Acme Lead Screws
pg. **9**-2

Advanced Anti-Backlash Acme Nuts
pg. **9**-3

Advanced Anti-Backlash Acme Nuts
pg. **9**-4

Advanced Anti-Backlash Acme Nuts
pg. **9**-5

Anti-Backlash Acme Nuts
pgs. **9**-6 & **9**-7

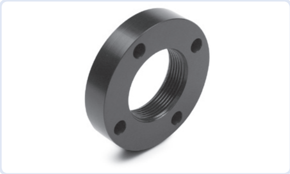
Anti-Backlash Acme Nuts
pg. **9**-8

Thread Mount Acme Nuts
pg. **9**-9

Thread Mount Acme Nuts
pgs. **9**-10 & **9**-11

Flange Mount Acme Nuts
pg. **9**-12

Flange Mount Acme Nuts
pg. **9**-13



Mounting Flanges
pg. **9**-14

BALL & ACME LEAD SCREW TECHNICAL INFORMATION

CENTERLESS GROUND AND STANDARD ROLLED
2G THREADFORM

Inch
0 1

MATERIAL:
300 Series Stainless Steel

FEATURES:
Low cost alternative to ball screw assemblies
Ideal in corrosive environments
Well suited for vertical motion applications

SPECIFICATIONS:
Lead accuracy: ±0.010 inches per foot
Straightness: 0.010 inches per foot

INCH COMPONENT CATALOG NUMBER

A B 1 1 S A - □□□□□□

Screw Size Code — Length in Feet

Screw Size Code	Screw Size	No. of Starts	Root Dia. in.	Lead in.	Available Lengths ft.
*25201	1/4-20	1	.19	.050	1, 3
*25161	1/4-16		.17	.063	
31082	5/16-8	2	.23	.250	1, 3, 6
31084		4		.500	
31122	5/16-12	2		.167	
*37081	3/8-8	stub	.29	.125	
37084		4	.27	.500	
Δ 37055	3/8-5	5	.24	1.000	
Δ 37045	3/8-4			1.200	
*37101	3/8-10	1	.26	.100	
37102		2		.200	
37114	3/8-11	4	.27	.375	
*37121	3/8-12	1	.28	.083	
37122		2	.31	.167	
*37161	3/8-16	1	.30	.063	
43082	7/16-8	2	.36	.250	2, 4, 6
43084		4		.500	
*50101	1/2-10	1	.39	.100	
50102		2		.200	
*62081	5/8-8	stub	.52	.125	
*62101	5/8-10	1		.100	
62102		2		.200	
*75061	3/4-6	1	.56	.167	
*75081	3/4-8		.61	.125	
*75101	3/4-10		.63	.100	
10005	1-5		.78	.200	
10008	1-8		.86	.125	
10010	1-10		.88	.100	

*Left-hand threads available on special order.
Δ Fast lead high helix lead screws.

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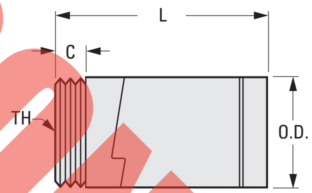
DISCONTINUED 6/12/2020

› MATERIAL:
Acetal with PTFE

› TEMPERATURE RANGE:
32° F to 180° F

› FEATURES:
Reduced drag

For use with Acme Lead Screw AB11SA-...



INCH COMPONENT

Catalog Number*	Screw Size	Number of Starts	Lead in.	Efficiency %	O.D.	L
AB27SN-31082AB	5/16-8	2	.125	65	.82	1.875
AB27SN-31084AB		4	.500	80		
AB27SN-31122AB	5/16-12	2	.167	72		
AB27SN-37081AB	3/8-8	1	.125	53		
AB27SN-37102AB	3/8-10	2	.200	65		
AB27SN-37114AB	3/8-11	4	.375	75		
AB27SN-37121AB	3/8-12	1	.500	79		
AB27SN-37122AB		2				
AB27SN-37161AB	3/8-16	1	.063	36		
AB27SN-43082AB	7/16-8	2	.250	65	1.12	2.250
AB27SN-43084AB		4	.500	76		
AB27SN-62081AB	5/8-8	1	.125	40		
AB27SN-62101AB	5/8-10		.100	35	1.40	2.600
AB27SN-62102AB		2	.200	51		
AB27SN-75061AB	3/4-6	1	.100	31	1.63	2.900
AB27SN-75081AB	3/4-8		.125	36		
AB27SN-10005AB	1-5		.200	41		
AB27SN-10008AB	1-8		.125	29	1.88	3.000
AB27SN-10010AB	1-10		.100	25		

Catalog Number (Ref.)	C	TH	Design Load lbf	Drag Torque oz. in.	Use with Flange
AB27SN-31...	.250	5/8-18	25	1-3	AB250F-037
AB27SN-37...					
AB27SN-43...	.375	15/16-16	125		AB250F-050
AB27SN-62...	.500	1.25-16	175	2-6	—
AB27SN-75...		1-3/8-16	250	3-10	AB250F-075
AB27SN-10...	.600	1-9/16-18	350	5-15	AB250F-100

* To be discontinued when present stock is depleted.

I R T 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 A

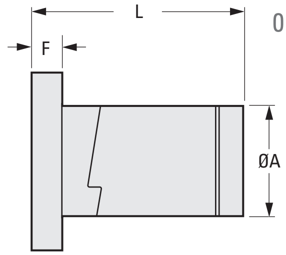
FLANGED

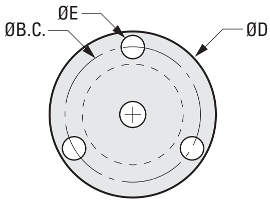
❯ MATERIAL:
Acetal with PTFE

❯ TEMPERATURE RANGE:
32° F to 180° F

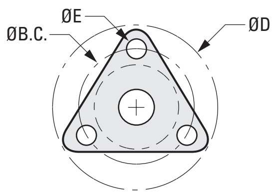
❯ FEATURES:
Reduced drag

For use with
Acme Lead Screw
AB11SA-...

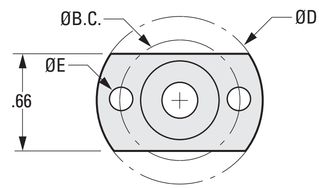




7/16 AND 5/8 SCREWS



5/16 AND 3/8 SCREWS



1/4 SCREW ONLY

INCH COMPONENT

Catalog Number	Screw Size	Number of Starts	Lead in.	Efficiency %	O.D.	L Max.
AB27FT-25201AB	1/4-20	1	.050	41	.64	1.180
AB27FT-31084AB	5/16-8	4	.500	80	.82	1.875
AB27FT-31122AB	5/16-12	2	.167	65		
AB27FT-37045AB	3/8-4	5	1.200	82		
AB27FT-37081AB	3/8-8	1	.125	53		
AB27FT-37084AB		4	.500	79		
AB27FT-37101AB	3/8-10	1	.100	49		
AB27FT-37102AB		2	.200	65		
AB27FT-37114AB	3/8-11	4	.375	75		
AB27FT-37121AB	3/8-12	1	.083	44		
AB27FT-37122AB		2	.167	60		
AB27FT-37161AB	3/8-16	1	.063	36		
AB27FT-43082AB	7/16-8	2	.250	65	1.12	2.250
AB27FT-43084AB		4	.500	76		
AB27FT-62081AB	5/8-8	1	.125	40	1.40	2.600
AB27FT-62102AB	5/8-10	2	.200	51		

