

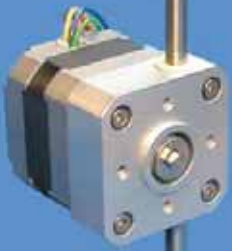


Reliance

Precision Mechatronics LLP

Precision Motion Control Components & Mechatronic Assemblies

Racks & Pinions



Reliance Standard & Customised Components



Racks & Pinions

Associated Products



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.



Fasteners

A wide range of stainless steel screws and fasteners available. Alternative materials also available.



Couplings

A range of precision flexible shaft couplings, manufactured from aluminium alloy. Bores from 1.5mm to 12mm as standard.



Bearings

Precision stainless steel ball bearings and bearing spacers with bores up to 10mm. Bronze and plastic plain bearings with bores up to 12mm available.



Product index

A general overview of Reliance's complete product range is available on the Reliance Precision Mechatronics LLP website at: www.rpmechatronics.co.uk

www.rpmechatronics.co.uk

Standard Product Sales : ☎ +44 (0)1484 601060 📠 +44 (0)1484 601061
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Page Title	Page
Round & tubular rack	2
Rectangular actuation rack	5
Rectangular rack	6
Rack pinions	8
Hardened rack pinions	12
PEEK™ polymer pinions	14
Tubular rack actuator	15
Application stories	19
Technical information	21
Assembly solutions	28
International sales representatives	29

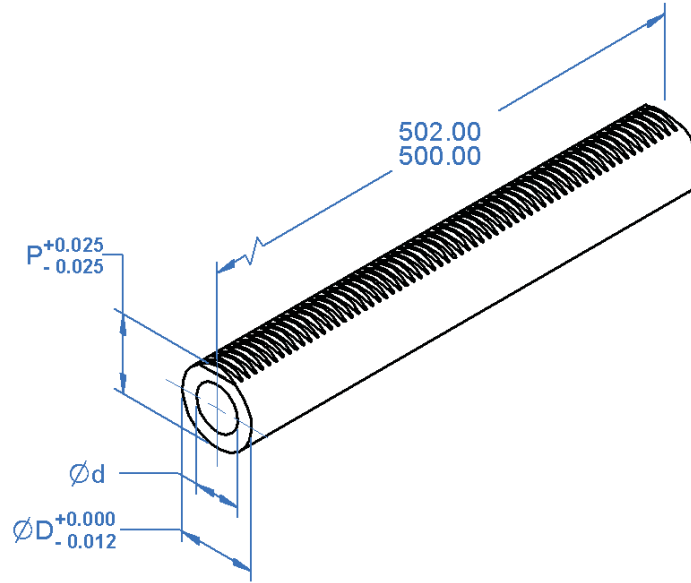


Tubular Rack

Ø6 - Ø10mm

General Information

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



Associated Products

PEEK™ polymer pinions - page 14
 Stainless steel pinions - pages 8 - 11
 Bearings
 Stepper motors

Or visit our online catalogue for associated products

Notes

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

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	

* Rack thrust based on meshing 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.
- High resistance to 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.



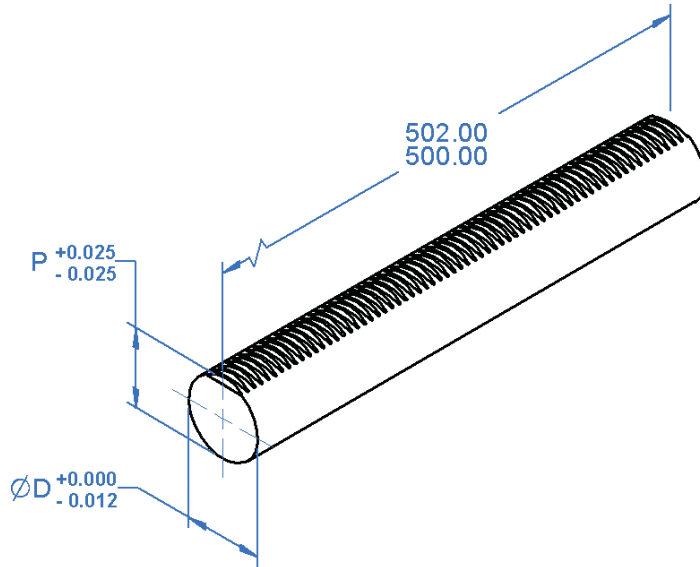
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Ø6 - Ø10mm

Soft Round Rack



General Information

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

Associated Products

PEEK™ polymer pinions - page 14
 Stainless steel pinions - pages 8 - 11
 Bearings
 Stepper motors

Or visit our online catalogue for associated products at:

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 meshing 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.
- High resistance to 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.



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Hardened Round Rack

Ø10 - Ø20mm

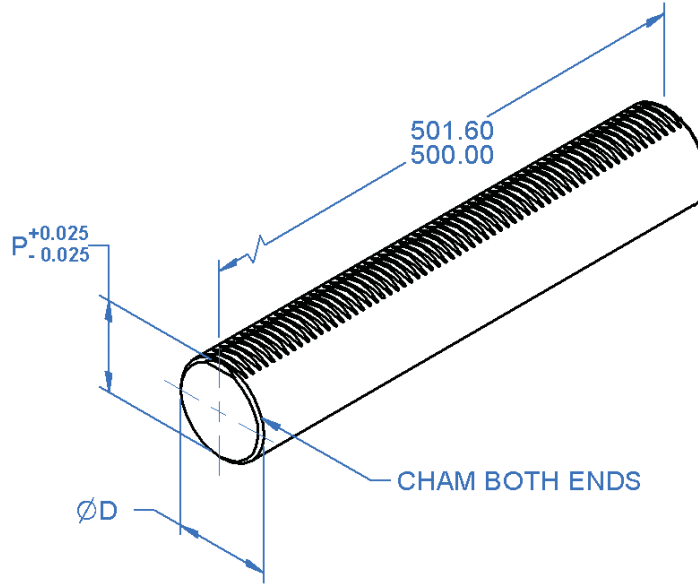
General Information

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°

Associated Products

Hardened rack pinions
 - pages 12 - 13
 Bearings
 Stepper motors

Or visit our online
 catalogue for
 associated products at:



Part number selection table

Part Number	Circular Pitch (mm)	Outer Dia ØD		Pitch Height P	Rack Thrust (N)
RR10-1M-500	1	10	+0.000 -0.011	9.682	60*
RR12-1M-500		12		11.682	
RR16-1M-500		16		15.682	
RR20-1M-500		20	+0.000 -0.013	19.682	

* Rack thrust based on meshing 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, page 22.)
- 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.



