ROLLED TRAPEZOIDAL SCREWS

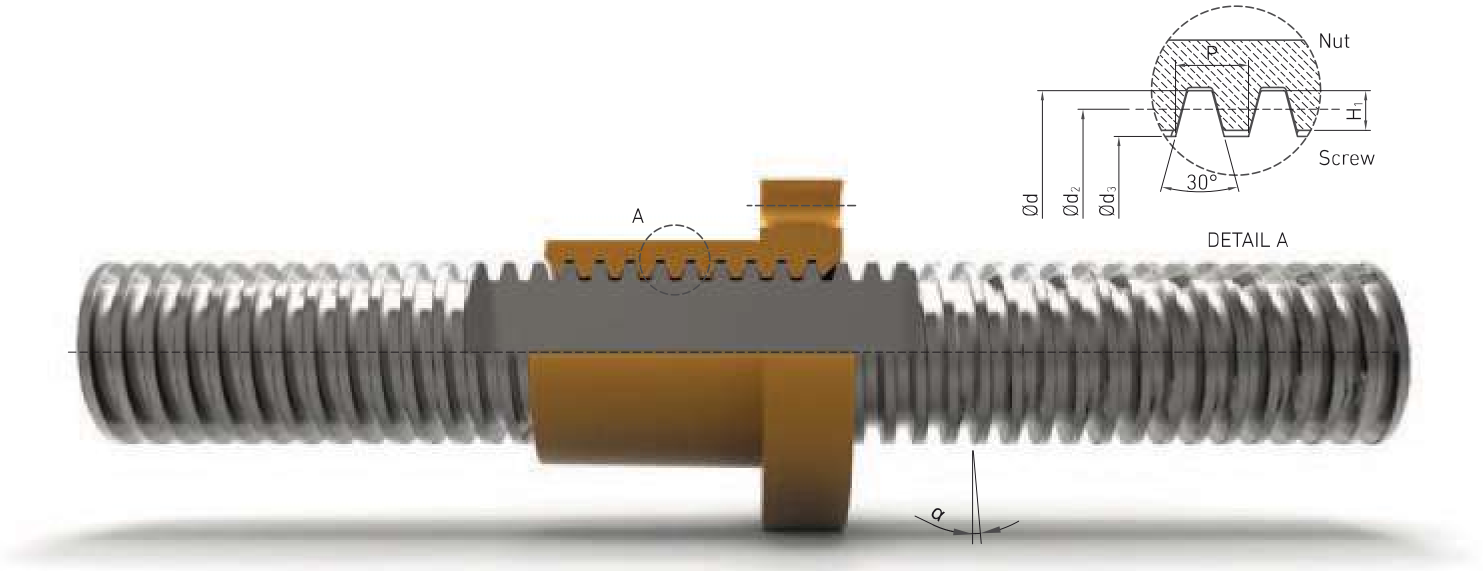
NIASA trapezoidal screws are usually obtained using a cold deformation lamination process, in which the fires on the teeth are shaped without cutting. Against others obtained by machining with stock removal, they have the following advantages:

- High resistance to fatigue.
- Higher resistance to wear.
- More polished thread flanks.
- Higher resistance to corrosion.
- More precise profile.

NIASA manufactures screws with their sides machined according to your requirements. Please also ask if any thermal treatment is required.

The maximum standard length is 3,000 mm and its precision is 100 µm/300 mm; for higher values, please contact NIASA. Out of stock NIASA has many other screw diameters/pitches, also with left thread, and also in other materials (AISI 304, AISI 316, etc). Nuts can also be supplied in plastic materials, with threaded body, etc.

