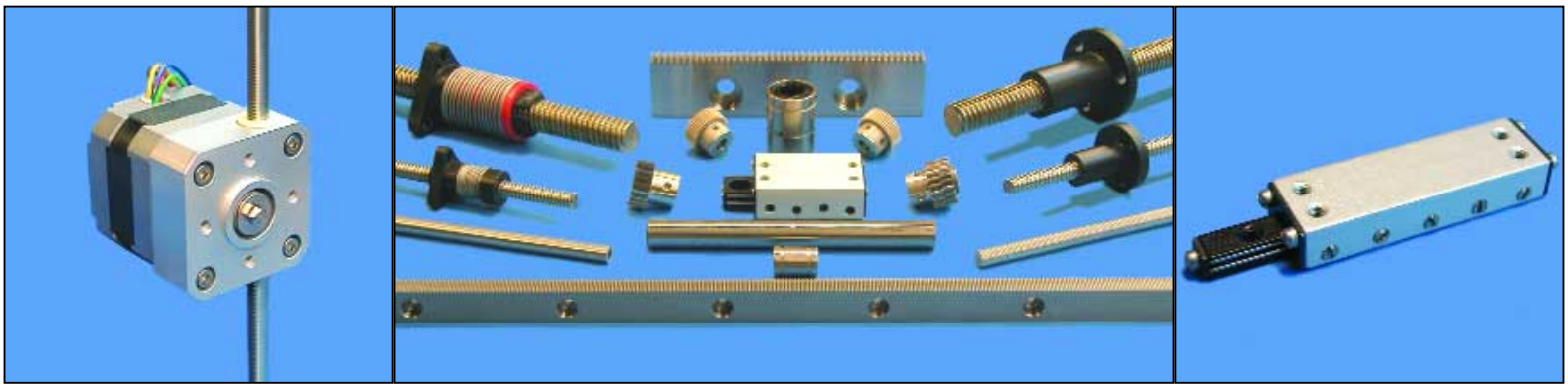
Gear Rack,
Gears, Pinions,
& Related Products

from

Schlenker Enterprises, Ltd.



Standard & Custom

Components

Nov 2003

Quality system

Reliance operations are controlled by a quality management system approved to BS EN ISO 9001:2000.

Standard products and assemblies

Accurate positioning from modifiable standards for instrumentation, measurement and light actuation applications.

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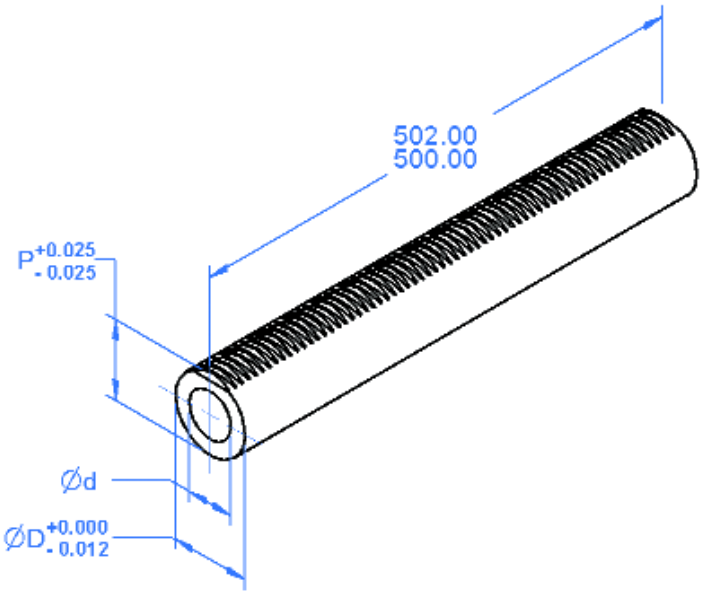
Page Title	Page

Tubular Rack

Ground Round Rack

General Information

All dimensions in mm
General tolerances:
±0.13mm
Material:
Stainless steel
Grade 316 series.
Pressure angle 20°



Part number selection table

Part Number	Circular Pitch (mm)	Outer Dia ØD	Bore Dia Ød	Pitch Height P	Rack Thrust (N)
RRT06-1M-500	1	6	3.4	5.682	20*
RRT08-1M-500		8	5	7.682	
RRT10-1M-500		10	6	9.682	

Notes

(1): 0.5 module not available on Ø6 tube.

* Rack thrust based on a mesh with a 50 tooth stainless steel pinion, 3N if used with a 50 tooth PEEK™ polymer pinion.

- Cumulative pitch error less than 0.050mm.
- Ground teeth, standard accuracy grade 2.
- Hollow shaft allows for the passage of fluids, fibre-optics and gasses etc.
- Highly stainless material resists pitting corrosion.
- Ideal for medical and scientific applications.
- Bearing surface and drive in one.

Non-standard options, please enquire....

- Modifications :
  ie. flats, journals, end modifications.
- Shorter lengths.
- Alternative pitches, including 0.3 and 0.5(1) module.
- Higher accuracy grades.

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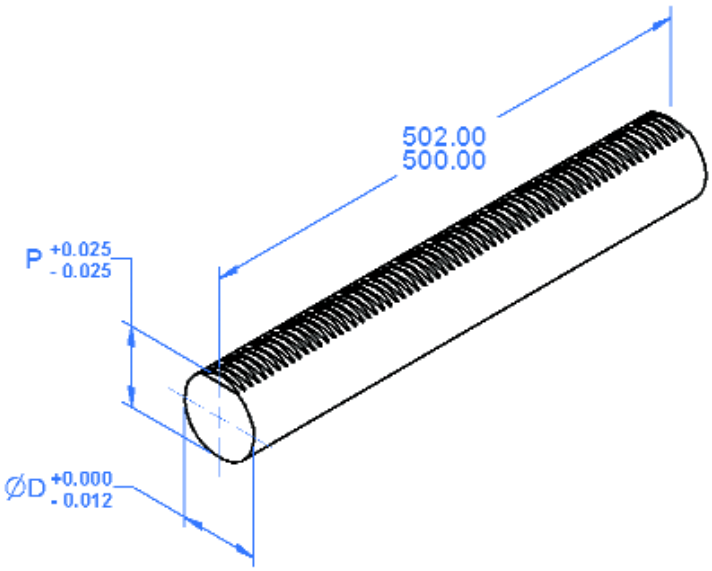
Soft Round Rack



General Information

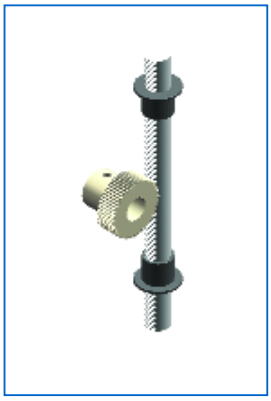
All dimensions in mm
General tolerances:
±0.13mm
Material:
Stainless steel
Grade 300 series
Pressure angle 20°

Part number selection table

Part Number	Circular Pitch (mm)	Outer Dia ØD	Pitch Height P	Rack Thrust (N)
RRS06-1M-500	1	6	5.682	20*
RRS08-1M-500		8	7.682	
RRS10-1M-500		10	9.682	

* Rack thrust based on a mesh with a 50 tooth stainless steel pinion, 3N if used with a 50 tooth PEEK™ polymer pinion.

- Cumulative pitch error less than 0.050mm.
- Ground teeth, standard accuracy grade 2.
- Highly stainless material resists pitting corrosion.
- Ideal for medical and scientific applications.
- Bearing surface and drive in one.



Non-standard options, please enquire....

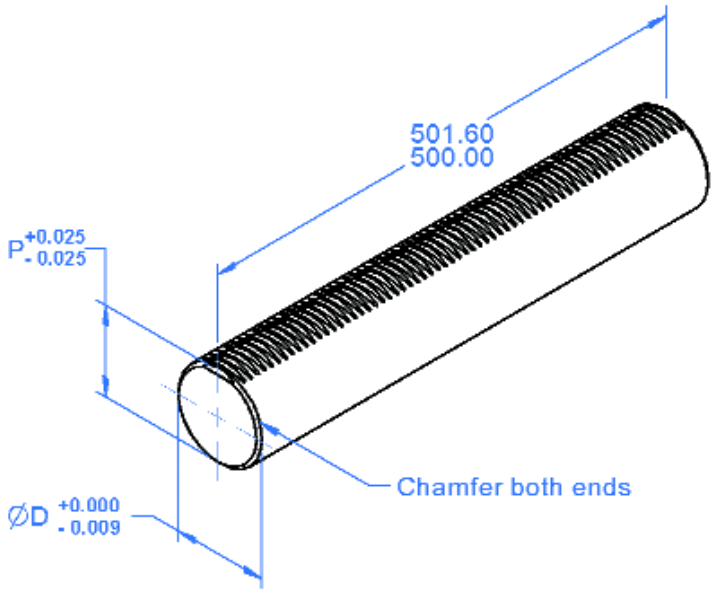
- Modifications :
  ie. flats, journals, end modifications.
- Shorter lengths.
- Alternative pitches, including 0.3 and 0.5 module.
- Higher accuracy grades.

