- **GENERAL PRODUCT GUIDE with sizing according to specific use.**

(*Suggested values, not "absolute", to consider with the client's own assessment of their merits for the specific project being considered.*)

To simplify and help with product selection in relation to customer's own construction requirements, we recommend quantifying certain fundamental technical data to achieve the best product sizing selection, using the following tables :

1)	**MOVEMENT SPEED/TRAVERSE SPEED PER MINUTE** (screw turns per step) **=**	**mm/minuto ....**
2)	**WEIGHT OF LOAD TO BE MOVED/TRAVERSE =**	**Kg ....**
3a)	**OBBLIQUE OR VERTICAL HANDLING/LIFTING** (with guided load)	☐ **vertical**
3b)	**HORIZONTAL HANDLING/MOVEMENT** (with guided load)	☐ **horizontal**
4)	**MAXIMUM LENGTH OF TRAVEL (STROKE) REQUIRED =**	**mm ....**

The perfect sizing selection of threaded bars with trapezoidal profiles and the relevant lead nut, used to perform linear movements **is determined by many factors**. To indicate the theoretical sizing selection method we cannot therefore simply list the calculation formulas, because when they are used individually they do not give real, practical results, leading to **optimized design and construction which are both functional and reliable throughout the working life of the mechanism concerned.**

Factors assessed in preparing the "basic theoretical table" for dynamic movement during lifting :
Speed, load, , type of movement, length of the constrained screw, thread surface engaged, need of safety lead nut, lubrification, efficiency, friction coefficient, required torque with service factor, static load in relation to dynamic load.

Considering the above-mentioned factors which determine performance, we firstly established maximum parameters in the **Basic Theoretical Table to avoid critical working situations.** These parameters concern the maximum sliding contact speed that can be applied during lifting and the maximum pressure allowed on the threaded profile, **considering that for good optimization and efficiency it is not advisable to exceed a sliding contact speed of 25 metres per minute.** By proportionately diminishing this last factor the load can be increased **to a maximum allowable pressure on the thread profile of Kg 0.8 on the first thread engaged,** on which theoretically weighs 1/3 of the entire moving load. As these are dynamic movements with scrolling screw/bronze lead nut in sliding contact, exceeding these parameters can lead to the start of possible vibrations, increasing temperatures and associated wear on the thread profile. To best solve the problem, and restrict contact speed within the above-mentioned limit in relation to the load, it is necessary to use **specific lubricating grease (see lubricants on pages 306-309) to improve sliding, considering, where higher loads are involved, using our threaded bars with nitriding treatment in R80 steel or higher quality R100 steel.**
When a greater sliding speed is absolutely necessary this can be applied but subject to specific technical tests or using our standard nylon lead nuts, always providing good lubrication, as these **allow approximately 20% more speed in relation to the value shown in the table but with 75% less load.**

On the subject of new technical solutions, Bimeccanica has developed and patented new items which can improve the performance described in the **basic table**, to an extent which is to be quantified through specific technical tests.
These new items include **supports and sleeves with bush for coupling two lead nuts,** to achieve more thread catch and to adjust axial play in horizontal movements, as well as **safety systems to avoid loads falling during lifting , with mechanical, electro-mechanical or visual control of wear.** To ensure better sliding between screw and lead nut, to be smoother and better lubricated, we have produced **"anti-dust cups" to be applied on the lead nuts** serving two purposes: to prevent dust and residue entering inside the lead nuts and to keep the lubricant constantly inside the lead nuts. These new products are already available from stock and documented in the present **Technical Catalogue GDM** as well as in **Technical Catalogue BFC, or visit our website www.bimeccanica.it**
Our company, which produces all of the items listed, is at your disposal for any further technical information you may require.

