POWERJACKS

PRECISION ACTUATION

POWERAM
Linear Actuators

Unified Design for Standardised Machine Building

POWERJACKS

Best engineered solution for precision linear actuation, power transmission & jacking systems.

Capability

OUR EXPERTISE HAS BEEN BUILT ON A HISTORY OF MORE THAN 100 YEARS OF ENGINEERING, CRAFTSMANSHIP, VISIONARY DESIGN, QUALITY MANUFACTURE AND CUSTOMER CARE.

Power Jacks is a manufacturing/engineering company specialising in the design and manufacture of actuation, lifting and positioning solutions for applications in Industrial Automation, Energy, Defence, Medical, Transport, and the Civil Engineering sectors.

Headquartered near Aberdeen in the UK, the company is the UK's largest screw jack manufacturing facility, that uses the latest engineering technologies to deliver quality products (ISO 9001) that offer reliability, performance and economy.

Power Jacks deliver this high quality service in a safe (ISO 45001) and environmentally friendly (ISO 14001) working environment thanks to the highly trained, flexible and motivated teams that work throughout the business driving the company to higher levels of performance.

We know our customers demand our engineering expertise to help find a solution for their applications. We take pride in designing and delivering the best solution using standard or special designs that help improve your business.

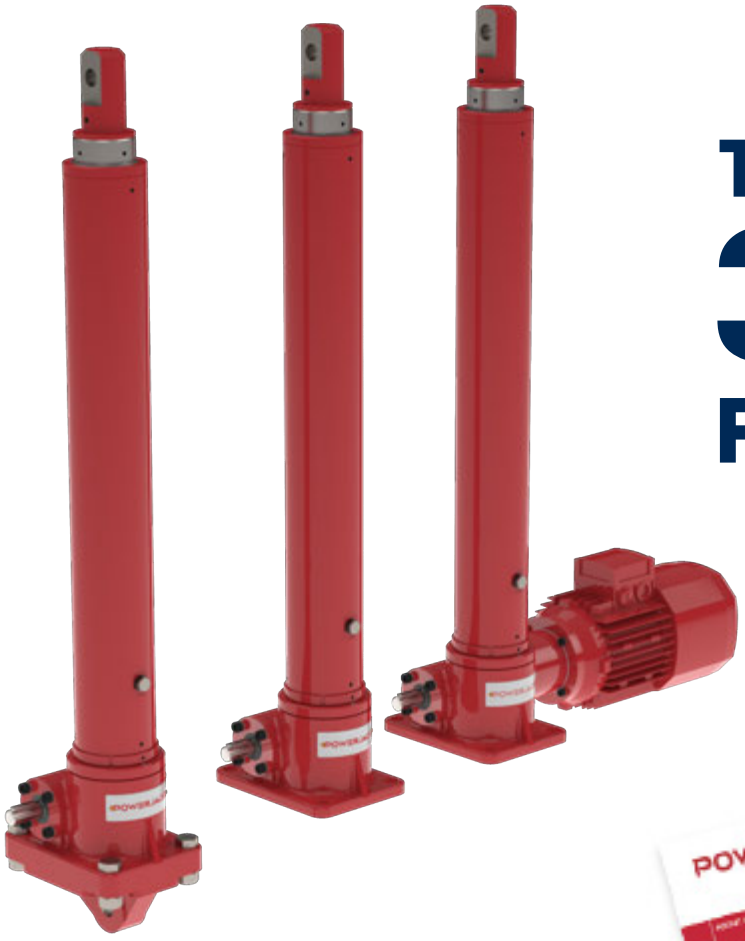
Our Vision is to become the partner of choice for our products globally
Our Mission is to provide high quality lifting & positioning solutions.

Global Reach

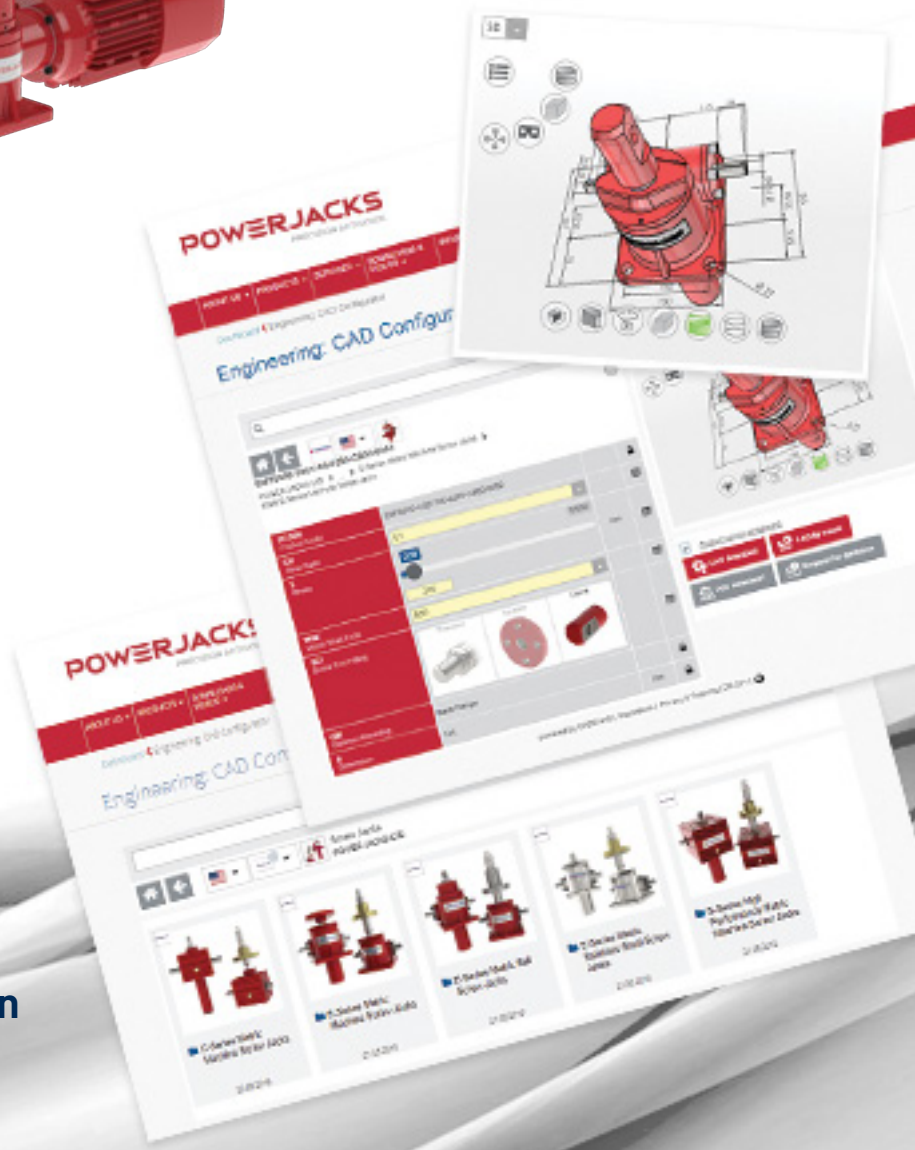
Power Jacks has local representation in 26 countries and supplies its products to more than 80 countries worldwide.