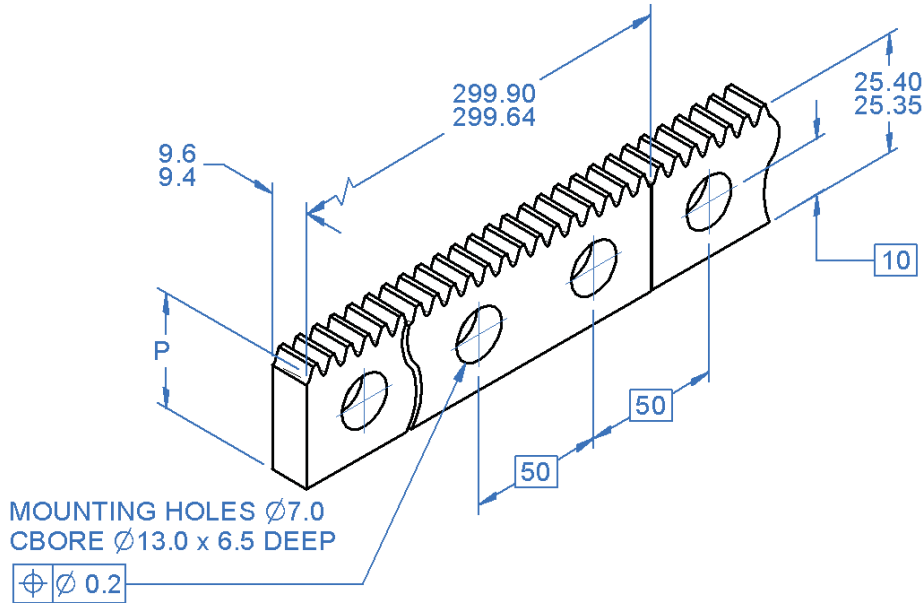
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9.5mm x 25.4mm

Rectangular Actuation Rack



General Information

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

Associated Products

Hardened rack pinions - pages 12 - 13
 Bearings
 Stepper motors

Or visit our online catalogue for associated products at:

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, maximum 500mm.
- Alternative pitches, including module.
- 25° pressure angle available.



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Rectangular Rack

7.5mm x 12.2mm

General Information

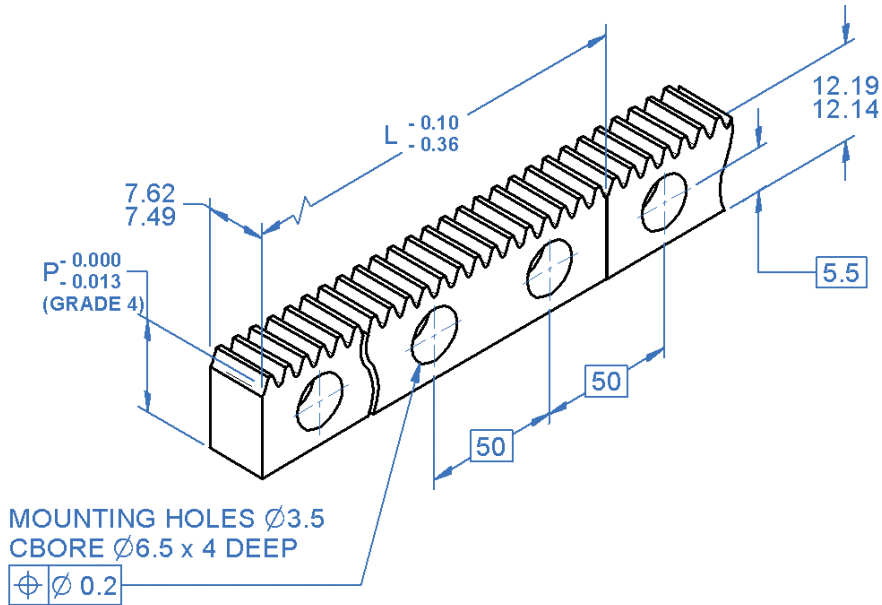
All dimensions in mm
 General tolerances:
 $\pm 0.13\text{mm}$
 Material:
 Stainless steel
 Grade 416
 Treatment:
 Hardened to
 35-45 HRC.
 Pressure angle 20°

Associated Products

Rack pinions
 - pages 8 - 13
 Fasteners

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 catalogue for
 associated products at:

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Part number selection table

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

- Cumulative pitch error less than 0.008mm per 300mm.
- Ground teeth, standard accuracy grade 4.
- Manufactured from 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 20 for alternative grades.

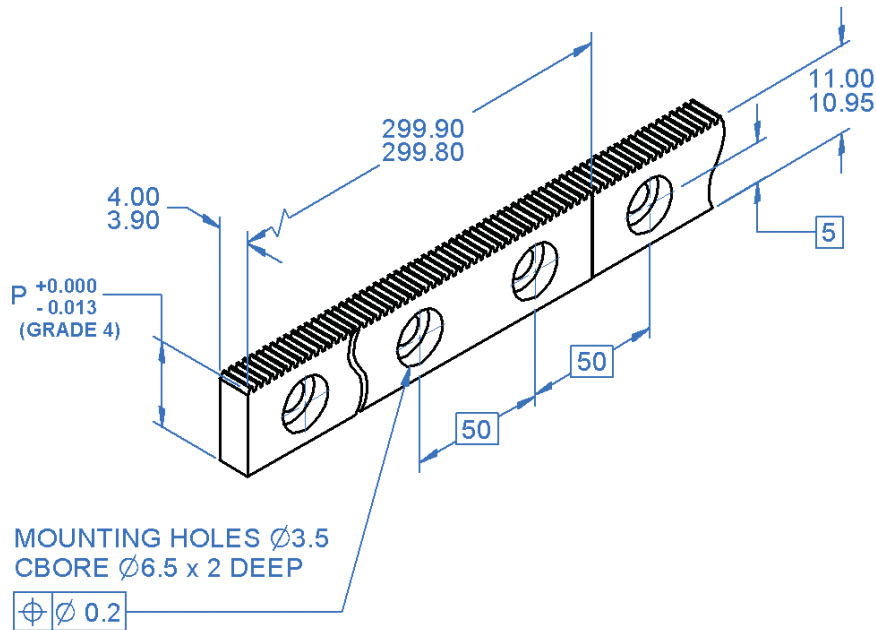


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4mm x 11mm

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°

Associated Products

Rack pins
 - pages 8 - 13
 Fasteners

Or visit our online catalogue for associated products at:

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 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 20 for alternative grades.