Bimeccanica, as well has having developed the new products, is now preparing a quality control room which includes specific equipment for checking theoretical data. **This allows the following basic table to be supported by in-house tests, as well as specific tests on request, including wear on the lead nuts relating to he ratio between load, speed and working time, as well as certification of the pitch tolerances detected on each individual threaded bar, which determines the quality classification.**

EXAMPLES OF CALCULATIONS USING THE FOLLOWING BASIC TABLE:

Vertical movement of a Kg 285 load at the maximum speed allowed with a Ø25 screw and a 2500 mm stroke:

- **VALUE "B" Load** indicated in the table *= 190 kg. (Ø25 screw), load to be moved 285 kg. = increase of + 50%*
- **VALUE "C" Torque** *(Nm)* indicated in the table *= 9,40 Nm + 50% (for the load increase) = 14,40 Nm (torque always proportional to the load)*
- **VALUE "A" max Speed** *in the table (Ø25 screw) screw rpm 353 - 50% (for the load increase) = 176,5 rpm (speed is inversely proportional to load)*
- **VALUES OBTAINED**: ***TR 25x2500 Screw*** - **Revs "A"** ***= 176,5 rpm*** - **Load "B"** ***= 285 Kg*** - **Torque "C"** ***= 14,10 Nm***

– (***Horizontal version)*** *with the same application, but horizontal, values* ***"A"*** *and* ***"C"*** *remain unchanged, whilst value* ***"B" of 285 kg. can be increased by approximately 400% and becomes 1,425 Kg.*** *(with load on guides and sliding blocks with ball bearings, with use assessment of inverter with slow start, acceleration and deceleration; it is without doubt also an improved system for vertical lifting).*

– (Length ***variant****) Screw length version* **"L"***exceeding* ***100xØ25 vertically considering a stroke of 3000 mm instead of 2500 mm = length increase* "L"*+20%)***
Values "A", "B" and "C" ***must be reduced by half of the value* "L" *equal to 10%*** *and therefore* **"A"*= 159 rpm* - "B"*= 256 Kg* - "C"*= 12,70 Nm.***

• • **BASIC THEORETICAL TABLE** (*Values not "ABSOLUTE" but recommended and to be taken into consideration with client's own assessment of their mer-*

Sizing with maximum values for dynamic vertical movements (when lifting) with bronze lead nut and trapezoidal screw with max. length 100 times its diameter, constrained at both ends with appropriate supports and bearings. Values valid on movements alternating with 50% stops, drive to the TR screw with gear - motor (inverter driver for heavy loads) load on guides with ball bearings sliding blocks and safety lead nuts where there is a risk of injury.

The values can be used on mechanisms where the load, as previously stated, slides on guides with ball-bearings or similar, in such a way that only the axial load weighs on the screw. The calculations are based upon a contact speed for the threaded profile of **25 metres/minute and a pressure on the first thread of 0,4 kg/mm²** (this can be increased up to 0,8 kg/mm² by proportionally decreasing the contact speed) **with good lubrication using a specific grease.** ***Exceeding these values requires specific technical tests, please contact our technical office.***

CALCULATION METHODS FOR MULTIPLE USES STARTING FROM THE VALUES IN THE "BASIC TABLE"

The calculation ratio is inversely proportional between factor "A" and factors B" and "C". *Reducing the Rotation Speed **"A"** of the trapezoidal screw as a percentage allows an increase of the same percentage of the Load **"B"** and the Torque **"C"**. Alternatively it can be used inversely, firstly increasing the Load **"B"** and the Torque **"C"** and reducing the Speed **"A"** by the same percentage.*

