PLANETARY ROLLER SCREW

SPIRACON™

POWER JACKS

www.powerjacks.com

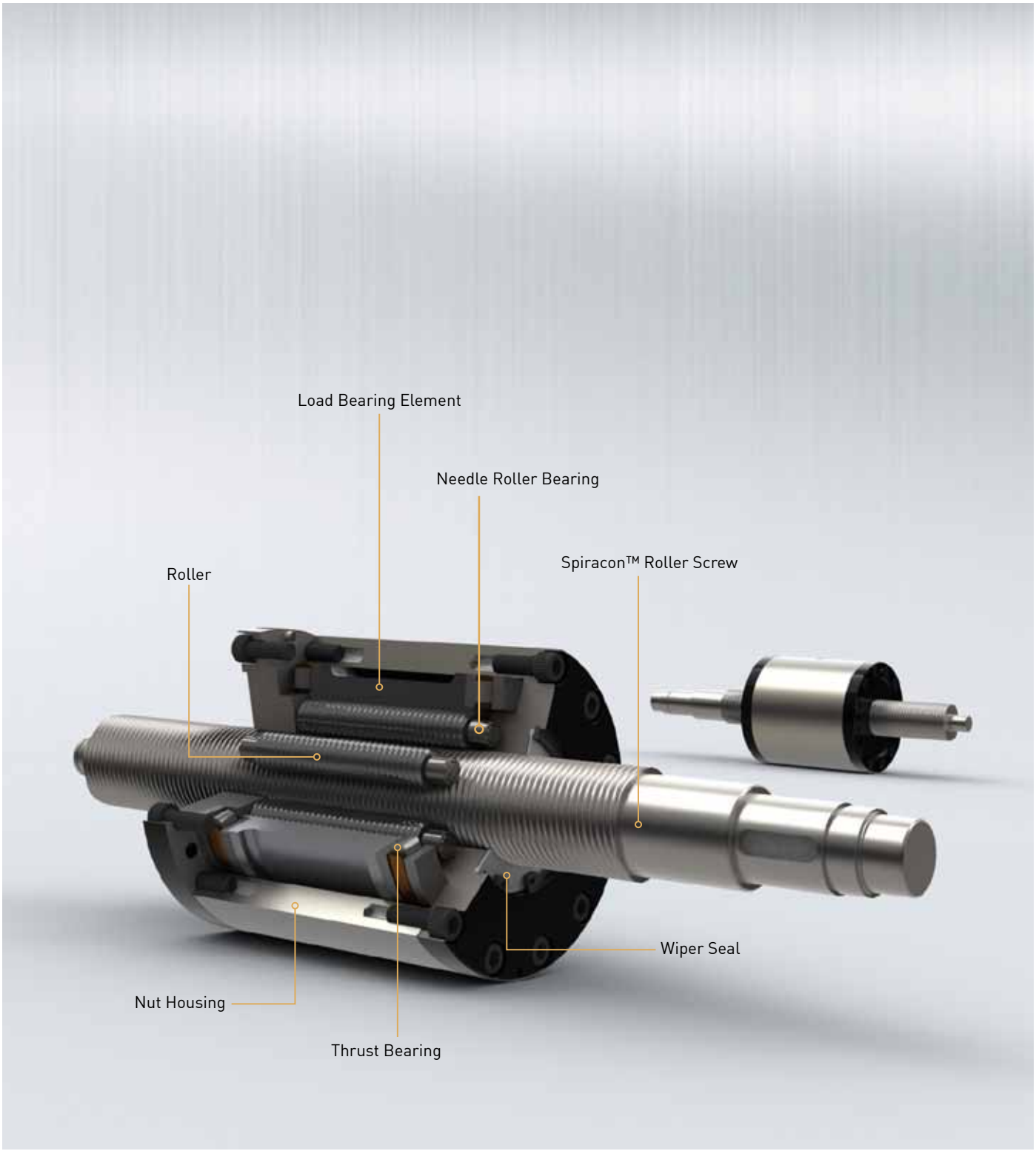
Contents

1. Spiracon™ Roller Screw Overview

Go beyond the performance of ball screw with our high performance Spiracon™ Planetary Roller Screw. It's a unique design to meet unique needs for linear motion applications.