Catalog Number (Ref.)	D Dia.	E Dia.	F	B.C. Dia.	Design Load lbf	Drag Torque oz. in.
AB27FT-2501AB	1.19	.141	.16	.900	100	<1
AB27FT-31...	1.50	.200	.20	1.125	250	1-3
AB27FT-37...						
AB27FT-43...	1.75		.30	1.406	125	
AB27FT-62...	2.13	.220	.50	1.688	175	2-6

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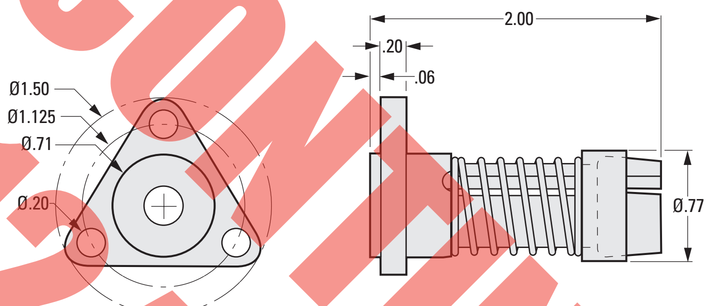
FLANGED

› MATERIAL:
Acetal with PTFE

› TEMPERATURE RANGE:
32° F to 180° F

› FEATURES:
- Low cost
- Low friction
- Non-corrosive
- Reduced drag
- Self-lubricating

For use with Acme Lead Screw AB11SA-...



INCH COMPONENT

Catalog Number*	Screw Size	Number of Starts	Lead in.	Efficiency %	Design Load lbf	Drag Torque oz. in.
AB28FT-37045AB	3/8-4	5	1.200	82	10	2-5
AB28FT-37081AB	3/8-8	1	.125	53		
AB28FT-37114AB	3/8-11	4	.364	75		
AB28FT-37121AB	3/8-12	1	.083	44		
AB28FT-37122AB		2	.167	60		

* To be discontinued when present stock is depleted.

I R T 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

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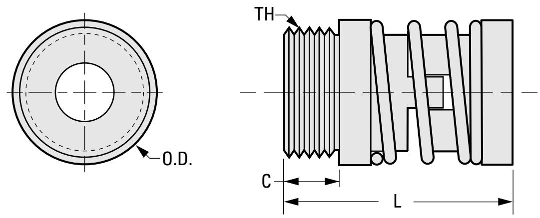
MATERIAL:
Acetal with PTFE

TEMPERATURE RANGE:
32° F to 180° F

For use with Acme Lead Screw
AB11SA-...



INCH COMPONENT

Catalog Number	Screw Size	Number of Starts	Lead in.	Efficiency %	O.D.	L Min.	L Max.
AB22SN-25161AB	1/4-16	1	.063	48	.625	1.125	1.250
AB22SN-25201AB	1/4-20		.050	41			
AB22SN-31082AB	5/16-8	2	.250	72	.750	1.160	1.340
AB22SN-31084AB		4	.500	80			
AB22SN-31122AB	5/16-12	2	.167	65			
AB22SN-37081AB	3/8-8	stub	.125	53			
AB22SN-37084AB		4	.500	79			
AB22SN-37101AB	3/8-10	1	.100	49			
AB22SN-37102AB		2	.200	65			
AB22SN-37114AB	3/8-11	4	.375	75			
AB22SN-37121AB	3/8-12	1	.083	44			
AB22SN-37122AB		2	.167	60			
AB22SN-37161AB	3/8-16	1	.063	36			

Catalog Number (Ref.)	C	TH	Preload lbf	Design Load lbf	Max. Static Load lbf	Drag Torque oz. in.	Use with Flange
AB22SN-25161AB	.187	9/16-18	1-3	25	225	2-4	AB250F-025
AB22SN-25201AB							
AB22SN-31082AB	.250	5/8-18	2-5	50	350		AB250F-037
AB22SN-31084AB							
AB22SN-31122AB							
AB22SN-37081AB				70			
AB22SN-37084AB							
AB22SN-37101AB							
AB22SN-37102AB							
AB22SN-37114AB							
AB22SN-37121AB							
AB22SN-37122AB							
AB22SN-37161AB							

Continued on the next page

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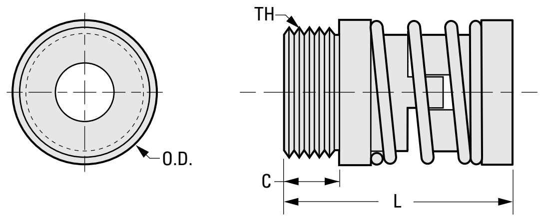
MATERIAL:
Acetal with PTFE

TEMPERATURE RANGE:
32° F to 180° F

For use with Acme Lead Screw AB11SA-...



INCH COMPONENT

Catalog Number	Screw Size	Number of Starts	Lead in.	Efficiency %	O.D.	L Min.	L Max.
AB22SN-43082AB	7/16-8	2	.250	65	1.000	1.700	2.000
AB22SN-50042AB	1/2-4		.500	75			
AB22SN-50101AB	1/2-10	1	.100	41			
AB22SN-50102AB		2	.200	57			
AB22SN-62101AB	5/8-10	1	.100	35			
AB22SN-62102AB		2	.200	51			
AB22SN-75061AB	3/4-6	1	.167	44	1.750	2.500	3.000
AB22SN-75081AB	3/4-8		.125	36			
AB22SN-75101AB	3/4-10		.100	31			
AB22SN-10008AB	1-8		.125	29			
AB22SN-10010AB	1-10		.100	25			

Catalog Number (Ref.)	C	TH	Preload lbf	Design Load lbf	Max. Static Load lbf	Drag Torque oz. in.	Use with Flange
AB22SN-43082AB	.375	15/16-16	4-9	100	500	3-5	AB250F-050
AB22SN-50042AB				150	750	5-8	
AB22SN-50101AB							
AB22SN-50102AB							
AB22SN-62101AB				160	800	7-10	
AB22SN-62102AB							
AB22SN-75061AB	.600	1-9/6-18	10-20	300	1500	15-20	AB250F-100
AB22SN-75081AB							
AB22SN-75101AB							
AB22SN-10008AB				400	2000		
AB22SN-10010AB							

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I R T 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

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I R T 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 A

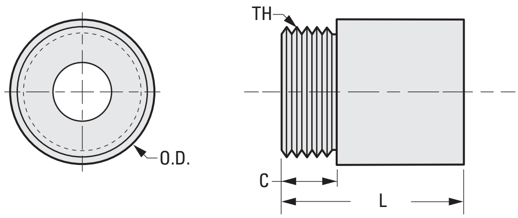
› MATERIAL:
Bronze SAE 660

› TEMPERATURE RANGE:
-65° F to 250° F

› SPECIFICATIONS:
Friction Coefficient: .2 to .3

Lubrication is recommended

For use with Acme Lead Screw AB11SA-...