MEASUREMENTS WHICH NORMALLY DO NOT VARY							PROPORTIONAL DECREASING VALUES			PROPORTIONAL INCREASING VALUES			
TRAPEZOIDAL THREAD	STANDARD / NORMAL LEAD NUT LENGTH	NUMBER OF CATCHING THREADS STANDARD / NORMAL LEAD NUT	CONTACT SURFACE OF ONE THREAD ON "dm"	CONTACT SURFACE OF THE WHOLE STANARD / NORMAL LEAD NUT PROFILE ON "dm"	LINEAR CONTACT SURFACE OF THE "dm" ON ONE THREAD	η EFFICIENCY (f=0,10) with good lubrification	MAXIMUM SPEED CALCULATED ON THE LINEAR CONTACT SURFACE OF A THREAD FOR THE NUMBER OF REVOLUTIONS /MIN. ON THE BASIS OF 25 M/ MIN.		CONTACT SPEED	MAX LOAD TO BE LIFTED AT MAXIMUM SPEED (L. screw max 100 times dia. Ø)	MEAN PRESSURE DISTRIBUTED OVER LEAD NUT THREADS	PRESSURE ON THE FIRST THREAD (1/3 of the entire load)	TORQUE NECESSARY FOR LIFTING (Service factor FS 2,5)
TR x Ø x PITCH	mm	n.	mm²	mm²	mm	-	Revs./min.	mm (linear) per minute	metres minute	Kg	Kg/mm²	Kg/mm²	Nm
TR 10x2	20	10	28,3	283	28,3	0,40	883	1.766	25	30	0,11	0,36	0,60
TR 10x3	20	6,7	40	268	26,7	0,51	936	2.808	25	40	0,15	0,34	0,95
TR 12x3	22	7,3	49,5	361	33	0,46	757	2.271	25	51	0,15	0,35	1,33
TR 14x3	25	8,3	58,9	489	39,2	0,42	637	1.911	25	63	0,13	0,36	1,80
TR 14x4	25	6,3	75,4	475	37,7	0,50	663	2.652	25	76	0,16	0,34	2,43
TR 16x4	30	7,5	88	660	44	0,46	568	2.272	25	91	0,14	0,35	3,15
TR 18x4	35	8,7	100,4	873	50,2	0,43	498	1.992	25	107	0,13	0,36	3,98
TR 20x4	40	10	113	1.130	56,5	0,40	442	1.768	25	122	0,11	0,36	4,83
TR 22x5	40	8	153	1.224	61,2	0,44	408	2.040	25	162	0,14	0,36	7,40
TR 24x5	45	9	168	1.512	67,5	0,41	370	1.850	25	181	0,12	0,36	8,73
TR 25x5	45	9	177	1.593	70,7	0,40	353	1.765	25	190	0,12	0,36	9,40
TR 26x5	45	9	185	1.665	73,8	0,39	338	1.690	25	200	0,13	0,37	10,15
TR 28x5	50	10	200	2.000	80	0,37	312	1.560	25	219	0,11	0,37	11,68
TR 30x6	50	8,3	255	2.116	84,8	0,40	295	1.770	25	274	0,13	0,36	16,25
TR 32x6	50	8,3	273	2.266	91	0,39	275	1.650	25	297	0,14	0,37	18,38
TR 35x6	60	10	300	3.000	100	0,36	250	1.500	25	331	0,12	0,37	21,78
TR 36x6	60	10	312	3.120	104	0,36	240	1.440	25	343	0,11	0,37	23,00
TR 40x7	65	9,3	403	3.748	115	0,37	217	1.519	25	440	0,12	0,37	33,28
TR 45x8	80	10	516	5.160	129	0,37	194	1.552	25	564	0,11	0,37	48,20
TR 46x8	80	10	528	5.280	132	0,37	190	1.520	25	579	0,11	0,37	50,25
TR 50x8	80	10	580	5.800	145	0,35	172	1.376	25	640	0,12	0,37	58,83
TR 55x9	95	10,6	714	7.568	159	0,35	157	1.413	25	788	0,11	0,37	80,20
TR 60x9	95	10,6	784	8.310	175	0,33	143	1.287	25	874	0,11	0,37	94,60
TR 65x10	95	9,5	940	8.930	188	0,34	133	1.330	25	1.048	0,12	0,37	123,78
TR 70x10	120	12	1.020	12.240	204	0,32	123	1.230	25	1.143	0,10	0,37	142,38
TR 75x10	120	12	1.100	13.200	220	0,30	114	1.140	25	1.218	0,10	0,37	159,60
TR 80x10	120	12	1.175	14.100	235	0,29	106	1.060	25	1.333	0,10	0,38	183,28
TR 90x12	150	12,5	1.584	19.800	264	0,30	95	1.140	25	1.782	0,10	0,38	273,12
TR 100x12	150	12,5	1.770	22.125	295	0,28	85	1.020	25	2.011	0,10	0,38	335,82
							A			**B**			**C**

A = SPEED (n° screw revolutions - mm movement - metres contact)
B = LOAD during lifting with guides (weight Kg - pressure Kg/mm²)
C = TORQUE (required force Nm)

VARIATION OF VALUES "B" FOR HORIZONTAL LOAD: CAN BE INCREASED UP TO 400% WITHOUT VARIATION OF FACTORS "A" AND "C"

