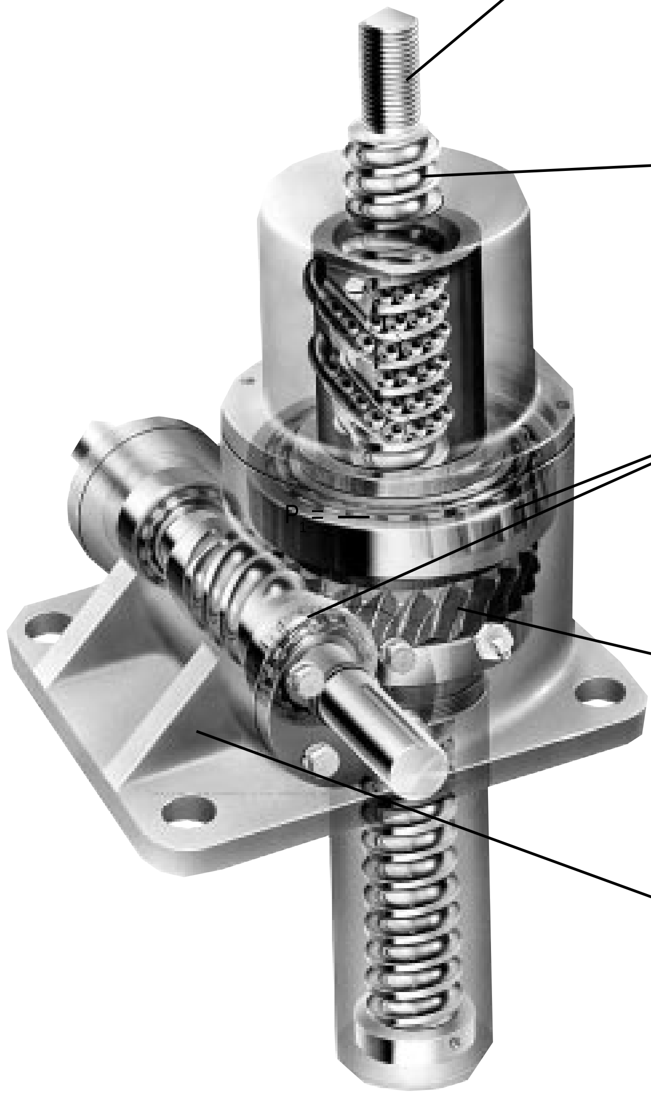
B-SERIES BALL SCREW ACTUATOR

LINEAR MOTION
800-323-9114

FEATURES & BENEFITS

Interchangeability. B-Series ball screw actuators are available in 1 ton through 100 ton capacities, and are directly interchangeable with competitive units.



Superior Performance

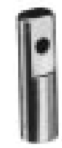
■ Uni-Lift Ball Screw Actuators and systems provide smooth, fast operation, high cycle reliability, and rugged construction to provide an affordable choice for a wide variety of applications.

Synchronized Travel

■ Uni-Lift Ball Screw Actuators require less input horsepower. These actuators are well suited for multi-unit synchronized systems.

"V" Threaded Screw End

■ Easy mounting of optional screw end accessories or customer connection, insures better alignment.



Clevis

Top Plate

■ Bearing journal on end of load screw for rotating jacks provides better column stability.

High Strength Rolled Formed Ball Thread Load Screws

■ Provides 95% efficiency for minimum input force to position loads.
■ Ball Screw is rolled and hardened for strength and wear resistance.

Tapered Roller Bearings

■ Provides total support of the gear nut and worm shaft for thrust and radial forces.
■ Better design bearing arrangement with upper and lower thrust bearings located in the main housing and mounted directly on the gear nut for full support under any loading conditions (vertical or horizontal).

High Strength Gearing

■ Precision formed and finished worm gear sets.
■ All gearing is designed in accordance with established American Gear Manufacturing Standards.
■ Precision gearing provides greater efficiency and allows higher input speeds.