A global reach with a local service as we work closely with our customers to ensure the best solution for all their Electro-Mechanical solution applications.

Headquarters & Factory
Local Power Jacks Sales Offices
Local Representative

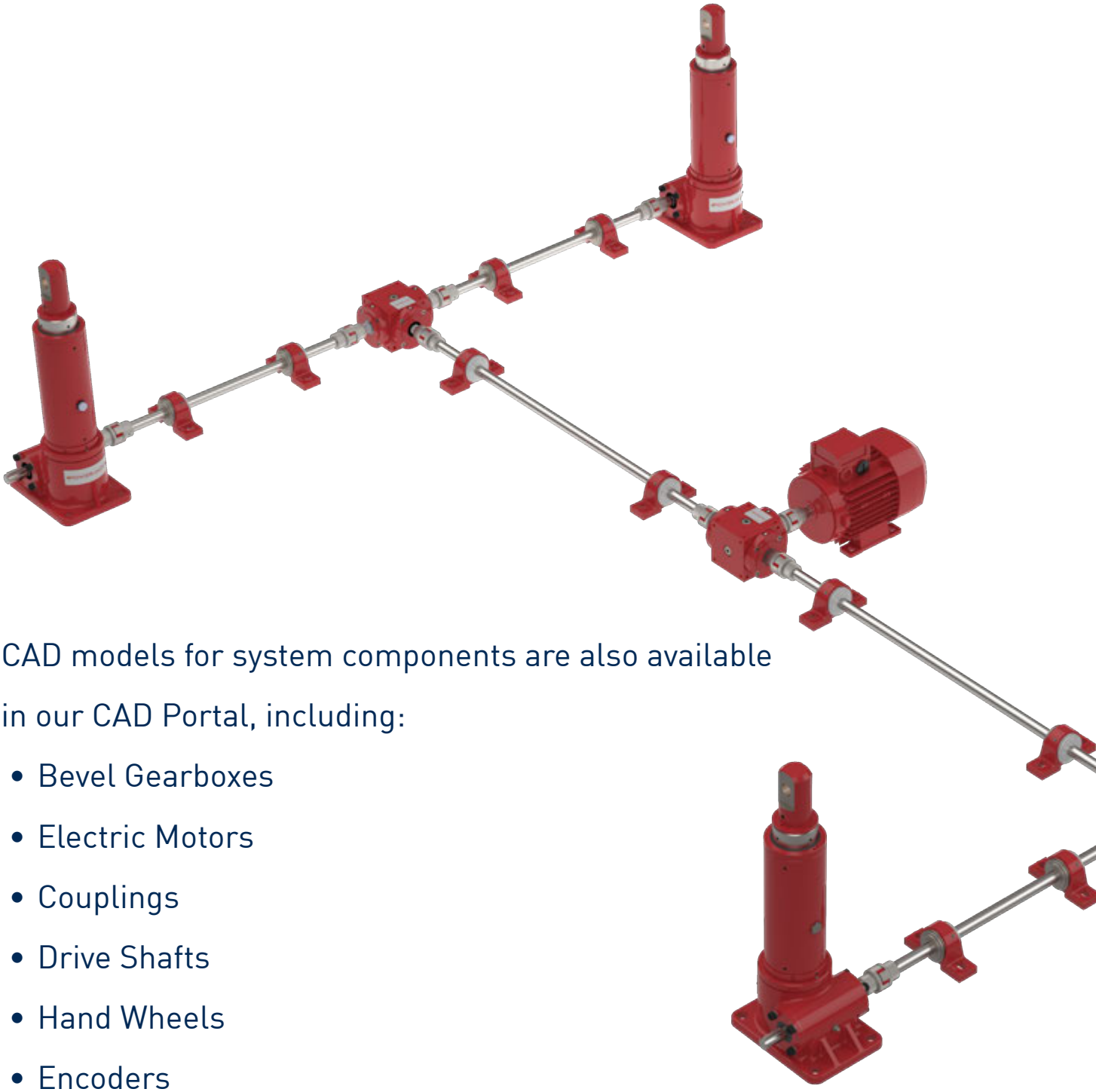


TRY OUR 3D CAD PORTAL



- 3D CAD Models
- 2D CAD Drawings
- Dimensioned Data Sheet
- POWERAM CAD Coming to Portal September 2025.
- **POWERAM CAD available on 24hr email request service prior to Portal release.**

BUILDING A SYSTEM?



CAD models for system components are also available in our CAD Portal, including:

- Bevel Gearboxes
- Electric Motors
- Couplings
- Drive Shafts
- Hand Wheels
- Encoders
- Rotary Limit Switches

or just ask our engineering team to build it for you !

Note:
1. Designs subject to change without notice.
2. All colours for illustrative purposes only.

NEED HELP SELECTING A GEARBOX? THEN TRY OUR PRODUCT SELECTOR

Just enter your application details and the Product Selector will recommend a suitable product with a calculation summary and links to the associated CAD and Data Sheets. An ideal tool if you are not familiar with the products or need answers fast.