Standard Material	Approx. surface hardness
1.0401 (C15 SH) / F1110	500 Brinell



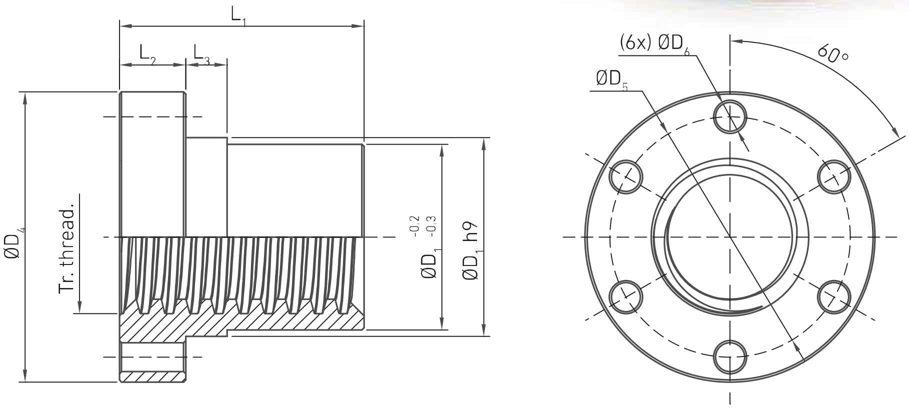
Ext. diam. (mm) x Pitch (mm)	d_o (mm)	$d_{2,min}$ (mm)	$d_{2,max}$ (mm)	d_3	H_1	Thread angle α[1]	Performance η[2]	Weight (kg/m)	Inertia moment (mm^4)	Module section (cm^3)	Mass inertia moment J_{rot} $(kg.m^2/m)$
Tr 16x4	16	13,640	13,905	10,80	2	5°11'	0,46	1,21	0,067	0,124	$2,96\cdot10^{-5}$
Tr 18x4	18	15,640	15,905	12,80	2	4°32'	0,43	1,58	0,132	0,206	$5,05\cdot10^{-5}$
Tr 20x4	20	17,640	17,905	14,80	2	4°2'	0,40	2,00	0,236	0,318	$8,10\cdot10^{-5}$
Tr 22x5	22	19,114	19,394	15,50	2.5	4°39'	0,43	2,34	0,283	0,366	$1,11\cdot10^{-4}$
Tr 24x5	24	21,094	21,394	17,50	2.5	4°14'	0,41	2,85	0,460	0,526	$1,65\cdot10^{-4}$
Tr 26x5	26	23,094	23,394	19,50	2.5	3°52'	0,39	3,40	0,710	0,728	$2,35\cdot10^{-4}$
Tr 28x5	28	25,094	25,394	21,50	2.5	3°34'	0,37	4,01	1,050	0,976	$3,26\cdot10^{-4}$
Tr 30x6	30	26,547	26,882	21,90	3	4°2'	0,40	4,50	1,130	1,030	$4,10\cdot10^{-4}$
Tr 32x6	32	28,547	28,882	23,90	3	3°46'	0,38	5,19	1,600	1,340	$5,45\cdot10^{-4}$
Tr 36x6	36	32,547	32,882	27,90	3	3°18'	0,35	6,71	2,970	2,130	$9,10\cdot10^{-4}$
Tr 40x7	40	36,020	36,375	30,50	3.5	3°29'	0,37	8,21	4,250	2,790	$1,37\cdot10^{-3}$
Tr 44x7	44	40,020	40,275	34,50	3.5	3°8'	0,34	10,10	6,950	4,030	$2,10\cdot10^{-3}$
Tr 48x8	48	43,468	43,868	37,80	4	3°18'	0,35	12,00	10,000	5,300	$2,90\cdot10^{-3}$
Tr 50x8	50	45,468	45,868	39,30	4	3°10'	0,34	13,10	11,700	5,960	$3,40\cdot10^{-3}$
Tr 60x9	60	54,935	55,360	48,15	4.5	2°57'	0,33	19,00	26,400	11,000	$7,30\cdot10^{-3}$
Tr 70x10	70	64,425	64,850	57,00	5	2°48'	0,32	26,00	51,800	18,200	$1,40\cdot10^{-2}$
Tr 80x10	80	74,425	74,850	67,00	5	2°25'	0,29	34,70	98,900	29,500	$2,40\cdot10^{-2}$

[1] Pitch angle on the pitch diameter.

[2] Theoretical efficiency on transforming a turning movement into an axial transfer of the screw, with friction coefficient μ = 0.1. For other cases, contact the corresponding calculation section.