INCH COMPONENT

Catalog Number	Screw Size	Number of Starts	Lead in.	Torque to Raise 1 lb. oz. in.	O.D.	L
AB20BN-25201	1/4-20		.050	.41	.625	.625
AB20BN-37101	3/8-10		.100	.67		
AB20BN-37121	3/8-12	1	.083	.64	.750	.750
AB20BN-37161	3/8-16		.063	.61		
AB20BN-50101	1/2-10		.100	.83		
AB20BN-50102		2	.200	1.10		
AB20BN-62081	5/8-8	stub	.125	1.06	1.000	1.000
AB20BN-62101	5/8-10	1	.100	.99		
AB20BN-62102		2	.200	1.26		
AB20BN-75061	3/4-6		.167	1.28		
AB20BN-75101	3/4-10		.100	1.15		
AB20BN-10005	1-5	1	.200	1.67	1.500	1.500
AB20BN-10008	1-8		.125	1.52		
AB20BN-10010	1-10		.100	1.47		

Catalog Number (Ref.)	C	TH	Design Load lbf	Max. Static Load lbf	Use with Flange
AB20BN-25...	.187	9/16-18	110	550	AB250F-025
AB20BN-37...	.250	5/8-18	300	1500	AB250F-037
AB20BN-50...	.375	15/16-16	620	3100	AB250F-050
AB20BN-62...			860	4300	
AB20BN-75...	.500	1-3/8-16	1500	1500	AB250F-075
AB20BN-100..			1900	9500	

THREAD MOUNT ACME NUTS

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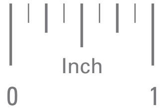
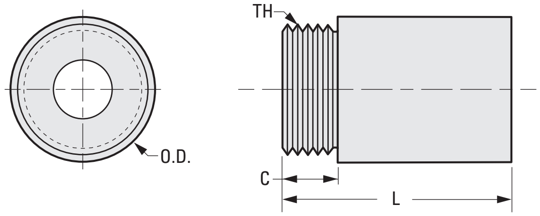


› MATERIAL:
Acetal with PTFE

› TEMPERATURE RANGE:
32° F to 180° F

For use with Acme Lead Screw
AB11SA-...



INCH COMPONENT

Catalog Number	Screw Size	Number of Starts	Lead in.	Efficiency %	O.D.	L
AB21SN-25161	1/4-16	1	.063	48	.625	.500
AB21SN-25201	1/4-20		.050	41		
AB21SN-31082	5/16-8	2	.250	72	.750	.750
AB21SN-31084		4	.500	80		
AB21SN-31122	5/16-12	2	.167	65		
AB21SN-37081	3/8-8	stub	.125	53		
AB21SN-37084		4	.500	79		
AB21SN-37101	3/8-10	1	.100	49		
AB21SN-37102		2	.200	65		
AB21SN-37114	3/8-11	4	.375	75		
AB21SN-37121	3/8-12	1	.083	44		
AB21SN-37122		2	.167	60		
AB21SN-37161	3/8-16	1	.063	36		

Catalog Number (Ref.)	C	TH	Design Load lbf	Max. Static Load lbf	Use with Flange
AB21SN-25161	.187	9/16-18	45	225	AB250F-025
AB21SN-25201					
AB21SN-31082	.250	5/8-18	70	350	AB250F-037
AB21SN-31084					
AB21SN-31122					
AB21SN-37081					
AB21SN-37084					
AB21SN-37101					
AB21SN-37102					
AB21SN-37114					
AB21SN-37121					
AB21SN-37122					
AB21SN-37161					

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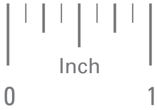
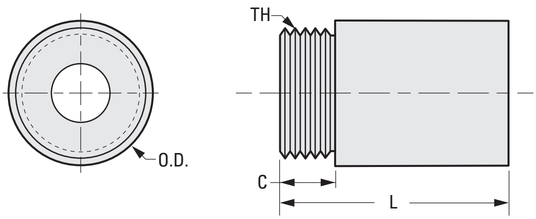
MATERIAL:
Acetal with PTFE

TEMPERATURE RANGE:
32° F to 180° F

For use with Acme Lead Screw AB11SA-...





INCH COMPONENT

Catalog Number	Screw Size	Number of Starts	Lead in.	Efficiency %	O.D.	L
AB21SN-43082	7/16-8	2	.250	65	1.000	1.000
AB21SN-43084		4	.500	76		
AB21SN-50042	1/2-4	2		75		
AB21SN-50101	1/2-10	1	.100	41		
AB21SN-50102		2	.200	57		
AB21SN-62101	5/8-10	1	.100	35		
AB21SN-62102		2	.200	51		
AB21SN-75061	3/4-6	1	.167	44	1.500	1.500
AB21SN-75081	3/4-8		.125	36		
AB21SN-75101	3/4-10		.100	31		
AB21SN-10008	1-8		.125	29		
AB21SN-10010	1-10		.100	25		

Catalog Number (Ref.)	C	TH	Design Load lbf	Max. Static Load lbf	Use with Flange
AB21SN-43082	.375	15/16-16	100	500	AB250F-050
AB21SN-43084					
AB21SN-50042			150	750	
AB21SN-50101					
AB21SN-50102					
AB21SN-62101			160	800	
AB21SN-62102					
AB21SN-75061	.500	1-3/8-16	300	1500	AB250F-075
AB21SN-75081					
AB21SN-75101					
AB21SN-10008			400	2000	
AB21SN-10010					

Continued from the previous page

FLANGE MOUNT ACME NUTS

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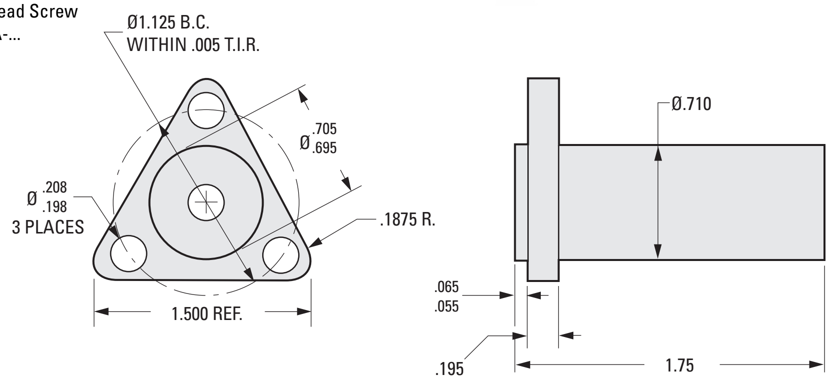
› MATERIAL:
Turcite® X (Acetal, PTFE & Silicone Filled)

› TEMPERATURE RANGE:
32° F to 160° F

› FEATURES:
Lightweight
Low cost
Low friction
Self-lubricating
Up to 75,000,000 inches of travel

Left-hand threads available on special order

For use with
Acme Lead Screw
AB11SA-...



INCH COMPONENT

Catalog Number	Screw Size	Number of Starts	Lead in.	Max. Static Load lbf	Dynamic Load** lbf	Torque to Produce 1 lbf oz. in.
AB23FT-25201	1/4-20	1	.050	125	25	.40
AB23FT-25161	1/4-16		.063			.42
AB23FT-31082	5/16-8	2	.250	250	50	1.02
AB23FT-31084		4	.500			1.75
AB23FT-31122	5/16-12	2	.167			.79
AB23FT-37081*	3/8-8	stub	.125	350	70	.69
AB23FT-37084*		4	.500			1.80
AB23FT-37055	3/8-5	5	1.000			3.45
AB23FT-37045	3/8-4		1.200			4.20
AB23FT-37101	3/8-10	1	.100			.64
AB23FT-37102		2	.200			.92
AB23FT-37114	3/8-11	4	.375			1.42
AB23FT-37121	3/8-12	1	.083			.61
AB23FT-37122		2	.167			.83
AB23FT-37161	3/8-16	1	.063			.58
AB23FT-43082	3/8-8	2	.250			1.14
AB23FT-43084		4	.500			1.85
AB23FT-50042	1/2-4	2				1.91
AB23FT-50101	1/2-10	1	.100			.80
AB23FT-50102		2	.200			1.07

* Nut has ribbed body shape within the .710 dimensions above.
** Reduce load by 90% for continuous load applications.