Benefits of Electro-Mechanical Solutions

Our products have the advantage over hydraulics of improved performance, effectiveness, reliability and safety while at the same time lowering downtime and costs. Simple to install and easy to control our products support the move to fully electro-mechanical systems.

Advantages of Electromechanical Systems Over Hydraulic Systems

- Simplified System Design
- Reduction in Number of System Components
- Lower System Weight
- Reduced Energy Consumption
- High Reliability
- Fast & Easy Installation
- Simplified & Low Maintenance
- Reduction in Operation & Lifetime Costs
- Reduced Fuel Costs for Mobile Applications
- No Hydraulic Fluid Leaks
- No Hydraulic Fluid Contamination
- Increased Reliability
- Improved Personnel Safety
- Easy to integrate to control system
- Easy connection to backup power systems
- Excellent Long-Term Storage
- Better and More Data for System Analysis
- System Longevity Improved

Reduced Weight and Energy Consumption

Electro-mechanical systems only require one energy conversion compared to two with a hydraulic system. This eliminates the weight of the components that do the second conversion (including hydraulic power pack, connections & fluid). Plus, electro-mechanical systems only consume power while being used (e.g. actuator holding load & position) compared to the continuous power drain of a hydraulic pump.

Improved Performance Through Better Effectiveness and Reliability

Integration with control systems is simpler and easier with electro-mechanical systems. Plus, their feedback devices increase the quantity and quality of data in real-time for precise and accurate control. This provides the vital data for diagnostic systems for simple and fast fault finding that can be continuously monitored. Far better than the indirect feedback data from hydraulic systems.
By reducing the number of components in a system, electro-mechanical solutions simplify design, reduce the risk of system failure and improve reliability.

Reduced Installation, Downtime, Maintenance & Lifetime Costs

The reduced number of components and complexity of an electro-mechanical system allows for faster and lower cost installation. This is also reflected in the maintenance costs due to fewer components, fewer wearing parts and the elimination of pressure drop issues. Personnel training and costs are simplified and reduced as only an electrical and mechanical skill set is required removing the need for the extra hydraulic skill set. All of this helps to keep the systems in service with minimal downtime and lower lifetime costs.

Increased Reliability and Safety

The elimination of the use of hydraulic fluid means the risk of hydraulic fluid leak is removed, improving both reliability and safety. Personnel health is improved as no risk of hydraulic fluid exposure via skin contact, eye contact, inhalation and ingestion. The electro-mechanical systems allow for simpler and easy integration into backup power system should the application require them.
Also the long term viability of a system is improved by using Power Jacks proven technology that is fully supported for spares, repairs and replacements should they be requires.

Powerful, Smooth and Precise Linear Motion

POWERAM is an industrial precision Electro-Mechanical Linear Actuator that is enabling engineers to quickly and easily:

- Automate a manual system
- Improve Performance by Switching from Hydraulics to Electro-Mechanical
- Upgrade a screw jack to a linear actuator

Our POWERAM electro-mechanical linear actuators are designed for low to medium duty applications, with loads up to 200kN as standard. Loads up to 1000kN are available on request.

They consist of either a trapezoidal or ball type lead screw, with worm gearing that is driven by an electric motor directly or linked to one via a system drive shaft. The lead screw converts the rotary motion into linear movement. As the screw rotates, the nut travels along the screw extending and retracting the ram, which is attached to the load.

The POWERAM Linear Actuator Range

A design for every occasion thanks to 3 main POWERAM versions

1. Machine Screw – Typically for Intermittent duty
2. Stainless Steel – High corrosion protection, intermittent duty
3. Ball Screw – normally used for medium to high duty or high speed or low power consumption applications

Where the standard range does not meet the application specification, special actuators can be designed to meet customers' specific requirements.

The Unified Design of the POWERAM Linear Actuator Range aids standardisation of machine building design, as the three main variants (above) share the same dimensions*.

*excluding models LBA0100 & LBA0200 with lead option-2 specified.

POWERAM Actuator Benefits

Unified Design Helps Machine Builders Standardise System & Machine Design

The 3 POWERAM actuator designs use the same common housing for all screw type options. This allows system builders to alter the performance of the actuator and their system while maintaining the same dimensions for the actuator.

High Corrosion Resistance with Stainless Steel Version

A complete stainless steel version is available as standard using our proven marine and subsea technology.

Easy upgrade from screw jack to POWERAM

Both POWERAM and E-Series use the same worm gearbox design for each nominal capacity size, which provides an easy upgrade path.

Proven Gearbox Technology

The actuators use a precision worm gear set that has proven it effectiveness in millions of our E-Series screw jacks.

Precision Lead Screw

Either a precision thread whirled trapezoidal machine screw or rolled ball screw are used for the lead screw in the actuators that have been proven in demanding industrial actuation projects worldwide.

Motorised or Non-Motorised Options.

Add an electric motor to the base POWERAM unit by just add the corresponding IEC motor adapter & coupling to one of the actuators free worm shafts. For integrated geared motors just ask, as these can be fitted on request using parallel, in-line or right-angled geared motors with a performance to suit the application.

Easy Integration into Control Systems

POWERAM actuators can be equipped with standard industrial feedback devices, such as limit switches and encoders.

Modular Building System For Actuators

Create the actuator you need with our modular actuator building system. If you need more features and options, then just ask and we'll make them for you.

Quality by Design

High quality is built into every POWERAM from the initial design concept through to high volume production thanks to our effective ISO9001 certified quality system.

Robust Design

Designed and manufactured to survive the toughest of industrial environments.

Build Actuator Systems – Mechanically Linked or Electronically Synchronised

With two free drive shafts as standard, you can easily mechanically link multiple units together just the same as our popular jacking systems. If there is no room for mechanical shafts then the actuators can be individually motorised and synchronised electronically.

POWERAM Actuator Features

Design with Power

Dynamic Load Capacity and Speed

The dynamic load capacity range is up to 200 kN as standard.
The linear speed is up to 6m/min as standard, depending on the combination of gear ratio, screw lead & the input speed. Higher speeds are available on request.