BRONZE NUT WITH EFM FLANGE

Out of stock NIASA has many other screw diameters/pitches, also with left thread, and also in other materials (AISI 304, AISI 316, etc). Nuts can also be supplied in plastic materials, with threaded body, etc.



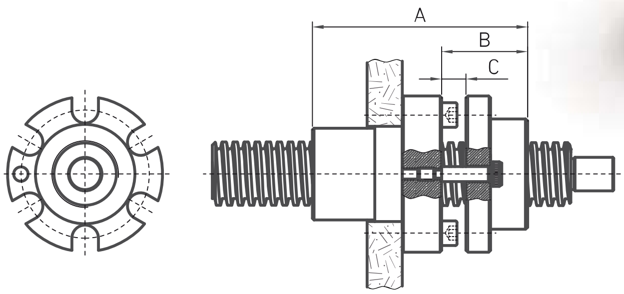
Standard Material	Elastic limit 0.2% $R_{p0.2}$ (N/mm²)	Min. resistance to breakage R_m (N/mm²)	Elongation to breakage A5 min.	Approx. (HB 10/1000)	Density (kg/dm³)	Module of elasticity (N/mm²)	Max. cinematic pressure Pc (N/mm².m/min)
G-CuSn 12 (G Bz 12)	150	280-350	5%	100-110	8.8	90000	400

For screw	D_1 (mm)	D_4 (mm)	D_5 (mm)	D_6 (mm)	L_1	L_2	L_3	Weight (kg)	Surface support A_s (mm²)
Tr 16x4	28	48	38	6	44	12	8	0,25	670
Tr 18x4	28	48	38	6	44	12	8	0,25	770
Tr 20x4	32	55	45	7	44	12	8	0,30	870
Tr 24x5	32	55	45	7	44	12	8	0,30	1040
Tr 30x6	38	62	50	7	46	14	8	0,40	1370
Tr 36x6	45	70	58	7	59	16	10	0,60	2140
Tr 40x7	63	95	78	9	73	16	10	1,70	2930
Tr 50x8	72	110	90	11	97	18	10	2,60	4900
Tr 60x9	85	125	105	11	99	20	10	3,70	6040
Tr 70x10	95	180	140	17	100	30	16	7,80	8250
Tr 80x10	105	190	150	17	110	30	16	8,90	10890

BRONZE SAFETY NUT WITH EFMS FLANGE

Nut applicable to R Series screw jacks and SH screw supports. The same standard material as the EFM type flange.

	A	B	C	Guide screw ISO 7379
Tr 18 x 4	69	25	8	M5
Tr 20 x 4	69	25	8	M5
Tr 30 x 6	78	32	10	M5
Tr 36 x 6	94	35	10	M5
Tr 40 x 7	108	35	10	M6
Tr 50 x 8	132	35	10	M8
Tr 55 x 9	132	35	10	M8
Tr 60 x 9	144	45	15	M8
Tr 70 x 10	155	55	15	M10



LRM TYPE CYLINDRICAL BRONZE NUT

Tr TRAPEZ.

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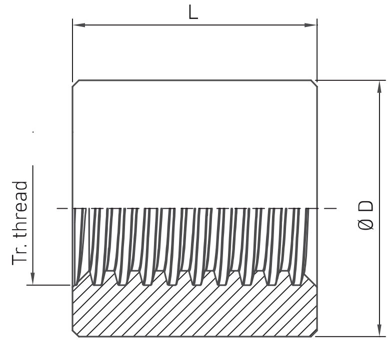


Standard Material	**Elastic limit 0.2%** $R_{p0.2}$ (N/mm^2)	**Min. resistance to breakage** R_m (N/mm^2)	**Elongation to breakage** A5 min.	**Approx.** (HB 10/1000)	**Density** (kg/dm^3)	**Module of elasticity** (N/mm^2)	**Max. cinematic pressure** Pc (N/mm^2.m/min)
G-CuSn 12 (G bz 12)	150	280-350	5%	100-110	8.8	90000	400