Principle of Operation

The Spiracon™ system consists of a multi-start screw with an involute thread form and a number of planetary rollers with annular grooves, which engage with the screw. These rollers also engage with a grooved load bearing element, which transmits the load through roller thrust bearings, to the nut housing. The rolling action results in a high efficiency mechanism, while the line contact and hardened and ground construction achieves a high dynamic load carrying capacity, together with almost no axial backlash or wear.

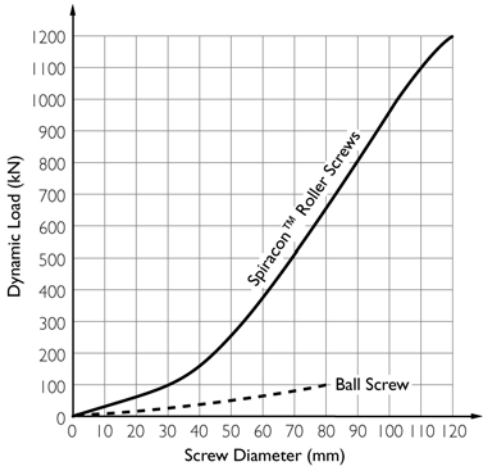


Main Features of Spiracon™ Roller Screws

- High dynamic load capacity
- High efficiency
- High positional accuracy
- Long life and low maintenance
- Same nut fits both right and left handed screws
- Hardened and ground rolling elements
- Clean operation
- Low noise

Advantage over Ball Screws

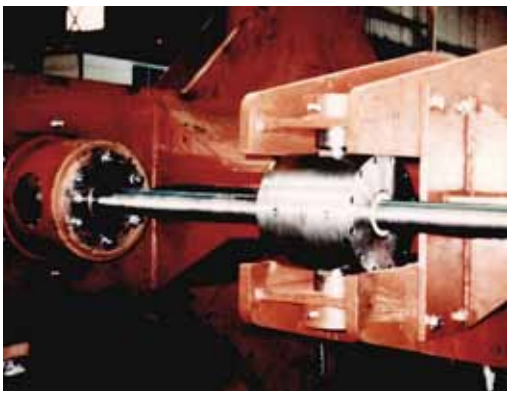
- Higher dynamic load capacity
- Larger diameters and higher leads
- Higher positional accuracy
- Longer life
- Higher stiffness
- Higher speed and acceleration
- Low temperature operation
- Lower noise
- Nut easily removed with rollers retained
- Higher safety.



Applications for Spiracon™ Roller Screws

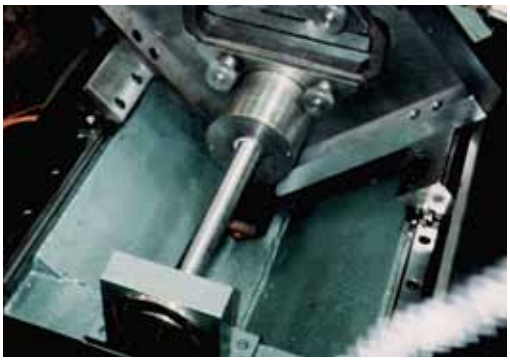
Spiracon™ roller screws are well proven throughout the world in a wide variety of industries including:

- Nuclear
- Aerospace
- Metal processing
- Medical
- Automotive
- Food Processing
- Paper
- Offshore and marine
- Communications
- Defence



Typical applications include:

- Robotics
- Laser tracking
- Indexing/adjusting
- Simulators
- Seismic testing
- Shield door adjustment
- Machine Tools
- Antenna dish adjustment
- Clamping mechanisms
- Medical scanners
- Continuous casting



2. Applications for Spiracon™ Roller Screws

Application

Anti-sway mechanism on ship-to-shore container cranes in Hong Kong.