Round Bar Rack

Hardened Round Rack

General Information

All dimensions in mm
General tolerances:
±0.13mm
Material:
linear brg shaft
St steel, Grade 440C
or X90CrMoV18.
Treatment:
Case hardened to
55HRc min.
Pressure angle 20°

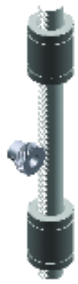


Part number selection table

Part Number	Circular Pitch (mm)	Outer Dia ØD	Pitch Height P	Rack Thrust (N)
RR10-1M-500	1	10	9.682	60*
RR12-1M-500		12	11.682	
RR16-1M-500		16	15.682	
RR20-1M-500		20	19.682	

* Rack thrust based on a mesh with a 60 tooth hardened rack pinion.

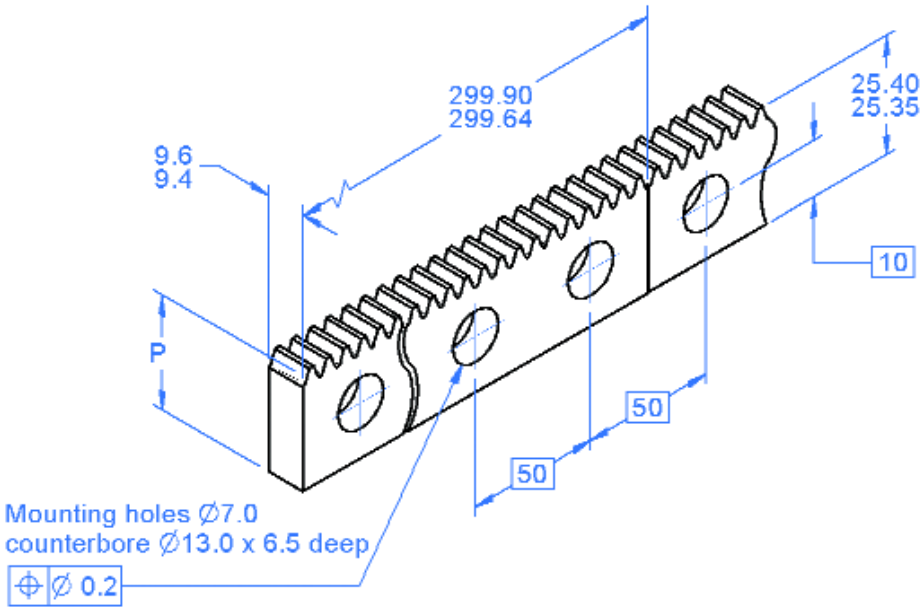
- Cumulative pitch error less than 0.025mm.
- Ground teeth, standard accuracy grade 3.
- Manufactured from a linear bearing stainless steel.
- Can be used with both open and closed linear bearings with either 4, 5 or 6 ball tracks. (The bearing must be positioned so the balls do not run on the edges of the teeth. See technical section.)
- Bearing surface and drive in one.



Non-standard options, please enquire....

- Modifications :
  ie. flats, journals, end modifications.
- Shorter lengths.
- Alternative pitches, including 0.3 and 0.5 module.
- Higher accuracy grades.

Rectangular Rack



General Information

All dimensions in mm
General tolerances:
±0.13mm
Material:
Stainless steel
Grade 416
Treatment:
Hardened to
35-45 HRc.
Pressure angle 20°

Part number selection table

Part Number	Circular Pitch (mm)	Pitch Height P	Rack Thrust (N)	Number of Holes
RH79-25M-300	2.5	24.601 24.576	130*	6

* Quoted rack thrust based on meshing with a 76 tooth pinion.

- Cumulative pitch error 0.015mm.
- Ground teeth, standard accuracy grade 3.
- Manufactured from stainless steel.
- High load capacity.
- Unlimited axis lengths possible by setting individual racks together.

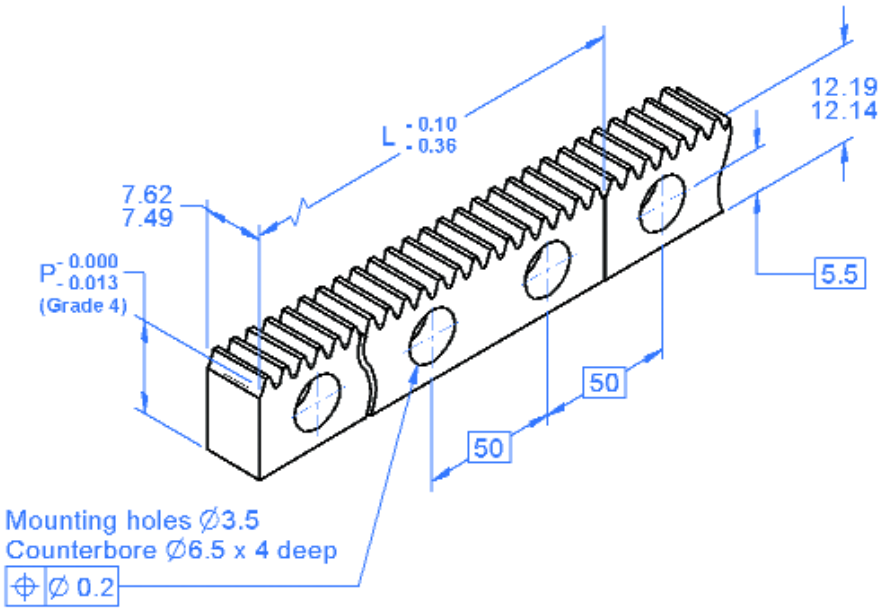
Non-standard options, please enquire....

- Alternative lengths available, to a maximum of 500mm.
- Shorter lengths.
- Alternative pitches, including module.
- 25° pressure angle available.

Rectangular Rack

General Information

All dimensions in mm
General tolerances:
±0.13mm
Material:
Stainless steel
Grade 416
Treatment:
Hardened to
35-45 HRc.
Pressure angle 20°



Part number selection table

Part Number	Circular Pitch (mm)	Length L	Pitch Height P	Number of Holes
R9-1M-300 R9-2M-300 R9-25M-300	1 2 2.5	300	11.869 11.550 11.391	6
R11-1M-600 R11-2M-600 R11-25M-600	1 2 2.5	600	11.869 11.550 11.391	12

- Cumulative pitch error less than 0.008mm per 300mm.
- Ground teeth, standard accuracy grade 4.
- Manufactured from a stainless steel.
- Unlimited axis lengths possible by setting individual racks together.

Non-standard options, please enquire....

- Shorter lengths.
- Alternative pitches, including module.
- Higher accuracy grades.
- See technical data, page 56 for alternative grades.

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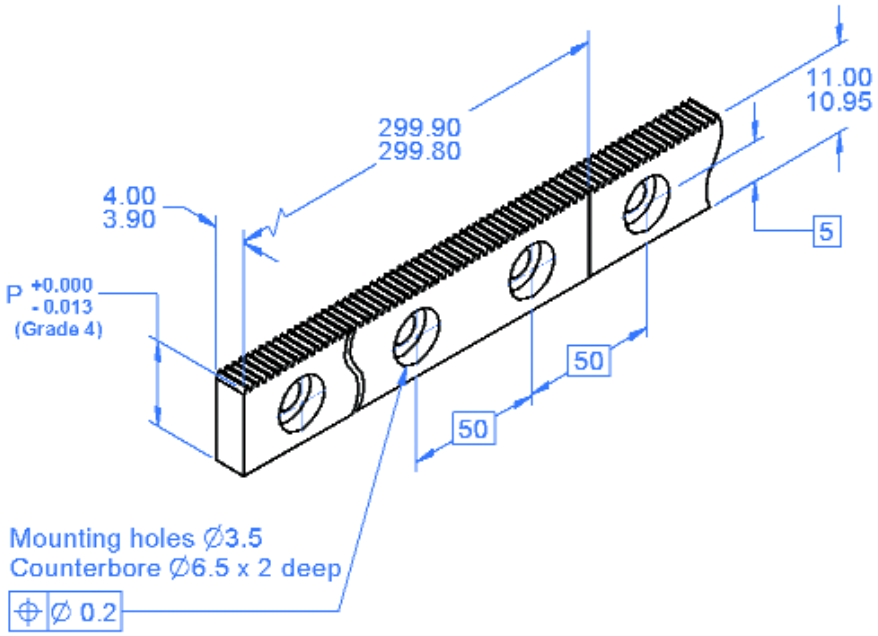
Rectangular Rack



General Information

All dimensions in mm
General tolerances:
±0.13mm
Material:
Stainless steel
Grade 416
Treatment:
Hardened to
35-45 HRc.
Pressure angle 20°

Part number selection table

Part Number	Circular Pitch (mm)	Pitch Height P	Number of Holes
R5-1M-300	1	10.679	6

- Cumulative pitch error less than 0.008mm per 300mm.
- Ground teeth, standard accuracy grade 4.
- Manufactured from a stainless steel.
- Unlimited axis lengths possible by setting individual racks together.