Rugged Housings

■ Manufactured from high grade iron and steel alloys designed to withstand the most severe applications.
■ Low closed height design saves space, reduces weight, and allows these ball screw actuators to fit into tight areas.

B-SERIES TECHNICAL SPECIFICATIONS (Table 7)

MODEL TYPE AND SIZE		B1	B2.5	B5	B10	B20	B30	B50	B75	B100
CAPACITY IN POUNDS (P)		2,000	5,000	10,000	20,000	40,000	60,000	100,000	150,000	200,000
DIA. OF LOAD SCREW		0.75	1.0	1.5	1.5	2.25	3.0	4.0	4.0	4.0
LEAD OF SCREW		0.500	0.250	0.474	0.474	0.500	0.666	1.0	1.0	1.0
GEAR CENTERS		1.504	1.750	2.188	2.598	2.875	3.750	5.313	6.000	7.500
GEAR RATIO	LOW	5:1	6:1	6:1	8:1	8:1	10 2/3:1	10 2/3:1	10 2/3:1	12:1
	HIGH	10:1	24:1	24:1	24:1	24:1	32:1	32:1	32:1	36:1
(TPI) TURNS OF INPUT SHAFT FOR 1" OF RISE	LOW	10	24	12.66	16.88	16	16	10.66	10.66	12
	HIGH	20	96	50.66	50.66	48	48	32	32	36
TORQUE REQUIRED TO LIFT ONE POUND (lb-in) (Tp)	LOW	0.024	0.008	0.019	0.015	0.016	0.017	0.025	0.024	0.023
	HIGH	0.014	0.003	0.007	0.008	0.008	0.009	0.014	0.012	0.013
HOLDING TORQUE (lb-ft) (Thb)	LOW	1.4	4	14	13	27	21	40	107	128
	HIGH	2	1.5	5	4	7	5	10	24	50
NO LOAD TORQUE (lb-in) (To)		4	5	12	18	36	48	96	156	204
MAXIMUM INPUT RPM		1800	1800	1800	1800	1800	1200	1200	1200	1200
APPROXIMATE WEIGHT IN POUNDS	0" TRAVEL	2.3	17	35	50	85	220	340	590	960
	PER INCH	0.07	0.6	0.6	0.8	1.5	2.4	2.8	4.6	4.6
RADIUS OF GYRATION (r)		0.154	0.205	0.285	0.285	0.463	0.620	0.835	0.835	0.835

1. Complete the Uni-Lift Selection Guide located in the inside front cover.

2. Determine the maximum load on one actuator: P_1

$$P_1 = \frac{P_2}{N}$$

P_2 = Total system load (lbs.)
N = Number of actuators in the system
On multi-unit systems where load is not equally distributed, change P_1 to the greatest load supported by one unit.

3. Check Load Screw Column Capacity:
- If the load screw is in tension, select a Uni-Lift with a rated capacity equal to or greater than the maximum load (P_1) on one actuator. Go to step 4.
- If the load screw is in compression, use the calculation steps on page 50 to determine the maximum permissible Extended Screw Length, (ESL). Select a Uni-Lift that has a load screw column length capacity equal to or greater than the length required for the load.

4. Determine the desired load screw velocity (in./min.): (V_d)

$$V_d = \frac{Rise}{t_2}$$

Rise = One way travel under load (in.)
t_2 = Required one way travel time (min.)

5. Determine Desired Input Speed: (RPM_d)

$$RPM_d = TPI \times V_d$$

TPI = Turns of the input shaft for 1 inch of rise. (See technical specification table 7.)