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Plain Rack Pinions

6mm & 1/4" Bore

General Information

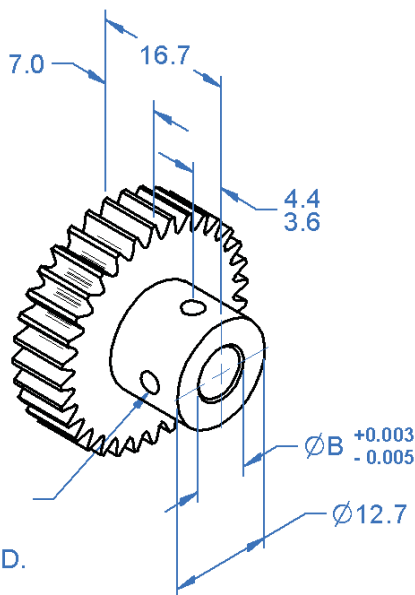
All dimensions in mm
 General tolerances:
 ±0.13mm
 Material:
 Stainless steel
 Grade 316
 Pressure angle 20°

Associated Products

Round racks
 - pages 2 - 3
 Rectangular Racks
 - Pages 6 - 7
 Flexplates

Visit our online catalogue for associated products at:

www.rpmechatronics.co.uk



Part number selection table

Example Part No:- **SH25MS2B6F7A- 32**

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

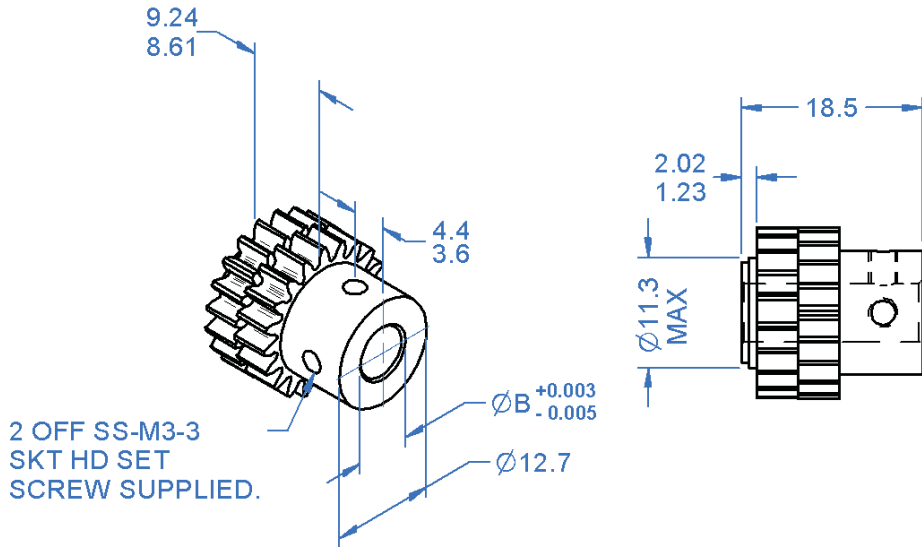
- Standard accuracy AQ10.
- Higher accuracy & zero backlash when used with Flexplate assemblies - see page 24.
- Ideal for use with Reliance soft & hardened, round & rectangular rack.

Non-standard options, please enquire....

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



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General Information

All dimensions in mm
 General tolerances: $\pm 0.13\text{mm}$
 Material: Stainless steel Grade 316
 Pressure angle 20°

Associated Products

Round racks - pages 2 - 3
 Rectangular Racks - Pages 6 - 7

Visit our online catalogue for associated products at:

Part number selection table

Example Part No:- **AH25MS2B6F89A- 20**

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



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Plain Rack Pinions

10mm & 3/8" Bore

General Information

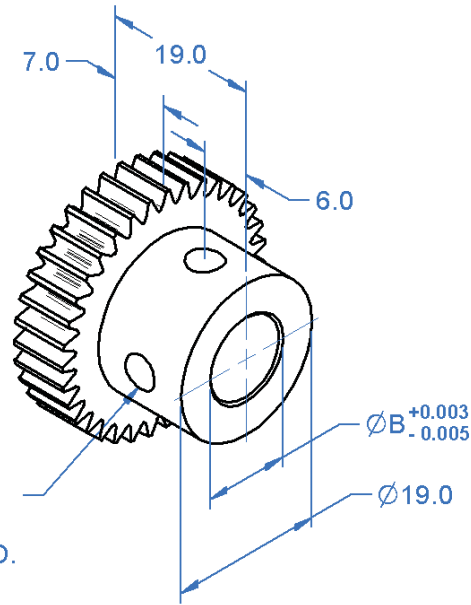
All dimensions in mm
 General tolerances:
 ±0.13mm
 Material:
 Stainless steel
 Grade 316
 Pressure angle 20°

Associated Products

Round racks
 - pages 2 - 3
 Rectangular Racks
 - Pages 6 - 7
 Flexplates

Visit our online catalogue for associated products at:

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Part number selection table

Example Part No:- **SH25MS2B10F7A- 32**

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

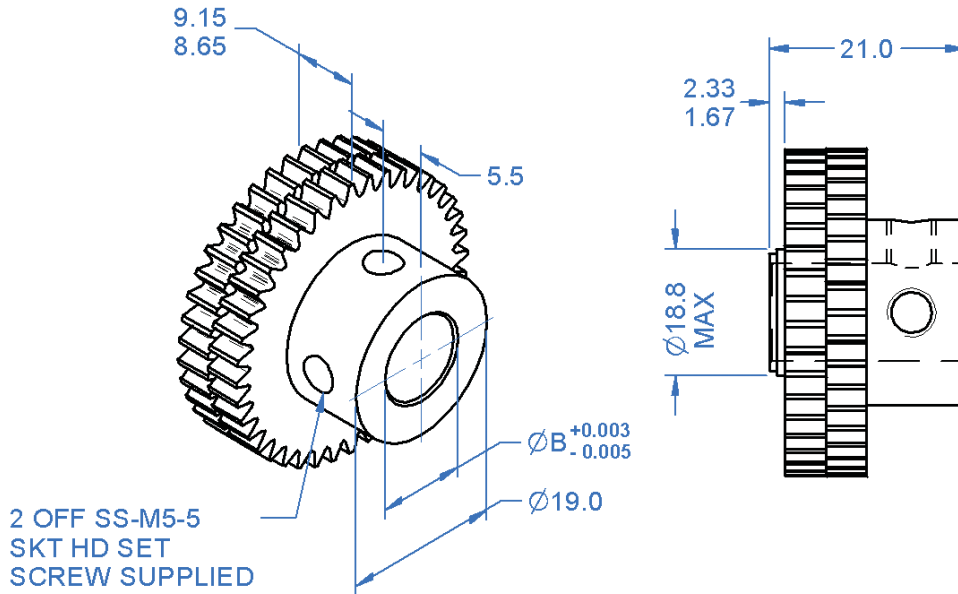
- Standard accuracy AQ10.
- Higher accuracy, zero backlash when used with Flexplate assemblies - see page 24.
- Ideal for use with Reliance soft & hardened, round & rectangular rack.

Non-standard options, please enquire....

