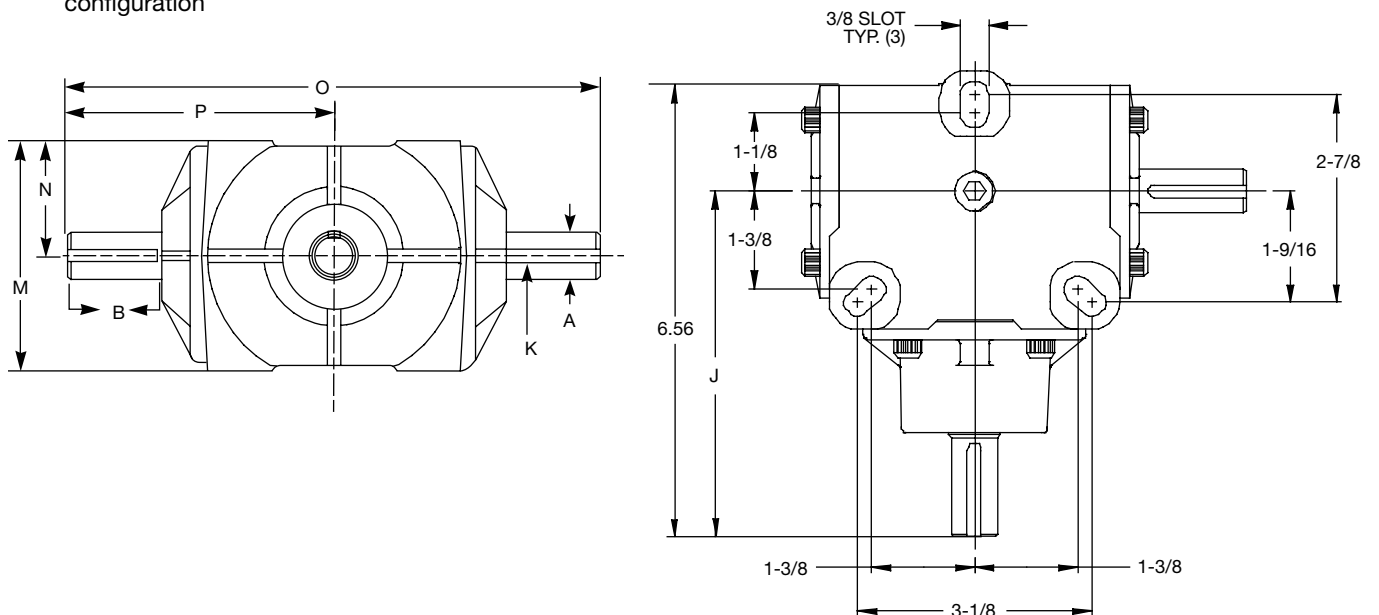
MITRE BOX DIMENSIONAL SPECIFICATIONS

Model	Torque	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
MB-4	23	0.375	0.625	0.781	1.313	1.313	1.375	2.750	2.156	FLAT	2.938	0.219	2.156	1.250	0.875	1.188	0.188
MB-8	97	0.750	1.375	1.563	3.000	3.000	3.000	6.000	4.563	3/16"	6.563	0.375	5.000	3.000	2.250	3.000	0.375



Model	Torque	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
MB-16	344	0.625	1.219	—	—	—	—	—	—	1.688	4.875	0.187	—	3.188	1.594	7.250	3.625

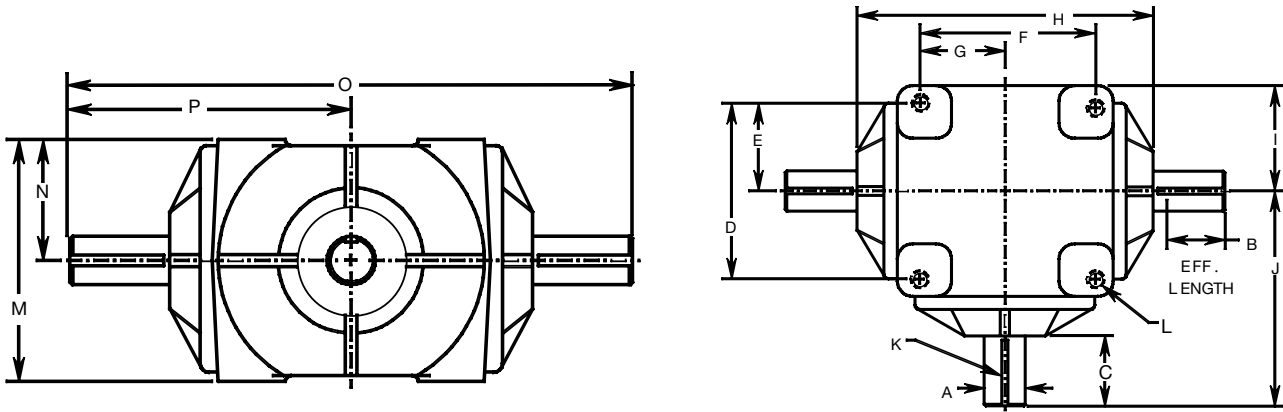
Note: Standard model is a 3-way configuration