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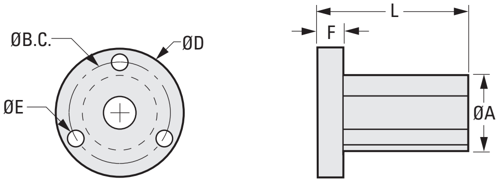
Inch
0 1

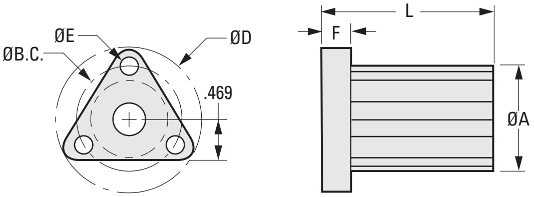
› MATERIAL:
Acetal with PTFE

› TEMPERATURE RANGE:
32° F to 180° F

For use with Acme Lead Screw
AB11SA-...



1/2, 5/8 AND 3/4 SCREWS



3/8 AND 7/16 SCREWS

INCH COMPONENT

<table>
<tr><th>Catalog Number</th><th>Screw Size</th><th>Number of Starts</th><th>Lead in.</th><th>Efficiency %</th><th>Design Load lbf</th></tr>
<tr><td>AB29FT-37045</td><td>3/8-4</td><td>5</td><td>1.200</td><td>82</td><td rowspan="5">60</td></tr>
<tr><td>AB29FT-37081</td><td>3/8-8</td><td>1</td><td>.125</td><td>53</td></tr>
<tr><td>AB29FT-37102</td><td>3/8-10</td><td>2</td><td>.200</td><td>65</td></tr>
<tr><td>AB29FT-37121</td><td rowspan="2">3/8-12</td><td>1</td><td>.083</td><td>44</td></tr>
<tr><td>AB29FT-37122</td><td rowspan="3">2</td><td>.167</td><td>60</td></tr>
<tr><td>AB29FT-43082</td><td>7/16-8</td><td>.250</td><td>65</td><td>75</td></tr>
<tr><td>AB29FT-50102</td><td>1/2-10</td><td>.200</td><td>57</td><td>125</td></tr>
<tr><td>AB29FT-62081</td><td>5/8-8</td><td rowspan="5">1</td><td>.125</td><td>40</td><td rowspan="2">175</td></tr>
<tr><td>AB29FT-62101</td><td>5/8-10</td><td>.100</td><td>35</td></tr>
<tr><td>AB29FT-75061</td><td>3/4-6</td><td>.167</td><td>44</td><td rowspan="3">275</td></tr>
<tr><td>AB29FT-75081</td><td>3/4-8</td><td>.125</td><td>36</td></tr>
<tr><td>AB29FT-75101</td><td>3/4-10</td><td>.100</td><td>31</td></tr>
</table>

<table>
<tr><th>Catalog Number (Ref.)</th><th>A Dia.</th><th>L</th><th>D Dia.</th><th>E Dia.</th><th>F</th><th>B.C. Dia.</th></tr>
<tr><td>AB29FT-37...</td><td rowspan="2">.71</td><td rowspan="3">1.50</td><td rowspan="4">1.50</td><td rowspan="5">.20</td><td rowspan="2">.20</td><td rowspan="3">1.125</td></tr>
<tr><td>AB29FT-43...</td></tr>
<tr><td>AB29FT-50...</td><td>.75</td><td>.25</td></tr>
<tr><td>AB29FT-62...</td><td>.88</td><td>1.63</td><td rowspan="2">.30</td><td>1.188</td></tr>
<tr><td>AB29FT-75...</td><td>1.125</td><td>1.75</td><td>2.00</td><td>1.438</td></tr>
</table>

MOUNTING FLANGES

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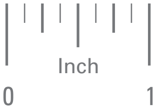
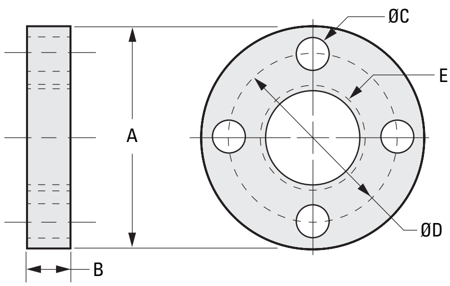
FOR ACME NUTS



› **MATERIAL:**
Aluminum 6062-T6



INCH COMPONENT

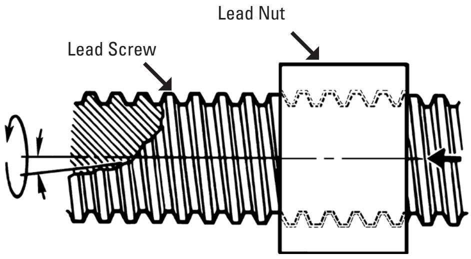
Catalog Number	A	B	C Dia.	D Dia.	E Thread
AB250F-025	1.25	.187	.140	1.00	9/16-18
AB250F-037	1.60	.250	.177	1.24	5/8-18
AB250F-050	2.00	.375		1.50	15/16-16
AB250F-075	2.50	.500	.266	2.00	1-3/8-16
AB250F-100	3.00	.600		2.37	1-9/16-18

Ball and Acme Screw Drive Mechanisms:

This section will introduce most of the more common types of drive mechanisms found in linear motion machinery. Ideally, a drive system should not support any loads, with all the loads being handled by a bearing system. Topics discussed will include, but not be limited to, the mechanism of actuation, efficiency, accuracy, load transfer, speed, pitch, life cycle, application, and maintenance. Each type of drive system will be accompanied by a diagram and useful equations when applicable. Some of the terms used with screws, the most common drive component, are as follows:

lead – advance of the nut along the length of the screw per revolution.
pitch – distance between corresponding points on adjacent thread forms (pitch = lead / # of starts).
# of threads – number of teeth found along a unit length of the screw (1 / pitch).
# of starts – number of helical grooves cut into the length of the shaft.
outer diameter – largest diameter over the threaded section (at top of threads).
root diameter – smallest diameter over the threaded section (at base of threads).
stub – specific type of ACME thread where the root diameter is larger to provide for a more heavy-duty screw (the threads look "stubby").
critical shaft speed – operating speed of spinning shaft that produces severe vibrations during operation. This is a function of length, diameter, and end supports.
maximum compressive load – maximum load that can be axially applied to the screw before buckling or permanent deformation is experienced. Also referred to as column strength.
end bearing supports – the screw must be supported at one or both ends with thrust type bearings. Depending upon the application, it may also be desirable to provide for a stiffer system by incorporating angular contact bearings (fixed support).

Although shafts, gear trains, belt and pulley, rack and pinion, and chain and sprocket drives are practical in other applications, they require special consideration when used in CNC machinery. This is because there is typically backlash associated with these types of drives, which increases the system error. Thorough technical descriptions of these types of drives can be found in the SDP/SI Components Library, www.sdp-si.com.

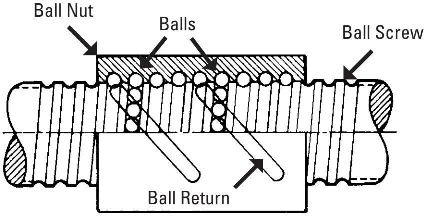


Lead Screw System

Lead screws are threaded rods that are fitted with a nut. There are many types of threads used, but the most prevalent in industry is the ACME lead screw. Because the ACME thread is an industry standardized thread style, it is easily interchanged with parts from various manufacturers.The basic function of a screw is to convert rotary input motion to linear output motion. The nut is constrained from rotating with the screw, so as the screw is rotated the nut travels back and forth along the length of the shaft. The friction on the nut is a function of environment, lubrication, load, and duty cycle; therefore, practical life cycle is difficult to quantify.