Linear Actuation Requirements

All 4 screws and nuts required to be synchronised. High loads and an aggressive marine environment were also factors.

Solution

Four model 65 mm Spiracon™ roller screws (2 left hand and 2 right hand) with associated bevel gearboxes, couplings and shafting, per crane.

Application

Clamping machine for reclamation of steel rolls.

Linear Actuation Requirements

High dynamic load requirement, reliability of operation and a demanding operating environment.

Solution

Model 75 mm Spiracon™ roller screw operating a vertical clamp, to hold steel rolls in position.

Application

Flying shear for cutting to length pre-formed steel sheets.

Linear Actuation Requirements

The shear required to be operated continuously and accurate repeatability of positioning was important. Long life and low maintenance were necessary.

Solution

Model 55 mm Spiracon™ roller screw operating on a continuous reversal basis.

Application

Road bridge inspection and maintenance platforms.

Linear Actuation Requirements

Safety was the overriding requirement, as human cargo was involved. The units would be subjected to high load requirements and hostile weather conditions.

Solution

Two 15 tonne platforms, raised and lowered by model 75 mm Spiracon™ roller screws, fitted with disk brakes and mechanical stops as safety features.

3. Spiracon™ Roller Screw Product Code

The product code is of the following form:

1				2				3			4		5			6					7					8		9
			-				-			-		-			-					-				-		-	

(1) Product

SPT - Spiracon™ Screw and Nut.
SPS - Spiracon™ Screw only.
SPM - Spiracon™ Nut only.

(2) Model

A 3 figure code taken from the Technical Chart (Page 14).

(3) Lead

A 2 figure code taken from the Technical Chart (Page 14).

(4) Pitch

A 1 figure code taken from the Technical Chart (Page 14).

(5) Direction of Thread

RH - Right Hand
LH - Left Hand.

(6) Overall Screw Length

A 4 figure code to represent the overall screw length in mm.

(7) Screw Threaded Length

A 4 figure code to represent the threaded length of the screw in mm ie stroke (travel) + B (nut length) + overtravel at each end.

(8) Number of Siracon™ Nuts

A 1 figure code to represent the number of nuts required.

(9) Nut Mounting Holes

O - Standard Mounting Holes
S - To Customer Drawing

Example Part Number

1				2				3			4		5			6					7					8		9
S	P	T	-	0	6	5	-	3	6	-	6	-	R	H	-	1	5	4	0	-	1	4	5	0	-	1	-	0

(1) Spiracon™ Screw and Nut
(2) Model 65
(3) 36 mm Lead
(4) 6 mm Pitch
(5) Right Hand Thread
(6) 1540 mm Overall Screw Length
(7) 1450 mm Screw Threaded Length
(8) 1 Spiracon™ Nut
(9) Standard Nut Mounting Holes

Notes:

1. In all cases, the customer should supply a detailed drawing, indicating the screw end matching details.
2. The above part number defines a standard catalogue unit. Where a standard unit does not meet the customer's requirement, PowerJacks will be pleased to design a special unit.
3. All goods are sold subject to our Standard Conditions of Sale, a copy of which is available upon request.

4. Spiracon™ Roller Screw Range

There are 10 standard Spiracon™ roller screw models, with diameters from 15 mm to 120 mm, each with a choice of up to 3 leads. Dynamic load capacities of over 1000 kN (100 tonnes) and linear speeds of over 30 m/min are possible.