SCREW JACK

POWER TRANSMISSION COMPONENTS

MITRE BOX DIMENSIONAL SPECIFICATIONS

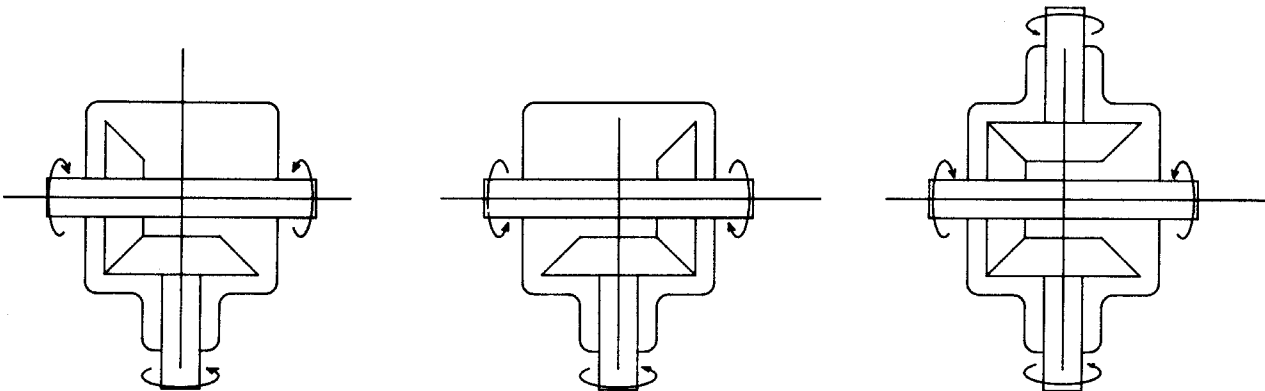


Model	Torque	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
MB-19 (G)	1400	1.000	1.396	2.000	4.250	2.125	4.250	2.125	7.000	2.750	5.500	1/4"	3/8"-16	4.125	2.062	11.000	5.500
MB-20 (G)	3000	1.250	1.840	2.500	4.500	2.250	4.500	2.250	8.000	2.875	6.500	1/4"	1/2"-13	5.625	2.813	13.000	6.500
MB-22 (G)	5000	1.375	2.170	2.938	6.000	3.000	6.000	3.000	10.625	4.125	8.250	5/16"	1/2"-13	7.500	3.750	16.500	8.250

Mitre Box Shaft Rotation

Three and four way Duff-Norton MB series mitre boxes are made for reversible mounting. The relationship between input and output shaft rotation can be reversed by mounting the gearbox upside down.

Two way boxes should be specified as "CW in/CW out" or "CW in/CCW out".



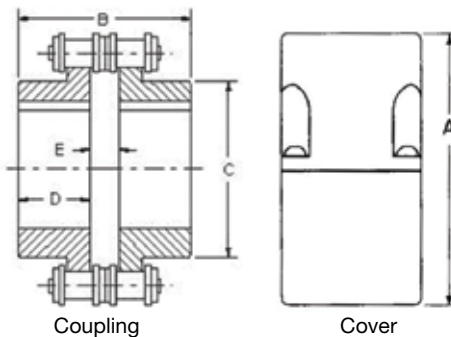
SCREW JACK POWER TRANSMISSION COMPONENTS ACTUATOR - CHAIN COUPLINGS

Duff-Norton provides three coupling types which have been tailored to specific actuator requirements:

FEATURES

Chain Couplings:

- Integrates well with Duff-Norton mid and larger capacity actuators.
- High torque capacities.
- Standard ANSI dimensions, straight bore diameters.
- Common bore diameters may be custom ordered.
- Special bore diameters may be custom ordered.
- Long service lives.
- Easy fit onto the actuator's worm shaft.
- Allows for incremental system adjustments.



Coupling with cover

Chain Coupling Specifications

Capacity	Part Number	Measurements in inches								Actual Torque at Load **	Coupling Torque	Misalignment (Max.)	
		Standard Bore***	Maximum Bore	Key Broach Dimensions	A*	B	C	D	E			Parallel	Angular
2 Ton	CP03-500500	.500	.875	.125 x .63	4.00	2.53	1.41	1.13	.28	132	1354	.015	1/2 Deg.
3 Ton	CP03-625625	.625	.875	.125 x .63	4.00	2.53	1.41	1.13	.28	181	1354	.015	1/2 Deg.
5 Ton	CP05-750750	.750	1.25	.1875 x .093	4.00	2.53	1.41	1.13	.28	4.95	1354	.015	1/2 Deg.
10-20 Ton	CP20-10001000	1.000	1.687	.25 x .125	5.13	3.25	2.50	1.44	.38	2255	4614	.015	1/2 Deg.
25-30 Ton	CP35-13751375	1.375	2.000	.313 x .156	5.13	3.75	2.97	1.69	.38	4400	5969	.015	1/2 Deg.
50 Ton	CP50-15001500	1.500	2.437	.375 x .1875	6.38	4.23	3.50	1.88	.47	8250	10899	.015	1/2 Deg.

*Includes two hubs, four rubber gaskets, chain, and cover
 ***Tolerance for all bores is +.001/- .000

**Based on Anti-backlash actuator torque ratings

NOTE: Duff-Norton recommends using the cover assembly with the chain coupling

Coupling Selection Guide

1. Flexible couplings are made up of components. Two hubs each with a bore and keyway to match the shafts being coupled and a chain cover (for chain couplings) or a sleeve kit (for gear-type couplings) or a spider (for jaw-type couplings). The bores in the coupling hubs are sized to give an easy fit on actuator worm shafts.
2. Determine required coupling torque with this formula: Torque Requirement per Actuator X Number of Actuators to Be Driven by the Coupling.
3. Verify the required coupling torque. Make sure it's not greater than the maximum rating in the accompanying coupling tables.
4. Chain or full-flex gear couplings are recommended for close coupled arrangements.
5. Chain or flex-rigid gear couplings are recommended for floating shaft arrangements with the rigid hub (if selected) mounted to the floating shaft.
6. For maximum performance, the actuators, shafts, gear boxes and motor should be carefully aligned.