Non-standard options, please enquire....

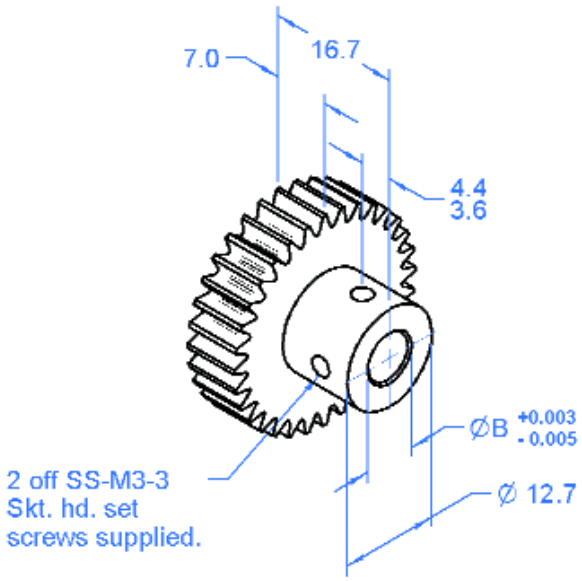
- Shorter lengths.
- Alternative pitches, including module.
- Higher accuracy grades.
- See technical data, page 56 for alternative grades.

Plain Rack Pinions

6mm & 1/4" Bore

General Information

All dimensions in mm
General tolerances:
±0.13mm
Material:
Stainless steel
Grade 316
Pressure angle 20°



Part number selection table

Example Part No:- SH25MS2B6F7A- 32

Basic Part Number	Circular Pitch (mm)	Bore Size ØB	No. of Teeth	
			Min	Max
SH1MS2B6F7A-	1	6	43	111
SH2MS2B6F7A-	2		23	54
SH25MS2B6F7A-	2.5		19	43
SH1MS2B250F7A-	1	1/4"	43	111
SH2MS2B250F7A-	2		23	54
SH25MS2B250F7A-	2.5		19	43

- Standard accuracy AQ10.
- Higher accuracy & zero backlash when used with Flexplate assemblies.
- Ideal for use with Reliance soft & hardened, round & rectangular rack.

Non-standard options, please enquire....

- Higher accuracy grades.
- Alternative pitches, including module.
- Alternative bore sizes.

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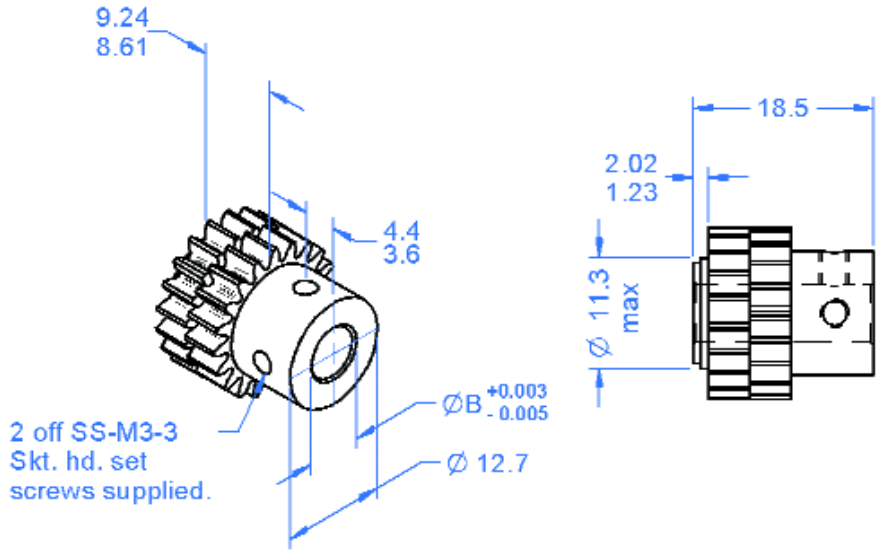
Anti-backlash Rack Pinions



General Information

All dimensions in mm
General tolerances:
±0.13mm
Material:
Stainless steel
Grade 316
Pressure angle 20°

Part number selection table

Example Part No:- AH25MS2B6F89A- 20

Basic Part Number	Circular Pitch (mm)	Bore Size ØB	No. of Teeth	
			Min	Max
AH1MS2B6F89A-	1	6	46	54
AH2MS2B6F89A-	2		24	26
AH25MS2B6F89A-	2.5		20	20
AH1MS2B250F89A-	1	1/4"	46	54
AH2MS2B250F89A-	2		24	26
AH25MS2B250F89A-	2.5		20	20

- Standard accuracy AQ10.
- Ideal for use with Reliance soft & hardened, round & rectangular rack.
- Ideal for lightly loaded measurement applications.

Non-standard options, please enquire....

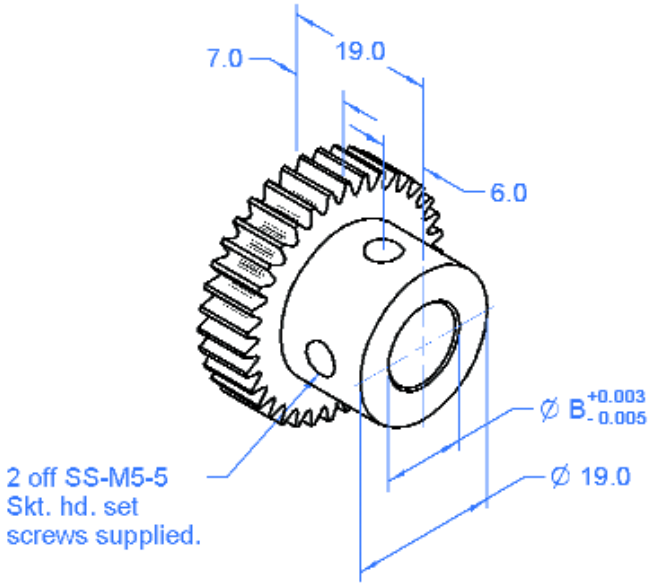
- Higher accuracy grades.
- Alternative pitches, including module.
- Alternative bore sizes.

Plain Rack Pinions

10mm & 3/8" Bore

General Information

All dimensions in mm
General tolerances:
±0.13mm
Material:
Stainless steel
Grade 316
Pressure angle 20°



Part number selection table

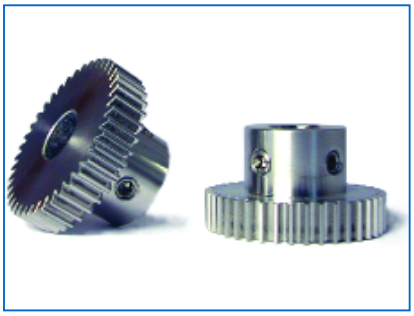
Example Part No:- SH25MS2B10F7A- 32

Basic Part Number	Circular Pitch (mm)	Bore Size ØB	No. of Teeth	
			Min	Max
SH1MS2B10F7A-	1	10	63	104
SH2MS2B10F7A-	2		33	51
SH25MS2B10F7A-	2.5		27	40
SH1MS2B375F7A-	1	3/8"	63	104
SH2MS2B375F7A-	2		33	51
SH25MS2B375F7A-	2.5		27	40

- Standard accuracy AQ10.
- Higher accuracy when used with Flexplate assemblies.
- Ideal for use with Reliance soft & hardened, round & rectangular rack.

Non-standard options, please enquire....

- Higher accuracy grades.
- Alternative pitches, including module.
- Alternative bore sizes.