6. Determine Load Screw Velocity: (V)
From the catalog data, select the drive equipment with an output speed close to the desired input speed (RPM_d). Use the output speed to recalculate the actual load screw velocity (V).

$$V = \frac{RPM}{TPI}$$

7. Check the Duty Limit of the actuator:

$$D_1 = \frac{(2 \times Rise \times C_h)}{V}$$

D_1= Duty time per hour
C_h= Cycles per hour
Determine if D_1 is equal to or greater than D_2. If D_2 is less than D_1 reduce the input speed to the actuator, or reduce the load per actuator by adding more actuators to the system.
D_2 = Duty Limit (see page 49 for calculations)

Motor Sizing:

Once you have determined the motor horsepower, you need to calculate the Motor Brake Torque. All ball screw jacks and systems must be supplied with a brake. This is necessary to stop the jack and also to hold the position. Stop Nuts are to be used only for emergencies. They are available as an option.

The following is a QUICK ESTIMATE FOR MOTOR SIZING FOR A ONE ACTUATOR SYSTEM. For detailed motor sizing and torque requirements on single or multi-unit systems, skip steps 8 and 9, and go to step 10.

8. Estimate the Input Torque T_e (lbs/in):

$$T_e = T_p \times P_3$$

T_p = Torque required to lift one pound (see table 4 for T_p values.)
P_3 = Maximum system running load.

9. Estimate Uni-Lift Horsepower: HP_e

$$HP_e = \frac{(T_e \times RPM)}{63025}$$

B-SERIES MOTOR SIZING AND TORQUE CALCULATIONS (Table 8)

MODEL No.	GEAR RATIO	Turns per inch TPI	Rated cap (lbs) P	STATIC TORQUE Ts	UNIT INPUT TORQUE AT RATED CAPACITY T = RUNNING TORQUE (lb-in) at VARIOUS RPM (Theoretical) 50 RPM	115 RPM	172 RPM	345 RPM	600 RPM	870 RPM	1140 RPM	1725 RPM	NO LOAD TORQUE To
B-1	**5:1**	**10**	**2,000**	49	44	43	42	41	40	40	39	38	3
	10:1	**20**		29	26	25	24	23	22	22	21	21	
B 2.5	**6:1**	**24**	**5,000**	41	37	36	35	34	33	33	32	32	5
	24:1	**96**		17	14	13	13	12	11	11	10	10	
B 5	**6:1**	**12.66**	**10,000**	186	170	167	164	160	156	154	152	150	12
	24:1	**50.66**		71	59	57	54	51	48	47	45	43	
B 10	**8:1**	**16.88**	**20,000**	302	269	262	256	247	240	236	233	229	18
	24:1	**50.66**		154	125	118	112	105	98	94	91	87	
B 20	**8:1**	**16**	**40,000**	628	561	546	533	516	502	493	487	479	36
	24:1	**48**		313	254	242	230	215	202	194	189	181	
B 30	**10 2/3:1**	**16**	**60,000**	987	864	838	815	784	761	746	736		48
	32:1	**48**		520	408	384	363	335	312	298	289		
B 50	**10 2/3:1**	**16**	**100,000**	2519	2149	2105	2010	1929	1870	1835	1814		96
	32:1	**48**		1361	1017	948	887	811	755	722	631		
B 75	**10 2/3:1**	**10.66**	**150,000**	3604	3132	3036	2952	2846	2769	2723	2335		156
	32:1	**32**		1781	1384	1303	1232	1141	1074	1035	1010		
B 100	**12:1**	**12**	**200,000**	4622	3844	3696	3567	3413	3307	3248	3212		204
	36:1	**48**		2568	1837	1697	1575	1429	1327	1271	1236		

For RPM's not shown use the next slowest RPM. For speeds less than 50 RPM contact factory.