SCREW JACK

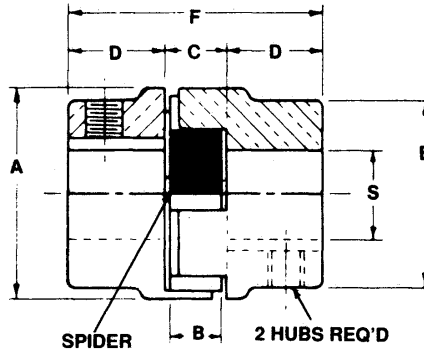
POWER TRANSMISSION COMPONENTS

ACTUATOR - JAW, FULL-FLEX, & FLEX-RIGID GEAR COUPLINGS

FEATURES

Jaw Couplings:

- Integrates well with Duff-Norton smaller capacity actuators.
- Does not require lubrication.
- Our Hytrel® spiders provide 2 times the torque capability vs. a standard urethane or BUNA® spider.
- Easy fit onto the actuators worm shaft.



Jaw Type Coupling Specifications

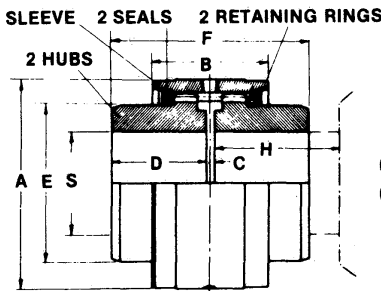
Part Number		Standard Bore***	Maximum Bore	Key Broach Dimensions	A*	B	C	D	E	F	Coupling Torque	Misalignment (Max)	
Hub #	Spider #											Parallel	Angular
SK2555H2	SK2555-29S	.375"	.875"	None	1-5/64	7/16	15/32	5/8	1-5/64	1-23/32	50	.015	1/2 Deg.
SK2402J-H1	SK2402-JS	.375"	.875"	.125" x .63"	1-3/4	15/32	1/2	13/16	1-3/4	2-1/8	250	.015	1/2 Deg.
SK2402J-H2	SK2402-JS	.626"	.875"	.1875" x .0938"	1-3/4	15/32	1/2	13/16	1-3/4	2-1/8	250	.015	1/2 Deg.

*Includes two hubs, and Hytrel spider **Based on Anti-backlash actuator torque ratings ***Tolerance for all bores is +.001/-.000

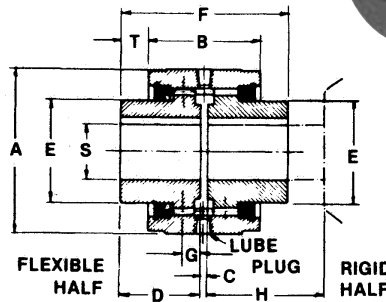
FEATURES

Full-Flex and Flex-Rigid Gear Couplings:

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



Gear Coupling



Flex—Rigid Coupling



Gear Coupling Performance Specifications

Capacity	Part Number			Std. Bore***	Max. Bore***	Key Broach Dimensions	A*	B	C	D	E	F	H	Actual Torque at Load**	Coupling Torque	Misalignment (Max)	
	Sleeve Kit	Flex Hub	Rigid Hub													Parallel	Angular
5 Ton	SK2405S	SK2405H	SK2404H	.0751	1.25	.1875" x .0938"	3-5/16	2	1/8	1-1/2	2	3-1/8	2-1/8	495	6300	+	1/2 Deg.
10-20 Ton	SK2410S	SK2410H	SK2409H	1.001	1.25	.25" x .125"	3-5/16	2	1/8	1-1/2	2	3-1/8	2-1/8	2255	6300	+	1/2 Deg.
25-35 Ton	SK2425S	SK2425H	SK2424H	1.376	1.625	.313" x .156"	3-3/4	2-17/32	1/8	1-13/16	2-3/8	3-3/4	2-21/32	4400	18900	+	1/2 Deg.
50 Ton	SK2450S	SK2450H	SK2449H	1.501	1.625	.375" x .1875"	3-3/4	2-17/32	1/8	1-13/16	2-3/8	3-3/4	2-21/32	8250	18900	+	1/2 Deg.
100 Ton	SK2499S	SK2499H	SK2498H	1.751	2.125	.50" x .25"	4-3/4	2-9/16	1/8	2-1/16	3-1/4	4-1/4	2-11/16	17600	50000	+	1/2 Deg.

*Includes two hubs, and Hytrel spider **Based on Anti-backlash actuator torque ratings ***Tolerance for all bores is +.001/-.000