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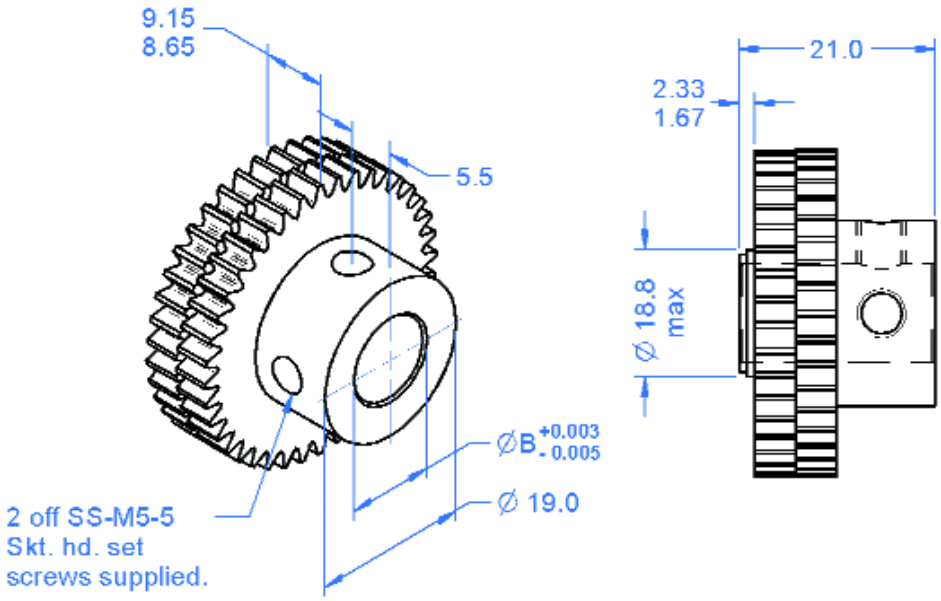
Anti-backlash Rack Pinions



General Information

All dimensions in mm
General tolerances:
±0.13mm
Material:
Stainless steel
Grade 316
Pressure angle 20°

Part number selection table

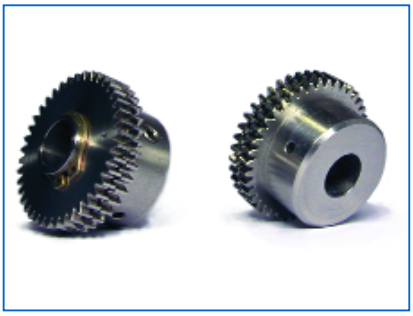
Example Part No:- AH25MS2B10F89A- 40

Basic Part Number	Circular Pitch (mm)	Bore Size ØB	No. of Teeth	
			Min	Max
AH1MS2B10F89A-	1	10	87	104
AH2MS2B10F89A-	2		45	51
AH25MS2B10F89A-	2.5		37	40
AH1MS2B375F89A-	1	3/8"	87	104
AH2MS2B375F89A-	2		45	51
AH25MS2B375F89A-	2.5		37	40

- Standard accuracy AQ10.
- Ideal for use with Reliance soft & hardened, round & rectangular rack.
- Ideal for lightly loaded measurement applications.

Non-standard options, please enquire....

- Higher accuracy grades.
- Alternative pitches, including module.
- Alternative bore sizes.

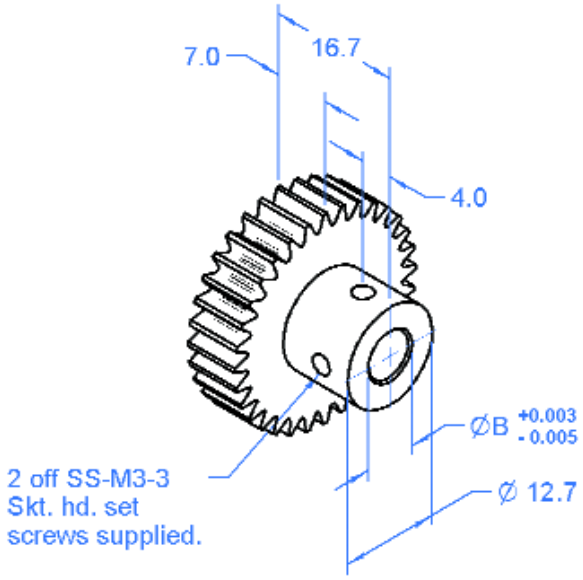


Hardened Rack Pinions

6mm & 1/4" Bore

General Information

All dimensions in mm
General tolerances:
±0.13mm
Material:
Stainless steel,
17-4PH
Hardened to:
36/40 HRc.
Pressure angle 20°



Part number selection table

Example Part No:- SH25MS9B6F7A- 35

Basic Part Number	Circular Pitch (mm)	Bore Size ØB	No. of Teeth	
			Min	Max
SH1MS9B6F7A-	1	6	43	111
SH2MS9B6F7A-	2		23	54
SH25MS9B6F7A-	2.5		19	43
SH1MS9B250F7A-	1	1/4"	43	111
SH2MS9B250F7A-	2		23	54
SH25MS9B250F7A-	2.5		19	43

- Standard accuracy AQ10.
- Suitable for light actuation applications.
- Longer pinion life, higher load and provides higher thrust.
- Ideal for use with Reliance hardened round and rectangular rack.

Non-standard options, please enquire....

- Higher accuracies.
- Alternative pitches, including module.
- Alternative bore sizes.
- Alternative materials.
- Special wear resistant coating.

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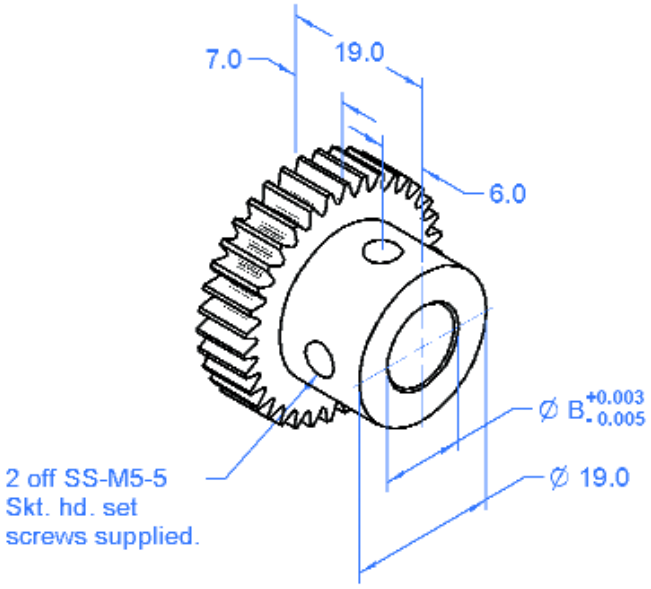
Hardened Rack Pinions



General Information

All dimensions in mm
General tolerances:
±0.13mm
Material:
Stainless steel,
17-4PH
Hardened to:
36/40HRc.
Pressure angle 20°

Part number selection table

Example Part No:- SH25MS9B10F7A- 35

Basic Part Number	Circular Pitch (mm)	Bore Size ØB	No. of Teeth	
			Min	Max
SH1MS9B10F7A-	1	10	63	104
SH2MS9B10F7A-	2		33	51
SH25MS9B10F7A-	2.5		27	40
SH1MS9B375F7A-	1	3/8"	63	104
SH2MS9B375F7A-	2		33	51
SH25MS9B375F7A-	2.5		27	40

- Standard accuracy AQ10.
- Suitable for light actuation applications.
- Longer pinion life, higher load and provides higher thrust.
- Ideal for use with Reliance hardened round and rectangular rack.

Non-standard options, please enquire....

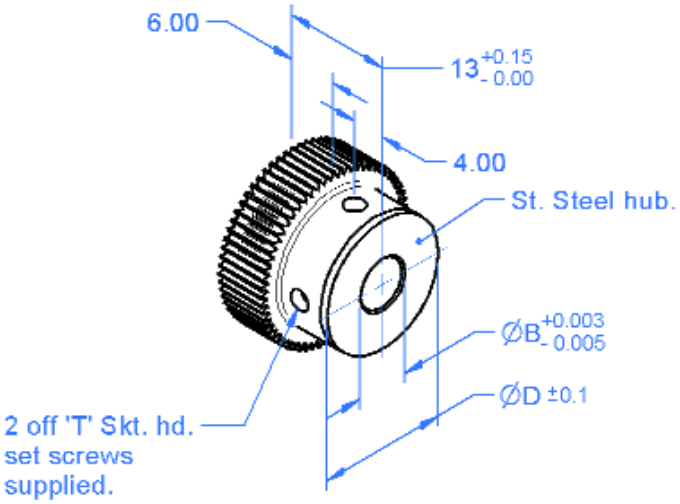
- Higher accuracies.
- Alternative pitches, including module.
- Alternative bore sizes.
- Alternative materials.
- Special wear resistant coating.

PEEK™ Polymer Rack Pinions

4 & 5mm Bore

General Information

All dimensions in mm
General tolerances:
±0.13mm
Material:
PEEK™ 450G pinion with
Stainless steel 303 hub.
Pressure angle 20°



Part number selection table

Example Part No:- SH1MP1B4F6A- 35

Basic Part Number	Circular Pitch (mm)	Bore Size ØB	Boss Dia ØD	Screw T	Standard No. of Teeth
SH1MP1B4F6A-	1	4	10	SS-M2.5-3	35
SH1MP1B5F6A-	1	5	12	SS-M3-3	40 50

Notes

PEEK™ is a trademark of Victrex PLC.