For screw	Ø D (mm)	L (mm)	Weight (kg)	Support surface A_s (mm^2)
Tr 16x4	36	32	0.25	490
Tr 18x4	40	36	0.34	630
Tr 20x4	45	40	0.48	790
Tr 22x5	45	40	0.46	850
Tr 24x5	50	48	0.69	1130
Tr 26x5	50	48	0.58	1240
Tr 28x5	60	60	1.2	1680
Tr 30x6	60	60	1.2	1780
Tr 32x6	60	60	1.2	1910
Tr 36x6	75	72	2.2	2610
Tr 40x7	80	80	2.8	3210
Tr 44x7	80	80	2.6	3560
Tr 48x8	90	100	4.3	4840
Tr 50x8	90	100	4.2	5060
Tr 60x9	100	120	5.7	7320
Tr 70x10	110	140	7.6	10000
Tr 80x10	120	160	9.7	13200

TRAPEZOIDAL SCREWS
TECHNICAL SPECIFICATIONS

PARTS

The systems with trapezoidal screws are made up of simply the screw itself and a nut that moves along it.

These systems are less sensitive to the input of dirtiness than those based on ball bearings. Therefore they usually do not include protectors on the sides of the nut, except in the case of very high turning speeds. Please contact NIASA if this is the case.

EFFICIENCY

The efficiency of the trapezoidal screws basically depends on the geometry of the screw (diameter and pitch) and the friction coefficient between the screw and the nut. It is therefore essential that the lubrication conditions are those indicated so that the losses due to friction do not surpass the established values.

For the most usual sizes and with standard lubrication conditions, in general, the efficiency of these types of systems is 30% to 40%.

SPEED

The turning speed of a trapezoidal screw is limited in its maximum value by the lower of the following:

... Critical resonance speed of the column.

... Critical velocity of the nut/screw to avoid premature wear on the nut. This depends on the specifications of the materials of both elements, on the contact surface between them and the load applied.

REVERSIBILITY

Opposite to what happens with ball screws, the trapezoidal screws are not always reversible. Only those with a helix angle with a larger thread than the friction angle are reversible (or not self-locking). The efficiency for converting axial force on the screw on turning torque is always less than that corresponding to the transformation of the turning torque on axial force.

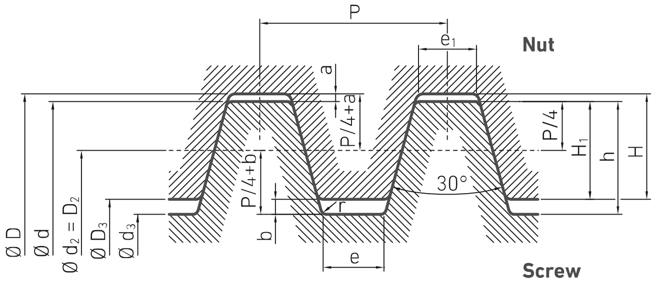
However, especially on vertical assemblies, it is in any case advisable to incorporate motors with brakes that avoid small movements in the case of vibrations and that stop the movement without excessive slipping from the inertia of the set.

ASSEMBLY POSITION

The screw can be mounted in any position, paying special care to the possible lateral loads that are not supported by the screw, but by guide systems designed for this purpose.

THREAD PROFILE

NIASA screws and nuts have metric ISO trapezoidal thread according to DIN 103 (screw tolerance: 7e on the flanks and 4h on the exterior diameter; nut tolerance: 7H).