SCREW JACK POWER TRANSMISSION COMPONENTS CONNECTING SHAFTS

Problem Scenario

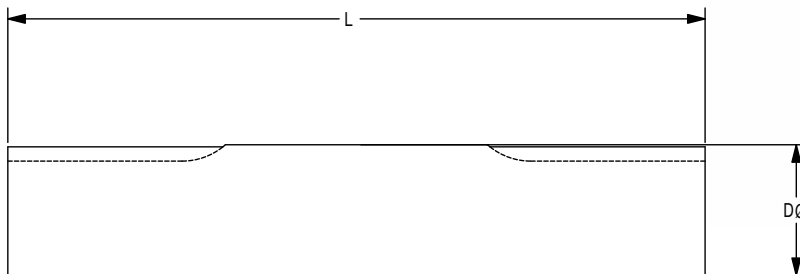
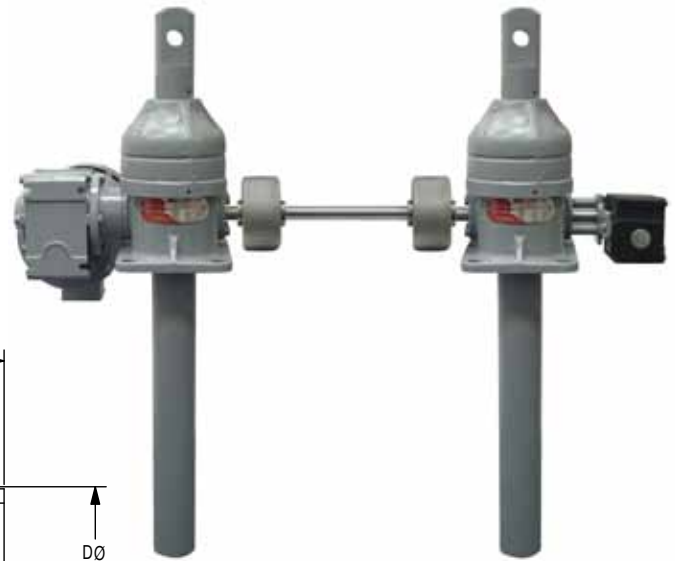
A common system operating problem stems from connecting shafts made from standard steel, which are often bowed or out-of-round. This results in a whipping effect while the system is being run with the connecting shaft working its way loose from the system at high speeds and doing a great deal of damage to the system's equipment.

Solution

Duff-Norton connecting shafts, which are furnished with close tolerance Turned, Ground, and Polished steel for smooth rotation.

FEATURES

- Turned, Ground, and Polished steel
- Shaft material is machined from cold-drawn bar.
- Furnished with ANSI-standard in-line keyways.
- Coordinates well with Duff-Norton Couplings (pages 142-143) and Block Supports (pages 146-147).



Dimensions and Minimum Size												
Model	SH50	SH63	SH75	SH100	SH125	SH150	SH163	SH175	SH200	SH225	SH250	
Minimum Shaft Length* "L" (in)	5	5	5	5	6	7	7	7	8	10	10	
Shaft Diameter "D" (in)	Nominal	1/2	5/8	3/4	1	1-1/4	1-1/2	1-5/8	1-3/4	2	2-1/4	2-1/2
	Actual	0.500	0.625	0.750	1.000	1.250	1.500	1.625	1.750	2.000	2.250	2.500
Keyway Width (in)	1/8	3/16	3/16	1/4	1/4	3/8	3/8	3/8	1/2	1/2	5/8	
Keyway Flat (in)	1.25	1.25	1.25	1.25	1.5	1.75	1.75	2	2	2.5	2.5	

Note: Minimum shaft length may vary depending on the specified coupling.

SCREW JACK

POWER TRANSMISSION COMPONENTS

SHAFT SELECTION CRITERIA

Instructions:

1. Find a torque value that is greater than or equal to your calculated torque requirements.
2. Use the second column to find the required shaft diameter (rounding up is recommended.)
3. Check the third column for the maximum allowable shaft span before supports are required.
4. Match your selected shaft's maximum allowable speed (rpm) to actual shaft speed (rpm). Increasing your selected shaft size is recommended until it falls into the allowable range.



Shaft Diameter (Inches)	Maximum Torque (in/lbs)	Maximum** Distance Between Supports (inches)	For Shaft Lengths below, Maximum Allowable RPMs***									
			36	48	60	72	84	96	108	120	132	144
0.500	9	68	1469	826	529	367	270	207	163	132	109	92
0.625	22	79	1836	1033	661	459	337	258	204	165	137	115
0.750	45	89	2204	1240	793	551	405	310	245	198	164	138
1.000	141	107	2938	1653	1058	735	540	413	326	264	219	184
1.250	345	125	3673	2066	1322	918	675	516	408	331	273	230
1.500	716	141	4407	2479	1587	1102	810	620	490	397	328	275
1.625	986	148	4775	2686	1719	1194	877	671	531	430	355	298
1.750	1326	156	5142	2892	1851	1285	944	723	571	463	382	321
2.000	2262	170	5877	3306	2116	1469	1079	826	653	529	437	367
2.250	3624	184	6611	3719	2380	1653	1214	930	735	595	492	413
2.500	5523	198	7346	4132	2644	1836	1349	1033	816	661	546	459

* Based on .08 degrees per foot torsional deflection.

** Based on .010 in/ft maximum sag between bearings. Shaded area exceeds sag recommendation.

*** Based on 80% critical speed, simple supports

Reference: Machinery's Handbook, 23rd edition.

Maximum Torque:	$D = .29(T)^{1/4}$	$T = (D/.29)^4$
Bearing Distance:	$L(\text{ft.}) = 8.95(D^2)^{1/3}$	$L(\text{in.}) = 107.4(D^2)^{1/3}$
Critical Speed, Shaft Only, Simple Supports:	$N = 1.0 \times 4.76 \times 10^6 \times D/L^2$	

SCREW JACK POWER TRANSMISSION COMPONENTS BELLOWS BOOTS

Duff-Norton highly recommends the use of a bellows boot for most actuator applications. Duff-Norton can provide bellows boots for the most stringent application requirement.