Stroke

Each model can be provided with a stroke length up to the maximum shown in the Technical Charts. The standard maximum stroke length for the range is 2m. Where the stroke required exceeds, the maximum shown, or there is a high compressive load, please contact our Technical Sales Department.

Drives

As standard, the units can have an integrated electric motor using the standard range of IEC B14 face mount motor adapters. If you need a different motor mounting option or would like to directly mount a gearbox or geared motor to the actuator then please contact us and we will provide the design information to meet your requirements.

Standard Features & Options

- 2 Gear Ratios & 2 Screw Leads As Standard
- Ram End Fittings: Clevis, Fork End, Top Plate, Rod or Threaded End
- Gearbox Mounting Options Of Base Flange, Rear Clevis Or Trunnions
- Motor Adapters
- Encoders
- Hand Wheels
- Couplings For Mechanical Linkages & Drives

Limit Switches

Limit switches are fitted to provide end of stroke or ultimate over travel safety. As standard the actuator accepts the RLS-51 rotary cam limit switch mounted to a free worm shaft via the standard matching adaptor. The RLS-51 allows for 2,4,6 or 8 limit switches to be individually set for any position over the entire stroke of the actuator.

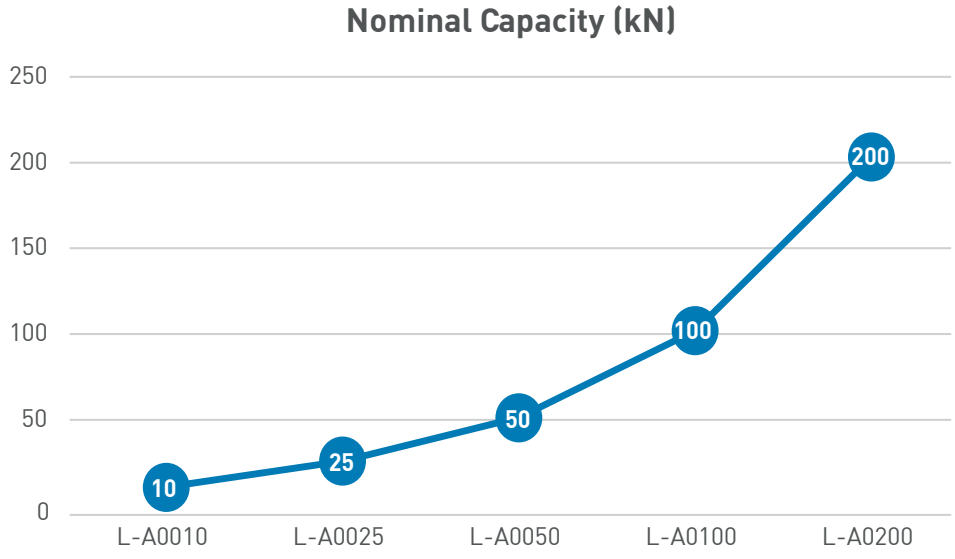
Guiding the Load

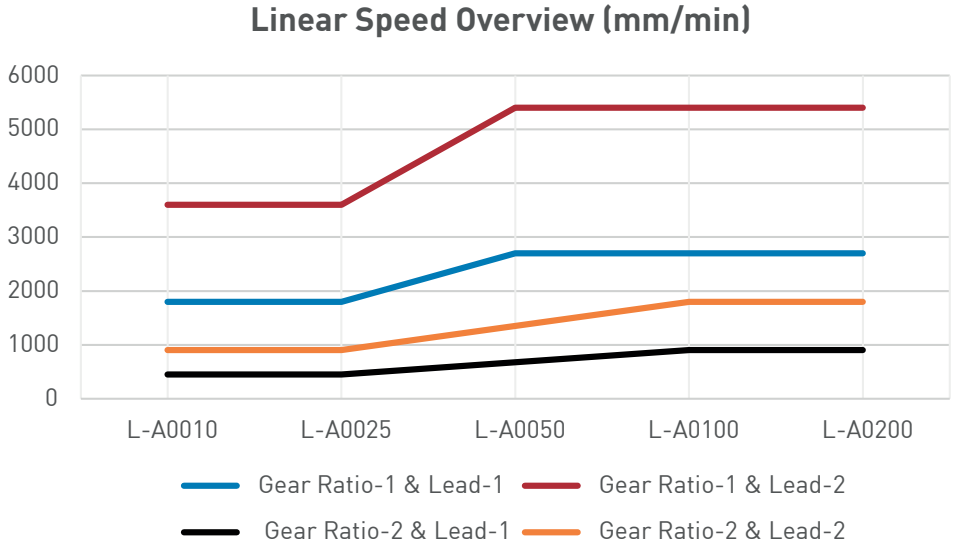
Side loads on the actuator ram should be avoided by ensuring that the load is guided. The load guide mechanism should resist the torque developed at the ram by the screw mechanism. A guided ram can be supplied on request, which utilises an internal anti-rotation mechanism in the ram, this eliminates the need for torsional restraint and therefore allows movement of rotationally unconstrained loads.

Construction

All units are constructed and finished to suit industrial operating conditions. The actuator gearbox and outer tube are painted for protection and the ram is electroless nickel plated steel. The actuator is sealed at the ram. The Stainless Steel version can be supplied in the bare metal finish or painted.

POWERAM Range Overview

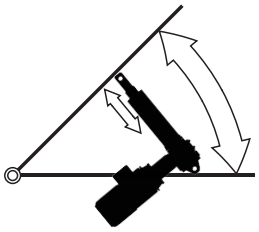




POWERAM Movements

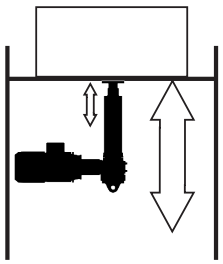
Tilt/Pivot

POWERAM Linear Actuators can be used to tilt objects, fixed at one end, up to 180° from their starting positions. The extension and retraction of the actuator causes the object to pivot about its stationary end.



