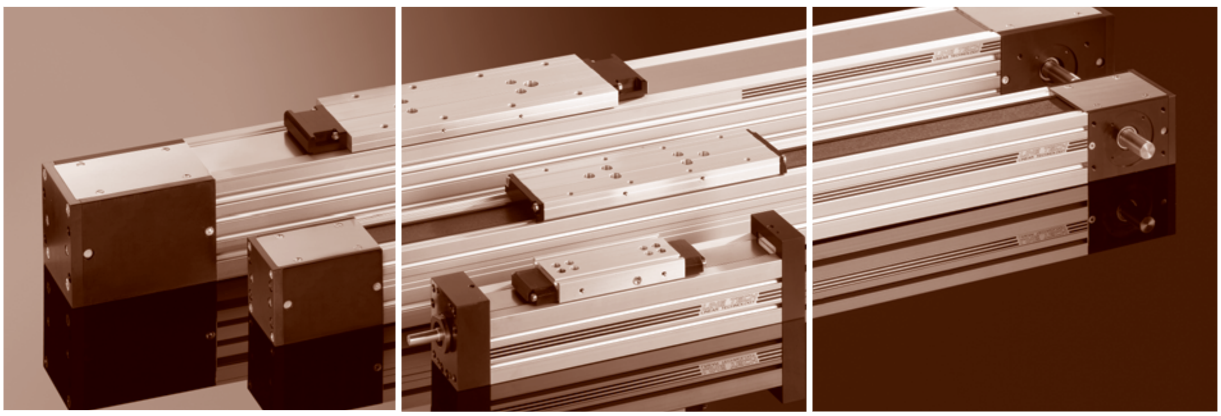
EXTRAK



Modular Rodless Belt-Driven Actuators

EXLAR

Exlar, the leading supplier of industrial servo controlled actuators, now offers a complete line of rodless actuators. Exlar's new Extrak™ rodless actuators complement Exlar's "long life" line of rod style actuators and create, in one source, the broadest offering of electric linear actuators anywhere. This addition makes Exlar your one-stop solution center for all your linear and rotary actuator needs.

Exlar's products are designed for heavy duty [continuous motion] applications and are ideal for industrial positioning or material handling applications with their high speed and long stroke length capabilities. Electric actuators from Exlar will perform millions of operations over the life span of your machine. Like Exlar's rod style actuators, Exlar's rodless actuators use components which are designed for extreme robustness and long life.

By choosing Exlar you can be sure you have the most robust mechanical drive possible in your rodless actuator application. This commitment to quality and long life makes Exlar your sure choice for rodless actuators in industrial applications.

There are numerous advantages to the Extrak design:

►Speed of over 16 feet per second (5m/sec) is achievable depending on the load, driving motor, and actuator drive type. These higher speeds greatly increase the application versatility of the actuator.

►Stroke lengths are available up to 22 feet (6.7m). Optional limit switch packages allow the stroke length limits and homing reference positions to be set within the physical limits of the actuator.

►Flexible – The rodless actuators utilize a close-coupled motor mounting flange for mounting your choice of NEMA or metric dimension motors, gearboxes, clutches, and brakes. This allows the unit to be customized to specific application requirements with the smallest possible package.

►Shorter overall length – Unlike the rod-style actuator, the extended and retracted lengths are the same. This permits a smaller envelope for the actuator and allows it to be applied in more size restricted applications.

Profile Size

Exlar's Extrak actuators are available in three different profile [frame] sizes; 65 mm, 80 mm, and 110 mm. This allows you to conveniently match the physical size allowed by your application with the required performance. Stroke lengths are available up to 22 feet (6.7m) of usable stroke. These rugged actuators can carry heavy loads in excess of 10,000 lb (4500kg) in high duty applications – even higher loads are possible for intermittent duty service.

Frame/Enclosure

Exlar rodless actuators consist of a precision aluminum frame/housing with a movable platen. The extruded housing acts as the frame of the unit and provides for the mounting of linear bearing guides and the driving motor. The linear guide system incorporates high performance linear rails which assure high radial stiffness and vibration free operation. These criteria are important to assure both precise execution of motion profiles and extremely long life.

Protection

An optional steel band seal is available for protection. The steel band is held to the case magnetically and covers the belt and guides. This helps to keep debris out of the drive system which may eventually adversely affect the operation of the belt and guides.

All Extrak actuators can be supplied with pressure ports for applying positive air pressure to the actuator in extreme environments. This feature, when employed, will provide additional protection against debris penetrating the housing and affecting operational mechanisms.

Motors

Exlar Extrak actuators are modular in design thus allowing the user to mount any IEC 60, 90, or 115 mm frame or Nema 23, 34, 42 or 56 frame motor. Motors are available from Exlar, compatible with nearly any servo amplifier. Alternatively the user can readily mount his own motor. In this case Exlar will manufacture the adapter flange to the required dimensions for simple mounting of the user's motor to the actuator.

Toothed Belt Drive

Exlar's belt drive rodless actuator employs a tooth Power Grip™ premium belt from Gates to convert the rotary motion of the driving motion to the high speed linear motion of the platen. The "long-life" belts provide higher possible speeds of up to 16 ft/sec, (5m/sec) and due to their composition allow long life. Please be aware that belt drives exhibit high rotational inertia and that proper matching of the driving motor and actuator is important. A planetary gear reducer is an option to assure proper inertia matching.

Mounting

Mounting of the Extrak actuator to your machine frame is simple. The profile of the Extrak includes multiple sized T-slots which allow mounting to other commercially available extruded machine frame products. These also offer mounting of multiple Extrak modules to each other for multi-axis systems.

Accessories

Accessories are available assuring that you can adapt the actuators to perform specific control functions necessary for each application you encounter.