FEATURES

- Protects the lifting screw from: dust, dirt, moisture, and corrosive contaminants.
- Helps maintain the proper lubrication.
- Can be provided for all actuator screw end types and configurations.
- Standard bellows boots are made of neoprene coated nylon with sewn construction.
- Special bellows boots can be provided with a variety of materials for applications involving high temperatures, highly corrosive atmospheres, and other special conditions.
- Bellows boots can also be provided from molded materials, with internal or external guides to prevent sagging, and with zippers for easy installation or removal.

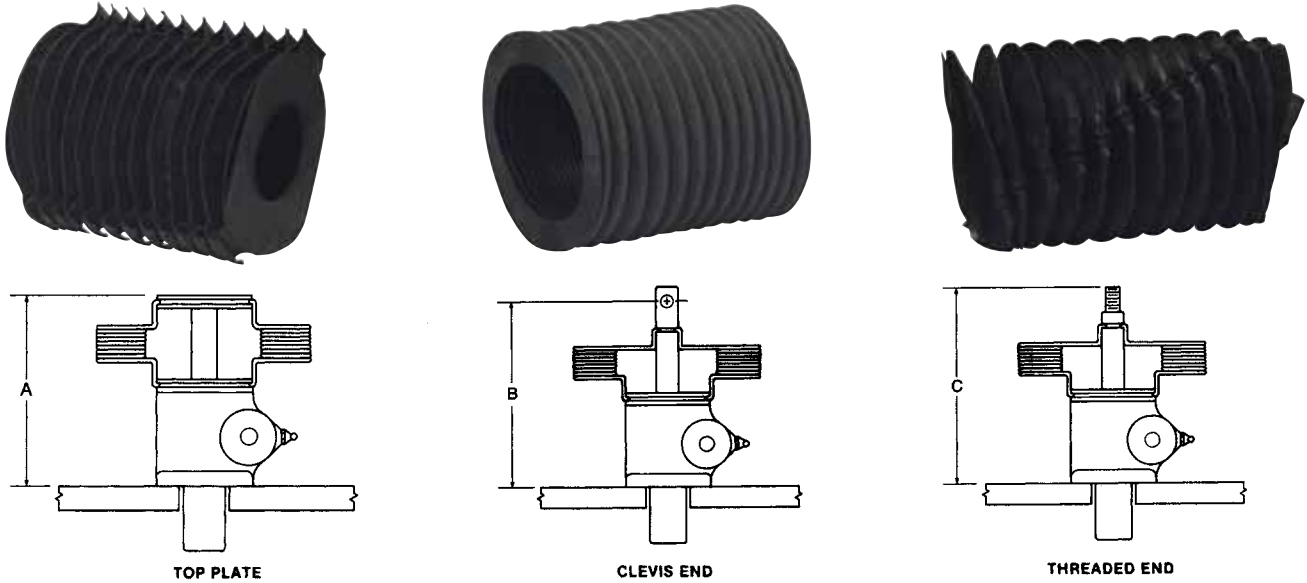
Shell Cap Dimensions			
Actuator Capacity	Shell Cap Diameter "A"	Actuator Capacity	Shell Cap Diameter "A"
1/4 Ton MS	2-1/4		
1/2 Ton MS	2-1/4	1/2 Ton BS	2-1/4
1 Ton MS	2-3/4	1 Ton BS	2-3/4
2 Ton MS	3-1/2	2 Ton BS	3-1/2
3 Ton MS	3-6/16	3 Ton BS	3-1/2
5 Ton MS	4-1/2	5 Ton BS	5-3/8
10 Ton MS	5-1/4	10 Ton BS	4-1/2
15 Ton MS	5-5/8	15 Ton BS	5-5/8
20 Ton MS	6	20 Ton BS	7
25 Ton MS	7-1/2	25 Ton BS	8-7/8
30 Ton MS	7-1/2	50 Ton BS	9-1/2
35 Ton MS	7-7/8		
50 Ton MS	11-1/4		
75 Ton MS	13-1/4		
100 Ton MS	10		
150 Ton MS	10		
250 Ton MS	16		

SCREW JACK

POWER TRANSMISSION COMPONENTS

BELLOWS BOOTS

Closed Height When Optional Bellows Boots are Required on Standard Upright Actuators



Machine Screw Closed Heights - Upright																									
Actuator Capacity	Boot O.D.	Raise up to 12"			Raise 12" to 18"			Raise 18" to 24"			Raise 24" to 30"			Raise 30" to 36"			Raise 36" to 48"			Raise 48" to 60"			Raise 60" to 72"		
		A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
¼ Ton MS	4-1/4	4	4	4-1/4	4-3/4	4-5/8	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
½ Ton MS	4-1/4	4	4	4-1/2	4-1/4	4-5/8	4-1/2	4-1/4	4-5/8	4-1/2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1 Ton MS	6	4-1/2	5	5-3/8	5-1/8	5-5/8	6	5-1/2	5-3/4	6-1/4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2 Ton MS	7-3/4	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	—	—	—	—	—	—	—	—	—
3 Ton MS	7-3/4	5-3/4	6-1/2	6-1/2	6-1/8	7	7	6-5/8	7	7	6-5/8	7-7/8	8	7-7/8	7-7/8	8	—	—	—	—	—	—	—	—	—
5 Ton MS	7-3/4	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	—	—	—	—	—	—
10 Ton MS	9	7-1/4	8-1/2	9-3/4	7-1/4	8-1/2	9-1/2	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
15 Ton MS	9	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
20 Ton MS	9	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
25 Ton MS	10-3/4	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
30 Ton MS	10-3/4	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
35 Ton MS	10-3/4	11	12	13	15	12	13	—	12	13	15	12	13-3/4	15-3/4	12	13-3/4	14-3/4	12-7/8	14-3/4	13-3/4	15-1/2	17-1/2	14-3/4	16-1/2	18-1/2
50 Ton MS	14-1/2	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
75 Ton MS	16-1/2	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	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
100 Ton MS	11-1/4	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
150 Ton MS	12-1/4	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
250 Ton MS	16	30	—	—	30	—	—	30	—	—	30-1/2	—	—	30-1/2	—	—	30-1/2	—	—	30-1/2	—	—	32	—	—