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



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General Information

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

Associated Products

Round racks
 - pages 2 - 3
 Rectangular Racks
 - Pages 6 - 7

Visit our online catalogue for associated products at:

Part number selection table

Example Part No:- **AH25MS2B10F89A- 40**

Basic Part Number	Circular Pitch (mm)	Bore Size $\varnothing B$	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.



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Hardened Rack Pinions

6mm & 1/4" Bore

General Information

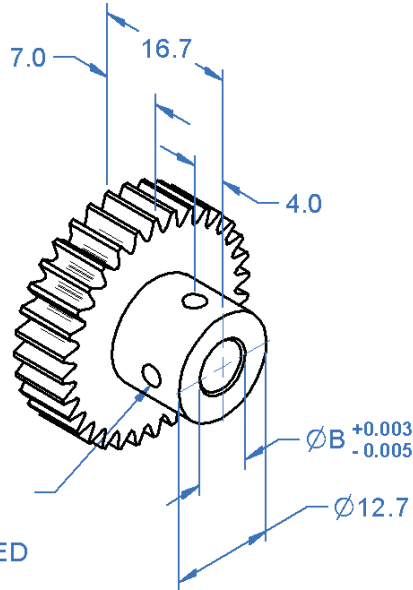
All dimensions in mm
 General tolerances:
 ±0.13mm
 Material:
 Stainless steel,
 17-4PH
 Hardened to:
 36/40 HRC.
 Pressure angle 20°

Associated Products

Racks - pages 4 - 7

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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 capacity 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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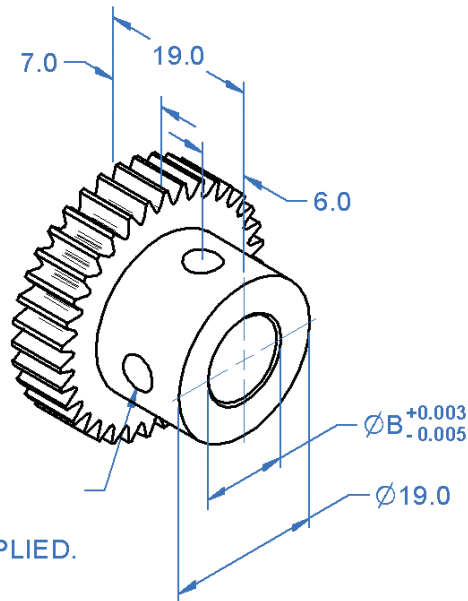
General Information

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

Associated Products

Racks - pages 4 - 7

Visit our online catalogue for associated products at:



Part number selection table

Example Part No:- **SH25MS9B10F7A- 35**

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

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- 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°

Associated Products

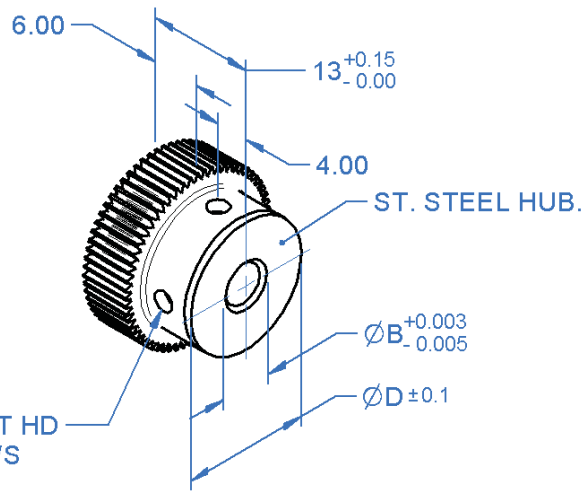
Round racks
 - pages 2 - 3
 Stepper motors

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 catalogue for
 associated products at:

Notes

PEEK™ is a trademark
 of Victrex PLC.

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Part number selection table

Example Part No:- **SH1MP1B4F6A- 35**

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

- Standard accuracy AQ10.
- Unique stainless steel insert for accurate non-slip attachment to shafts.
- Ideal for driving Reliance tubular rack for a low noise, lubrication free assembly - see page 2.

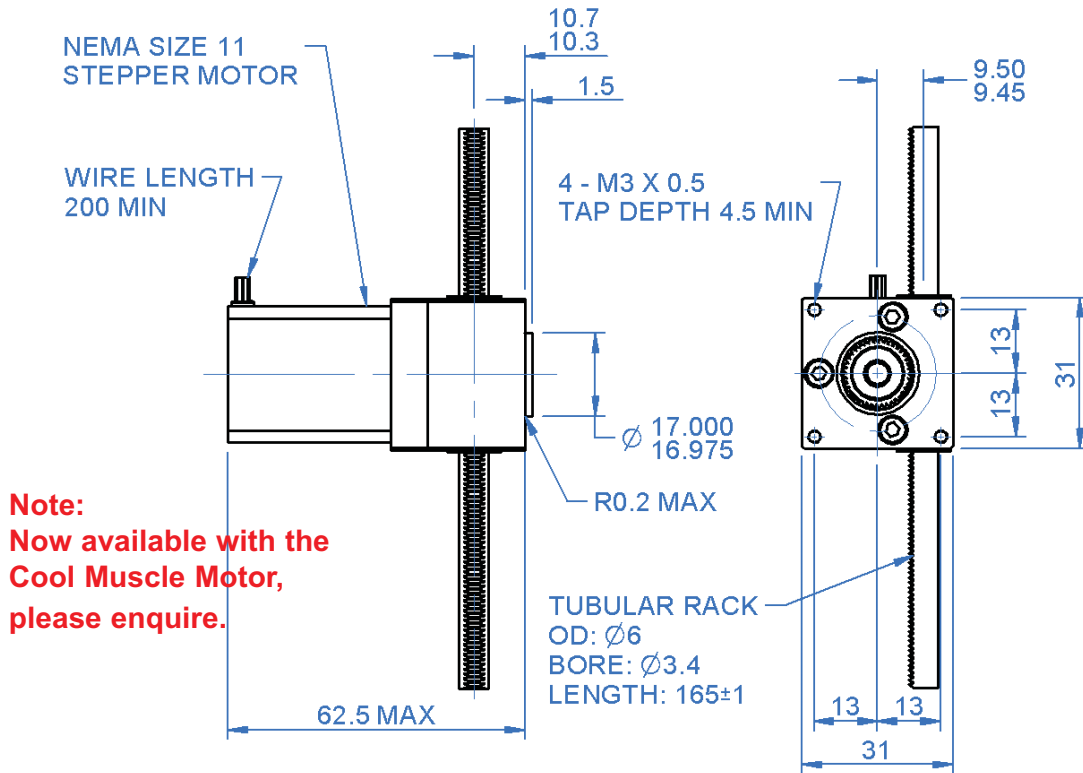
Non-standard options, please enquire....

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



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Note:
Now available with the Cool Muscle Motor, please enquire.