1. Limit switches
2. Limit switch cables
3. T-Nuts
4. Mounting screws
5. Additional travelers

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EXTRAK LMB SERIES ORDERING GUIDE
Example Part Number: LMx-AA-BBBB-CCC-DE-FFF-GGG-HH
Model
LMB = Belt Drive Rodless Module
AA = Size
30 = Size 3
40 = Size 4
50 = Size 5
BBBB = Stroke Length
0 - 7000
CCC = Travel per Input Revolution
155 = 155 mm (Size 3)
205 = 205 mm (Size 4)
296 = 296 mm (Size 5)
D = Linear Bearing Guides
2 = Standard, Long Platen
E = Steel Band Cover
N = None
S = Stainless Strapping
C = Carbon Steel Strapping
FFF = Input Mounting Type
FSL = Free Shaft Left
FSR = Free Shaft Right
DFS = Dual Free Shafts, L & R
SLP = Shaft Left with Mounting Plate
SRP = Shaft Right with Mounting Plate
DLM = Dual Shafts with Left Mounting Plate
DRM = Dual Shafts with Right Mounting Plate
GGG = Motor Type
NMT = No Motor Mount
M60 = Exlar 60mm SLM
M90 = Exlar 90mm SLM
M11 = Exlar 115mm SLM
M14 = Exlar 142mm SLM
G60 = Exlar 60mm SLG
G90 = Exlar 90mm SLG
G11 = Exlar 115mm SLG
N23 = NEMA 23
N34 = NEMA 34
N42 = NEMA 42
N56 = NEMA 56
HH = Limit Switches (12mm Turck Barrel prox., 3 wire, NC/NO
L1 = 1 Switch
L2 = 2 Switches
L3 = 3 Switches

Drive

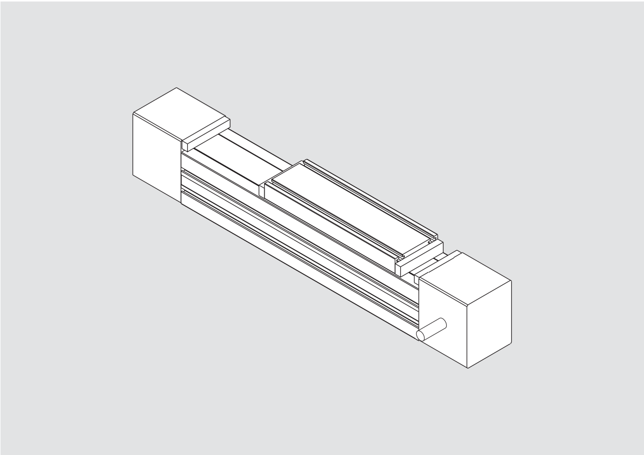
In order to simplify the selection of the optimal drive, you'll find below the various drive solutions in line with the most important performance data.

This allows for the comparison of the different drives and the selection of the drive solution appropriate to the customer's individual need.

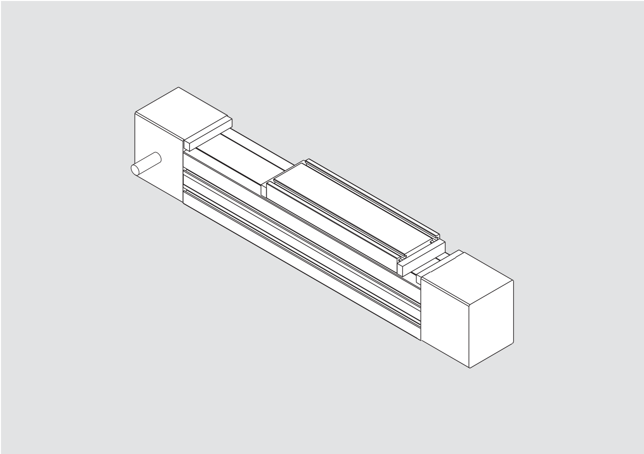
In case of any specific or higher requirements to the positioning system we ask you to get in contact with Exlar customer service.

Mounting Condition

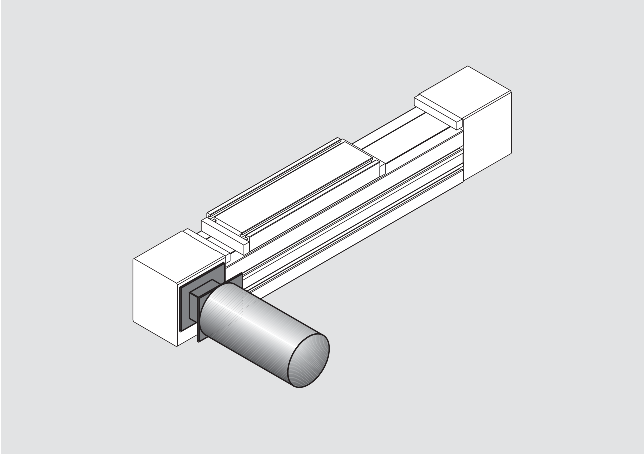
The Exlar positioning systems can be purchased in various mounting conditions. See dimensions on page 13.



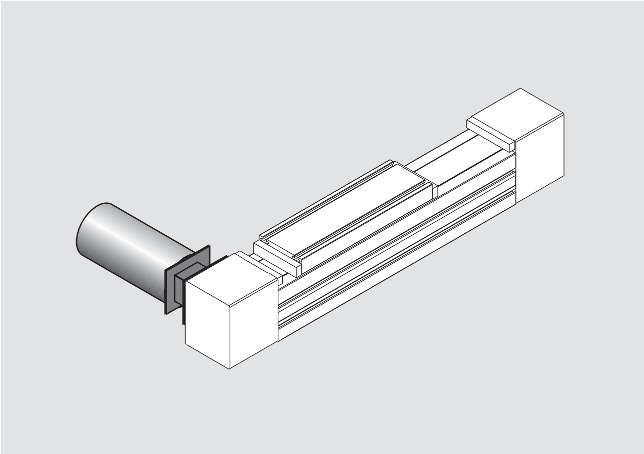
Picture 2: Free shaft end right hand side
(FSR Mounting Type)



Picture 3: Free shaft end left hand side
(FSL Mounting Type)



Picture 9: Belt drive left with coupling and intermediate plate
(SLP Mounting Type)



Picture 10: Belt drive right with coupling and intermediate plate
(SRP Mounting Type)

Limit Switches

The limit switches are used in conjunction with a control unit to limit the stroke (prevent overrunning of the carriage) and to define the reference position.
The standard inductive limit switches are PNP-N.C. with the following specifications:

Supply: 10…30 VDC
Current consumption off-load: < 10 mA
Load: max. 200 mA

Mechanical switch-ratio: ≤ 0.4mm

On request the following non standard limit switches are available:
– PNP-normally open (PNP-NO)
– NPN-normally closed (NPN-NC)
– NPN-normally open (NPN-NO)