Ball Screw Closed Heights - Upright																									
Actuator Capacity	Boot O.D.	Raise up to 12"			Raise 12" to 18"			Raise 18" to 24"			Raise 24" to 30"			Raise 30" to 36"			Raise 36" to 48"			Raise 48" to 60"			Raise 60" to 72"		
		A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1/2 Ton BS	4-1/2	—	—	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1 Ton BS	4-1/4	—	—	6-1/4	—	—	6-7/8	—	—	7-1/2	—	—	8	—	—	—	—	—	—	—	—	—	—	—	—
2 Ton BS	6-5/8	—	—	7-1/2	—	—	7-1/2	—	—	7-1/2	—	—	8-1/2	—	—	—	—	—	—	—	—	—	—	—	—
3 Ton BS	6-5/8	—	—	9-1/4	—	—	9-1/4	—	—	9-1/4	—	—	10-1/4	—	—	10-1/4	—	—	11-1/4	—	—	—	—	—	—
5 Ton BS	7-1/2	—	—	10-3/4	—	—	10-3/4	—	—	10-3/4	—	—	12-1/2	—	—	12-1/2	—	—	13-3/4	—	—	—	—	—	—
10 Ton BS	7	—	—	10-3/8	—	—	10-3/8	—	—	10-3/8	—	—	11-5/8	—	—	11-5/8	—	—	12-7/8	—	—	—	—	—	—
20 Ton BS	9	—	—	16-1/2	—	—	16-1/2	—	—	16-1/2	—	—	16-1/2	—	—	16-1/2	—	—	18-1/2	—	—	20-1/2	—	—	21-1/2
25 Ton BS	11	—	—	19-3/4	—	—	19-3/4	—	—	19-3/4	—	—	19-3/4	—	—	21-1/4	—	—	21-1/4	—	—	22-3/4	—	—	24-1/4
50 Ton BS	12	—	—	25-3/8	—	—	25-3/8	—	—	25-3/8	—	—	25-3/8	—	—	26-3/8	—	—	26-3/8	—	—	27-3/8	—	—	28-3/8

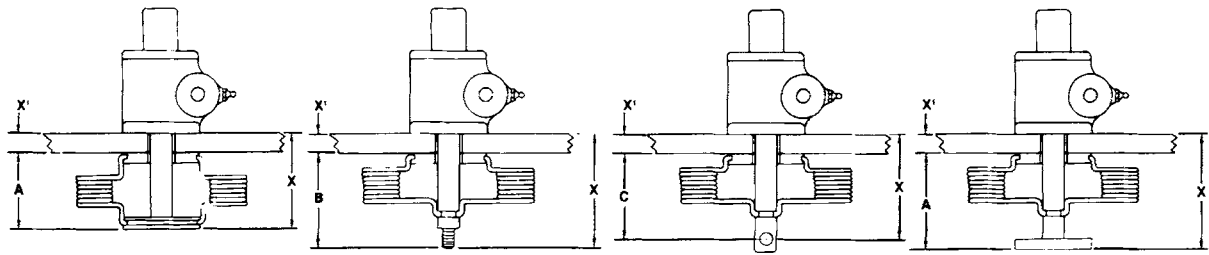
Note:(—) indicates "Not Applicable"

SCREW JACK

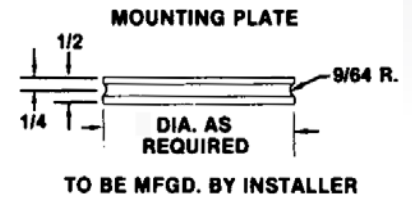
POWER TRANSMISSION COMPONENTS

INVERTED MACHINE SCREW & BALL SCREW ACTUATORS

Machine Screw Actuators - Inverted



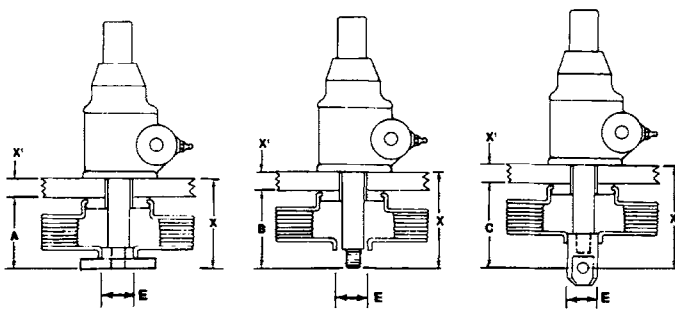
Machine Screw Closed Heights - Inverted												
Actuator Capacity	Raise up to 6"			Raise 7" to 12"			Raise 13" to 18"			Raise 19" to 24"		
	A	B	C	A	B	C	A	B	C	A	B	C
1/4 Ton BS	2	2-3/8	2	2	2-3/8	2	2-1/8	—	—	—	—	—
1/2 Ton BS	2	2-5/8	2-1/8	2	2-5/8	2-1/8	2-1/8	3-1/4	2-3/4	—	—	—
1 Ton BS	2-1/6	3	2-5/8	2-1/6	3	2-5/8	2-11/16	3-5/8	3-1/4	3-1/16	4	3
2 Ton BS	2-3/8	4-3/8	3-5/8	2-3/8	4-3/8	3-5/8	2-7/8	3-3/8	4-5/8	3	5-3/8	4-5/8
3 Ton BS	2-3/8	3	2-3/4	2-3/8	3-1/2	3-1/4	2-7/8	4	3-3/4	3	4	3-3/4
5 Ton BS	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
10 Ton BS	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
15 Ton BS	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
20 Ton BS	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
25 Ton BS	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
30 Ton BS	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
35 Ton BS	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
50 Ton BS	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
75 Ton BS	2-3/8	6-7/8	4-7/8	3-3/4	6-7/8	4-7/8	2-3/4	7-1/2	5-1/2	3-3/8	7-7/8	5-7/8
100 Ton BS	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
150 Ton BS	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