General Information

All dimensions in mm
General tolerances:
±0.13mm

Notes

* Please refer to note on page 18.

Part number selection table

Part Number	Rack Length	Rack Dia	Axial Load
RRA11-6-165	165 ±1	6	3N

Technical specification*

- Standard drive: NEMA size 11 stepper motor (catalogue part No. RSM11N1E2). See technical section, pages 26 - 27.
- Tubular rack: 6mm OD, 3.4mm bore, 165mm length, 316 stainless steel.
- Travel range: 130mm.
- 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: -20°C to +50°C.
- 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

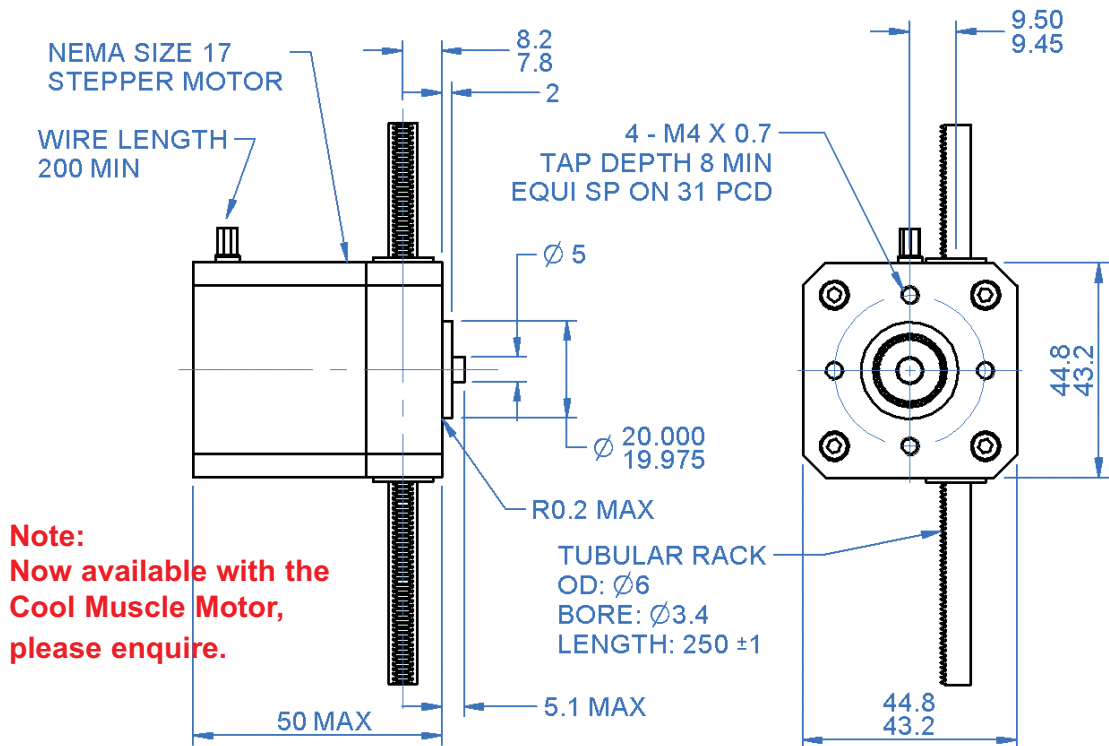
Size 17 Racktuator™

General Information

All dimensions in mm
General tolerances:
±0.13mm

Notes

* Please refer to note on page 18.



Note:
Now available with the Cool Muscle Motor, please enquire.

Part number selection table

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

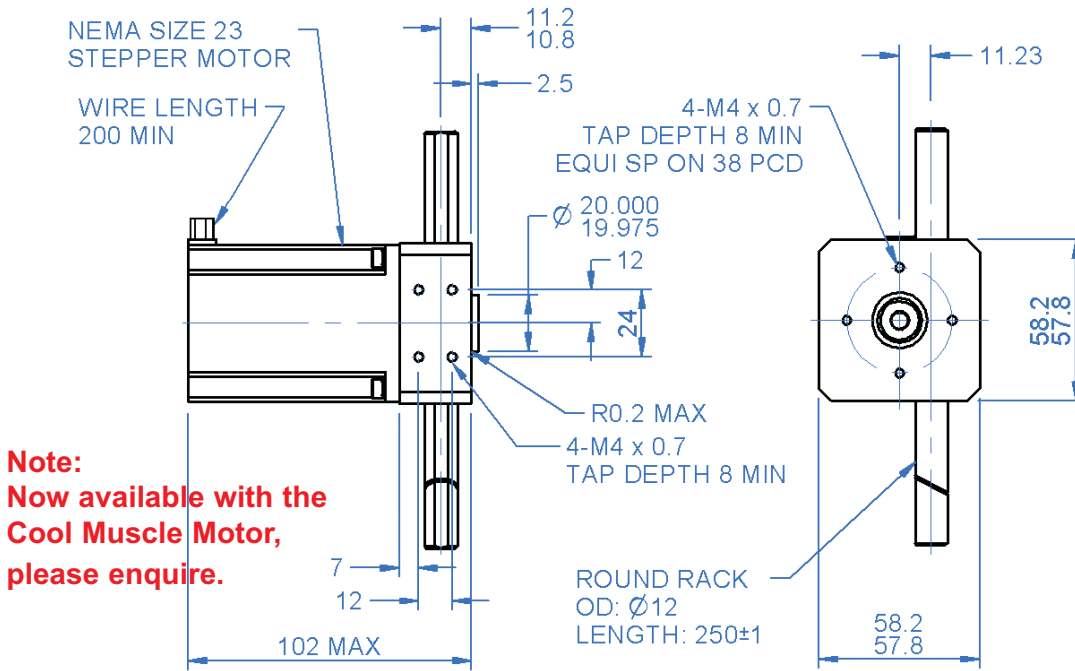
Technical specification*

- Standard drive: NEMA size 17 stepper motor (catalogue part No. RSM17N1E1). See technical section, pages 26 - 27.
- 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: -20°C to +50°C.
- 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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Note:
Now available with the Cool Muscle Motor, please enquire.

General Information

All dimensions in mm
General tolerances: ±0.13mm

Notes

* Please refer to note on page 18.

Part number selection table

Part Number	Rack Length	Rack Dia	Axial Load
RRA23-12-250	250 ±1	12	90N

Technical specification*

- Standard drive: NEMA size 23 stepper motor (catalogue part No. RSM23N3E7). See technical section, pages 26 - 27.
- Round rack: 12mm OD, 250mm length, hardened stainless steel.
- Mounting: front and side mounting possible.
- Travel range: 150mm.
- Max continuous axial load: 90N.
- Max speed: 200mm/sec.
- Resolution: 0.2mm with 200 steps/rev.
0.0031mm with microstepping (12800 steps/rev).
- Repeatability: 0.012mm.
- Temperature range: -10°C to +50°C.
- Life: 5 million cycles (based on 40mm stroke).
- Side wobble: max ±0.2mm. (measured 50mm from housing).
- Backlash: equivalent to less than 0.06mm linear movement.
- Smooth quiet operation. The rack and pinion is lubricated with a thin film of chemically inert vacuum grease.