Lead screw/nut drive systems are available in a variety of sizes and tolerances. Contact is primarily sliding, resulting in relatively low efficiency and a wear rate proportional to usage. **Advantages** include the self-locking capability in back drive mode. Diameter should be at least three times greater than the lead which is good for vertical applications, low initial costs, near silent operation, manufacturing ease, and a wide choice of a materials. **Disadvantages** of ACME screws include lower efficiencies (typically 30-50%, depending on nut preload) which require larger motor drives, and unpredictable service life. For increased efficiencies see Ball Screws; SDP/SI Series **S6513HM**...

Ball screws are very similar to lead screws with the exception of a ball bearing train riding between the screw and nut in a recirculating raceway. This raceway is generally lubricated, which allows for predictable service life. Due to the increased number of mating and moving parts, matching tolerances becomes more critical. The screw threads have rounded shapes to conform to the shape of the balls. The function, terminology, and formulas are the same as found with lead screws, however the performance of ball screws is far superior. The rolling action of the balls versus the sliding action of the ACME nut provides significant advantages. **Advantages** of ball screw drives are increased efficiency (typically up to 90 – 95%) which allows required motor torque to be lower, predictable service life, low wear rate and maintenance costs. **Disadvantages** include: limited material choice, higher initial cost, and an auxiliary brake is required to prevent back driving with vertical applications.



Ball Screw System

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Helpful Formulas:

When determining the amount of input torque required to produce an amount of output linear force, there are many factors to consider. The following equations provide a practical approach in making force and torque calculations.

Force Calculations:

$$F_T = F_A + F_E + F_F \tag{1}$$

where: F_T = Total Force
F_A = Acceleration Force
F_E = External Force
F_F = Friction Force

$$F_A = \frac{W}{g} \bullet \frac{a}{12} \text{ lb.} \tag{2}$$

where: W = total weight to accelerate (lb.)
a = linear acceleration (in./sec^2)
g = acceleration from gravity (ft./sec^2)

External Force (F_E) may be due to gravity in vertical applications, or may be from external work requirements (feeding material, stretching material, etc.)

Friction Force (F_F) required to overcome all of the friction in the load bearing system (with a low friction bearing system, this can be negligible)

The Total Force must be below the compressive (thrust) rating of the screw chosen. A modest factor of safety should be added to the total force so that unexpected dynamic loads are safely handled by the screw system.

Torque Calculations:

$$T = F_T \bullet \frac{L}{2\pi e} \tag{3}$$

where: F_T = Total Force (lbs)
L = Lead (inches)
e = efficiency (no units, use 0.9 for Ball screws assemblies.)

Total Force = 100 lbs (3)
Lead = 0.20 inches
Efficiency = 0.9 (Ball screw)

$$T = \frac{100 \text{ lbs} \times 0.20 \text{ inches}}{2\pi(0.9)} = 3.54 \text{ lb.-inches}$$

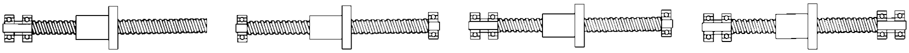
Total Force = 25 lbs (3)
Lead = 0.10 inches
Efficiency = 49%

$$T = \frac{25 \text{ lbs} \times 0.10 \text{ inches}}{2\pi(.49)} = 0.81 \text{ lb.-inches}$$

The Torque required should be well below the torque rating of the motor chosen. A modest factor of safety should be added to the torque required so that unexpected dynamic loads are safely handled by the driving system.

Selecting and Sizing Screw Drive Systems:

When choosing a particular screw for a given application, there are several factors to be considered. Required rpm, critical speed and maximum compressive strength are the most important design features that determine screw design parameters, and can be calculated according to the following equations. Since thread style design is irrelevant in these calculations, the same equations and charts can be used for both lead screws and ball screws. Bearing configuration must be considered when using these equations. The following diagrams represent the typical bearing end support arrangements.



A. Fixed-Free **B.** Simple-Simple **C.** Fixed-Simple **D.** Fixed-Fixed

$$\text{rpm} = \frac{\text{linear velocity (in./min.)}}{\text{lead (in./rev.)}} \qquad (4)$$

Maximum Speed:

$$C_S = F(4.76 \times 10^6)\,\frac{d}{L^2} \qquad (5)$$

where:

C_S = critical speed (rpm)
d = root diameter of screw (inches)
L = length between supports (inches)
F = end support factor (see diagram)
case **A**.: 0.36
case **B**.: 1.00
case **C**.: 1.47
case **D**.: 2.23

Maximum Load:

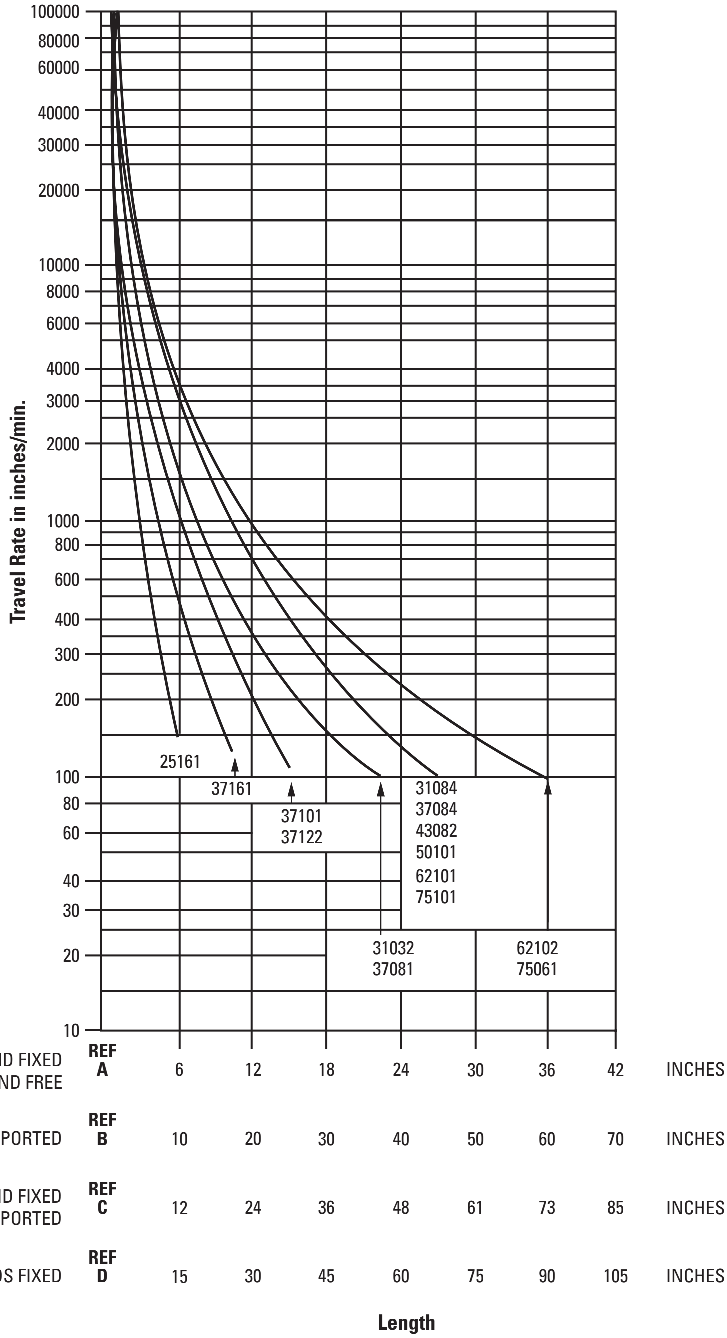
$$P = F(14.03 \times 10^6)\,\frac{d^4}{L^2} \qquad (6)$$

where:

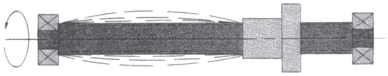
P = maximum load (lbs) (critical load)
d = root diameter of screw (inches)
L = maximum distance between nut and load carrying bearing
F = end support factor (see diagram)
case **A**.: 0.25
case **B**.: 1.00
case **C**.: 2.00
case **D**.: 4.00

The formulas above can be represented graphically by the charts on following pages. These charts have been compiled for screws made of stainless steel. Speeds, loads, diameters, bearing arrangements, and products are referenced. It must be realized that a screw may be able to rotate at very high rpm's, but the nut may have more strict limitations. For this reason, we have truncated the ball screw rpm diagrams to a top end of 4000 rpm and provided each type screw with their own charts. Please note that the ball screw charts are only represented for screws of 16 mm and 25 mm diameters.

Travel Rate vs. Length
For Standard ACME Lead Screws



CRITICAL SPEED

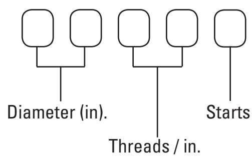


PURPOSE

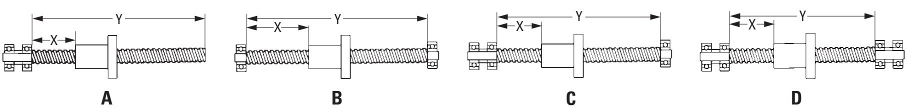
This graph was designed to simplify the selection of the proper lead screw so as to avoid lengths and speeds which will result in vibration of the assembly (critical speed). The factors which can be controlled after a particular maximum length is determined are: method of bearing support and choice of lead screw diameter.

USE OF THE GRAPH

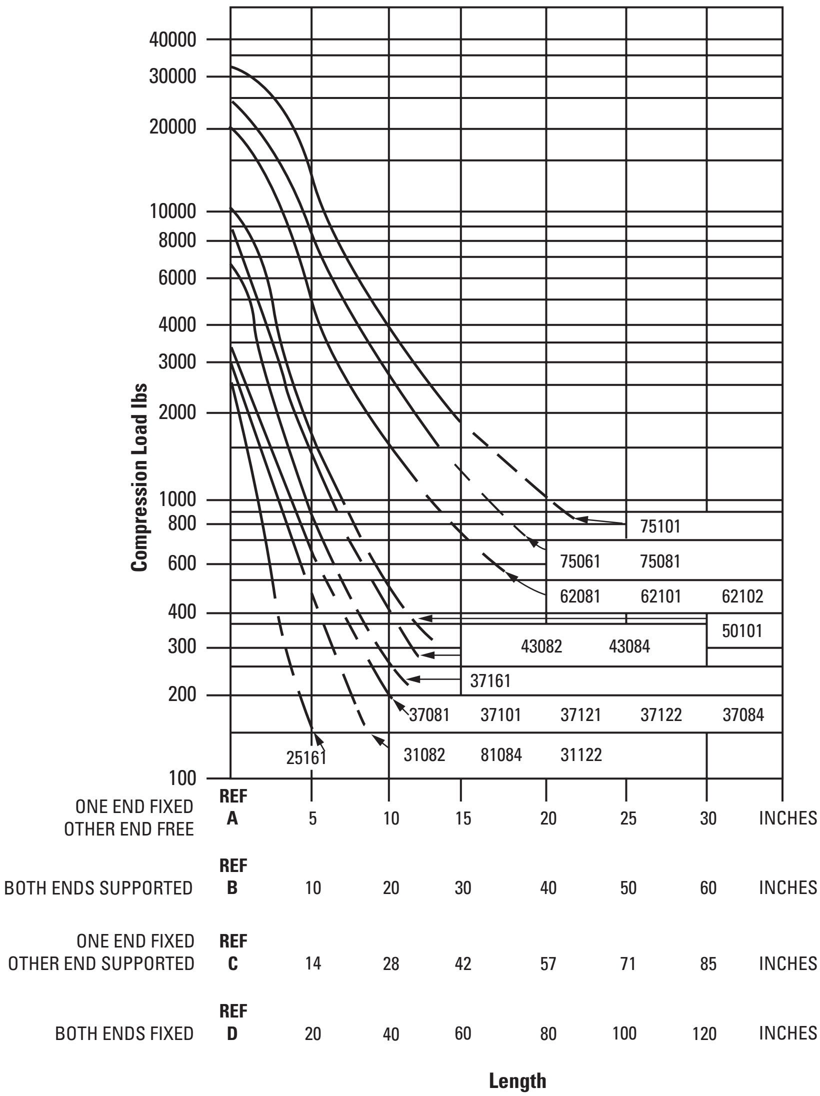
1. Choose preferred bearing support means, based on design considerations.
2. On the proper bearing support horizontal line (A, B, C or D) choose length of lead screw.
3. Draw vertical line at the lead screw length, determined at (2.), and draw a horizontal line at the travel rate.
4. All screw diameters to the right and above the intersection point in (3.) are suitable for this application.
5. Screw sizes are coded as follows:



Maximum Length (in.) Adjusted for Bearing Support
"Y" Dimension



Compression Load vs. Length
For Standard Ball Screws and ACME Lead Screws



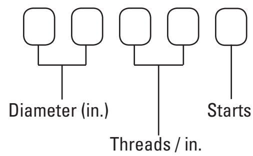
COLUMN LOADS

PURPOSE

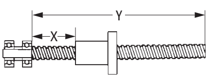
This graph was designed to simplify the selection of the proper lead screw so as to avoid buckling when subjected to the axial loading by means of the nut. The factors which can be controlled after a particular maximum length is determined are: method of bearing support and choice of lead screw diameter.

USE OF THE GRAPH

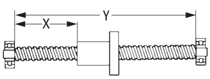
1. Choose preferred bearing support means, based on design considerations.
2. On the proper bearing support horizontal line (A, B, C or D) choose length of lead screw.
3. Draw vertical line at the lead screw length, determined at (2.), and draw a horizontal line at the compression load the unit is exerting on the screw.
4. All screw diameters to the right and above the intersection point in (3.) are suitable for this application.
5. Screw sizes are coded as follows:



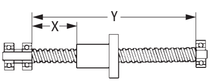
Maximum Length (in.) Adjusted for Bearing Support
"X" Dimension