SELECTION OF GEARMOTOR WITH OUTPUT VALUE "C" with no variation in value **B** in horizontally value **C is reduced by 75%.** **FOR HEAVY LOADS** use a drive with **inverter.**

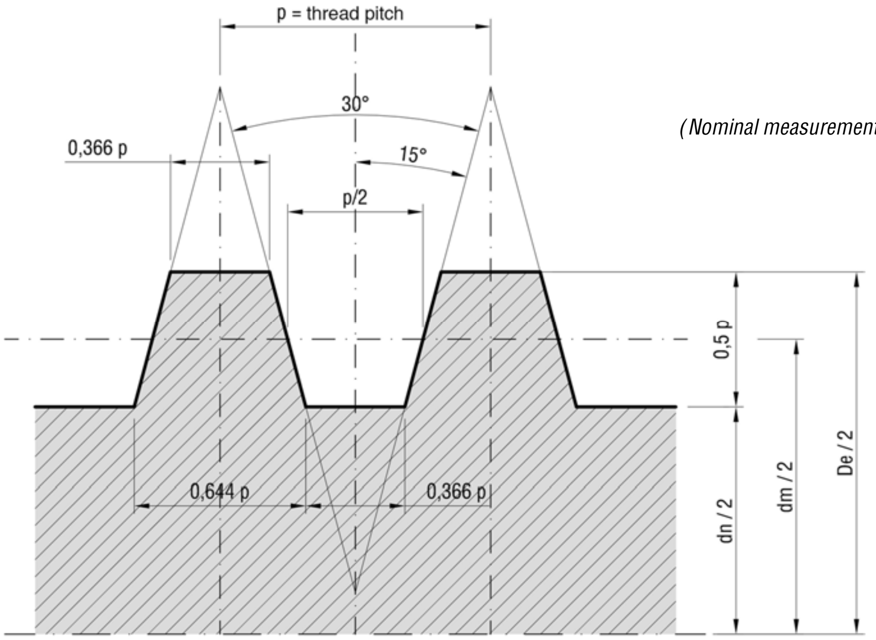
- The values listed above can be used for applications with bronze lead nuts under the above-mentioned conditions with our threaded bars for the entire range of steels types
- **For vertical/oblique lifting, with screw always constrained at both ends, we suggest using our threaded bar in R80 steel or higher quality R100 steel.**
- **Use of threaded bars with lengths 100 times diameter always constrained at both ends:**

First calculate the required values for the screw with a length of 100 times its diameter according to the basic table; access the percentage of exceeding screw length and remove half of the above-mentioned exceeding percentage from values "A","B" and "C". E.g.: if there is 50% excess screw length (over 100 times its diameter) the values "A" "B" and "C" obtained from the initial calculation are reduced by 25%.

N.B. The STATIC LOAD on the bronze lead nut is variable until it reaches the maximum values 10 times greater than the maximum DYNAMIC LOAD shown in the BASIC THEORETICAL TABLE, with the exception of peak loads that will require specific assessment according to safety regulations contained in Machinery Normatives. To reach the maximum STATIC LOADS mentioned, the threads for fitting the fixed and mobile supports must be well made from materials having a tensile strength of 50 kg/mm2, except for applications using aluminium alloy with lower loads using standard 8,8 or A2 steel bolts with the bolt thread captured equal to two times the diameter of the thread itself (example: 8mm diameter bolt needs at least 16mm of thread captured).
For greater security in preventing loosening we suggest using "Nord lock" (wedge lock) washers when mounting the bolts.

- **REFERENCE GEOMETRY: trapezoidal thread section.**

FIGURE (1) screw section



(Nominal measurements)

- **COMPRESSION RESISTANCE OF THE TRAPEZOIDAL SCREW IN RELATION TO THE TYPE OF CONSTRAINT USED.**

$$Q_{COMP} = \frac{p^2 \cdot E \cdot J}{2 \cdot \alpha^2 \cdot L^2}$$

$$L_{MAX} = \sqrt{\frac{p^2 \cdot E \cdot J}{2 \cdot \alpha^2 \cdot Q_{COMP}}}$$

Key to symbols:

Q_{COMP} = Resistance to compression bearable by the trapezoidal screw.
E = Elasticity of steel module (210.000).
J = Moment of inertia of **dn** (diameter of the screw core below the thread), obtainable with the formula: **$J = p/64 \cdot dn^4$**
α = Coefficient relative to the type of constraint (support) of the trapezoidal screw (see diagrams below).