- Standard accuracy AQ10.
- Unique stainless steel insert for accurate non-slip attachment to shafts.
- Ideal for driving Reliance tubular rack - see page 24.

Non-standard options, please enquire....

- Other numbers of teeth.
- Higher accuracies.
- Alternative pitches, including module.
- Alternative bore sizes.

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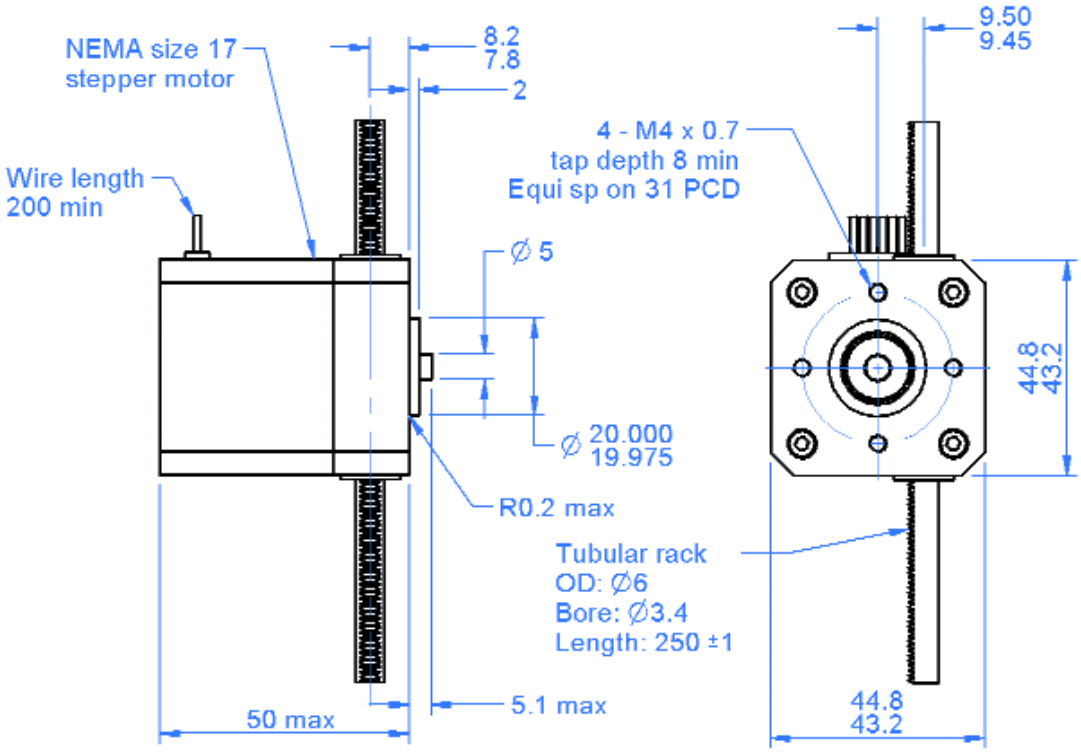
Tubular Rack Actuator

General Information

All dimensions in mm
General tolerances:
±0.13mm



Part number selection table

Part Number	Rack Length	Rack Dia	Axial Load
RRA17-6-250	250 ±1	6	3N

Technical specification*

- Drive: NEMA size 17 stepper motor, see technical section, pages 61 - 62.
- Tubular rack: 6mm OD, 3.4mm bore, 250mm length, 316 stainless steel.
- Travel range: 200mm.
- Max continuous axial load: 3N.
- Max momentary load: 12N.
- Max speed: 300mm/sec.
- Resolution: 0.21mm with 200 steps/rev.
  0.0033mm with microstepping (12800 steps/rev).
- Temperature range: -10ºC to +80ºC.
- Repeatability: 0.025mm.
- Life: in excess of 5 million cycles.
- Side wobble, fully extended: ±0.2mm.
- Backlash: equivalent to less than 0.08 linear movement.
- No lubricant required.
- Smooth quiet operation - no metal to metal contact.

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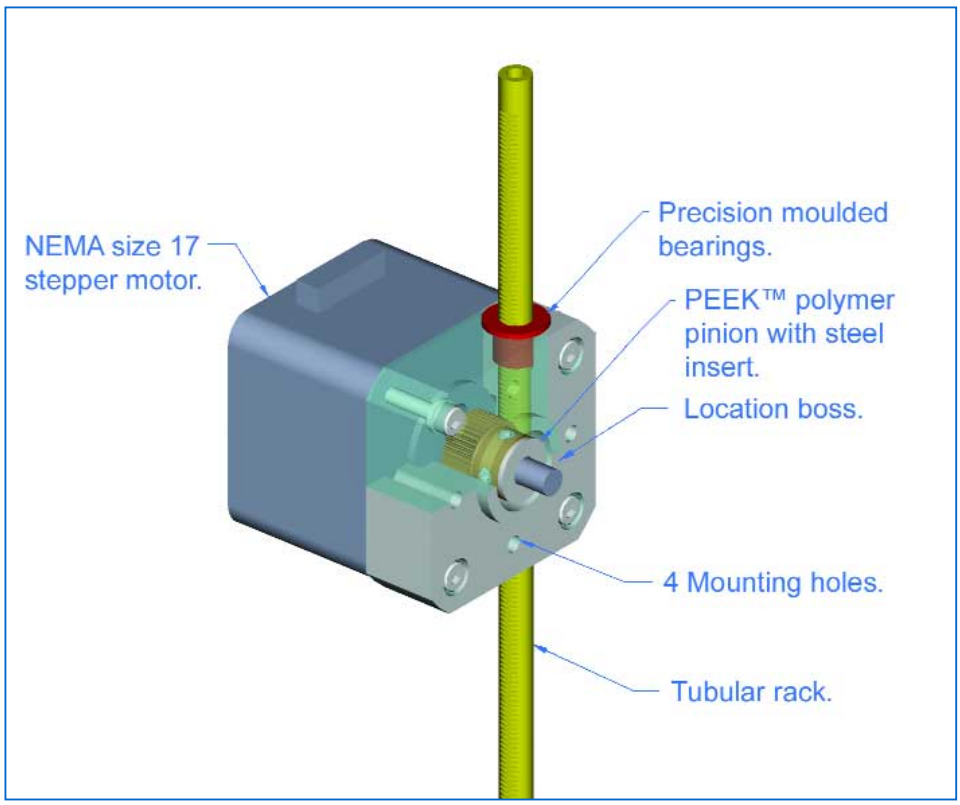
Tubular Rack Actuator



General Information

All dimensions in mm
General tolerances:
±0.13mm

* This actuator is supplied pre-assembled. Technical specification figures are only valid if the actuator has not been dismantled. If required, suitable customer supplied motors may be incorporated in the actuator assembly.

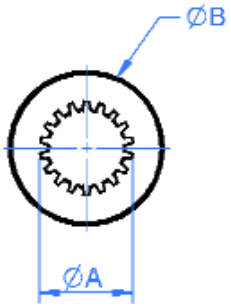
Non-standard options, please enquire....

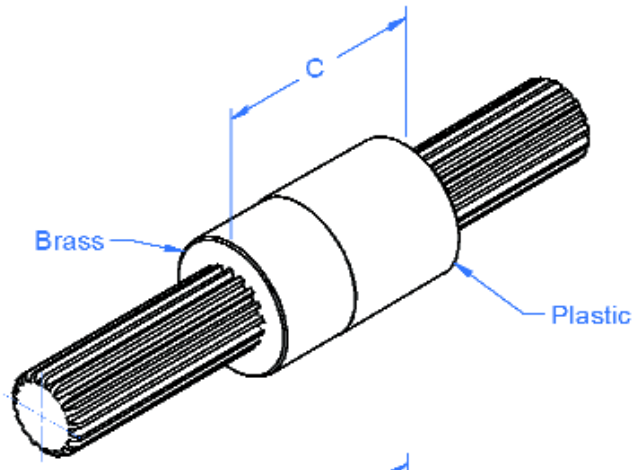
- Longer or shorter lengths of rack. Maximum length 500mm.
- Tubular rack end modifications.
- Custom designs.
- Size 11 stepper motor assembly.

General Information

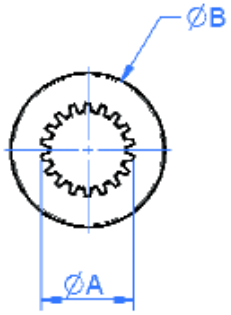
All dimensions in mm
General tolerances:
±0.13mm
Material:
Spline shaft -
Aluminium alloy, TFE coated.
Bushing - Graphite and PTFE filled thermoplastic, with brass collar.