Mounting of the Limit Switches

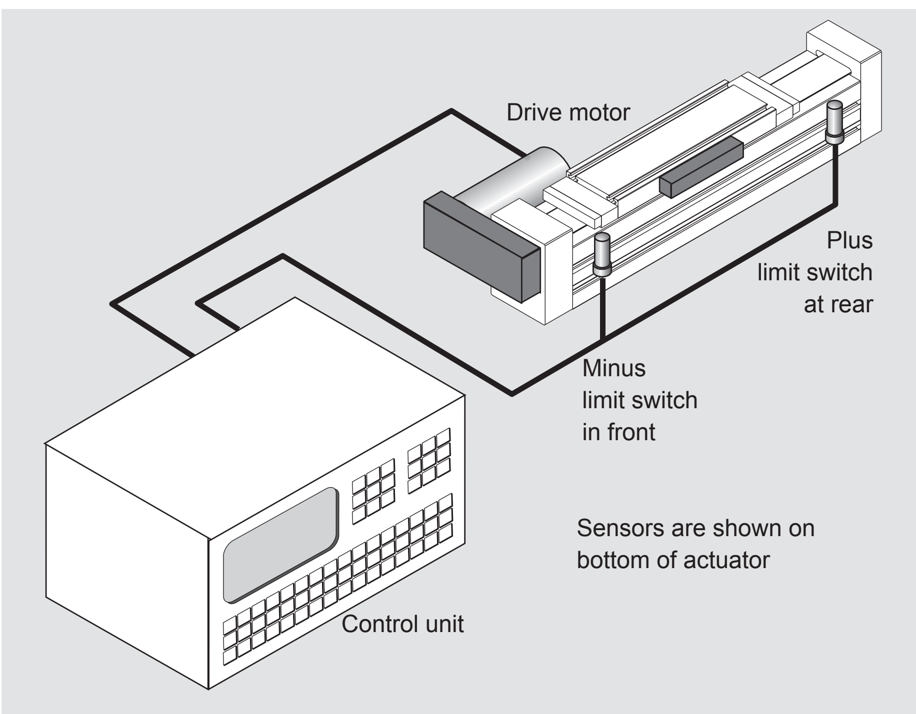
The mounting position of the limit switches is shown in picture 11a. The reference position can be located either to the plus (+) or to the minus (-) limit switch.

Limit switch cables are not included in the delivery. However they can be ordered separately (picture 11b).

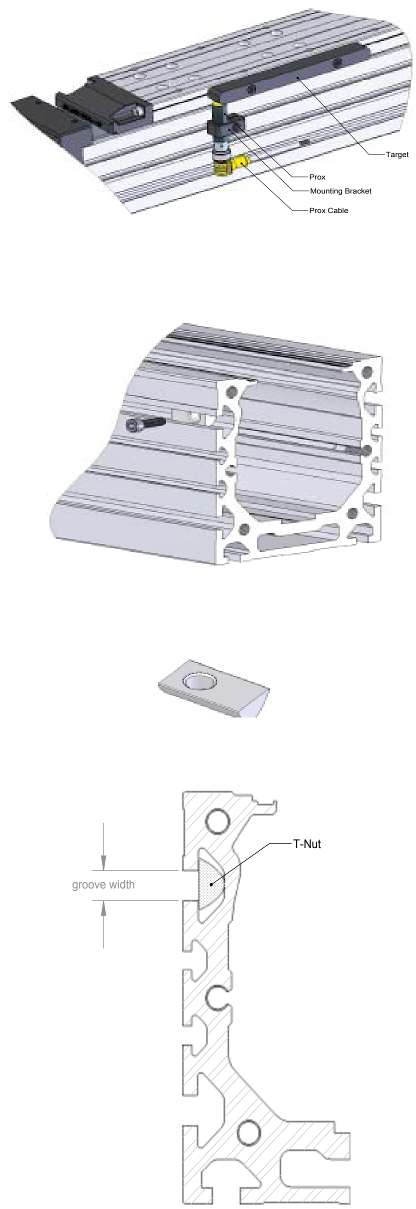
On request the limit switches can be connected to a connector shell (picture 11b).

The limit switch cable is equipped with a plug on one side.

Use of T Nuts



Picture 11a: Fitting position of the limit switches



Picture 11b: Limit Switch Profile

Load Capacity

Load Capacity

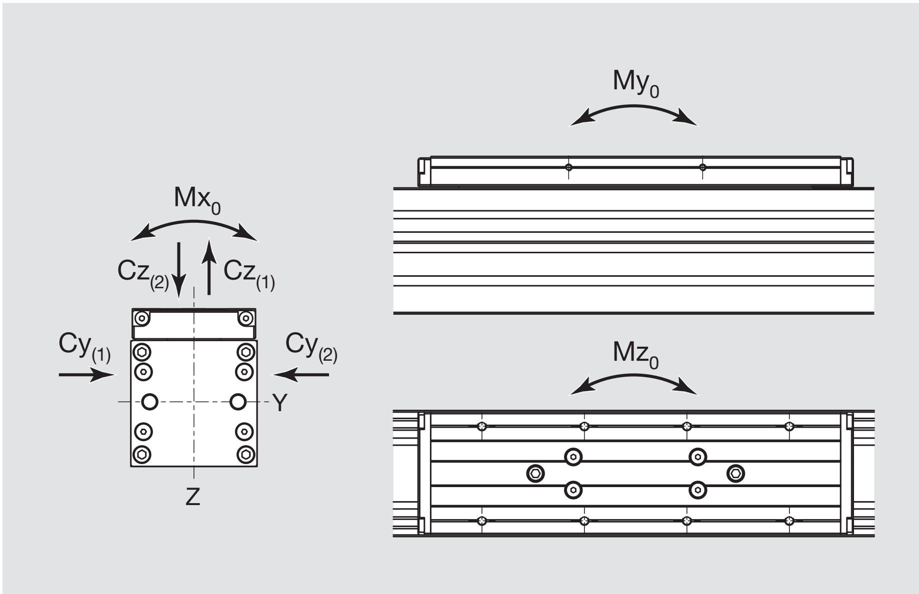
The load capacity is determined by the selected guiding system. We recommend to applying max. 20% of the dynamic load rate to the unit.

Applied Moment Load

The allowable values for applied moments are determined by the selected guiding system. The illustration at the right (picture 12) shows the descriptions of moment loads as depicted in the table below.

Deflection

For positioning units the maximum allowed deflection angle is of 0.5º. Exceeding this value will decrease the unit's life.