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General Information

All dimensions in mm
General tolerances:
±0.13mm
Material:

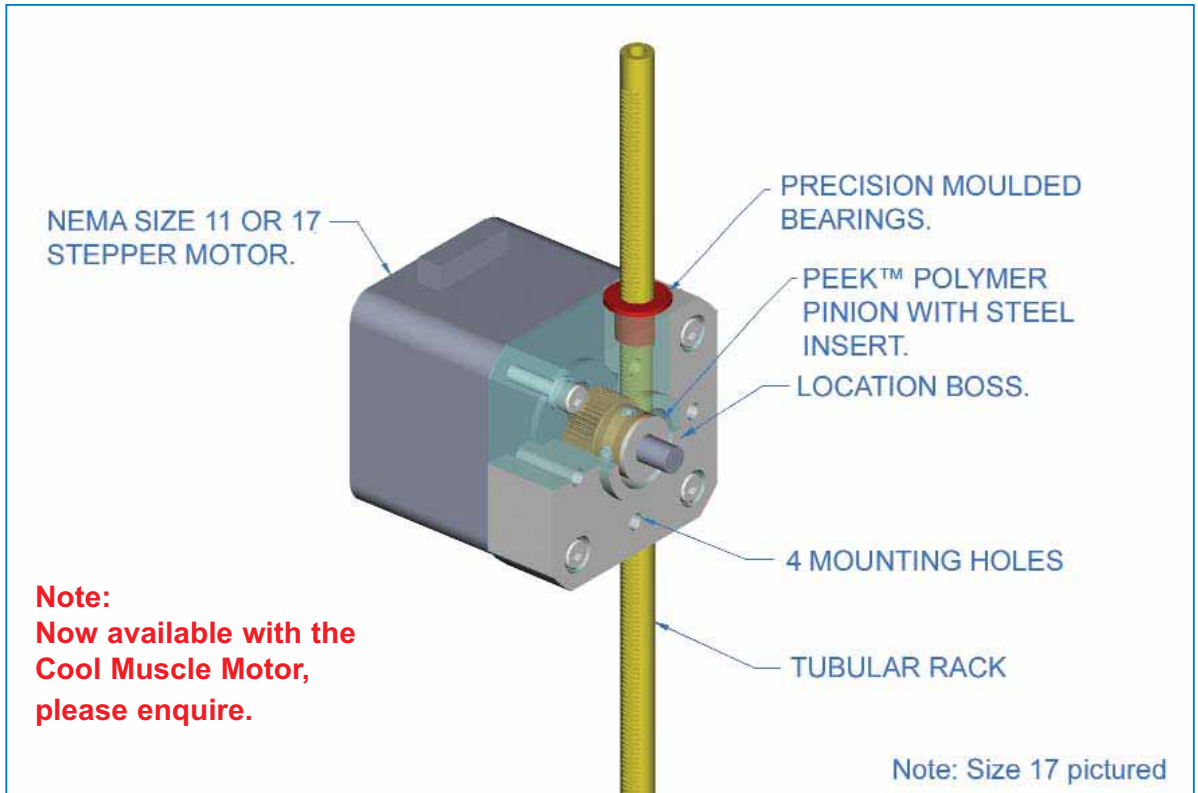
Associated Products

Visit our online catalogue for associated products at:

www.rpmechatronics.co.uk

Tubular Rack Actuator

Typical Applications



* 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.



Standard Product Sales : ☎ +44 (0)1484 601060 📠 +44 (0)1484 601061
www.rpmechatronics.co.uk sales@rpmechatronics.co.uk

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Reliance tubular rack helps Swiss engineers break new ground with their robotic sampling station.

When engineers at an innovative medical equipment manufacturer in Switzerland were designing their new robotic sampling station, they needed a miniature, accurate linear actuation system that would comply with rigorous worldwide medical requirements.

The Swiss company approached engineers at Reliance Gear Company of Huddersfield because of their expertise in this field. Reliance had no hesitation in recommending the use of tubular rack, one of their specialist components, in the design, knowing that it could benefit their customer in many ways.

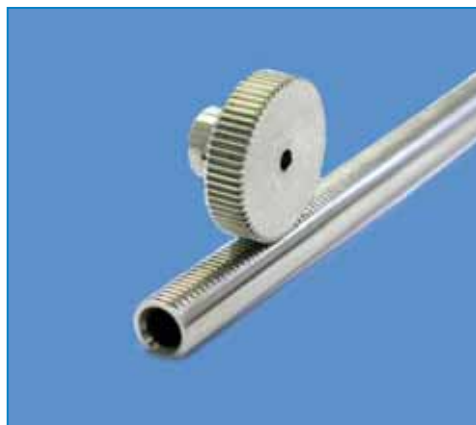
Reliance tubular rack is a stainless steel linear tube with helicoidal teeth. It is both a drive component and a bearing surface. By using it for the Z-axis of the machine, smaller drive components could be used on the Y-axis. This gave room for more pipetting space on the machine and made it more efficient. Attaching the pipetting head to the machine did not pose a problem, as Reliance could offer a variety of interfacing methods (screw threads, bores, slots etc) for their customer to choose from.

The Swiss engineers also needed to avoid possible human contact with sampling materials or re-agents when the machine was in use. Tubular rack provided the ideal solution, because the fine pitch module on the outside of the tube which formed the z-axis meant that a relatively large inner bore was available, through which the wiring and liquid supply tube could be threaded.

Reliance's range of standard products, coupled with its rapid prototyping and test facilities, was also highly significant for their customer. Proof of principle for the design was easy to establish using off the shelf products, which eliminated the need for expensive tooling and testing during the prototype stage.

Once proof of principle was established, Reliance worked closely with the Swiss engineers to source the most cost effective raw material from which to manufacture the tubular rack without loss of performance, giving their customer the price point they needed for production quantities.

Reliance tubular rack is used by many different manufacturers/designers of sampling stations around the globe and is available in a large variety of sizes or modules.





Not just racks and pinions but so much more!

For over fifty years Reliance has been well known for supplying precision fine pitch racks and pinions for instrumentation and light actuation, but the company is not just another catalogue supplier of racks and associated components. Reliance offers so much more.....

Reliance consists of Reliance Precision Ltd (formerly Reliance Gear Company Ltd) and its sister company Reliance Precision Mechatronics LLP.