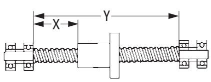
A



B

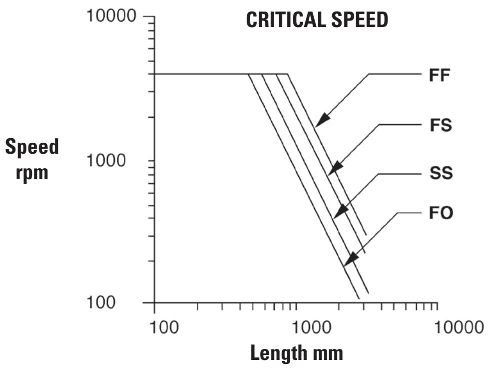


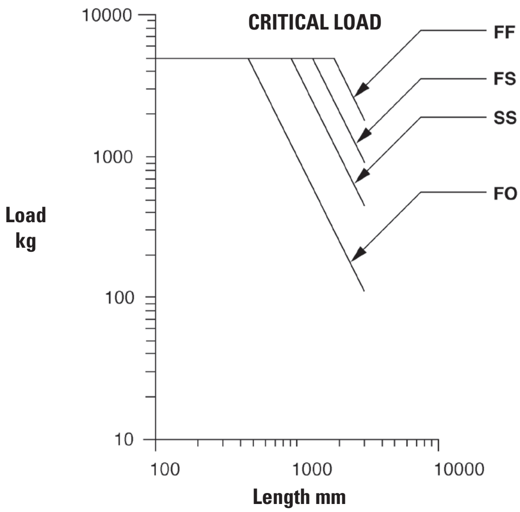
C



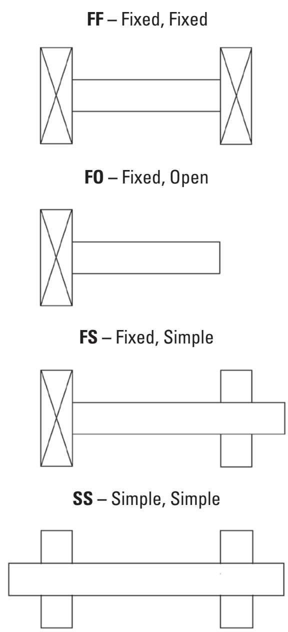
D

CRITICAL SPEED & LOAD
LOAD AND SPEED LIMITS ON 16 mm BALL SCREWS

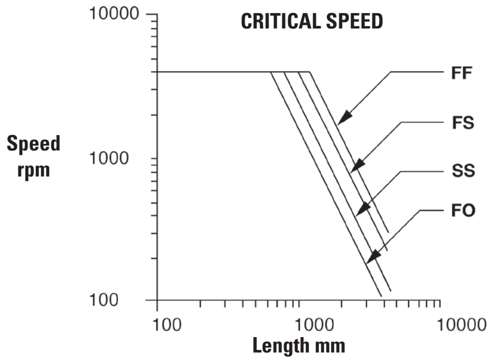


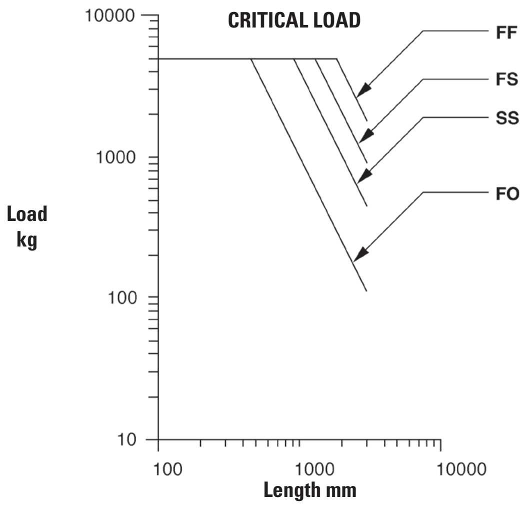


BEARING SUPPORT TYPES



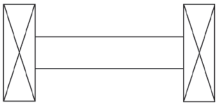
CRITICAL SPEED & LOAD
LOAD AND SPEED LIMITS ON 25 mm BALL SCREWS



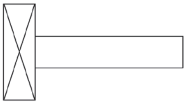


BEARING SUPPORT TYPES

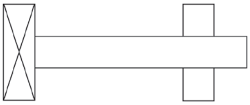
FF – Fixed, Fixed



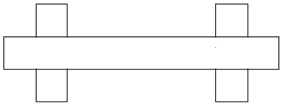
FO – Fixed, Open



FS – Fixed, Simple

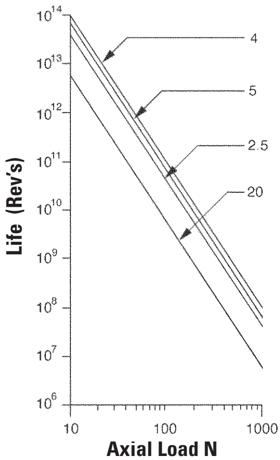


SS – Simple, Simple



BALL & ACME LEAD SCREW ASSEMBLY LIFE EXPECTANCY

16 mm LIFE EXPECTANCY



SPECIFICATIONS			
Pitch	Screw Dia.	Axial Load (N)	
		Dynamic (C_a)	Static
2.5	16	3500	5500
4	16	2600	4200
5	16	4600	7200
5	25	5100	12600
10	16	4200	6500
10	25	5100	12600
20	16	1900	2500
20	25	3570	8800

$$L = \left[\frac{C_a}{F_m}\right]^3 \times 10^6$$

L = life expectancy expressed in number of revolutions

C_a = dynamic load rating (N) [for acme nuts, see design load column on catalog pages].

F_m = average axial load (N).

Example: For 10 mm pitch screw, 16 mm dia., C_a = 4200 N carrying an average axial load, F_m = 200 N (45 lbs) the expected life is:

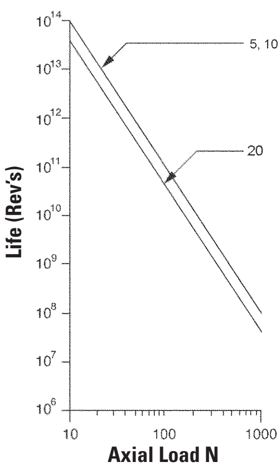
$$L = \left(\frac{4200}{200}\right)^3 \times 10^6 = 9.261 \times 10^9 \text{ revolutions.}$$

At an average of 1000 rpm this will result in:

$$\frac{9.261 \times 10^9 \text{ revolutions}}{1000 \text{ rpm}} \times \frac{1 \text{ hour}}{60 \text{ minutes}} = 154{,}000 \text{ hours}$$

of expected operational life. Note that the nature of the motion (jerky, smooth, etc.) will affect the life expectancy.

25 mm LIFE EXPECTANCY



Lead Screw Formulas and Sample Calculations:

Linear Speed (ipm)

$$\text{Linear Speed} = \frac{\text{steps / second}}{\text{steps / revolution}} \times 60 \times \frac{1}{p}$$

where:

p = lead screw pitch in threads per inch

Axial Force (lb)

$$\text{Force} = \frac{2\pi}{16} \times T \times p \times eff.$$

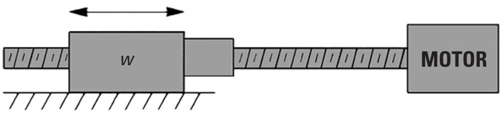
where:

T = torque (oz.•in.)
p = lead screw pitch in threads per inch
eff. = efficiency expressed as a decimal: 90% = 0.90

Note: Ball screws are generally 85% to 95% efficient. Acme lead screw efficiency is generally 35% to 45%, but can be as high as 85%.