Picture 12: Directions of possible torque application

EXTRAK LOAD RATINGS

Type	Drive	Dynamic Load Rating (kN)				Dynamic Torque Rating (Nm)			Static Load Rating (kN)				Static Torque Rating (Nm)			Area Moment of Inertia (cm^4)	
		$Cy_{(1)}$	$Cy_{(2)}$	$Cz_{(1)}$	$Cz_{(2)}$	Mx_0	My_0	Mz_0	$Cy_{0(1)}$	$Cy_{0(2)}$	$Cz_{0(1)}$	$Cz_{0(2)}$	Mx_0	My_0	Mz_0	Iy_5	Iz_5
LMB30	Toothed Belt	14.6	14.6	16.7	16.7	20.0	918.5	808.3	21.2	21.2	25.3	33.8	170	1330	1117	66.9	82.4
LMB40	Toothed Belt	20.5	20.5	23.4	23.4	39.2	1719.9	1513.5	29.6	29.6	35.2	47.0	320	2590	2176	131.2	197.8
LMB50	Toothed Belt	33.0	33.0	37.6	37.6	88.6	5555.2	4888.5	45.9	45.9	54.7	73.0	572	5803	4874	451.9	623.9

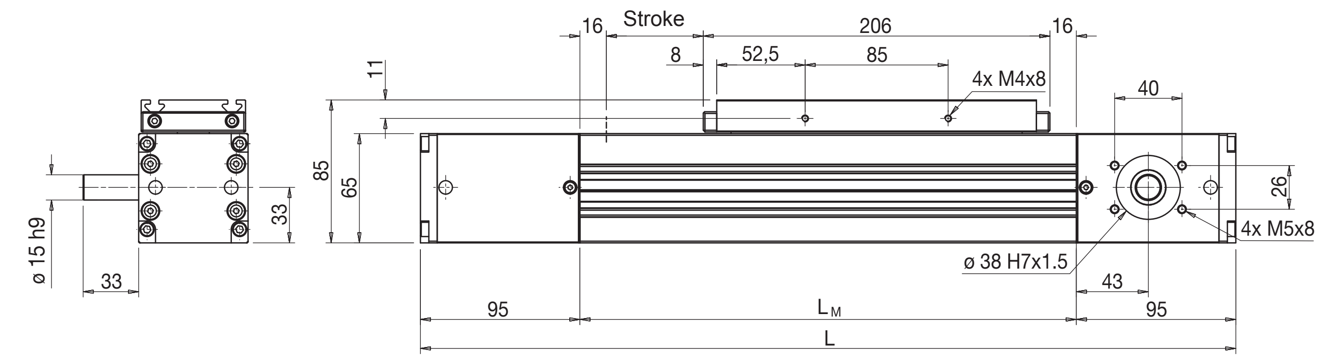
EXTRAK PERFORMANCE RATINGS, TOOTHED BELT CIRCUMFERENTIAL

Size	Belt Type	Travel/Rev (mm)	Stroke Range (mm)	Positioning Accuracy (µm/mm)	Repeating Accuracy (+/- mm)	Reversal Backlash (mm)	Max Speed (m/s^2)	Max Accel (m/s^2)	Max Axial Force (N)	Max Input Torque (Nm)
LMB30	GT 5/25	155 mm/rev	≤ 7600	200/1000	0.1	0	1.6	Limited by max input torque	1560	38
LMB40	GT 5/40	205 mm/rev	≤ 7500	200/1000	0.1	0	1.6		2200	70
LMB50	ST 8/50	296 mm/rev	≤ 7400	200/1000	0.1	0	1.6		3720	175

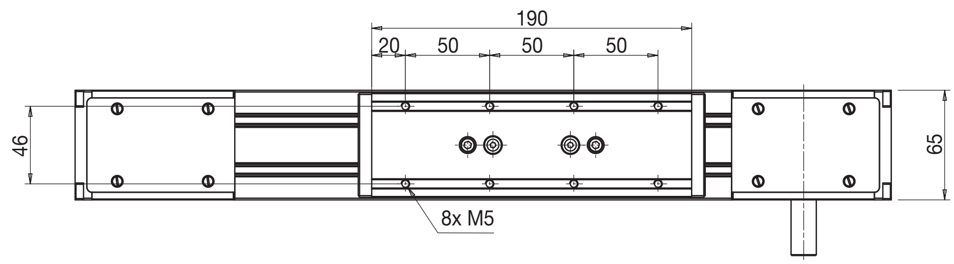
EXTRAK BELT DRIVE MODULES

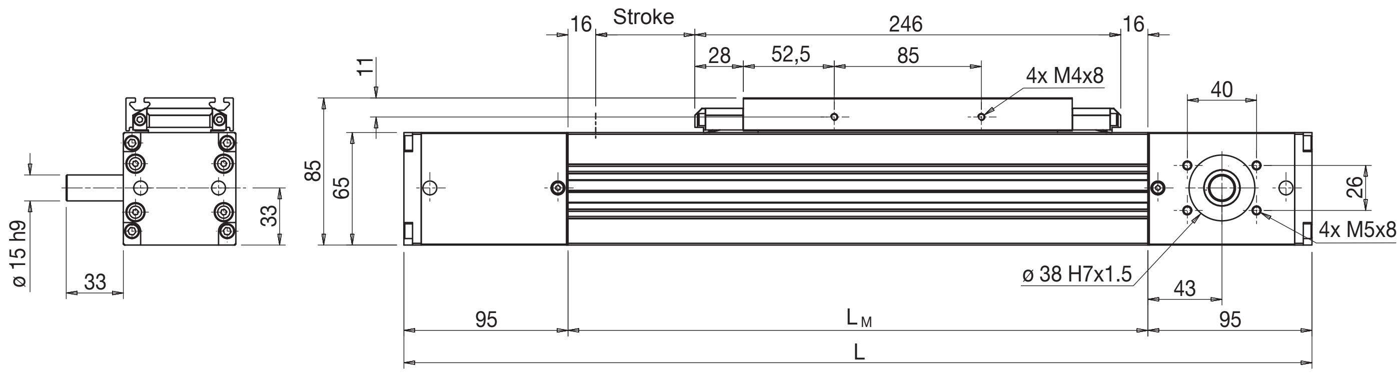
		LMB30	LMB40	LMB50
Travel per Revolution	in (mm)	6.1 (155)	8.1 (205)	11.7 (296)
Maximum Input Torque	lbf-in (Nm)	336 (38)	620 (70)	1549 (175)
Base Unit Inertia	lbf-in-sec^2 (kgm^2)	0.0080 (0.0009)	0.0239 (0.0027)	0.1195 (0.0135)
Positioning Accuracy	in/in (µm/mm)	2-E4 (200/1000)	2-E4 (200/1000)	2-E4 (200/1000)
Repeating Accuracy	+/- in (mm)	0.0039 (0.1)	0.0039 (0.1)	0.0039 (0.1)
		add per 100 mm stroke		
Additive Inertia	lbf-in-sec^2 (kgm^2)	0.0009 (0.0001)	0.0027 (0.0003)	0.0133 (0.0015)
Axial Force - Friction without steel strap	lbf (N)	1.1 (5)	2.2 (10)	4.5 (20)
Axial Force - Friction with steel strap	lbf (N)	2.2 (10)	4.0 (18)	6.7 (30)