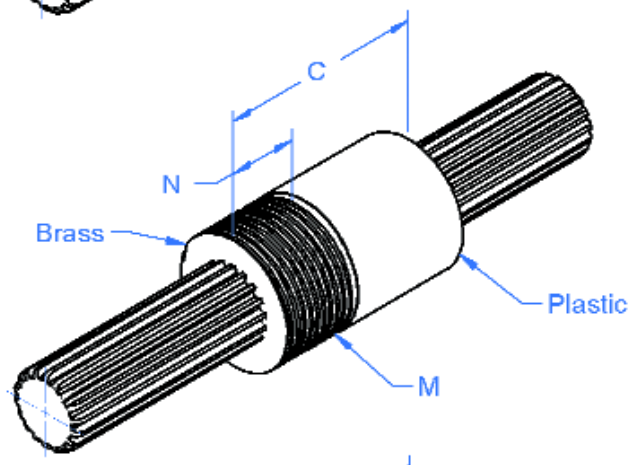
RSSBP (Basic)



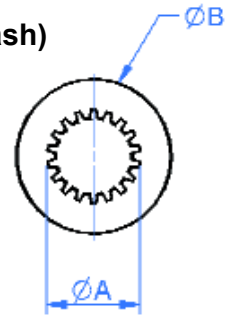


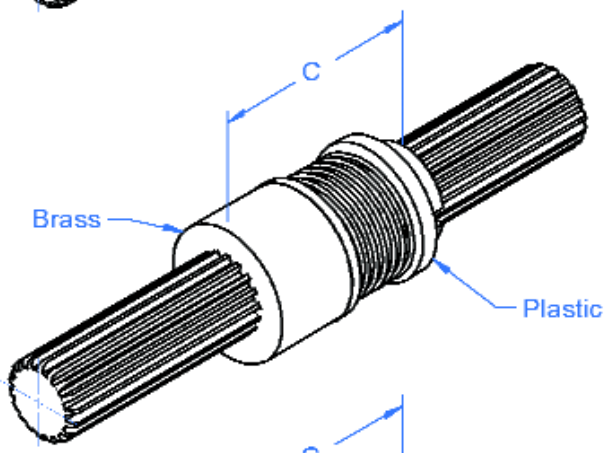
RSSBY (Basic)



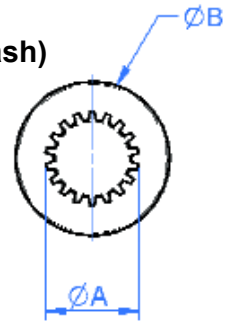


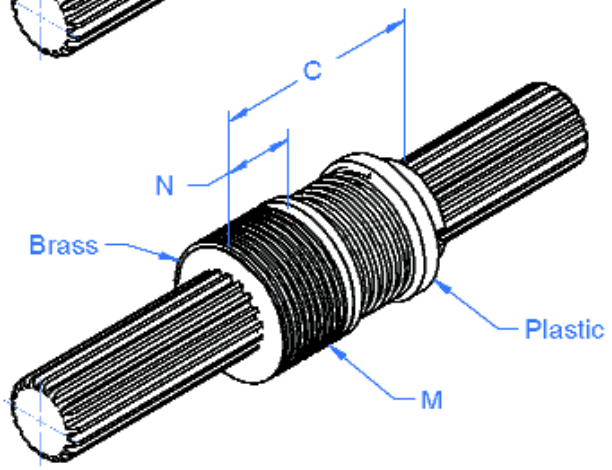
RSSZP (Anti-backlash)





RSSZY (Anti-backlash)





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Spline Shafts

Part number selection table

Example Part No:- RSS B P 6 T 1 - 100mm

- Shaft length
- Number of bushings
- TFE coating (standard)

Basic Part No.	Bushing Style	Mount	Size Code	Shaft Dia ØA ±0.05mm	Bushing Outside Dia ØB ±0.025mm	Bushing Length C ±0.25mm	Thread M* (Inch)	Thread Length N* ±0.13mm
RSS	B (Basic) Z (Anti-backlash)	P (Plain Dia) Y (Thread)	6	6.35	12.70	19.1	7/16"-20	6.35
			10	9.53	15.88	25.4	9/16"-20	9.53
			13	12.70	20.65	38.1	3/4"-20	12.70

* Only on thread mounting spline shafts.

General Information

All dimensions in mm
General tolerances: ±0.13mm
Material:
Spline shaft - Aluminium alloy, TFE coated.
Bushing - Graphite and PTFE filled thermoplastic, with brass collar.

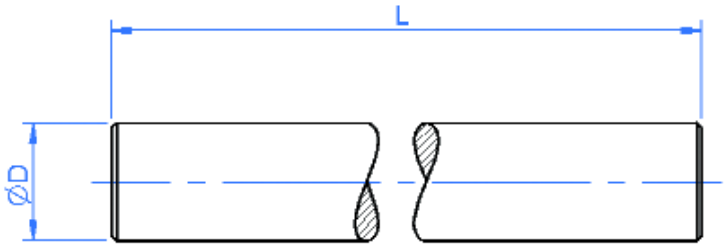
- For spline shaft lengths of up to 1000mm, add required length to basic part number.
- Standard shaft straightness is 0.076mm per 300mm.
- Typical radial and torsional clearance between shaft and bushing for basic assembly is 0.05 to 0.076mm. Anti-backlash assemblies provide additional system stiffness.
- Designed for light load applications.
- Maximum twist 3º/305mm.
- Torsional clearance (basic) 3º Bushing to shaft.
- Drag force 170g.

Non-standard options, please enquire....

- Longer lengths available.
- Larger number of bushings.
- Modified ends.

General Information

All dimensions in mm
General tolerances:
±0.13mm
Material:
Bearing steel SUJ2
Stainless steel 440C
Surface finish:
1.5µm Rz
Straightness: L/D (µm)
Hardness: 58-63HRc



Part number selection table

Example Part No.- RS-3-400

Basic Part Number	Outside Dia ØD	Outside Dia Tol		Available Lengths L									
		Max	Min	100	200	300	400	500	600	800	1000	1200	1500
RS-3	3	-0.009	-0.017	•#	•#	•#	•#						
RS-4	4			•#	•#	•#	•#						
RS-5	5			•#	•#	•#	•#						
RS-6	6	-0.010	-0.019	•#	•#	•#	•#	•#	•#	•#	•#		
RS-8	8			•#	•#	•#	•#	•#	•#	•#	•#		
RS-10	10			•#	•#	•#	•#	•#	•#	•#	•#	#	•#
RS-12	12			•	•#	•#	•#	•#	•#	•#	•#	#	•#

• SUJ2 bearing steel.
SUS440C stainless steel.

- Standard material = SUJ2 bearing steel, for stainless steel, add **-SS** to the part number.

Non-standard options, please enquire....

- Hard chrome plating (0.01mm deep) available on SUJ2 shafts.
- Ultra precision (straightness 0.5 L/D) on both SUJ2 and 440C shafts.
- Reduced clearance shafts manufactured to h6 tolerance.
- Custom end machining available to order.
- Non-standard lengths available.

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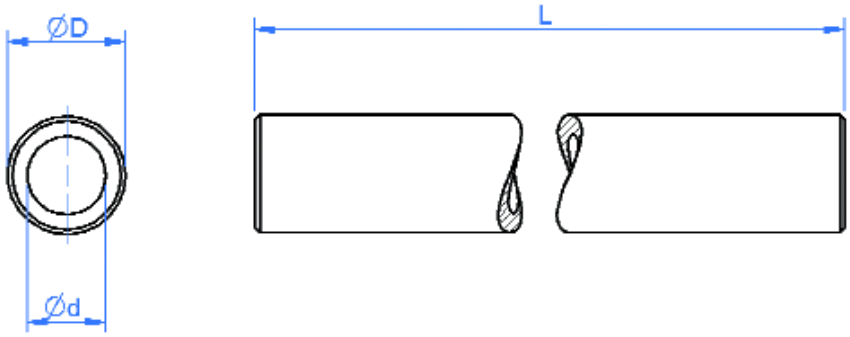
Hollow Linear Motion Shafting



General Information

All dimensions in mm
General tolerances:
±0.13mm
Material:
Bearing steel SUJ2
Surface finish:
1.5µm Rz
Straightness: L/D (µm)
Hardness: 58-63HRc

Part number selection table

Example Part No.- RPS-10-500

Basic Part Number	Outside Dia ØD	Outside Dia Tol		Inside Dia Ød	Available Lengths L				
		Max	Min		500	700	1000	1200	1500
RPS-10	10	-0.010	-0.019	4	•	•	•	•	•
RPS-12	12			6	•	•	•	•	•

• SUJ2 bearing steel.

Non-standard options, please enquire....