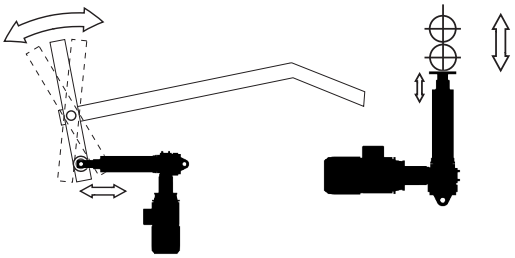
Lift/Lower

POWERAM Linear actuators can handle any lifting and lowering application up to 10kN. As the translating tube of the actuator extends and retracts, the object that the actuator is attached to is raised and lowered at a constant speed.



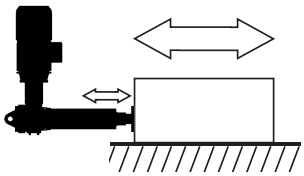
Position

When an application requires periodic adjustment to the position of an object or objects, POWERAM linear actuators provide the solution. The motion of the actuator allows the operator to position an object by simply pushing a button.



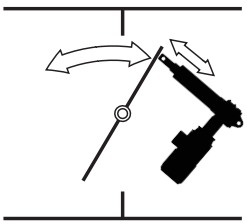
Roll/Slide

When it is necessary to roll or slide an object or a mechanical assembly into position, an POWERAM linear actuator is the answer. The movement of the actuator causes the clamping, rolling or sliding of the desired object.



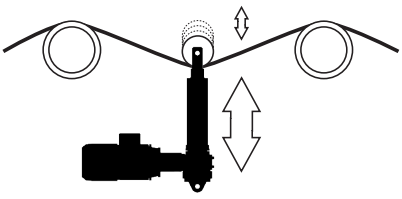
Open/Close

An POWERAM linear actuator mounted on a door, gate or valve allows opening and closing operations on either a timed, or on-demand basis. As the actuator retracts the gate is opened at a steady rate; the extension of the actuator returns the gate to a closed.



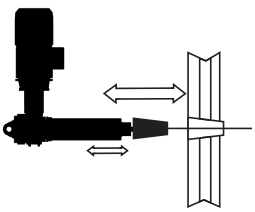
Tension

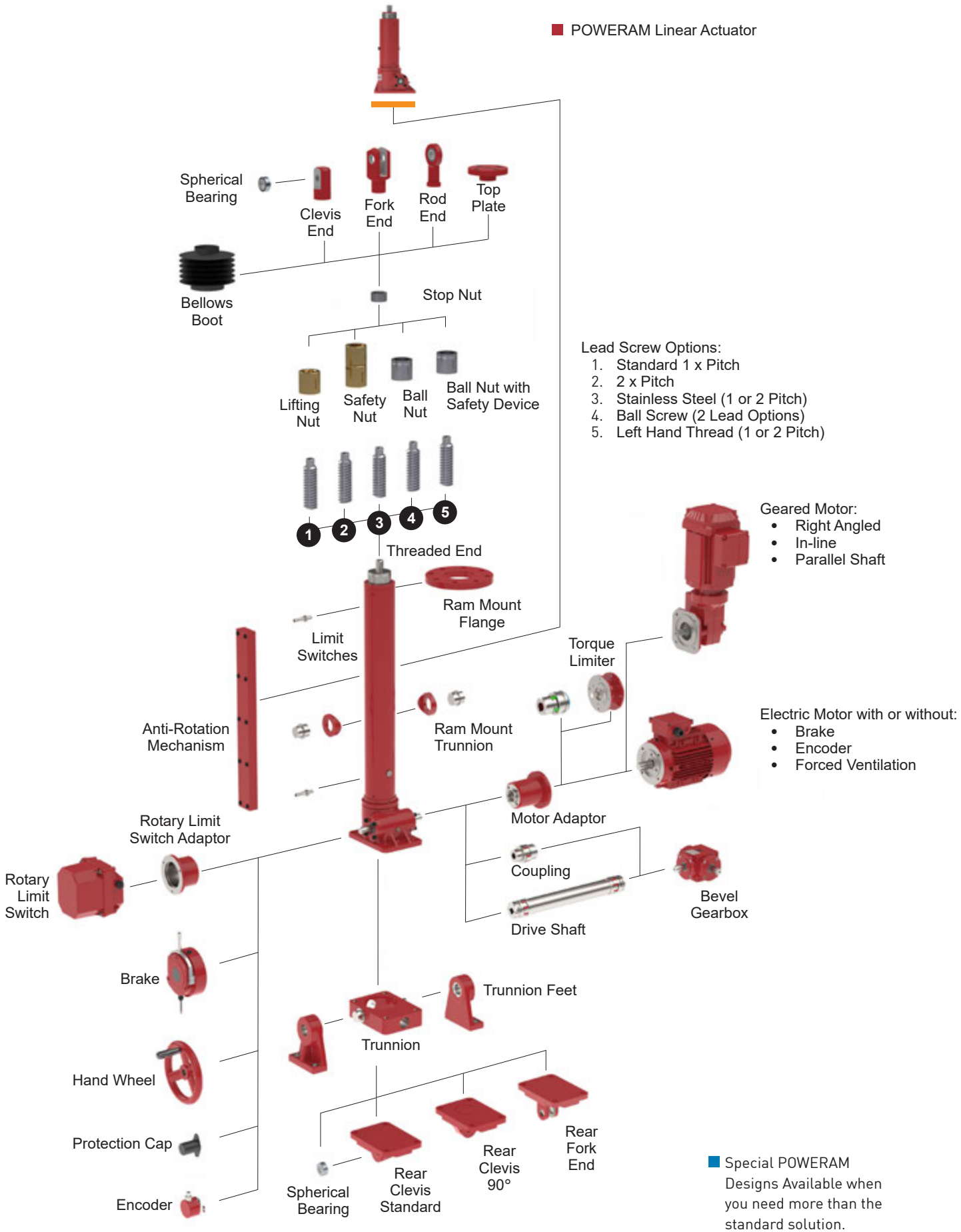
POWERAM linear actuators offer a perfect solution for applications in which tension on a conveyor or webb must be maintained and adjusted. An actuator mounted on a frame or roller extends and retracts to control the tension in the system.