LMB3.2 with linear rail guiding system and toothed belt drive

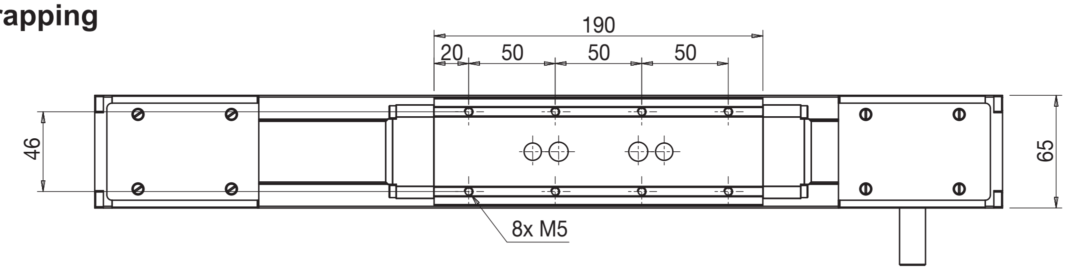


LMB3.2 Without Protection



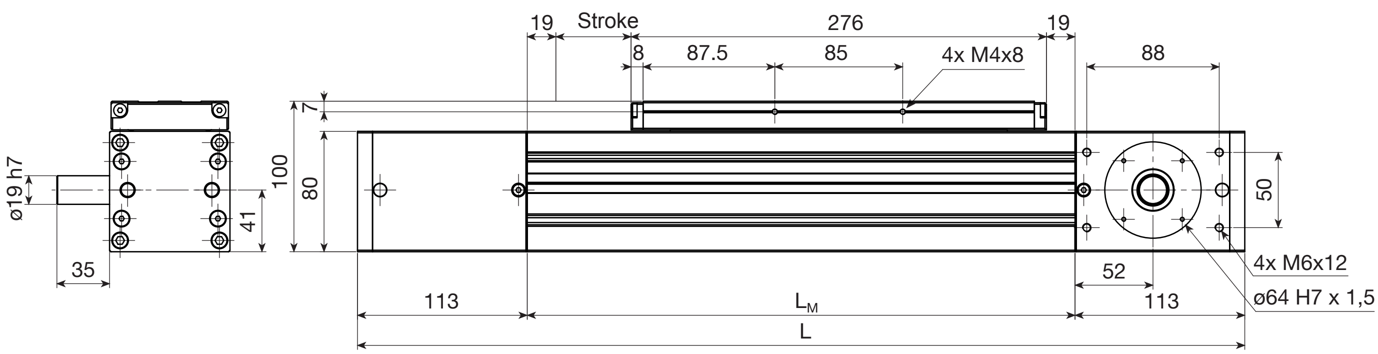


LMB3.2 With Steel Strapping

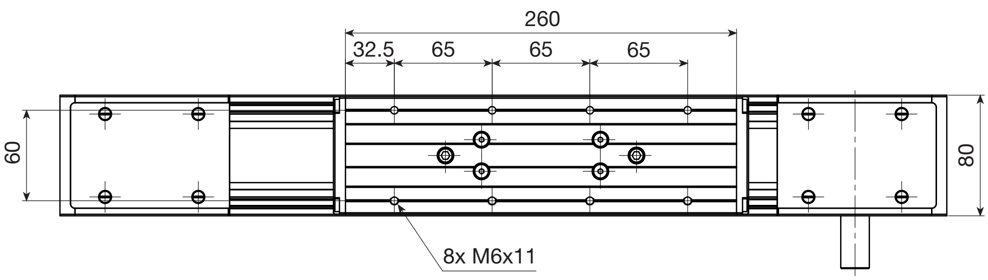


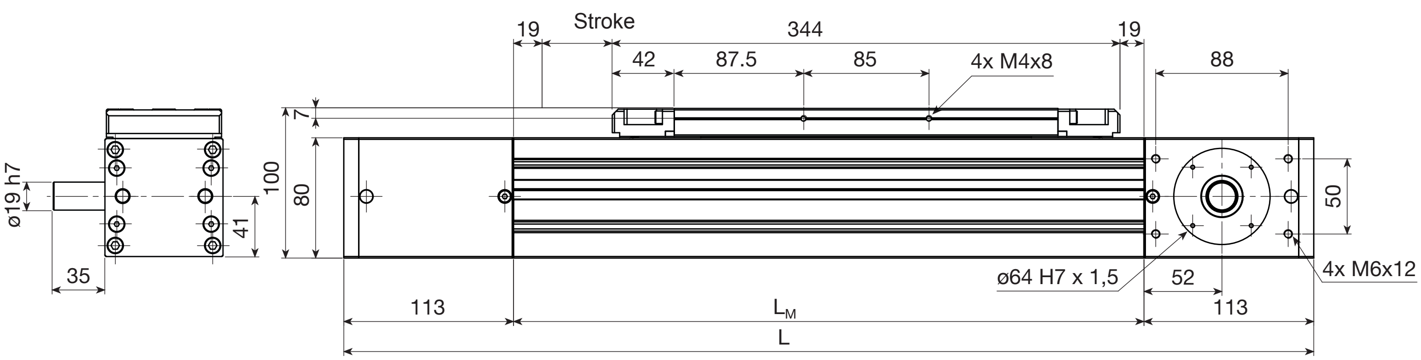
Model	L (mm)	L_M	Belt Length	Length Steel Strapping	Weight
LMB3.2 w/o steel cover	Stroke + 435	Stroke + 245	2 x Stroke + 730	N/A	4.5 kg + 0.60 kg/100 mm stroke
LMB3.2 w steel cover	Stroke + 475	Stroke + 285	2 x Stroke + 810	Stroke + 465	4.8 kg + 0.60 kg/100 mm stroke