1) **α = 0,5** for applications where the screw has axial/radial constraints. **(see image A)**
2) **α = 0,7** for applications where the screw has axial/radial constraints and radial constraints. **(see image B)**
3) **α = 1** for applications where the screw has radial constraints . **(see image C)**
4) **α = 2** for applications with cantilevered screw. **(see image D)**

L = Free length of the trapezoidal screw.
L_{MAX} = Maximum screw length in relation to the compressive load applied.

FIGURE (2) constraint conditions

Image (A) Screw with axial and radial constraints: **α = 0,5**

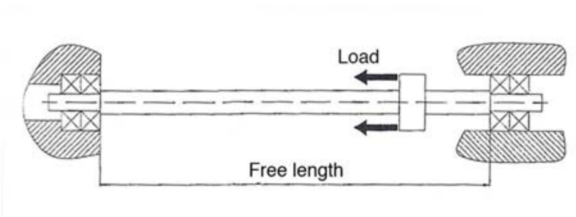


Image (B) Screw with axial/radial constraints & radial constraints: **α = 0,7**

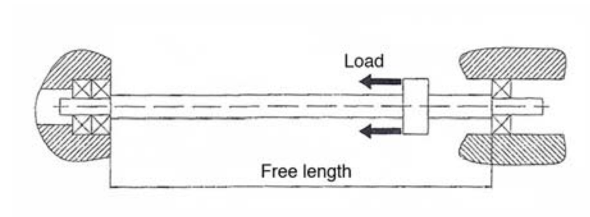


Image (C) Screw with radial constraints: **α = 1**

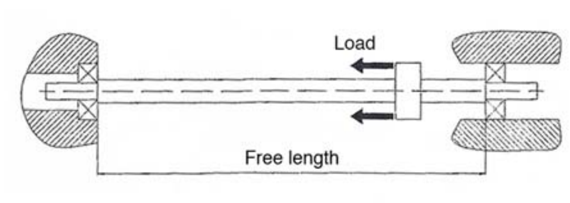
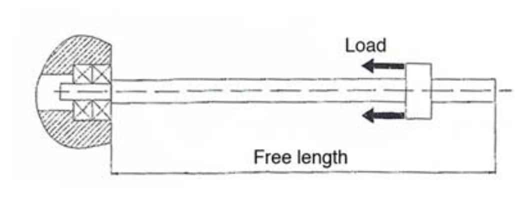


Image (D) Screw applied with cantilever constraints: **α = 2**



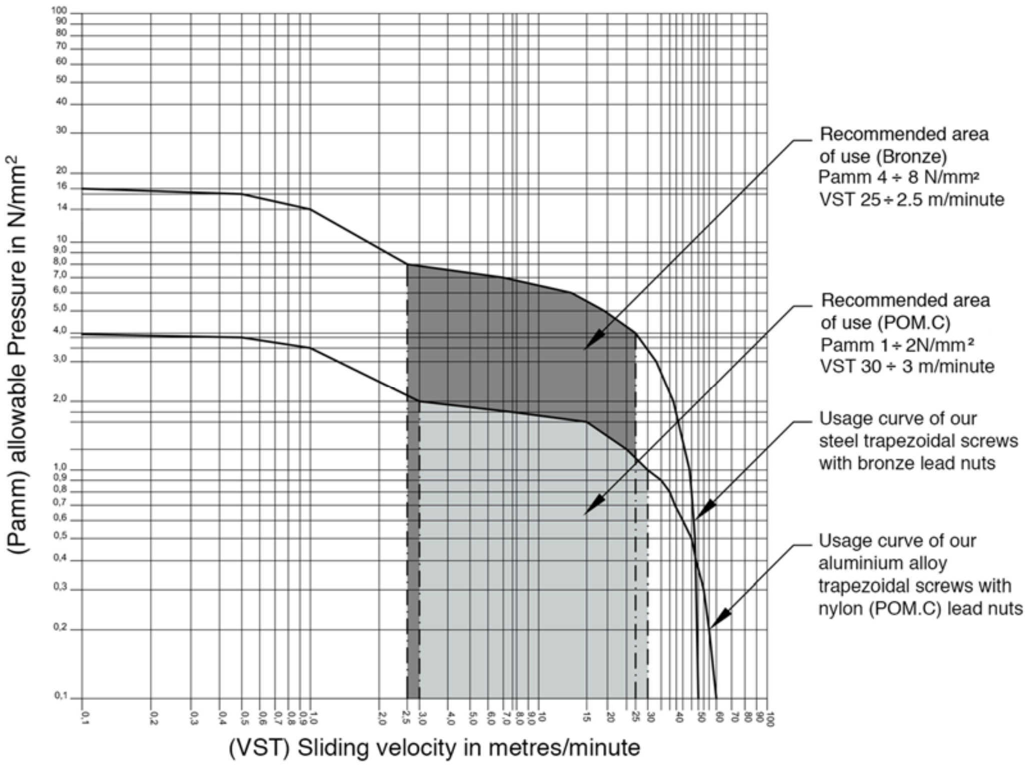
The above formula is valid **in compression** with two radial constraints or else with just one (as in **image "D"**) and in any case is not applicable for our Transmission Drive Groups (Technical *Catalogue GDM*) in such as we build them with **load axis grip** with steel supports, opposed conical wheels and stop rings for the load itself therefore, working in traction, they allow the handling of a greater load than the above calculation.