10. Determine Uni-Lift Running Load Proportion Factor: (f)

$$f = \frac{P_3}{(P \times N)}$$

P = Rated Capacity of Uni-lift

P_3 = Max. system running load N= Number of Uni-lifts

11. Determine Unit Running Torque: (T_1) (lb-in)

$$T_1 = (T \times f) + T_o$$

T_0 = No load torque from chart

T = Running torque from chart

12. Find the System Running Torque: (T_2) (lb-in)

$$T_2 = \frac{(T_1 \times N)}{e_1}$$

e_1 = System Arrangement Efficiency, see page 77

13. Find System Power:

$$\text{System HP} = \frac{(T_2 \times RPM)}{(63025 \times e_2)}$$

e_2 = Reducer Efficiency, see page 77

RPM = Uni-Lift input shaft speed

14. Determine System Starting Torque: (T_{s2})

$$T_{s2} = \frac{((T_s \times f) + T_o) \times N}{e_2}$$

T_s = Static torque from chart

15. Determine Motor Starting Torque: (T_{sm}) (lb in)

$$T_{sm} = \frac{T_{s2}}{(R \times e_2)}$$

R = Gear Reducer Ratio

16. Determine Motor Running Torque: (T_{rm})

$$T_{rm} = \frac{T_2}{(R \times e_1)}$$

- Select a motor with a power rating greater than HP requirement in step 13, a starting torque greater than T_{sm} requirement in step 15, and a motor running torque greater than T_{rm} in step 16.
- Select system torque transmission equipment (reducer, mitre gear boxes, couplings, etc.) with ratings greater than the torque to be transmitted, see step 12 and system arrangements, page 77.
- Size shafting for system starting torque to be transmitted, see step 16, and Table B page 76.

17. Select a Brake Size (required for all ball screw jack applications):

$$T_b = \frac{C}{TPI \times d \times R} \times \frac{(f \times T_{hb} \times N)}{R}$$

C = Motor brake factor

T_b = Motor brake torque

d = Stopping distance

R_1 = Reducer ratio

T_{hb} = Hold torque (see technical data)

N = Number of Uni-Lifts in the system

C Factor For Motor Brake (ft.-lbs.)

Motor	1140	1725	Motor	1140	1725
1/4	3.2	4.1	3	38	66.5
1/3	4	4.9	5	48.3	87.4
1/2	5.1	6.1	7 1/2	69.4	112
3/4	7.89	9.2	10	126	146
1	9.18	17.8	15	268	273
1 1/2	11.3	21.6	20	306	315
2	29.5	25.6	25	548	596

B SERIES DUTY CYCLE (Table 9)

Uni-Lift Duty Limit at Full Rated Capacity and 80° F Ambient Temperature

MODEL and SIZE	RATIO	TPI	L2 - DUTY LIMIT SERVICE FACTOR @ VARIOUS RPM INPUT SPEEDS								
			50 RPM	115 RPM	172 RPM	345 RPM	600 RPM	870 RPM	1140 RPM	1725 RPM	2587 RPM
B-1	5:1	10	553	268	191	108	69	52	42	30	22
	10:1	20	584	303	223	134	90	70	58	43	32
B-2.5	6:1	24	575	293	188	103	63	46	37	26	18
	24:1	96	1022	520	353	203	132	101	83	61	46
B-5	6:1	12.66	351	220	115	62	38	28	22	15	
	24:1	50.66	658	417	227	129	84	63	52	38	
B-10	8:1	16.88	252	158	84	46	29	21	17	12	
	24:1	50.66	373	239	132	76	50	38	31	23	
B-20	8:1	16	190	120	63	35	22	16	12	9	
	24:1	48	284	181	100	58	38	29	24	17	
B-30	10 2/3:1	16	185	117	63	35	22	16	12		
	32:1	48	261	172	96	56	38	29	24		
B-50	10 2/3:1	10.66	105	66	36	20	13	9	7		
	32:1	32	143	96	54	32	22	17	14		
B-75	10 2/3:1	10.66	110	71	36	21	13	9	8		
	32:1	32	177	116	65	38	25	19	16		
B-100	12:1	12	130	82	46	26	17	12	10		
	36:1	36	185	124	71	43	29	23	18		

- Duty Limit Service factor (L_2) = Operating time allowed per hour. The numbers greater than 60 are theoretical values and exceed 100% duty, solely to provide base data for adjusting L_2.
- The L_2 values are based on Uni-Lifts loaded at rated capacity, operating in an ambient temperature of 80° F., with a maximum allowable temperature rise of 100° F.
- For ambient temperatures above 180° F or below -20° F, consult factory.
- For speeds not shown, use the next fastest RPM value.