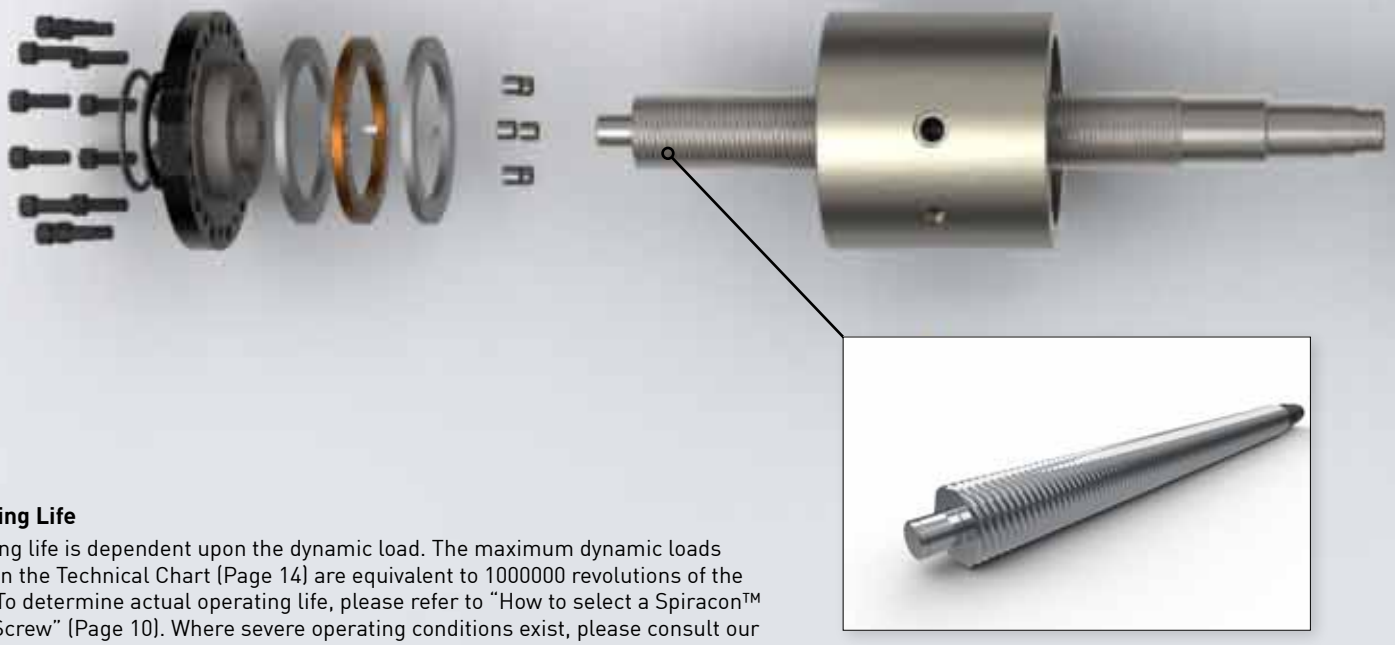
Where the standard range does not meet the application specification, special roller screws can be designed to meet customers' specific requirements (Page 9).

Efficiency

The Spiracon™ roller screw has an efficiency of typically 85%. Power consumption is therefore minimised, and a compact screw system is possible. Such a high efficiency means that the screw is not self-sustaining, and a braking system is needed to prevent back driving.

Tolerancing

The highly accurate machining and assembly of each roller screw means total axial play of less than 0.01mm can be achieved. The cumulative pitch error in the screw is typically less than 0.005 mm per 300 mm. Combined with a high stiffness, this means that accurate and repeatable positioning is possible. The screw straightness is within 0.1 : 1000.



Operating Life

Operating life is dependent upon the dynamic load. The maximum dynamic loads shown in the Technical Chart (Page 14) are equivalent to 1000000 revolutions of the screw. To determine actual operating life, please refer to "How to select a Spiracon™ Roller Screw" (Page 10). Where severe operating conditions exist, please consult our Technical Sales Department.

Guiding the Load

Loads should be guided, to remove any possible side load from the Spiracon™ nut. The guide system will also resist the torque developed by the roller screw mechanism.