A. Calculating the torque required to accelerate a mass moving horizontally and driven by a ball bearing lead screw and nut. The total torque the motor must provide includes the torque required to:

a. accelerate the weight
b. accelerate the lead screw
c. accelerate the motor rotor
d. overcome the frictional force



To calculate the rotational equivalent of weight *w*:

$$I_{(eq)} = w \times \frac{1}{p^2} \times \left(\frac{1}{2\pi}\right)^2$$

where:

w = weight (lb.)
p = pitch (threads per inch)
$I_{(eq)}$ = equivalent polar inertia (lb.•in.^{2})

to calculate lead screw inertia (steel screw)

$$I(\text{screw}) = D^4 \times \text{length} \times .028$$

Example:

Weight = 1000 lb.
Velocity = 0.15 feet per second
Time to Reach Velocity = 0.1 seconds
Ball Screw Diameter = 1.5 inches
Ball Screw Length = 48 inches
Ball Screw Pitch = 5 threads per inch
Motor Rotor Inertia = 2.5 lb•in.^{2}
Friction Force to Slide Weight = 6 oz.

$$I(\text{eq}) = w \times \frac{1}{p^2} \times .025 = 1000 \times \frac{1}{25} \times .025 = 1.0 \text{ lb.•in.}^2$$

$$I(\text{screw}) = D^4 \times \text{length} \times .028 = 5.06 \times 48 \times .028 = 6.8 \text{ lb•in.}^2$$

$$I(\text{rotor}) = 2.5 \text{ lb.•in.}^2$$

$$I(\text{total}) = 10.3 \text{ lb.•in.}^2$$

Velocity is 0.15 feet per second, which is equal to 1800 steps per second (motor steps in 1.8° increments).

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Torque to accelerate system:

$$T = 2 \times I_0 \times \frac{\omega'}{t} \times \frac{\pi \times 1.8}{180} \times \frac{1}{24} = 2 \times 10.3 \times \frac{1800}{0.1} \times \frac{3.1416 \times 1.8}{180} \times \frac{1}{24} = 484 \text{ oz.}\bullet\text{in.}$$

Torque to overcome friction:

$$F = .393 \times T \times p \times eff.$$

$$T = \frac{F}{.393 \times p \times eff.} = \frac{\frac{6}{16}}{.393 \times 5 \times 0.90} = 0.22 \text{ oz.}\bullet\text{in.}$$

where:

F = frictional force (lb.)
T = torque (oz.•in.)
p = lead screw pitch (threads per inch)

Total torque required = 0.22 oz.•in. + 484.00 oz.•in. = 484.22 oz.•in.

After determining the required motor size, it is recommended to add a 20% factor of safety so that unexpected dynamic loads are easily handled by the motor.

Sizing Servo Motors:

Two separate torque figures are needed when selecting a DC motor — a peak torque, being the sum of acceleration and friction torques, and a continuous torque, which is the friction component only. The torque produced by the motor is given by:

$$T = K_\tau I$$

where K is the motor torque constant (e.g., Nm/amp) and I is the drive current (amp). The choice of motor and drive must satisfy the following conditions:

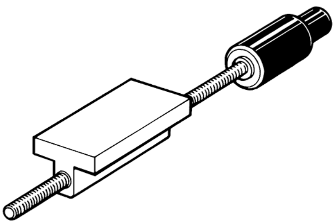
1. The product of K_τ and peak drive current must give the required peak torque.
2. The product of K_τ and continuous drive current must produce sufficient continuous torque.
3. The maximum allowable motor current must be greater than the peak drive current.
4. At maximum speed and peak current, the voltage developed across the motor must be less than 80% of the drive supply voltage.

The voltage across the motor is given by: $E = K_E \omega + R I$

where K_E is the motor voltage constant, ω the speed, R the winding resistance (ohms) and I the peak current (amperes). The speed units should be the same in each case; i.e., if the voltage constant is in volts per radian per second, then ω should also be in radians per second.

To make the most efficient use of the drive, the chosen solution should utilize most of the peak drive current and most of the available voltage. Motor manufacturers usually offer alternative windings, and care should be taken to select the most appropriate.

Example:
Leadscrew Length: 80 in.
Leadscrew Diameter: 1.5 in.
Leadscrew Pitch: 2.54 in.
Table Weight: 1000 lb.
Linear Table Speed Required: 472 inches/min.
Acceleration Time: 120 ms



Linear Table Driven by DC Motor

Inertia of Leadscrew: $J = \frac{D^4 L}{36} = 11.25 \text{ lb.}\bullet\text{in.}^2$

Inertia of Table: $J = \frac{W}{40\, p^2} = 3.88 \text{ lb.}\bullet\text{in.}^2$

Total inertia = 15.13 lb.•in.^{2}

Maximum Speed = 472"/min. = 1200 rpm (equivalent to 4000 full steps/sec)

Acceleration Torque:

$$T = \frac{J\omega}{764t} = 660 \text{ oz.}\bullet\text{in. } (4.65 \text{ N}\bullet\text{m})$$

This takes no account of motor inertia, so a suitable motor will be capable of producing around 1000 oz•in. torque.

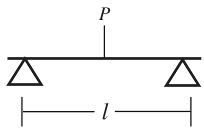
Again, as with stepper selection, it is recommended to add a 20% factor of safety so that unexpected dynamic loads are easily handled by the motor.

Bending Formulas for Extruded Profiles:

The deflection of a beam depends on how it is supported, the magnitude of the load it carries, the distribution of the load and the distance from the supports. Two examples will be considered — the simple beam and the cantilevered beam.

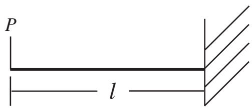
The deflection of a simple beam with the load concentrated at the center is given by the following equation:

$$y = \frac{Pl^3}{48\,EI}$$



The deflection of a cantilevered beam with the load concentrated at the free end is given by the following equation:

$$y = \frac{Pl^3}{3\,EI}$$



where:

- y = beam deflection at the loading point, cm
- P = concentrated loads, kgf
- l = length of beam, cm
- x = distance from support to any section, cm
- E = modulus of elasticity, kg/cm^2
- I = moment of inertia, cm^4

Example 1:

Structural Profile 40 x 80 is used as a simple beam with 100 cm between supports. If this beam carries a 100 kg load concentrated at the center of the beam, how much will the beam bend?

The modulus of elasticity of the aluminum alloy used for all the extrusions listed as example is 702,949 kg/cm. The moment of inertia for this beam is given which describes this beam. Since this beam is not symmetrical, two moments of inertia are given. Select the value corresponding to the way in which the beam will be used. For this example, we assume that the load is applied along the y-axis. The moment of inertia is 21.17 cm^4.

Substituting these values and the values from the example into the equation for the deflection of a simple beam, we obtain:

$$y = \frac{100 \text{ kg } (100 \text{ cm})^3}{48\,(702949 \text{ kg/cm}^2)\,(21.17 \text{ cm}^4)} = 0.14 \text{ cm}$$

Example 2:

Structural Profile 40 x 80 is supported at one end and a concentrated load is applied to the free end, 100 cm from the fixed end. Calculate the bending at the free end.

Substituting these values and the value for the modulus of elasticity and moment of inertia above, we obtain:

$$y = \frac{100 \text{ kg } (100 \text{ cm})^3}{3\,(702949 \text{ kg/cm}^2)\,(21.17 \text{ cm}^4)} = 2.24 \text{ cm}$$

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Ball and Acme Screw Application Worksheet

Name: ______________________________ Phone: ______________

Company Name: ______________________________ Fax: ______________

Address 1: ______________________________

Address 2: ______________________________

City: ______________________ State: ____________ Zip code: ____________

Brief Description of Application: ______________________________

____

____

Email: ______________________________

Max. Load: ______________________________

Max: Speed: ______________________________

Max. Accel: ______________________________

Travel: ______________________________

Complete Cycle Time: ______________________________

Orientation: ______________________________

Accuracy Needed: ______________________________

(please circle)
Anti-Backlash Nut Required: **YES** or **NO**

Integral Flange Nut Required: **YES** or **NO**

Finished End Required: **YES** or **NO**
Supply drawing (Note: Finished ends for OEM quantities only i.e, 25 or higher)

End Bearing Required: **YES** or **NO**

Base Mount of Flange Mount of End Bearings:

____

please use this for any notes or diagrams