Pitch (mm)	**2**	**3 - 4**	**5 - 12**	**13 - 26**
a and **r** (mm)	0,5	0,25		0,5
b (mm)	0,3	0,5	0,75	1,5

$$\mathbf{H_1} = \frac{\mathbf{P}}{\mathbf{2}}$$

$$\mathbf{h} = H1 + b = \frac{\mathbf{P}}{\mathbf{2}} + \mathbf{b}$$

$$\mathbf{H} = H1 + a = \frac{\mathbf{P}}{\mathbf{2}} + \mathbf{a}$$

$$\mathbf{D = d + 2a}$$

$$\mathbf{d_3} = d - 2h = \mathbf{d - (P + 2b)}$$

$$\mathbf{D_3} = D - 2H = \mathbf{D - (P + 2a)}$$

$$\mathbf{d_2} = \mathbf{D_2} = d - 2\frac{P}{\mathbf{4}} = \mathbf{d} - \frac{\mathbf{P}}{\mathbf{2}}$$

$$\mathbf{e} = \mathbf{e_1} = 0{,}634P - 0{,}536h$$

SERVICE TEMPERATURE

The maximum admissible working ambient temperature depends on the friction conditions between the nut and the screw. That is, the materials of both and the lubrication conditions.

In general, it is recommended not to operate in environments with temperatures over 100°C. Please contact NIASA about this.

PRECISION AND STRAIGHTNESS.

The usual precision of NIASA trapezoidal screws varies according to their nominal diameter and the thread pitch, which is usually 100 µm for each 300 mm of length.

LUBRICATION

The greases recommended for the trapezoidal screws and nuts are the same as the usual greases for roller bearings. Oils are not normally used.

Before greasing, perfectly clean the surface of the screw to leave it free from any kind of impurity. The time between two consecutive greasings depends on the application conditions (temperature, velocity and load).

STORAGE AND INSTALLATION

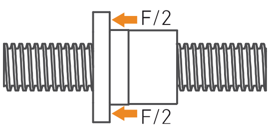
As standard, trapezoidal screws are supplied by NIASA lightly lubricated and protected with a completely sealed plastic film.

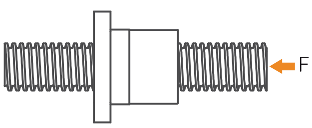
As they are precision elements, they must be handled with great care and stored in clean and dry places, supported on several points along their length and in their original packaging until the time they are installed.

When transporting the trapezoidal screws to their final destination, sharp movements and positions with false supports must be avoided, which may cause deformations due to flexion under their own weight.

The housings for the assembly of the nuts, or any other element (rollers, bearings, etc.) must be perfectly free from dust, paint or any other impurity. It is essential that the screws are assembled with roller, bearing, etc. supports perfectly perpendicular and aligned between each other.

Finally, apply the loads in the most central and uniform manner as possible on the screw or nut. If lateral loads need to be applied, please contact the NIASA technical department.