Lock/Unlock

For moving a locking device such as a pin in and out of retaining slot, POWERAM linear actuators provides the perfect solution. The motion of the actuator allows the operator to lock and unlock the device smoothly and safely by the touch of a button. Extend and retract limit switches on the actuator can be used as lock/unlock signals for a machines control system.



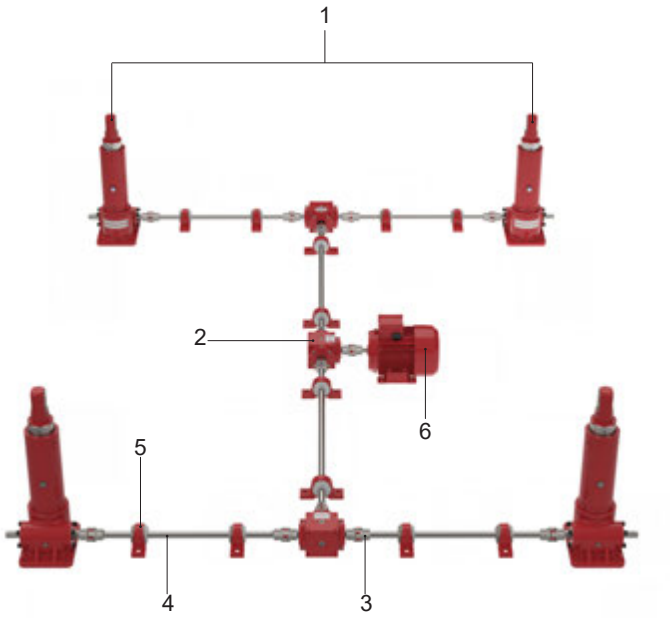

POWERAM Linear Actuator
Spherical Bearing
Clevis End
Fork End
Rod End
Top Plate
Bellows Boot
Stop Nut
Lifting Nut
Safety Nut
Ball Nut
Ball Nut with Safety Device
Lead Screw Options:
1. Standard 1 x Pitch
2. 2 x Pitch
3. Stainless Steel (1 or 2 Pitch)
4. Ball Screw (2 Lead Options)
5. Left Hand Thread (1 or 2 Pitch)
1
2
3
4
5
Threaded End
Ram Mount Flange
Limit Switches
Geared Motor:
• Right Angled
• In-line
• Parallel Shaft
Torque Limiter
Anti-Rotation Mechanism
Ram Mount Trunnion
Electric Motor with or without:
• Brake
• Encoder
• Forced Ventilation
Motor Adaptor
Rotary Limit Switch Adaptor
Coupling
Rotary Limit Switch
Bevel Gearbox
Drive Shaft
Brake
Trunnion Feet
Trunnion
Hand Wheel
Protection Cap
Encoder
Spherical Bearing
Rear Clevis Standard
Rear Clevis 90°
Rear Fork End
Special POWERAM Designs Available when you need more than the standard solution.

POWERAM actuators can be connected together in systems so that multiple units can be operated and controlled together. These actuator system arrangements or configurations can be built in many formats with the use of bevel gearboxes, motors, reduction gearboxes, drive shafts, couplings, plummer blocks and motion control devices.
Four of the most popular system configurations are the 'H', 'U', 'T' and 'I' configured actuator systems. Note that multiple POWERAM actuators can be linked together mechanically or electrically. The latter is useful if there is no space for linking drive shafts.

Actuator systems are not limited to the number of actuators shown here. They are regularly supplied to clients with 2, 4, 6, 8 actuator systems. Larger systems can extend up to 16 or higher. With the use of electronic synchronisation/ control multiple systems or actuators can be used in unison. Extending the possible number of actuators used in unison in excess of 100.

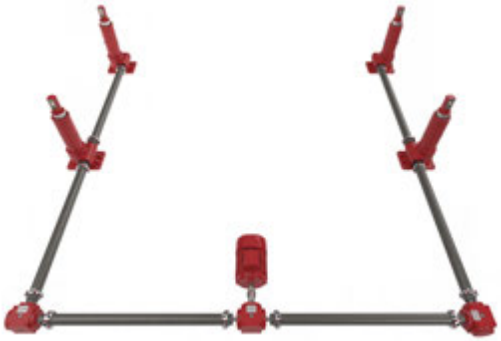
To facilitate electronic control of actuators, feedback devices (eg encoder, limit switch) are available, mounted on the actuator or its motor or another system component.

Typical 'H' configuration System



1. POWERAM Electric Linear Actuator
2. Bevel Gearbox
   Range-C Spiral Bevel Gearboxes
3. Flexible Coupling
   A range of couplings are available to suit each systems requirements including Jaw, Spacer and Geared types.
4. Drive Shaft
   Every drive shaft is manufactured to order for each system design. Self supporting drive shafts (spacer couplings) are also available.
5. Shaft Supports (plummer blocks).
6. Electric Motor
   Standard electric motors in 3 phase, 1 phase, DC and servo designs. Supplied as a basic motor or as part of a geared motor. Brakes are available for all motors.