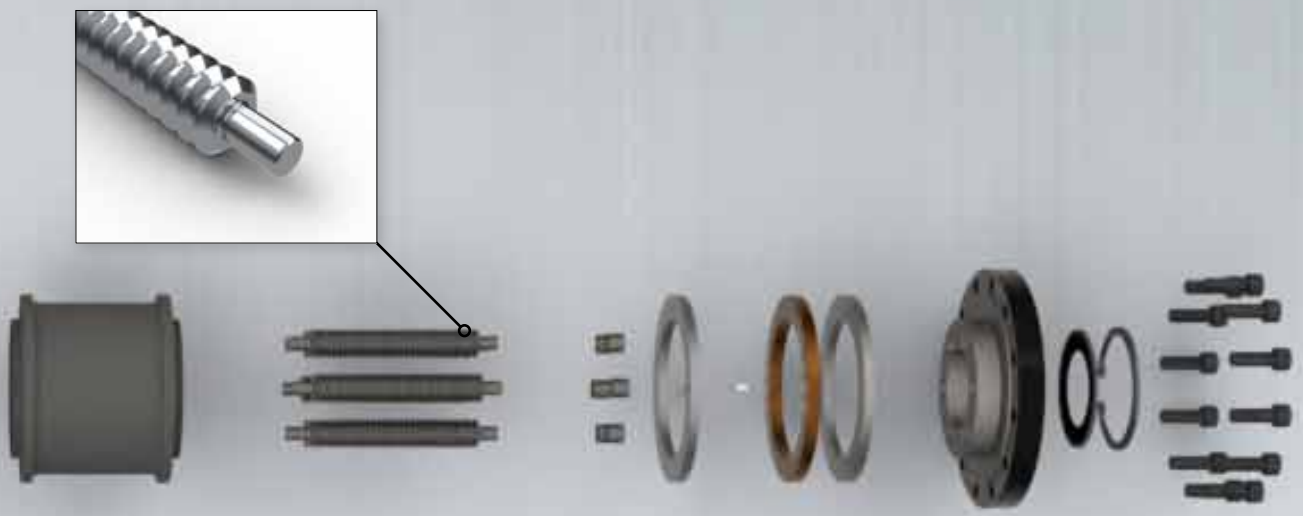
Mounting

The Spiracon™ nut can be mounted using the standard mounting holes and location diameter. Screw end machining to suit thrust bearings is provided, or this can be specified to suit customer requirements. Mounting for operation in any orientation is possible.

Screw Length

The screw length is determined by the load and speed conditions (please refer to Step 2 of How to Select a Spiracon™ Roller Screw, Page 11). For total screw lengths greater than shown in the table, please consult our Technical Sales Department.

Screw Diameter	Maximum Length
Up to 20mm	2 meters
30mm to 90mm	6 meters
120mm	3 meters



Operating Environment

All units are constructed and finished to suit industrial operating conditions. Normal operating temperatures are from -10°C to +50°C. However, Power Jacks products have been proven in very low operating temperatures (-30°C - Arctic) and in higher temperatures (+70°C - steelworks). Wiper seals prevent the entry of large particles into the nut mechanism, and bellows can be provided to protect the screw. Please contact our Technical Sales Department to discuss hostile or hazardous operating environments.

Lubrication and Maintenance

Spiracon™ roller screws require only a minimum of maintenance during the normal operating life. Depending upon the duty, periodic lubrication should be carried out using Rocol Sapphire Hi-Pressure 2 (or equivalent) grease, through the nipple provided.

Specials

Spiracon™ can be offered to suit "special" applications, requiring for example:

- Special screw diameters or leads.
- Left hand screw threads.
- Very high dynamic load (over 1000 kN).
- Special materials e.g stainless steel.
- Temperature extremes or hazardous environments.
- Special screw end machining or nut mounting e.g. trunnions.

6. How to Select a Spiracon Roller Screw

Step 1 - Load, Speed and Life

From the Technical Chart on page 14, make an initial selection of a Spiracon™ model to suit the required maximum dynamic and static loads.