LMB4.2 with linear rail guiding system and toothed belt drive

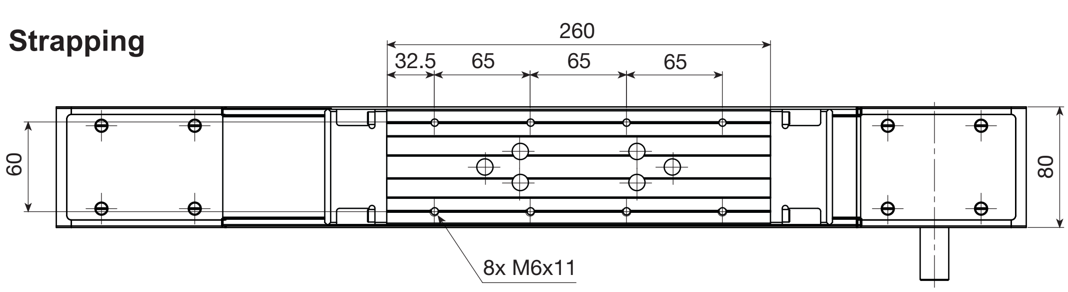


LMB4.2 Without Protection



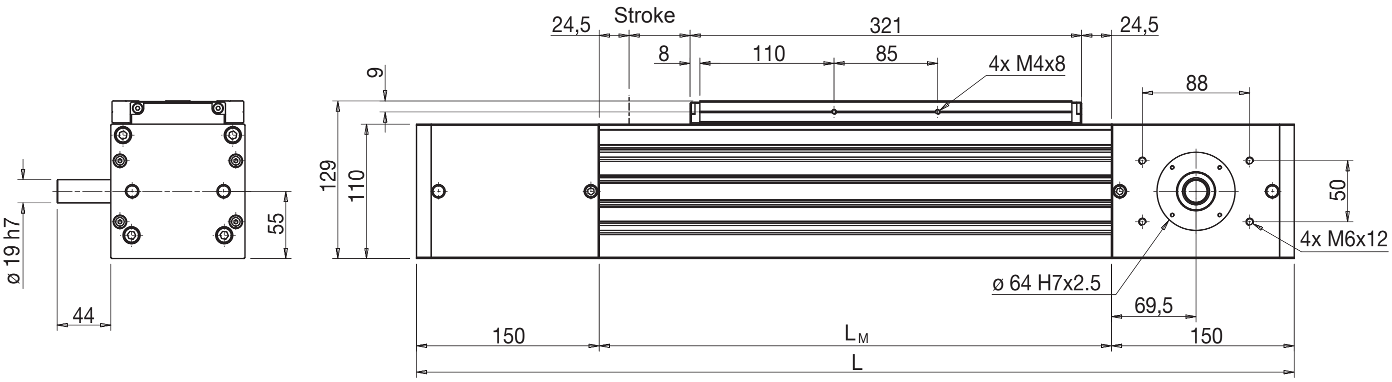


LMB4.2 With Steel Strapping

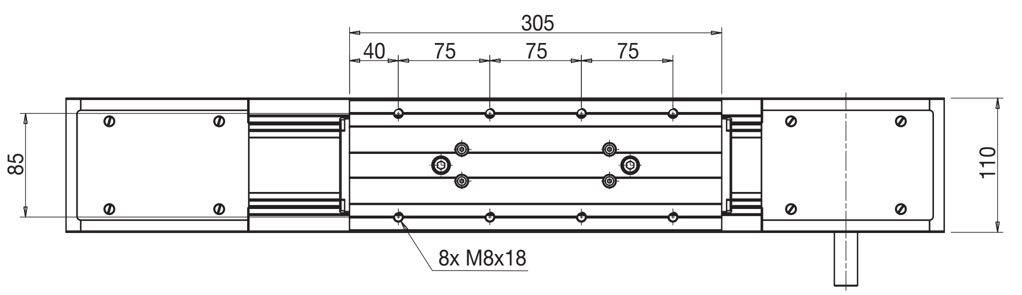


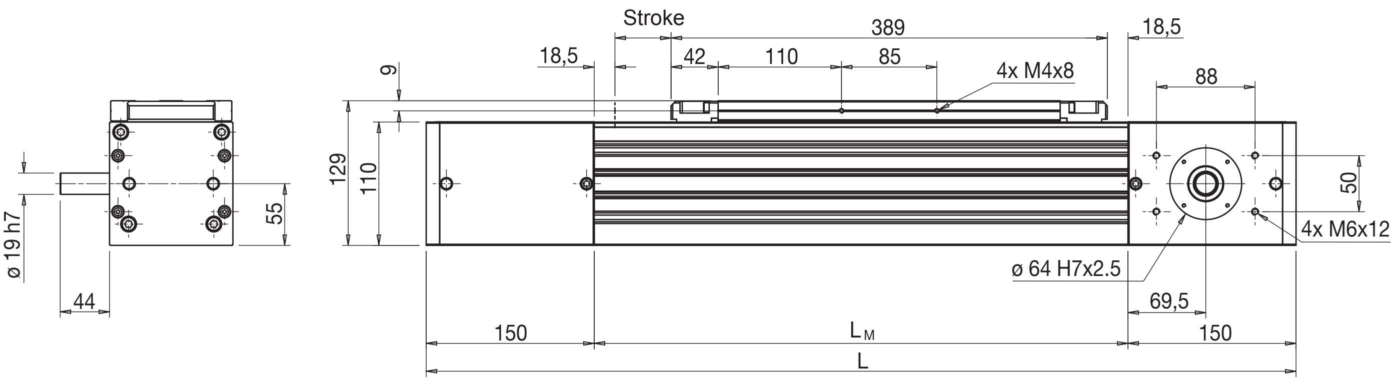
Model	L (mm)	L_M	Belt Length	Length Steel Strapping	Weight
LMB4.2 w/o steel cover	Stroke + 540	Stroke + 314	2 x Stroke + 900	N/A	8.4 kg + 0.93 kg/100 mm stroke
LMB4.2 w steel cover	Stroke + 608	Stroke + 382	2 x Stroke + 1040	Stroke + 596	9.1 kg + 0.95 kg/100 mm stroke