TRAPEZOIDAL SCREWS
CALCULATIONS

NUT AND SCREW SIZE PRE-SELECTION

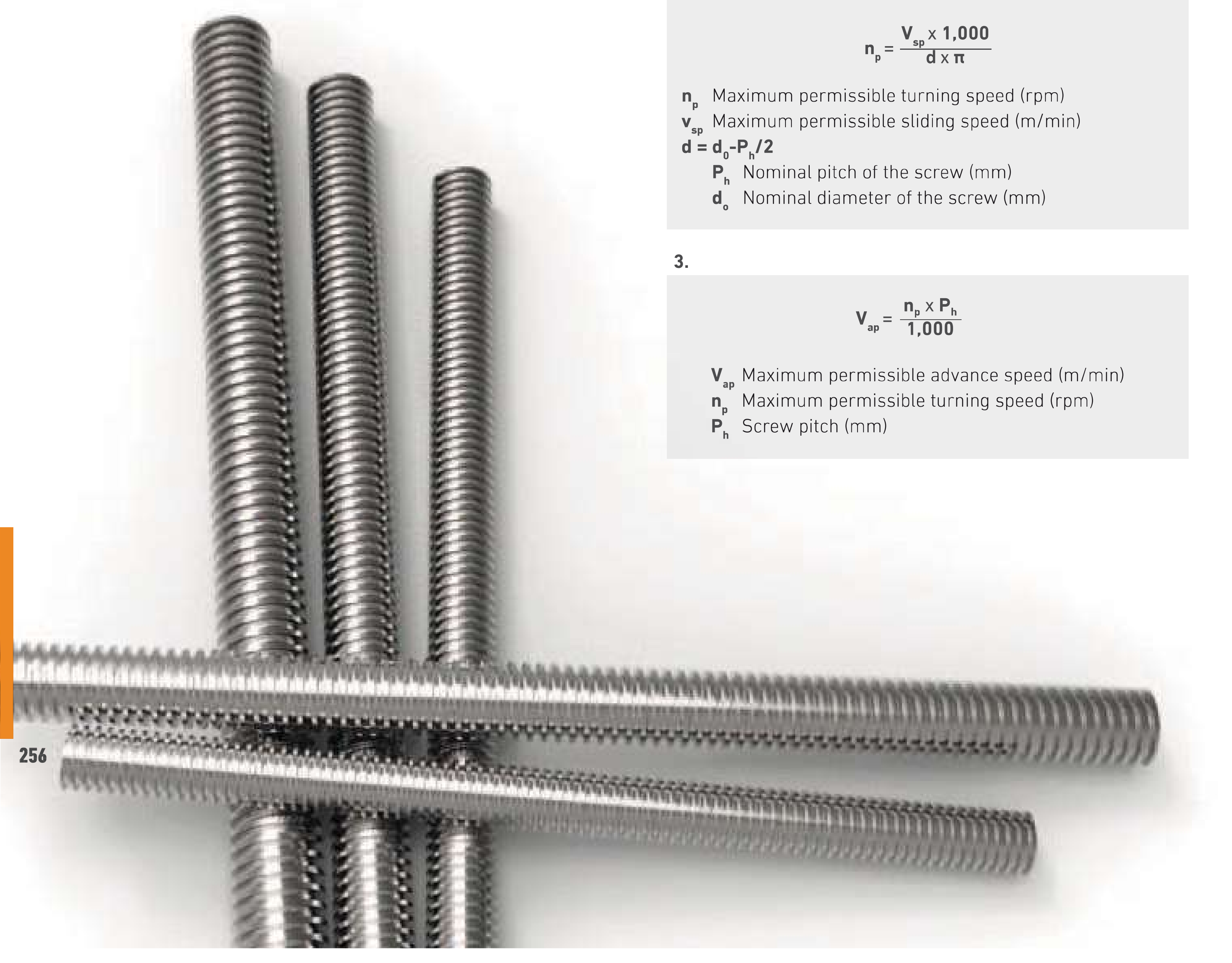
Calculation process:

1.

$$A_s = \frac{F}{P_p}$$

A_s Support area required (mm^2)
F Force applied (N)
P_p Maximum permissible pressure (5 N/mm^2, for sets with movement)

2. Select a nut size with an "A_s" higher than that calculated.



MAXIMUM ADVANCE SPEED

Calculation process:

1.

$$V_{sp} = \frac{P_c}{P_p}$$

v_{sp} Maximum permissible sliding speed (m/min)
P_c Cinematic precision ($N/mm^2.m/min$). See table
P_p Maximum permissible pressure (5 N/mm^2)

Material	P_c ($N/mm^2.m/min$)
G-CuSn 7 ZnPb (Rg 7)	300
G-CuSn 12 (G Bz 12)	400

2.

$$n_p = \frac{V_{sp} \times 1{,}000}{d \times \pi}$$

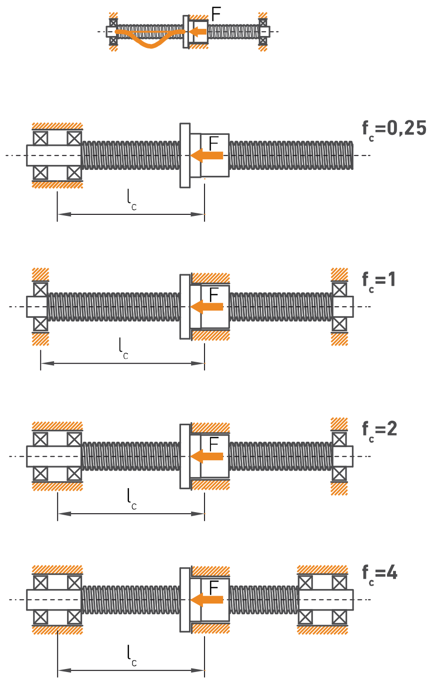
n_p Maximum permissible turning speed (rpm)
v_{sp} Maximum permissible sliding speed (m/min)
$d = d_0 - P_h/2$
P_h Nominal pitch of the screw (mm)
d_o Nominal diameter of the screw (mm)