Choose a screw lead and calculate the rotational speed to suit the required linear speed:

$$\text{Rotational speed} = \frac{\text{Linear speed (mm/minute)}}{\text{Screw lead (mm)}}$$

Check that the rotational speed is below the maximum speed shown in the Technical Chart for the model selected.
Calculate the total number of revolutions of the screw for the operating life required:

Required no. of screw revs. = Life (hours) x Rotational speed (rpm) x 60

Check the operating life for the selected Spiracon™ model:

C = Dynamic capacity (kN) from Technical Chart
F = Application dynamic load (kN) (or Fm, mean load as below)

$$\text{Actual no. of screw revs.} = \left(\frac{C}{F}\right)^{3.33} \times 10^6$$

$$\text{Therfore Actual life in hours} = \frac{\text{No. of screw revs.}}{\text{Rotational speed x 60}}$$

If required, reiterate the calculation to achieve the required life.
Where the dynamic load varies, the mean load (Fm) can be approximated as follows:

$$Fm = \sqrt[3]{\frac{(F1^3 \times U^1) + (F2^3 \times U2) + \ldots}{U}}$$

F1, F2 = constant loads during U1, U2 revolutions
U = total number of revolutions

Where the dynamic load varies between a minimum (Fmin) and maximum (Fmax) the mean load is :

$$Fm = \frac{Fmin + 2 \times Fmax}{3}$$

Step 2 - Critical Speed, Buckling and Deflection

Establish length (L) based on the required stroke and bearing support conditions. For length (L), check that the rotational speed is below the critical speed limit, given by the formula:

$$\text{Critical speed limit (rpm)} = \frac{10^7 \times f1 \times J}{L^2}$$

Where f1, f2 and f3 are defined by the bearing support conditions shown in the diagram below, and J is the root diameter of the Spiracon™ thread given in the Technical Chart on page 14.

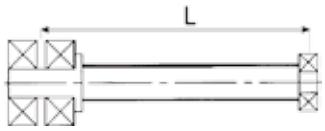
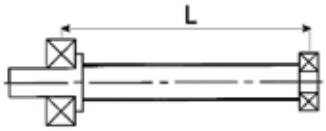
Where the screw is under a compression load, check that the chosen screw diameter and length (L) are within the load limit for column strength, given by the formula:

$$\text{Load limit (N)} = \frac{10^4 \times f2 \times J^4}{L^2}$$

For long horizontal screws, check the deflection of the screw under its own weight:

$$\text{Deflection (mm)} = \frac{6 \times 10^{-9} \times L^4}{f3 \times J^2}$$

Bearing Support Conditions

		f1	f2	f3
1		21	12.5	384
2		15	6.5	185
3		9.5	3	77
4		3.4	0.8	8

Step 3 - Torque and Power

Calculate the torque required to drive the screw:

$$\text{Torque (Nm)} = \frac{\text{Dynamic load (N)} \times \text{Lead (mm)}}{2000 \times \pi \times \text{Efficiency (0.85)}}$$

$$\text{Power (kW)} = \frac{\text{Torque (Nm)} \times \text{Rotational speed (rpm)}}{9550}$$

Note: Where there is a high acceleration or inertia, please consult out Technical Sales Department.

Example
Select a standard right hand Spiracon™ screw and nut for the following:

Dynamic load	=	220 kN (in compression)
Linear speed	=	900 mm/minute
Required life	=	2000 hours
Required stroke	=	1200 mm
Overall screw length	=	1850 mm
Screw mounting	=	Vertical
Bearing support condition	=	2

Step 1
From the chart on page 14, make initial selection of:

Model 65 x 36 lead

Select a lead of 36 mm to give a rotational speed of:

$$\frac{900}{36} = 25 \text{ rpm (OK<1700 rpm)}$$

Calculate the number of revolutions of the screw to give the required life:

Required no. of screw revs. = 2000 x 25 x 60 = 3 x 106

Check the operating life for selected Spiracon™ model:

$$\text{Actual no. of screw revs.} = \left(\frac{310}{220}\right)^{3.33} \times 10^6 = 3.14 \times 10^6 \text{ (OK>3 x } 10^6\text{)}$$

$$\text{Therefore Actual life in hours} = \frac{3.14 \times 10^6}{25 \times 60} = 2093 \text{ hours (OK>2000 hours)}$$

Step 2
Stroke = 1200 mm
Length (L) = 1600 mm (refer bearing support condition)

Check the critical speed limit:

$$\text{Speed limit (rpm)} = \frac{10^7 \times 15 \times 63.7}{1600^2} = 3732 \text{ rpm (OK>25 rpm)}$$

Check column strength of the screw:

$$\text{Load limit (N)} = \frac{10^4 \times 6.5 \times 63.7^4}{1600^2} = 418 \text{ kN (OK>220 kN)}$$

Step 3

The torque and power are:

$$\textbf{Torque (Nm)} = \frac{\textbf{220000 x 36}}{\textbf{2000 x } \pi \textbf{ x 0.85}} = \textbf{1483 Nm}$$

$$\textbf{Power (kW)} = \frac{\textbf{1483 x 25}}{\textbf{9550}} = \textbf{3.88 kW}$$

Therefore the complete product code is **SPT-065-36-6-RH-1850-1450-1-0** (refer Page 7 for full product code description)

Example Part Number

1				2				3			4		5			6					7					8		9
S	P	T	-	0	6	5	-	3	6	-	6	-	R	H	-	1	8	5	0	-	1	4	5	0	-	1	-	0

(1) Spiracon™ Screw and Nut
(2) Model 65
(3) 36mm Lead
(4) 6 mm Pitch
(5) Right Hand Thread
(6) 1850mm Overall Screw Length
(7) 1450mm Screw Threaded Length
(8) 1 Spiracon™ Nut
(9) Standard Nut Mounting Holes

Notes:

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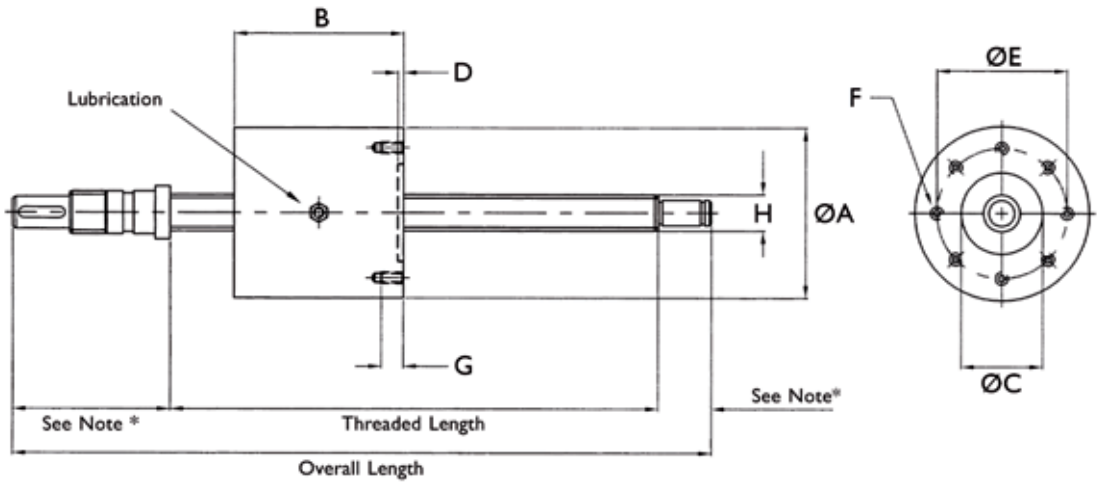
7. Technical Data and Dimensions