Typical 'U' configuration System



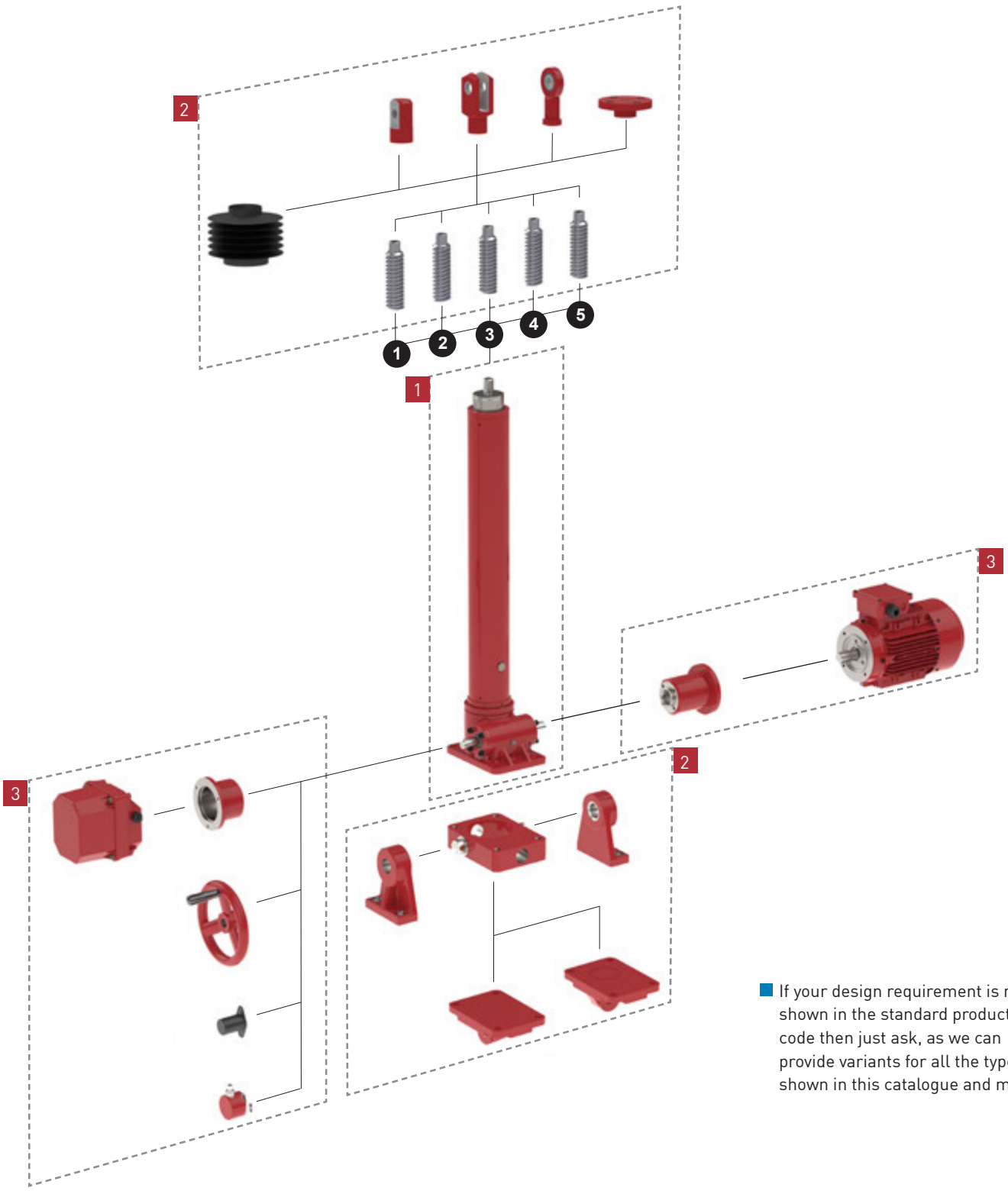
Typical 'I' configuration System

Typical 'T' configuration System

1	GROUP-1 - Actuator Gearbox Definition

2	GROUP-2 - Actuator Features

3	GROUP-3 - Accessories



If your design requirement is not shown in the standard product code then just ask, as we can provide variants for all the types shown in this catalogue and more.

1 GROUP-1 - Linear Actuator Primary Definition

1-Actuator Series	
L	POWERAM Actuator Series

2 - Screw Type	
M	Machine Screw
B	Ball Screw

3- Actuator Design Type	
A	Standard Design

4-7 - Capacity	0010	0025	0050	0100	0200
kN	10	25	50	100	200

8 - Character Space

9-Gearbox Type	
U	Standard
V	All Stainless Steel Actuator

2 GROUP-2 - Actuator Features

10 - Ram Feature - 1	
0	Standard Plated (Electorless Nickel) Ram #19
S	Stainless Steel Ram #20 #21

11 - Ram Feature - 2	
0	None
-	Reserved for Future Use

12 - Gear Ratio	
1	Option 1 Gear Ratio
2	Option 2 Gear Ratio

13 - Lifting Screw Lead	
1	Option 1 Lead - Right Hand (Standard) #3
2	Option 2 Lead - Right Hand #3
3	Option 1 Lead - Left Hand #4
4	Option 2 Lead - Left Hand #4

14 - Worm Shaft Type #16	
0	Standard Material
N	Nickel Plated Worm Shaft
S	Stainless Steel Worm Shaft
D	Duplex Stainless Steel Worm Shaft

15 - Worm Shaft Ends	
0	Both
L	Left Hand Only
R	Right Hand Only
X	Both with Protective Cap on LHS
Y	Both with Protective Cap on RHS

16 - Character Space

2 GROUP-2 - Actuator Features

17-20 - Stroke [#17] [#18]	0000
Stroke in mm	0-9999

21 - Character Space

22 - End Type [#5]	
E	Threaded End
C	Clevis End
T	Top Plate
F	Fork End
R	Rod End

23 - Gearbox Mounting	
B	Base Mount
C	Rear Clevis
D	Rear Clevis 90 degree
T	Trunnion Mount - Male - Standard [#1]
U	T + Trunnion Feet
V	Trunnion Mount - Female
X	Trunnion Mount 90 degree [#2]
Y	X + Trunnion Feet
Z	Trunnion Mount - Female 90 degree [#2]

24 - Lifting Screw Material	
0	Standard
S	Stainless Steel
D	Duplex Stainless Steel

25 - Protective Covers	
0	Standard
1	Fabric Bellows Boot
2	PU Waterproof Bellows Boot

26 - Character Space

3 GROUP-3 - Accessories

27 - Drive Type [#13] [#14]			
0	None, Standard Features (tapped holes on gearbox side if present)	H	Hand Wheel - LHS [#16]
A	Motor Adapter Only, B14 - LHS	J	Hand Wheel - RHS [#16]
B	Motor Adapter Only, B14 - RHS	R	Rotation Indicator (Visual) on worm shaft - LHS [#7]
C	Motor Adapter B14 & Coupling - LHS	T	Rotation Indicator (Visual) on worm shaft - RHS [#7]
E	Motor Adapter B14 & Coupling - RHS		