Note:

- a. If $A = X_1$ is less than 5 1/2", $X = 5$ 1/2"
 - b. If $B = X_1$ is less than 9 1/2", $X = 9$ 1/2"
 - 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 the dimensions shown.
- ** If $C + X_1$ is less than 9", $X = 9$ ". If greater than 9", use dimensions shown.

Ball Screw Actuators - Inverted



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 of the appropriate machine screw or ball screw actuator.

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

Ball Screw Closed Heights - Inverted														
Actuator Capacity	Raise up to 6"			Raise 7" to 12"			Raise 13" to 18"			Raise 19" to 24"			Standard Boot Collar Dia. E	
	A	B	C	A	B	C	A	B	C	A	B	C		
1/2 Ton BS	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	0.75	
1 Ton BS	2	2	2-7/8	3	2-7/8	3-5/8	3-3/4	3-5/8	4-3/8	4-3/8	4-1/4	5	1.25	
2 Ton BS	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	1.50	
3 Ton BS	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	1.50	
5 Ton BS	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	
10 Ton BS	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	1.50	
20 Ton BS	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	
25 Ton BS	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	3.50	
50 Ton BS	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	4.50	

Note: Dimensions subject to change without notice.

SCREW JACK LIFETIME WARRANTY

Lifetime Warranty

Subject to the conditions stated herein, Duff-Norton will repair or replace, at its option, to the original purchaser without charge, any parts proved to Duff-Norton's satisfaction to have been defective in material or workmanship. Duff-Norton will not repair or replace any parts that become inoperative because of normal repair or modification, improper installation, eccentric loading, overloading, chemical or abrasive action, excessive heat, or other abuse. Equipment and accessories not to 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.

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

SCREW JACK TERMS AND CONDITIONS

All sales by Seller are made pursuant to the following terms. No other or additional terms or conditions are or will be accepted.

ACCEPTANCE OF ORDERS -

All orders, whether placed directly or through an agent, and all subsequent amendments thereto, are subject to a final approval and acceptance by Seller's main office.

LIMITATION OF WARRANTIES, REMEDIES AND DAMAGES -

THE WARRANTY STATED BELOW IS GIVEN IN PLACE OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OTHERWISE. NO PROMISE OR AFFIRMATION OF FACT MADE BY ANY AGENT OR REPRESENTATIVE OF SELLER SHALL CONSTITUTE A WARRANTY BY SELLER OR GIVE RISE TO ANY LIABILITY OR OBLIGATION.

Seller warrants that on the date of its delivery to carrier the goods are free from defects in workmanship and materials.

SELLER'S SOLE OBLIGATION IN THE EVENT OF BREACH OF WARRANTY OR CONTRACT OR FOR NEGLIGENCE OR OTHERWISE WITH RESPECT TO GOODS SOLD SHALL BE EXCLUSIVELY LIMITED TO REPAIR OR REPLACEMENT, F.O.B. SELLER'S POINT OF SHIPMENT, OF ANY PARTS WHICH SELLER DETERMINES TO HAVE BEEN DEFECTIVE or if Seller determines that such repair or replacement is not feasible, to a refund of the purchase price upon return of the goods to Seller.

Any action against Seller for breach of warranty, negligence or otherwise must be commenced within one year after such cause of action accrues.

NO CLAIM AGAINST SELLER FOR ANY DEFECT IN THE GOODS SHALL BE VALID OR ENFORCEABLE UNLESS BUYER'S WRITTEN NOTICE THEREOF IS RECEIVED BY SELLER WITHIN ONE YEAR FROM THE DATE OF SHIPMENT.

Seller shall not be liable for any damage, injury or loss arising out of the use of the goods if, prior to such damage, injury or loss, such goods are (1) damaged or misused following Seller's delivery to carrier; (2) not maintained, inspected, or used in compliance with applicable law and Seller's written instructions and recommendations; or (3) installed, repaired, altered or modified without compliance with such law, instructions or recommendations.

UNDER NO CIRCUMSTANCES SHALL SELLER BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES AS THOSE TERMS ARE DEFINED IN SECTION 2-715 OF THE UNIFORM COMMERCIAL CODE.

TERMS OF PAYMENT -

Unless otherwise stated herein, payment of each invoice is required within thirty (30) days after date of shipment. Any balance unpaid after the required payment date shall be subject to a service charge of 1% per month from such date.

PRICE ADJUSTMENTS -

Amendments made by the Buyer to orders already placed shall, without formal notice to the Buyer, be subject to extra charges. If the estimated shipping date for the goods is more than sixty (60) days after date of order, the price of the goods are subject to increase by Seller.