1. Determine Adjusted Duty Limit : D_2

When the unit load is at rated capacity, and the ambient temperature is at 80° F, the L_2 value from the table equals D_2. If not, proceed to step 1A.

1A) For different temperature service, or a unit load less than rated capacity, use the following equation to determine the Adjusted Duty Limit Service Factor (D_2).

$$D_2 = \frac{(180 - T_A) \times P \times L_2}{100 \times P_4}$$

L_2 = Duty Limit Service Factor (see Table 9)
T_A = Ambient temperature (F°) P=Rated capacity (lbs.)
P_4 = Maximum running load per actuator (lbs.)
P = Rated capacity of the Uni-Lift

2. Determine if Duty Cycle is acceptable:
If **D_2> = 60** minutes, the application is rated for continuous duty.
If **D_2> = D_1** then the application is acceptable.
If **D_2<D_1** then the duty cycle limit has been exceeded for this application. You must do one of the following: select larger size Uni-Lift, reduce load by adding additional Uni-Lifts, or reduce speed. If you reduce speed, you must recalculate V_1 and D_1 from the Technical Specifications page 47 steps 6 and 7.

EXAMPLE

A. Consider for an B-10 low ratio 8:1 operating in 100°F ambient temperature, 10,000 lbs. load, and 1725 RPM, with a rise of 30 inches and 25 cycles per hour:

$$D_1 = \frac{(2 \times \text{Rise} \times C_h)}{V_1}$$

$$D_1 = \frac{(2 \times 30 \times 25)}{102.2}$$

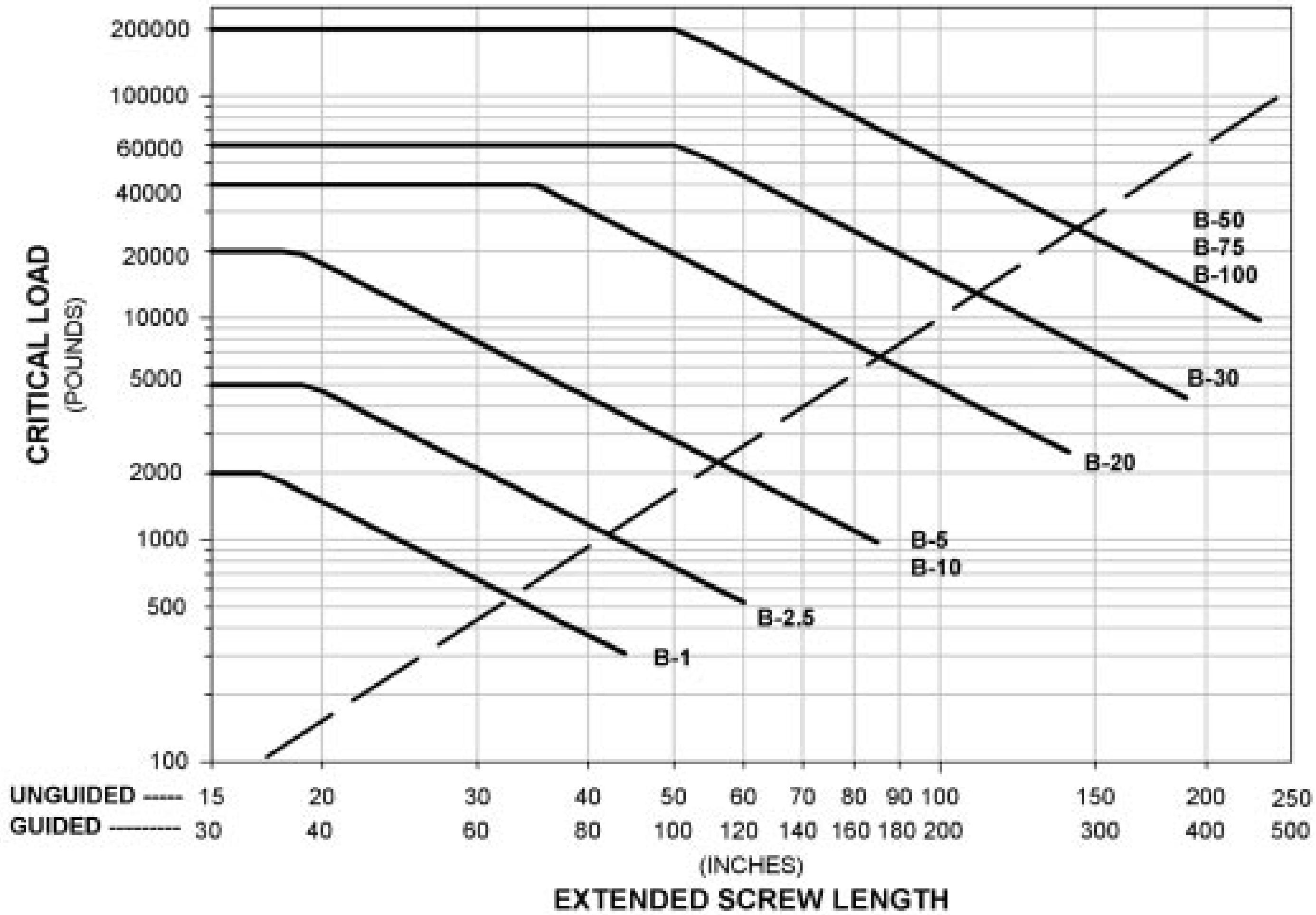
Duty time per hour = 14.76 minutes per hour