Formed in 2005 to distribute Reliance's standard product range, Reliance Precision Mechatronics LLP offers small quantities at stock prices for cost effective prototype development. To complete the customer service package the company can also:

- predict the performance of its standard components in your application
- specify associated components for your design
- modify standard components to suit your requirements
- offer unique solutions from proven concepts

A team of dedicated mechatronic design engineers is on hand to support customer design requirements and develop turnkey mechatronic solutions.

Reliance Precision Limited offers, in-house design, manufacture, assembly and test all under one roof. With dedicated manufacturing facilities the company can supply production quantities of customised components and, in many cases, provide full assembly support to its customers including:

- design for manufacture
- weight critical design and analysis
- safety critical design and analysis
- prototype manufacture
- life validation testing
- repair service and obsolescent management



Quality assured to BS EN ISO 9001:2000 and the aerospace standard AS 9100 Revision B, Reliance is committed to providing the highest quality in terms of both manufacture and service.

Reliance is certified to the environmental management standard BS EN ISO 14001:2004

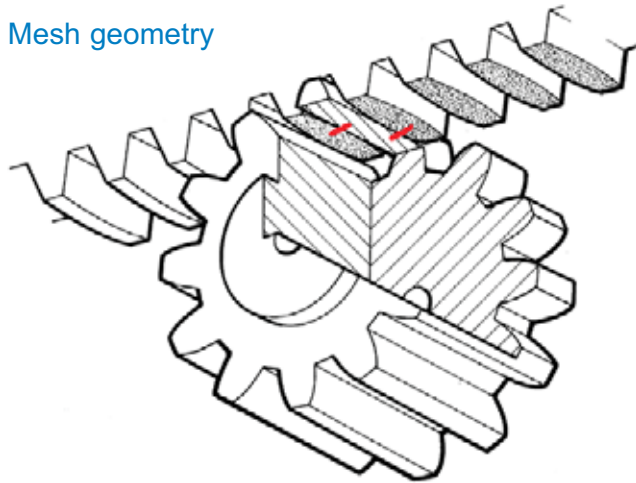


RACK MANUFACTURE

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 0.25°) 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 20°
25° 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 lengths >300mm

All dimensions in mm

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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.

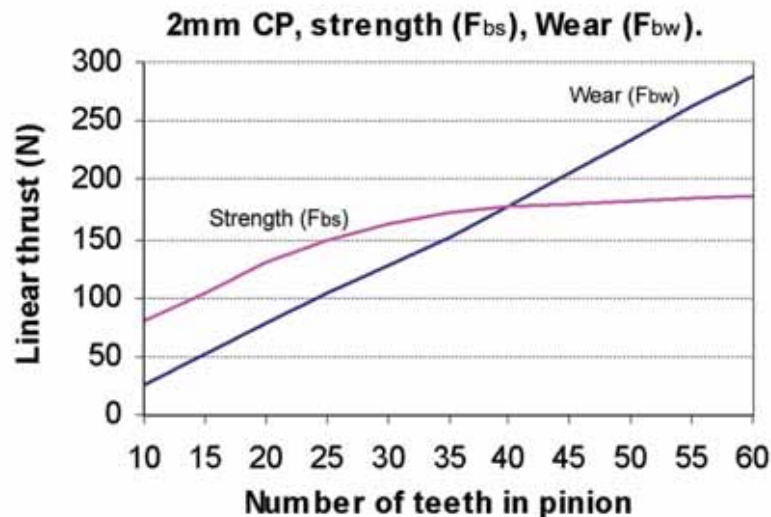
For tooth root strength $F_{ts} = F_{bs}/K_a$ $K_a \& C_a =$ application factors

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 10⁸ 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.

$$F_{bw} = 175 \times 0.10 = 17.5N$$

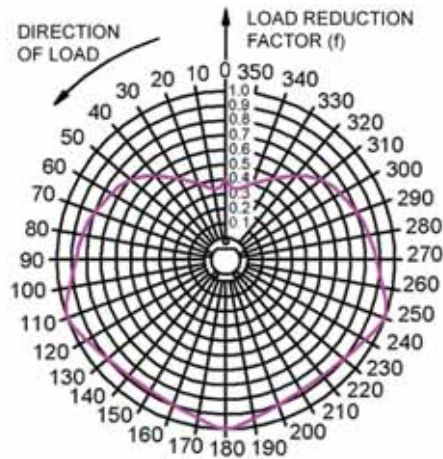
$$F_{bs} = 170 \times 0.23 = 39.1N$$

3. Bearing Capacity

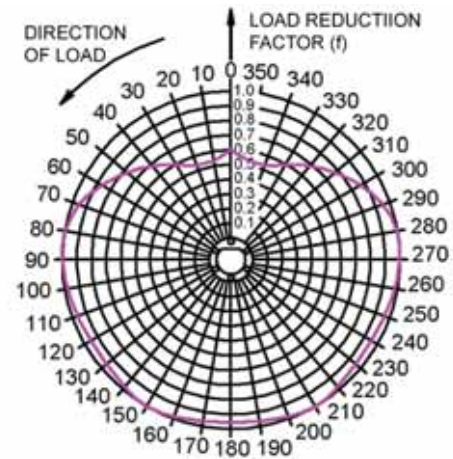
When linear bearings are used with the hardened round bar racks the capacity of the support bearings needs to be considered. Where possible the bearings should be positioned with all the ball rows running on the rack shaft. However, it is important that the balls do not run on the edges of the teeth. 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.



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.

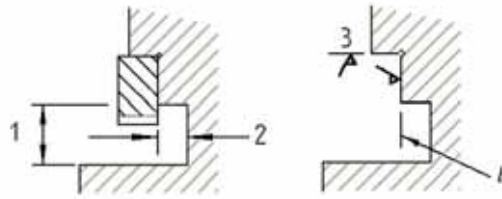
3. Rectangular Rack

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.

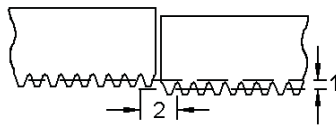


Machining requirements for rack location

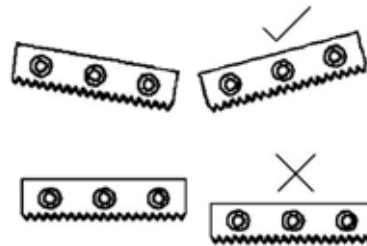
1. Pinion clearance
2. Clearance required if:
 - a) anti-backlash pinions are used
 - b) full face of rack is to be used
3. Abutment
4. Mounting face



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

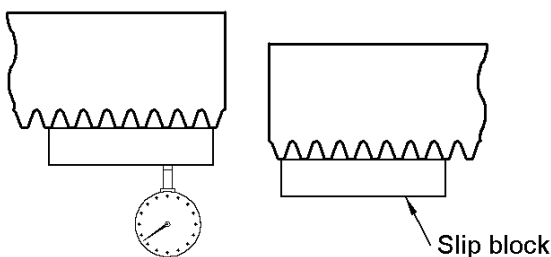


Pitch Line Alignment

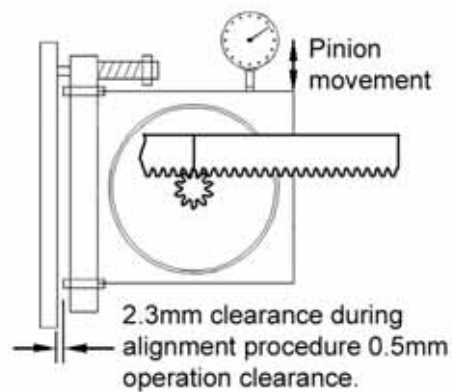
There are three methods of setting the pitch line at a joint. These are:

- 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 enquire.