TAXES -

Any sales, use, excise, and other taxes applicable to this transaction and the goods and/or services furnished by Seller are not included in the price and shall be paid by Buyer when due. If Seller pays any such taxes, Buyer shall reimburse Seller upon demand.

INDEMNIFICATION AND SAFE OPERATION -

Buyer shall comply with and require its employees to comply with directions set forth in instructions and manuals furnished by Seller and shall use and require its employees to follow such instructions and manuals and to use reasonable care in the use and maintenance of the goods. Buyer shall not remove or permit anyone to remove any warning or instruction signs on the goods. In the event of personal injury or damage to property or business arising from the use of the goods, Buyer shall, within forty-eight (48) hours thereafter, give Seller written notice of such injury or damage. Buyer shall cooperate with Seller in investigating any such injury or damage and in the defense of any claims arising therefrom.

If Buyer fails to comply with this section or if any injury or damage is caused, in whole or in part, by Buyer's failure to comply with applicable federal or state safety requirements, Buyer shall indemnify and hold Seller harmless against any claims, loss or expense for injury or damage arising from the use of the goods.

GOVERNING LAW -

This agreement shall be governed by and construed under the laws of the State of New York.

DELIVERY AND DELAYS -

Unless otherwise specified herein, deliveries shall be F.O.B. Seller's point of shipment and risk of loss shall pass to Buyer upon Seller's delivery to carrier. All shipping dates are approximate and Seller shall not be liable for loss or damage because of delays occasioned by labor disputes, damage to facilities, or failure of suppliers or subcontractors to meet

TERMS AND CONDITIONS

scheduled deliveries or any other cause beyond Seller's reasonable control or making its performance commercially impracticable.

Notwithstanding other provisions hereof, if shipment is delayed at Buyer's request, the goods shall be deemed to be stored at Buyer's risk and expense and Seller may thereupon bill Buyer for the full price and storage costs. Buyer shall pay such bill within 30 days after mailing thereof.

BUYER'S INSPECTION UPON RECEIPT OF SHIPMENT -

Buyer shall inspect the goods as soon as received. If any loss or damage is discovered, Buyer must notify both the carrier and Seller at once. Seller will cooperate with Buyer in filing claims with the carrier.

CHANGES AND CANCELLATION -

Seller reserves the right to change or cancel any order whenever circumstances require allocation of production or delivery or Seller deems change or cancellation to be necessary to comply with applicable laws, ordinances, regulations, directives or administrative actions. Seller reserves the right to make changes in materials or design which it determines appropriate for the goods.

SECURITY INTEREST AND REPOSSESSION -

Until full payment has been made therefor, Seller shall have a security interest in goods shipped to Buyer and the goods shall remain personal property. Upon request Buyer shall execute and deliver to Seller security agreements and financing statements further evidencing Seller's security interest. Buyer authorizes Seller to file a financing statement or statements relating to the goods, without Buyer's signature thereon, as Seller may deem appropriate and appoints Seller as Buyer's attorney-in-fact for the limited purpose of executing (without requiring Seller to do so) financing statements in Buyer's name and performing other acts which Seller deems appropriate to perfect and continue its security interest and to protect and preserve the goods.

In the event Buyer defaults in making any payment due Seller, Seller in addition to any other rights or remedies provided by law, shall have the right, with or without legal process, to enter the place where said goods are located and to repossess the goods in accordance with the Uniform Commercial Code.

ASSURANCES -

Shipment by Seller shall at all times be subject to the prior approval of its credit personnel and Seller may, at any time, decline to make shipment except upon receipt of prior payment or upon other terms and conditions or security satisfactory to such personnel.

PATENTS -

Except as to goods manufactured according to design supplied by Buyer, Seller will defend and hold Buyer free and harmless in a suit or proceeding brought against Buyer insofar as it is based on a claim that use of the goods by Buyer constitutes an infringement of any existing U.S. Patents, provided, however, that Buyer gives Seller prompt written notice of such suit or proceeding; permits Seller, through its counsel, to defend and/or settle the same; and gives Seller all necessary information, assistance and authority to enable Seller so to do. If Buyer's use of the goods is held to constitute infringement and further use is enjoined, Seller shall, at its option, either (i) procure for Buyer the right to continue using the goods; or (ii) replace the goods with non-infringing goods; or (iii) modify the goods to non-infringing goods. The foregoing states Seller's entire liability for patent infringement and shall not be construed to render Seller liable for damages based on product output.

MISCELLANEOUS -

This instrument constitutes the entire agreement between Seller and Buyer, superseding all previous understandings and writings regarding this transaction. Any amendment or modification of this Agreement shall be void unless in writing and signed by Seller.

No delay or omission by Seller in exercising any right or remedy hereunder shall be a waiver thereof or of any other right or remedy, and no single or partial exercise thereof shall preclude any other or further exercise thereof or the exercise of any other right or remedy. All rights and remedies of Seller are cumulative.

Sales made pursuant to this Agreement shall be governed by the Uniform Commercial Code as the same may from time to time be construed and in effect in the state wherein Seller has its main office.

ARBITRATION -

All disputes that may arise between the parties regarding the interpretation of the contract and the legal effect of the contract shall, to the exclusion of any court of law, be arbitrated and determined in accordance with the latest Commercial Arbitration Rules of the American Arbitration Association. The arbitration proceeding shall be held in the city in that state where the principal office of the Seller is located. The parties recognize and consent to the above mentioned arbitration association's jurisdiction over each and every one of them.

USTS rev. 2/98

MOTION TECHNOLOGY



SCREW JACKS



LINEAR ACTUATORS



ROTARY UNIONS



ACME AND BALL SCREW & NUTS



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