3.

$$V_{ap} = \frac{n_p \times P_h}{1{,}000}$$

V_{ap} Maximum permissible advance speed (m/min)
n_p Maximum permissible turning speed (rpm)
P_h Screw pitch (mm)

BUCKLING CRITICAL LOAD

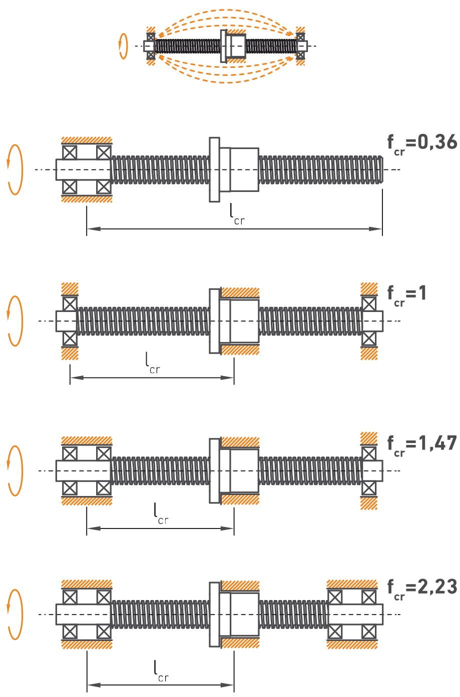


$$F \leq 0.8 \times f_c \times \frac{101.7 \times d_3^4}{l_c^2}$$

With safety factor: 1.25

- **F** Force applied (kN)
- **f_c** Correction factor, depending on the type of support on the sides of the screw. See figures
- **d_3** Screw core diameter (mm)
- **l_c** Buckling length (mm). See figures

RESONANCE CRITICAL SPEED



$$n \leq 0.8 \times f_{cr} \times \frac{1.2 \times 10^8 \times d_3}{l_{cr}^2}$$

With safety factor: 1.25

- **n** Application speed (rpm)
- **f_{cr}** Correction factor, depending on the type of support on the sides of the screw. See figures
- **d_3** Screw core diameter (mm)
- **l_{cr}** Resonance length (mm). See figures

SERVICE TIME

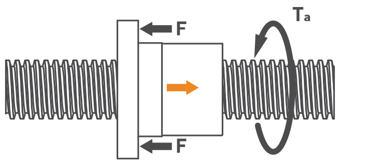
Periodically check the axial clearance between the screw and the nut. On screws with single-input threads, the nut must be replaced before the value of this set surpasses 25%of the pitch.

NIASA has tools that help manual measurement of the axial clearance, including automatic detection systems.

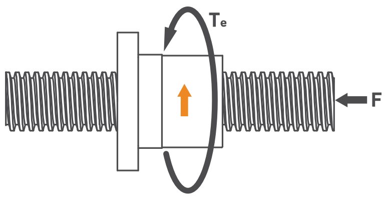
TRAPEZOIDAL SCREWS

CALCULATIONS

PERFORMANCE (EFFICIENCY)



$$\eta = \frac{\tan \alpha}{\tan (\alpha + \rho')}$$



$$\eta' = \frac{\tan (\alpha - \rho')}{\tan \alpha} = 0.7 \times \eta$$

η Performance when turning torque is converted into axial load on the screw

η' Performance when axial load is converted into turning torque on the screw

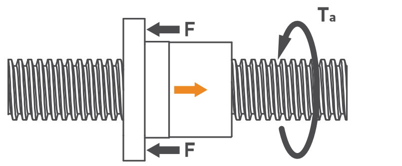
$\alpha = \text{atan}\,[P_h/(d_2 \cdot \pi)]$