LMB5.2 with linear rail guiding system and toothed belt drive

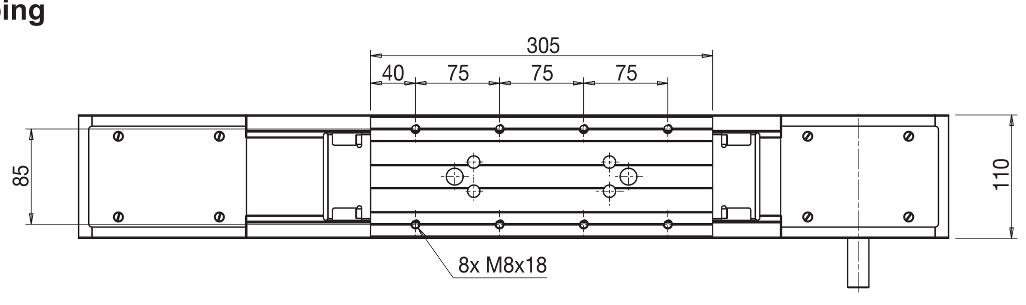


LMB5.2 Without Protection





LMB5.2 With Steel Strapping



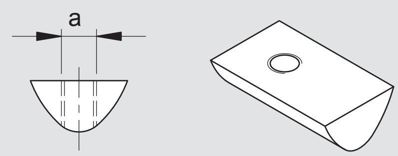
Model	L (mm)	L_M	Belt Length	Length Steel Strapping	Weight
LMB5.2 w/o steel cover	Stroke + 670	Stroke + 370	2 x Stroke + 1144	N/A	18.6 kg + 1.48 kg/100 mm stroke
LMB5.2 w steel cover	Stroke +726	Stroke + 426	2 x Stroke + 1256	Stroke + 712	19.5 kg + 1.50 kg/100 mm stroke

Mounting Grooves and Sliding Blocks

For all unit sizes the profiles, and often the carriages as well, come with grooves. The cradles of the linear modules LM4/LM5 are not equipped with such. The attachment of those two types is made through threaded holes. The positions of the grooves as well as the maximum thread reach are shown in profile cross-sections.

According to the groove width, sliding blocks of the types NS5, NS6 and NS8 are available. The sliding blocks are available from Exlar. The order number must show type, material and thread size (e.g. NS5 M5).

The available types are shown to the right.



Groove Width (mm)	Dimension "a" (mm)	Material	Order Number
5	M5	SS*	NS5 M 5
6	M6	SS	NS6 M 6
8	M8	SS	NS8 M 8

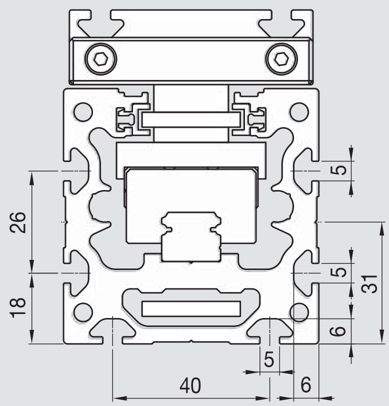
Material →
Dim "a" →

Sample: NS5 SS M5

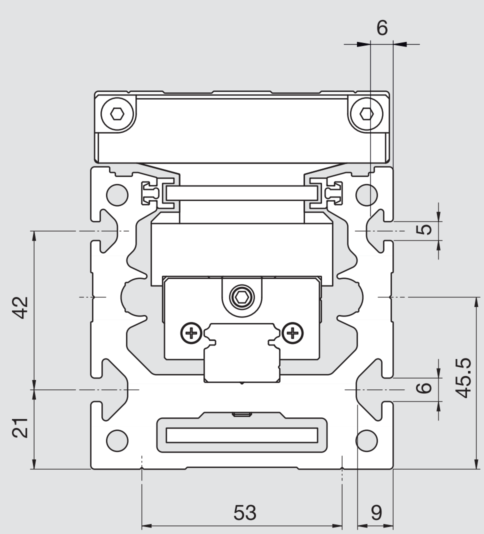
*SS = Stailnless Steel

Profile cross-sections

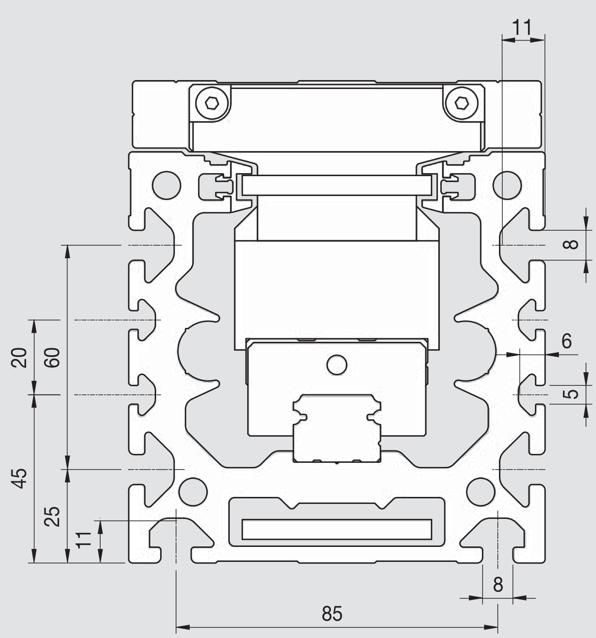
LM3.2
with linear rail guiding system and toothed belt drive



LM4.2
with linear rail guiding system and toothed belt drive



LM5.2
with linear rail guiding system and toothed belt drive



The determination of service life must be calculated based on the specifications of the linear guide system and the drive system.

It is the linear guide or guide roller system which normally determines the service life. Therefore the following equations can be used for an approximation of service life.

Dynamic load

The nominal service life L10 is being calculated from the dynamic load factor C_{dyn} [N] and the applied load F_r [N]:

$$L_{10} = \left(\frac{C_{dyn}}{F_r}\right)^3 \quad [10^5 \text{ m run}]$$

Static load

In cases where only static load is applied, the static load factor f_S is calculated in order to show that a module with an adequate load capacity has been selected. Taking into account the static load factor C_0 [N] and the load F_r [N] results:

$$f_S = \frac{C_0}{F_r}$$

If $f_S \geq 1$, the safety margin is sufficient

If $f_S \leq 1$, contact Exlar Applications Engineering for further advice.

The above formulas are applicable only in cases where all bearings are equally loaded, i.e. the load F_r F is applied at the center of the cradle. Especially in vertical arrangements of the linear modules, the drive (screw or belt) must be checked in addition to the guide capacity.