- **DYNAMIC LOAD AND MAXIMUM REVOLUTIONS**

The graph below represents the relationship between the allowable Pressure (Pamm) and the sliding Velocity **(Vst)** with the use of:

A) Steel screw and bronze lead nut (B12 UNI) with good lubrification. B) Aluminium alloy screw and nylon lead nut (POM.C) with good lubrification.

FIGURE (3)



Key to symbols:

$\mathbf{V_{ST}}$ = Sliding velocity between screw and lead nut.
dm = Average diameter of threaded screw and lead nut.
Rpm = Number of turns made by the trapezoidal screw.

$$V_{ST} = \frac{p \cdot dm \cdot Rpm}{1000}$$

$$Rpm = \frac{Vst \cdot 1000}{p \cdot dm}$$

$\mathbf{L_{CF}}$ = Critical flexural length.
De = Nominal diameter of trapezoidal screw.

1) **ß = 100** for use where the screw has axial/radial constraints **(image A)**
2) **ß = 70** for use where the screw has axial/radial and radial constraints **(image B)**
3) **ß = 44** for use with radial constraints **(image C)**
4) **ß = 16** for use with cantilever constraints **(image D)**

$\mathbf{Rpm_{MAX}}$ = max turns utilisable in relation to the critical flexural length (L_{CF}).
+L% = Excess difference between critical flexural length (L_{cf}) and free length (L), expressed as a percentage.

$$L_{CF} = De \cdot ß$$

$$Rpm_{MAX} = Rpm \cdot \left(\frac{100 - \frac{+L\%}{2}}{100} \right)$$

$\mathbf{Q_{DIN}}$ = Movable dynamic load using screw and nut/lead nut.
Asf = Contact area of the thread shoulder = **[(De/2)²·p] - [(dn/2)²·p]**
$\mathbf{P_{AMM}}$ = Allowable pressure on the contact surface of the thread.

$$Q_{DIN} = Asf \cdot P_{AMM} \cdot 3$$

η = Efficiency between the screw and nut/lead nut.
Tgα = Tangent of α in relation to the helix of the thread.
f = Friction coefficient between screw and nut/lead nut.
M = Torque required (twisting moment) to the screw/lead nut to move the load.
Fa = Thrust forces.
p = Trapezoidal screw thread pitch.
$\mathbf{P_{AZ}}$ = Drive power required (in Kw) in relation to torque (M).
Rpm = Number of turns made by the trapezoidal screw.
9,55 = Conversion factor.

$$\eta = \frac{1 - f \cdot Tg\alpha}{1 + \frac{f}{Tg\alpha}}$$

$$M = \frac{Fa \cdot p}{2p \cdot \eta \cdot 1000}$$

$$P_{AZ} = \frac{M \cdot Rpm}{9,55}$$