- Hard chrome plating (0.01mm deep).
- Ultra precision (straightness 0.5 L/D).
- Reduced clearance shafts manufactured to h6 tolerance.
- Custom end machining available to order.
- Non-standard lengths available.

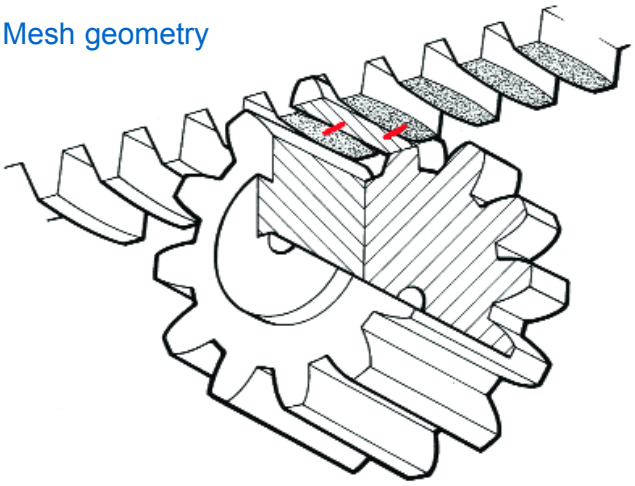
Technical section index Page

RACK MANUFACTURE

Reliance standard precision racks are produced by a thread grinding process, which generates teeth of helicoidal form. This provides two distinct advantages: very good pitch accuracy and sufficient tolerance of meshing conditions (within 0.25º) to make high precision alignment of the pinion unnecessary.

This feature will be appreciated from the diagram below. Slight misalignment of the straight-tooth pinion, in terms of deviation from a true right-angle between the axis and rack in either plane, results merely in a change of position of the contact points across the face.

Mesh geometry



Points of contact.
Standard pressure angle is 20º
25º pressure angle available on request.

RACK STANDARDS AND TOLERANCES

Reliance precision racks are offered in four basic grades of accuracy through most of the range, please see the individual product pages for details. Grade 4b has been introduced to offer a lower cost grade 4 where a single rack is to be used in a non-butting application.
The tooth form is generally in accordance with BS 4582 part 1. fig 1. for metric racks.

Rack Grade	5	4	4b	3	2	1
Max pitch error between any two points per 300mm of rack	0.005	0.008	0.008	0.015	0.025	0.050
Max end to end pitch error up to 300mm of track*	±0.004	±0.004	±0.008	±0.008	±0.013	±0.025
Adjacent Tooth Error	0.0025	0.0025	0.0025	0.005	0.010	0.013
Pitch Height Variation	+0 -0.013	+0 -0.013	+0 -0.013	+0 -0.013	+0 -0.018	+0 -0.025

* Applies pro rata to length >300mm

All dimensions in mm

ENGINEERING DATA

1. Linear Speed

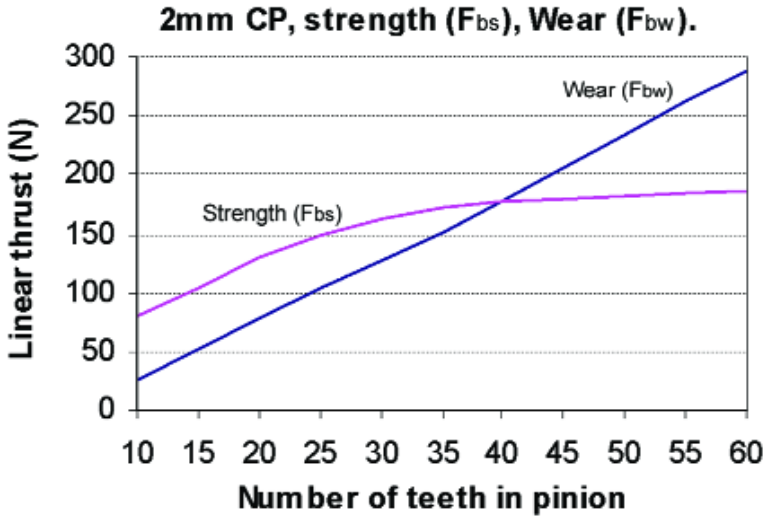
Linear speeds of up to 10 metres/second can be achieved with correctly installed rack and pinion systems. When specifying a system, care needs to be taken to ensure that the transducer count rates are not exceeded. With grease lubrication, care should be taken to ensure that the lubrication is not thrown off the pinion

2. Load Capacity

The following analysis is intended to give a guide to the load capacity of a rack system. To simplify the calculation a number of assumptions have to be made. In many applications this will give a conservative estimate of the gear capacity, therefore in critical applications an exact analysis must be completed. Please consult the relevant gear standards or Technical Sales.
The basic load capacity (F_b) of a rack and pinion is defined as the maximum linear force at which they can operate indefinitely.
F_b has two values: one calculated from tooth strength, (F_{bs}) and one for tooth flank wear (F_{bw}). The useful or transmitted load capacity, F_t, is usually less than F_b due to transient or dynamic loads generated within the mechanism.

For tooth root strength $F_{ts} = F_{bs}/K_a$ K_a&C_a = application factors
For tooth flank pitting (wear) $F_{tw} = F_{bw}/C_a$

Both calculations should be made and the lower value used.
The application factors K_a and C_a make allowance for any externally applied loads in excess of the nominal linear force F_b. These are most accurately determined by direct measurement application factors, consideration should be given to the fact that many prime movers develop momentary peak torques appreciably greater than those determined by the nominal ratings of either the prime mover or the driven equipment. There are many possible sources of overload which should be considered, including system vibrations, acceleration torques, overspeeds, variations in system operation and changes in process load conditions. Impact loads due to reversing across backlash can be significant in servo systems.
As a general guide application factors for a motor gear system range from 1.0 for uniform loads up to 1.75 where heavy shock loads are anticipated.



The previous graph has been calculated in accordance with AGMA 2001-B88 for a life of at least 10^8 load cycles, and a rack hardness exceeding 50HRc and pinion material 17-4PH. For alternative pitches and materials the graph values need to be modified as shown in the table below.

Pitch and Rack/Pinion material modification factors				
Rack	**Pinion**	**Pitch**	**Strength**	**Wear**
Hardened Round Rack (hardness>50HRc)	17-4PH	1	0.50	0.50
	316	1	0.23	0.10
	PEEK™ polymer	1	0.04	0.01
Rectangular Rack # (hardness 35-45HRc)	17-4PH	1	0.38	0.28
		2	0.75	0.56
		2.5	0.94	0.70
	316	1	0.23	0.10
		2	0.47	0.20
		2.5	0.59	0.25
	PEEK™ polymer	1	0.04	0.01
Tubular and Round Rack	17-4PH	1	0.23	0.10
	316	1	0.23	0.10
	PEEK™ polymer	1	0.04	0.01

For R5 a further reduction of 50% is required due to the thin face width

Example:
A 40 tooth, 1mm CP pinion material 316 meshing with rack of hardness <50HRc.
The application factors should be applied after the reduction for material and pitch.

$$F_{bw} = 175 \times 0.10 = 17.5N$$
$$F_{bs} = 170 \times 0.23 = 39.1N$$

3. Bearing Capacity

When linear bearings are used with the hardened round bar racks the capacity of the support bearings needs to be considered. Where possible the bearings should be positioned with all the ball rows running on the rack shaft. However, it is important that the balls do not run on the edges of the teeth. If necessary the 5 and 6 row bearings can be used with 1 row above the teeth. In this scenario, the manufacturer's ratings apply with a modification for the direction of the load application. The factors given in the following charts should be substituted for the bearing manufacturer's load reduction.

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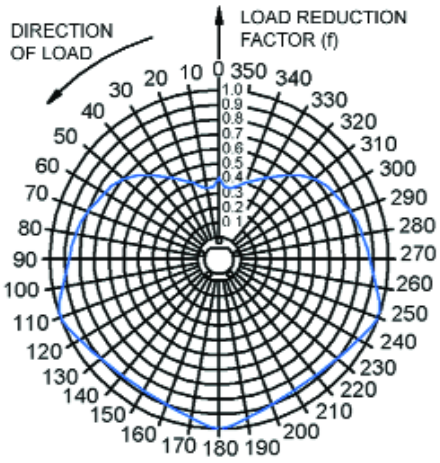
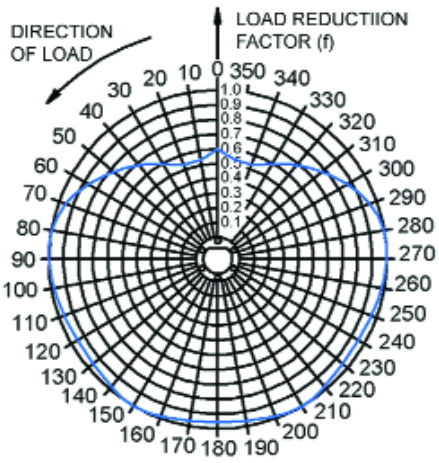
Closed bearing 5 rows of balls



Closed bearing 6 rows of balls



4. Lubrication

Lubrication is not required when using PEEK™ polymer pinions. For other combinations unlubricated systems are not recommended. Measurement applications should use a very thin coat of light oil, in many machine tool applications stray cutting oil is sufficient. Grease lubrication is recommended for higher loads, but care should be taken to ensure the lubrication is not thrown off the pinion at speed.