- P_h Nominal pitch of the screw. See screw data table
- d_2 Diameter pitch of the screw (mm). See data table screw

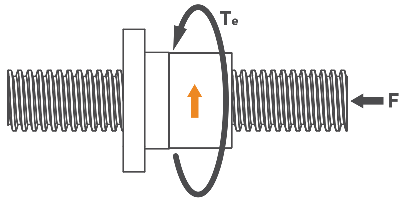
ρ' Friction angle (for ISO trapezoidal thread):
$\rho' = \text{atan}\,(\mu \times 1.07)$

μ Friction coefficient for bronze nuts			
On start-up		In movement	
Dry		Lubricated	
0.3	0.1	0.1	0.04

DRIVE TORQUE AND RETENTION



$$T_a = \frac{F \times P_h}{2 \times \pi \times \eta}$$



$$T_e = \frac{F \times P_h \times \eta'}{2 \times \pi}$$

T_a Drive torque(Nm) when turning torque is converted into axial load on the screw

T_e Retention torque (Nm) when axial load is converted into turning torque on the screw

F Force applied (kN)

P_h Nominal pitch of the screw

η Performance when turning torque is converted into axial load on the screw

η' Performance when axial load is converted into turning torque on the screw

Add to the above the torque required for the acceleration/deceleration of the set if the acceleration/deceleration values are important (applications with high speeds that change in short times).

$$T_{rot} = J_{rot} \times \alpha_0$$

T_{rot} Acceleration/deceleration torque (Nm)

J_{rot} Screw rotation inertia moment (kgm^2)

α_0 Angular acceleration (s^{-2})

DRIVE POWER

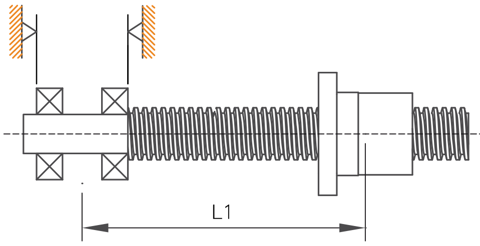
$$P_a = \frac{T_a \times n}{9550}$$

P_a Drive power (kW)
T_a Drive torque (Nm)
n Application speed (rpm)

Please contact the NIASA technical department for detailed motor sizing (motor/brake).

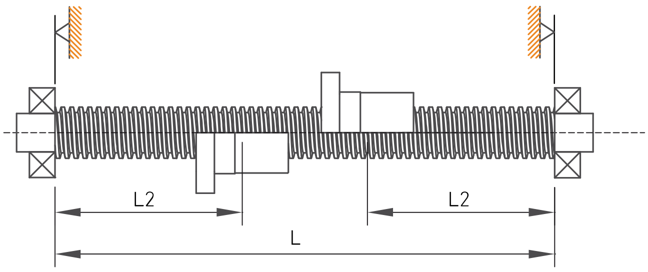
RIGIDITY

Support bearings on one end



$$R_{S1} = \frac{\pi \times d_3^2 \times E}{4 \times L_1 \times 10^6}$$

Support bearings on both sides



$$R_{S2} = \frac{\pi \times d_3^2 \times E}{4 \times L_2 \times 10^6} \times \frac{L}{L - L_2}$$

R_{s1} Axial rigidity of the screw (kN/μm), with bearings fixed on one end
R_{s2} Axial rigidity of the screw (kN/μm), with bearings on both sides
d_3 Screw core diameter (mm)
E Steel elastic module (210,000 N/mm^2)
L / L1 / L2 Length (mm), according to figures. Always take $L_2 \leq L/2$; R_{s2} as minimum when L2=L/2

$$\frac{1}{R_{tot}} = \frac{1}{R_S} + \frac{1}{R_{nu,ar}}$$

R_{tot} Axial rigidity of the screw+nut (kN/μm)
R_s Axial rigidity of the screw (kN/μm)
$R_{nu,r}$ Axial rigidity of the nut (kN/μm). Ask NIASA for their values

The deformations of the nuts are small as they are very compact elements, often negligible against deformations of the screws.