$$D_2 = \frac{(180 - 60) \times 20{,}000 \times 23}{100 \times 10{,}000}$$

Duty cycle limit = 55.2 minutes per hour

Since D_2 is greater than D_1 the application is OK for the duty cycle limit.

B-SERIES BALL SCREW COLUMN BUCKLE CHART



(For guided and unguided loads)

The maximum ESL values in the chart above are based on a **2:1 factor of safety against column buckle,** and on a standard design with a top plate, or a rotating design travel nut. Increased load screw lengths are not shown where the slenderness ratio exceeds 400.

1. Determine extended screw length: (ESL)
The ESL is the distance in inches the load screw can extend from the housing. See layout page for the model selected to determine ESL.

2. Determine the adjusted screw length: (ASL)
The chart above is for a standard design top plate or the rotating design travel nut. For other design configurations you must adjust the ESL value using the F factor multiplier to determine the adjusted screw length.

ASL=ESL x F

3. Select correct size Uni-lift: On the chart above, draw a horizontal line to represent the maximum load (P_1). Using the set of ESL values that apply to your design (guided or un-guided), draw a vertical line to represent the ESL or ASL. All of the Uni-Lift's above the point of intersection will be acceptable.

Screw lengths above the dotted line comply with AISC maximum slenderness ratio KL/r=200 specified for design and fabrication of structural steel buildings. This data is for reference only and is not a limiting factor, except as required.

F = Column Factor Multiplier

DESIGN CONFIGURATION	F factor	Guided K factor	Unguided K factor
Standard Design Top Plate	1	0.65	1.3
Rotating Design Traveling Nut	1	0.65	1.3
Standard Design Clevis End	1.25	0.8	1.6
Keyed Design Top Plate	1.25	0.65	1.3
Keyed Design Clevis End	2	0.65	1.6

K=Column Factor
L=Extended Screw Length (ESL)
r =Radius of Gyration
See Technical Specifications (Table 7) for r values