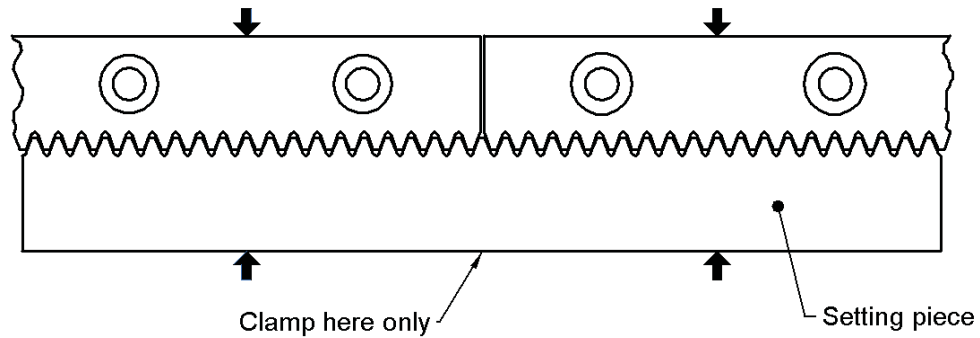


Pitch Adjustment and Error Correction

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 $\pm 0.020\text{mm}$ 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 20°C 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.

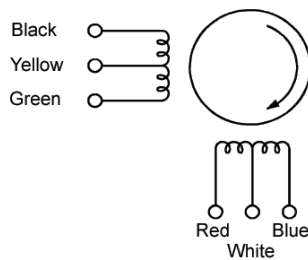


STEPPER MOTOR

The rack actuator is supplied as standard with a NEMA size 11, 17 or 23 stepper motor, which conforms to the following specification:

Motor Size	Voltage V	Current A/phase	Resistance Ω/phase	Inductance mH/phase
11	2.6	0.95	2.7	1.2
17	4.0	0.95	4.2	2.8
23	8.2	1.00	8.2	14.0

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



This stepper motor has a minimum cable length of 200mm. For more information, please visit our website at www.rpmechatronics.co.uk.

www.rpmechatronics.co.uk

Note - As a result of continuous product development, Reliance reserves the right without prior notice to change dimensions where this does not affect the function of the item. Please visit our website for the latest product news and developments.



Racks & Pinions

Assembly Solutions

Typical assembly solutions using Reliance modifiable standard parts, available from our current catalogues. Please enquire for further details.

Pipetting System

Tubular rack 1mm pitch, Ø8mm tube 500mm long. RRT08-1M-500		PEEK™ polymer pinion 1mm pitch, 50 tooth PEEK™ polymer pinion. SH1MP1B5F6A-50	
Moulded plastic bearing* Flanged, self lubricating, thermoplastic bearing. BM9-8		Stepper motor* Size 17, with integrated electronics. RCM1-C-17L30	

Round Rack Actuating System

Hardened round rack 1mm pitch, Ø12mm, 500mm long. RR12-1M-500		Hardened rack pinion 1mm pitch, 50 tooth hardened pinion. SH1MS9B250F7A-50	
Linear bearing* Corrosion resistant linear bearing with 4 ball circuits. MRL-12		Stepper motor* Size 23, with integrated electronics. RCM1-C-23L30	

Linear Measuring System

Rectangular rack 2mm pitch, ground helicoidal rack, 600mm long. R11-2M-600		Anti-backlash pinion 2mm pitch, 26 tooth anti- backlash pinion. AH2MS2B6F89A-26	
Fixing screws* Plain skt hd. M3 machine screws, 10mm long. S-M3-10		Optical encoder* 2000 line count optical encoder. R0D426E-2000	

* Indicates the item is available, but not shown in this brochure.

Please note that the above pictures specified are for guidance only, actual items may differ slightly.

For more information, please email our sales team at sales@reliance.co.uk or visit the Reliance online catalogue at www.rpmechatronics.co.uk.



International Sales Representatives

**Benelux, Denmark, Austria,
Germany, Switzerland**

Reliance Holland
Klaroenring 217
4876 ZE Etten - Leur
Noord - Brabant
Netherlands
Tel: +31 (0) 76504 0790
Fax: +31 (0) 76504 0791
e-mail: jb@reliance.co.uk

France

Reliance France
33 Rue Racine
11000 Carcassonne
France
Tel: +33 (0)468 470589
Fax: +33 (0)468 471772
e-mail: ph@reliance.co.uk

Australia

Reliance Australia
21 Jubilee Street
Stones Corner
Brisbane 4120
Queensland
Australia
Tel: +61 (0)7 3847 8694
Fax: +61 (0)7 3847 8670
e-mail: gmrq@bigpond.net.au

Hong Kong

Reliance Hong Kong
Kowloon
Hong Kong
Tel: +852 60971149
e-mail: ajw@reliance.co.uk

For our full range of standard and customised components and a complete overview of Reliance's manufacturing capabilities, visit the Reliance website at:

www.rpmechatronics.co.uk

www.rpmechatronics.co.uk

About Us

Reliance Precision Mechatronics LLP, a sister company to Reliance Precision Limited, was established in 2005 as the distribution arm of the business. In addition to distributing Reliance's existing standard product range, the company aims to design and develop market focused, fully integrated mechatronic assemblies.

Standard Products

For over forty 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.

Reliance Precision Limited (formerly Reliance Gear Company Limited)

Founded in Huddersfield in 1920, Reliance has been under current ownership since 1955. The company specialises in gears, gearboxes, assemblies and associated components 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. 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.

ISO 9001

Reliance Precision Limited and Reliance Precision Mechatronics LLP are both quality assured to BS/EN/ISO 9001:2000.



Reliance

Precision Mechatronics LLP

Precision Motion Control Components & Mechatronic Assemblies

Rowley Mills, Penistone Road, Lepton
Huddersfield, HD8 0LE, England.

Tel: +44 (0) 1484 601002

Fax: +44 (0) 1484 601061

www.rpmechatronics.co.uk

e-mail: sales@rpmechatronics.co.uk