INSTALLATION

The installation techniques differ according to the type of rack. All racks should be mounted with teeth pointing downwards wherever possible so that dust etc cannot settle in them.

1. Soft Round and Tubular Rack

Plastic moulded bearings are recommended for use with soft round and tubular rack, these can be found in the Bearings and Spacers section of the Reliance catalogue. Round racks are not recommended for multi section use.

2. Hardened Round Rack

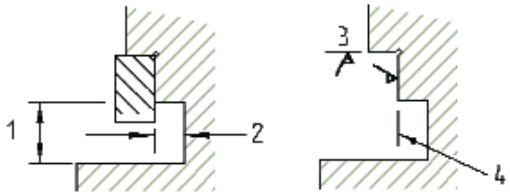
Bearings for the round bar rack should be fitted in accordance with the manufacturer's instructions. It is important that the balls do not run on the edge of the teeth. Suitable bearings can be found in the Linear Bearings section of the Reliance catalogue. Round racks are not recommended for multi section use.

3. Rectangular Rack

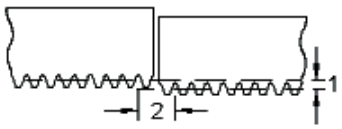
Reliance rectangular section rack is manufactured to enable butting to form infinite lengths. Socket head cap screws, plain washers and a thread locking adhesive are preferred for mounting. Dowels are not recommended. The pitch line of the rack must be constrained to be straight to obtain maximum accuracy. To avoid distortion, racks should be screwed to a machined flat surface.

Machining requirements for rack location

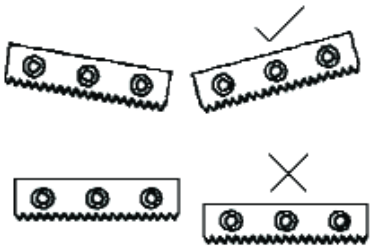
1. Pinion clearance
2. Clearance required if:
   a) anti-backlash pinions are used
   b) full face of rack is to be used
3. Abutment
4. Mounting face



To align racks, two adjustments need to be made, pitch line alignment and pitch adjustment. The pitch line straightness is not critical (see drawing below) but steps at the joints should be avoided as they can lead to excessive noise and wear.



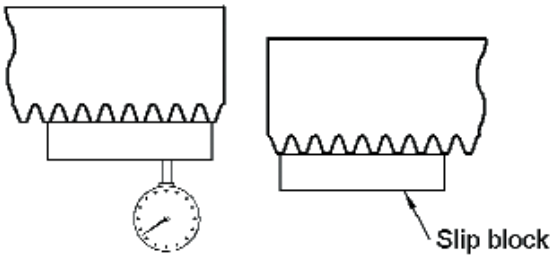
1. Pitch line alignment
2. Pitch adjustment and error compensation



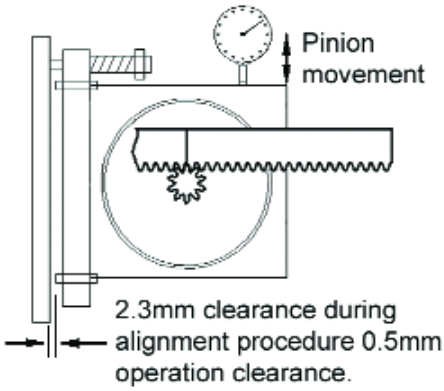
Pitch Line Alignment

There are three methods of setting the pitch line at a joint.These are:
i) Setting the base of the racks against an abutment perpendicular to the mounting face. The misalignment is then governed by the rack pitch line to base tolerance.
ii) Using the tops of the rack teeth as a reference. These are parallel to the pitch line within 0.008mm. Use a short straight edge (eg. slip block) as shown below.
iii) The best measurement of the pitch line is with the pinion installed on a Flexplate. A dial indicator fitted as shown gives a direct reading of the pitch line straightness.

Pitch line alignment using slip block



Dial indicator carried with Flexplate

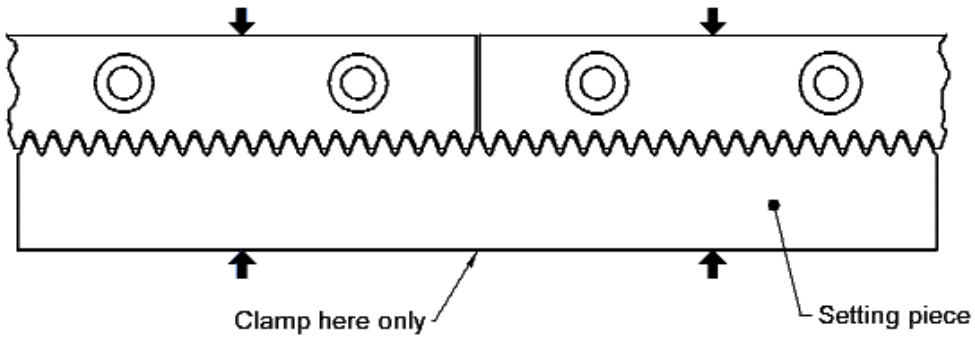


The Flexplate spring loads the pinion into mesh on both flanks of the teeth, ensuring complete backlash elimination. For more information on the Flexplate assembly please refer to the Rack Systems section of the Reliance catalogue.

Pitch Adjustment and Error Correction

Pitch accuracy can be obtained by one of three methods depending upon accuracy required.

GRADE 1 (and for the initial setting of all grades)
For pitch accuracy across the joint of ±0.020mm the Rack Setting Piece is the simplest method.



GRADE 2, 3 or 4
After initial setting and with the measuring system functioning, length bars may be used as references. Checks made against these allow adjustment to be made within the system resolution.

GRADE 3, 4 or 5
After initial setting and with the measuring system functioning, comparison should be made with a laser measuring system. This allows pitch adjustment and machine error compensation within the system resolution over the full travel of the axis.

RACK APPLICATIONS

Reliance precision rack is manufactured in both round and rectangular section, and can be used for both measurement and actuation. In general the smaller pitches (1mm) are ideal for measurement, as the smaller pinion diameter gives higher linear resolutions. The larger pitches (2mm and 2.5mm) allow a higher load capacity.

For most applications the rack can be used for both the feedback and the actuation. In very precise applications we recommend that an unused section of the actuation rack is used for feedback. Alternatively a separate rack can be used.

All Reliance racks are calibrated to measure correct at 20ºC using a temperature compensated laser. Calibration graphs can be supplied if required.

RACK ACTUATOR

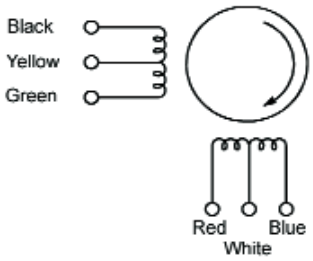
The rack actuator is supplied pre-assembled and should not be dismantled. The rack should not be removed from the housing. Any tampering with the assembly may result in the technical specification becoming invalid.

STEPPER MOTOR

The rack actuator is supplied as standard with a NEMA size 17 stepper motor, which conforms to the following specification:

Motor Size	Voltage V	Current A/phase	Resistance Ω/phase	Inductance mH/phase
17	4.0	0.95	4.2	2.8

Direction of rotation of motor resulting in downward movement of rack as shown:



This stepper motor has a minimum cable length of 200mm.

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Quality assured to BS/EN/ISO 9001, Reliance specialises in gears, gearboxes, assemblies and associated components which are used in instrumentation, measurement, diagnostic equipment and light actuation systems. Reliance aims to provide its customers with a single source for the design, production, assembly and testing of high quality mechanical components and electro-mechanical assemblies.

Standard Products
For over thirty years, Reliance has provided a standard range of precision mechanical components from stock or on short delivery. This service allows design engineers to order in small quantities at stock prices in order to develop prototypes effectively. Dedicated manufacturing facilities enable larger quantities to be supplied for full production requirements.

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Reliance also has over 350 square metres of clean room space for the assembly, wiring and testing of precision gearboxes, optical equipment and scientific instruments to customers' specifications. Particle counts in the clean rooms meet ISO 14644-1 Class ISO 7, but are readily adaptable to more stringent standards if required.

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