Note

* = Customer to define at time of ordering

øJ = Root diameter of Roller screw

Technical Dimensions Chart

Model	Lead (mm)	Pitch (mm)	Dynamic C (kN) Load Capacity	Static Co (kN) Load Capacity	NUT							SCREW			WEIGHTS	
					ø A	B	ø C	D	E	F	G	ø H	ø J	Max Speed (rpm)	Nut (kg)	Screw per 100mm (kg)
15	12	2	35	52	92	90	34	4	55	M8 X 6	12	17	15.3	5500	3.5	0.18
20	12	2	58	87	103	110	45	4	58	M8 X 6	12	21	18.4	4900	5.5	0.27
	18	3	50	74	103	110	45	4	58	M8 X 6	12	21	18.4	4900	5.5	0.27
30	18	3	90	120	125	130	50	4	70	M10 X 8	15	30.8	28.2	4300	9.3	0.55
	24	3	105	150	125	130	50	4	70	M10 X 8	15	30.8	28.2	4300	9.3	0.55
40	12	2	120	180	135	135	65	4	83	M12 X 8	18	39	28.2	3300	11.0	0.92
	24	3	128	192	135	135	65	4	83	M12 X 8	18	39	35.5	3300	11.0	0.92
	32	4	115	172	135	135	65	4	83	M12 X 8	18	39	35.5	3300	11.0	0.92
45	12	2	190	285	170	180	75	5	105	M16 X 8	24	46.6	41.3	2600	23.2	1.3
	24	4	170	255	170	180	75	5	105	M16 X 8	24	46.6	41.3	2600	23.2	1.3
	48	6	120	180	170	180	75	5	105	M16 X 8	24	46.6	41.3	2600	23.2	1.3
55	12	2	290	435	205	229	85	5	128	M20 X 8	30	56.1	50.9	2100	44.0	1.92
	24	4	270	405	205	229	85	5	128	M20 X 8	30	56.1	50.9	2100	44.0	1.92
	48	6	275	410	205	229	85	5	128	M20 X 8	30	56.1	50.9	2100	44.0	1.92
65	24	4	340	500	240	250	95	5	150	M20 X 8	30	68.8	63.7	1700	66.5	2.83
	36	6	310	465	240	250	95	5	150	M20 X 8	30	68.8	63.7	1700	66.5	2.83
	54	6	310	455	240	250	95	5	150	M20 X 8	30	68.8	63.7	1700	66.5	2.83
75	24	4	380	570	275	260	105	6	165	M20 X 8	30	75.2	70.1	1600	87.4	3.45
	36	6	340	510	275	260	105	6	165	M20 X 8	30	75.2	70.1	1600	87.4	3.45
	54	6	340	510	275	260	105	6	165	M20 X 8	30	75.2	70.1	1600	87.4	3.45
90	24	4	530	795	315	310	120	8	200	M24 X 10	35	90	85	1200	137	4.96
	36	6	520	780	315	310	120	8	200	M24 X 10	35	90	85	1200	137	4.96
	54	6	615	920	315	310	120	8	200	M24 X 10	35	90	85	1200	137	4.96
120	24	4	950	1425	420	400	150	8	250	M24 X 12	50	120	115	1000	310	8.82
	40	5	1200	1800	420	400	150	8	250	M24 X 12	50	120	115	1000	310	8.82
	54	6	1200	1800	420	400	150	8	250	M24 X 12	50	120	115	1000	310	8.82

Dimensions subject to change without notice.

PRECISION SCREW JACKS . ELECTRIC LINEAR ACTUATORS .
PLANETARY ROLLER SCREWS . SPIRAL BEVEL GEARBOXES .

Power Jacks are an industry leader in the manufacture of quality industrial lifting, positioning, material handling and power transmission equipment.

Our products are supplied globally to most industry sectors including nuclear, water, oil & gas, chemical, defence, steel, aluminium, automotive and others.

DESIGN WITH POWER

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