Definition of the drive motor

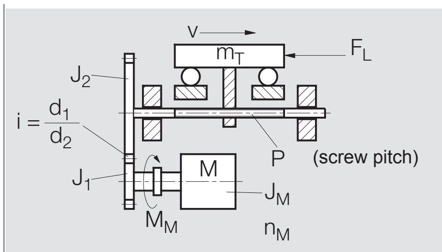
Size and type of the drive motor primarily depend on the load, the required displacement speed and the acceleration factor. Calculation and choice of a positioning unit shall be based on the worst case service conditions.

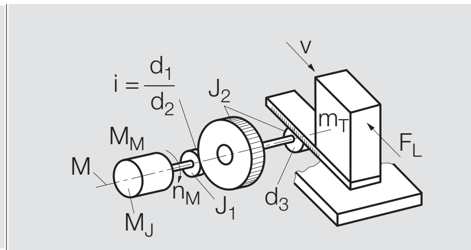
The linear modules can be configured to accept any type of motor includig brushless motors, gearmotors, or Tritex rotary actuators from Exlar.

The following formulas are provided for sizing assistance.

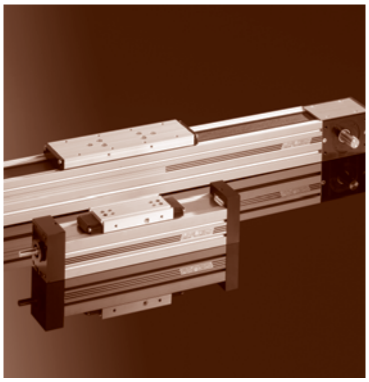
Key to the formulas on page 15:

d	[mm]	=	screw diameter
d_1	[mm]	=	diameter driving wheel
d_2	[mm]	=	diameter driven gear
d_3	[mm]	=	diameter pinion or belt pulley
F_L	[N]	=	feed power
i	[–]	=	gear reduction
J	[kgm²]	=	mass moment of inertia
J_1	[kgm²]	=	mass moment of inertia driving wheel
J_2	[kgm²]	=	mass moment of inertia driven gear
J_M	[kgm²]	=	mass moment of inertia drive motor
J_R	[kgm²]	=	rotatory mass moment of inertia
J_T	[kgm²]	=	translatory mass moment of inertia
l	[mm]	=	screw length
M_B	[Nm]	=	acceleration torque resp. breaking moment
M_d	[Nm]	=	motor – continuous torque (see motor spec.)
M_{eff}	[Nm]	=	motor – effective output torque
M_L	[Nm]	=	load moment
M_M	[Nm]	=	motor torque (see motor spec.)
M_{max}	[Nm]	=	motor torque peak
m_T	[kg]	=	external load (linear moving mass)
n_k	[min⁻¹]	=	critical speed for screw drive
n_M	[min⁻¹]	=	motor speed
p	[mm]	=	screw pitch
P_A	[W]	=	power output
s_B	[mm]	=	acceleration / brake path
t_B	[s]	=	acceleration / braking period
t_L	[s]	=	running time under load moment
t_0	[s]	=	stop period unloaded
v	[m/s]	=	rate of feed
η	[–]	=	mechanical efficiency on motor shaft





Motor speed	[min^{-1}]	$n_M = \frac{v \cdot 6 \cdot 10^4}{p \cdot i}$	$n_M = \frac{v \cdot 6 \cdot 10^4}{\pi \cdot d_3 \cdot i}$
Critical speed	[min^{-1}]	$n_k = 120 \cdot 10^6 \cdot \frac{d}{l^2}$	
Load moment	[Nm]	$M_L = p \cdot i \frac{F_L}{2000 \cdot \pi}$	$M_L = d_3 \cdot i \frac{F_L}{2000}$
Translatory mass moment of inertia	[kgm^2]	$J_T = m_T \left(\frac{p}{2 \cdot \pi}\right)^2 \cdot 10^{-6}$	$J_T = m_T \left(\frac{d_3}{2}\right)^2 \cdot 10^{-6}$
Rotatory mass moment of inertia (for steel)	[kgm^2]	$J_R = 7{,}7 \cdot d^4 \cdot l \cdot 10^{-13}$	
Total of reduced mass moments of inertia	[kgm^2]	$J = J_M + J_1 + i^2 (J_R + J_T + J_2)$ (at gear reduction 2:1 → i = 0,5)	
Acceleration torque resp. breaking moment $M_B = f(n_M)$	[Nm]	$M_B = \frac{n_M \cdot J}{9{,}55 \cdot t_B}$	
Acceleration torque resp. breaking moment $M_B = f(s_B)$	[Nm]	$M_B = \frac{4 \cdot \pi \cdot s_B \cdot J}{p \cdot i \cdot t_B^2}$	$M_B = \frac{4 \cdot s_B \cdot J}{d_3 \cdot i \cdot t_B^2}$
Acceleration- / braking period $t_B = f(n_m)$	[s]	$t_B = \frac{n_M \cdot J}{9{,}55 \cdot M_B}$	
Acceleration- / braking period $t_B = f(s_B)$	[s]	$t_B = \sqrt{\frac{4 \cdot \pi \cdot s_B \cdot J}{p \cdot i \cdot M_B}}$	$t_B = \sqrt{\frac{4 \cdot s_B \cdot J}{d_3 \cdot i \cdot M_B}}$
Resulting speed (rpm) after acceleration	[min^{-1}]	$n_M = \frac{120 \cdot s_B}{p \cdot i \cdot t_B}$	$n_M = \frac{120 \cdot s_B}{d_3 \cdot \pi \cdot i \cdot t_B}$
Resulting distance of acceleration	[mm]	$s_B = \frac{n_M \cdot t_B \cdot p \cdot i}{120}$	$s_B = \frac{n_M \cdot t_B \cdot d_3 \cdot \pi \cdot i}{120}$
Total of moments to override by the motor	[Nm]	$M_M = \frac{1}{\eta} (M_L + M_B)$	
Power output	[W]	$P_A = \frac{M_M \cdot n_M}{9{,}55}$	
Effective output torque of motor	[Nm]	$M_{eff} = \sqrt{\frac{\Sigma t_B (M/M_M)^2 + \Sigma t_L (M_L/M_M)^2}{\Sigma t_B + \Sigma t_L + t_0}} \cdot M_M$	



Exlar specializes in the manufacture of electric actuation solutions in addition to components. Please see Exlar's 140 page catalog containing seven product families of motors and actuators.

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