28- Motor Frame Size / Drive Interface Size [#9]			
0	Not Applicable	F	112 Size IEC Frame
A	63 Size IEC Frame	G	132 Size IEC Frame
B	71 Size IEC Frame	H	160 Size IEC Frame
C	80 Size IEC Frame		
D	90 Size IEC Frame		
E	100 Size IEC Frame		

29 - Mounting Kit for Limit Switches [#6] [#15]			
0	None	F	RLS-51 Rotary Cam Limit Switch - LHS - 4 Switches [#8] [#10]
A	RLS-51 Rotary Cam Limit Switch - RHS - 2 Switches [#8] [#10]	G	RLS-51 Rotary Cam Limit Switch - LHS - 6 Switches [#8] [#10]
B	RLS-51 Rotary Cam Limit Switch - RHS - 4 Switches [#8] [#10]	H	RLS-51 Rotary Cam Limit Switch - LHS - 8 Switches [#8] [#10]
C	RLS-51 Rotary Cam Limit Switch - RHS - 6 Switches [#8] [#10]		
D	RLS-51 Rotary Cam Limit Switch - RHS - 8 Switches [#8] [#10]		
E	RLS-51 Rotary Cam Limit Switch - LHS - 2 Switches [#8] [#10]		

30 - Paint, Lubricant, Seals #11 #12	
0	Standard Paint, Lubricant & Seals
1	Standard Paint & Food Grade Lubricant & Standard Seals
2	Standard Paint, Nuclear Grade Lubricant & Seals
3	Standard Paint, High Temperature Lubricant & Seals
4	Standard Paint, Low Temperature Lubricant & Seals
5	Standard Paint, Biodegradable Lubricant & Standard Seals
A	No Paint, Standard Lubricant & Seals
B	No Paint & Food Grade Lubricant & Standard Seals
C	No Paint, Nuclear Grade Lubricant & Seals
D	No Paint, High Temperature Lubricant & Seals
E	No Paint, Low Temperature Lubricant & Seals
F	No Paint, Biodegradable Lubricant & Standard Seals
G	Standard Primer, Lubricant & Seals
H	Standard Primer & Food Grade Lubricant & Standard Seals
I	Standard Primer, Nuclear Grade Lubricant & Seals
J	Standard Primer, High Temperature Lubricant & Seals
K	Standard Primer, Low Temperature Lubricant & Seals
L	Standard Primer, Biodegradable Lubricant & Standard Seals
M	Epoxy Paint, Standard Lubricant & Seals
N	Epoxy Paint & Food Grade Lubricant & Standard Seals
P	Epoxy Paint, Nuclear Grade Lubricant & Seals
R	Epoxy Paint, High Temperature Lubricant & Seals
S	Epoxy Paint, Low Temperature Lubricant & Seals
T	Epoxy Paint, Biodegradable Lubricant & Standard Seals

Notes:

#1 Trunnions on same side as worm shaft (standard).

#2 Trunnions at 90° to worm shaft.

#3 Standard right hand thread form.

#4 Left hand thread form.

#5 Standard clevis and fork end pin hole axis parallel to worm shaft.

#6 Limit switch mounting included.

#7 Plastic rotation indicator

#8 All RLS-51 individual limit switches are fully adjustable over the entire actuator stroke

#9 IEC, B14 motor frame sizes as standard. B5 flange available on request.

#10 Face mount is standard. Flange mount available on request.

#11 Power Jacks defined standard paint - available as a data sheet

#12 Power Jacks defined standard lubricant - available as a data sheet and in manual.

#13 Actuators with geared motor, external brake or encoder are all specified as a unique design due to the large number of variations available in the aforementioned devices.

#14 Electric motors are defined as a separate item due to the large number of motor options available

#15 Limit switches (all types) are defined as separate items due to the large number of switch options available.

#16 Standard hand wheel as defined in catalogue.

#17 There are standard stroke lengths for the actuators (refer to charts & tables in catalogue).

#18 Customised stroke lengths are available on request.

#19 Stainless steel ram - inner tube and end fitting all in stainless steel.

#20 Standard ram has electroless nikel plated inner tube. End fitting is standard material and not plated.

#21 Stainless Steel Ram material same type as lifting screw material.

Product Code Example

LMA0050-U001100-0500-CC00-CAA0 POWERAM Actuator, Machine Screw, 50kN, 6:1 gear ratio, 9mm lead on screw, Standard Worm Shaft Material and Ends, 500mm Stroke, Clevis End on Ram, Clevis End on Gearbox, Standard Lifting Screw Material, No Extra Protective Covers, IEC 80 Frame Motor Adaptor B14 & Coupling on LHS, RLS-51 Rotary Cam Limit Switch on RHS with 2 Switches, Standard Paint and Lubrication.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
L	M	A	0	0	5	0	-	U	P	0	1	1	0	0	-	0	5	0	0	-	C	C	0	0	-	C	C	A	0

Five Step Guide to Initial POWERAM Linear Actuator Selection

The following selection procedure is applicable for Machine Screw, Stainless Steel and Ball Screw linear actuators.

Calculate Power and Torque Requirements

Select a linear actuator from the tables with adequate load carrying capacity and note the linear actuator static and dynamic efficiency for required input speed.

Step 1 - Linear Actuator Input Speed

$$N\ (rpm) = \frac{\text{Linear Speed (mm/min) x Gear Ratio}}{\text{Pitch (mm) x N° of Starts on Lifting Screw}}$$

Input speed should not exceed 1800 rpm. Number of starts on lifting screw is usually 1, unless otherwise stated.

Note: Screw Lead = Pitch x No of Starts

Step 2 - Operating Input Power (kW), P_{in}

$$P_{in}(kW) = \frac{\text{Load (kN) x Linear Speed (mm/min)}}{60000 \times \eta_d}$$

η_d = Dynamic Actuator Efficiency

Step 3 - Operating Input Torque

$$T_{ino}\ (Nm) = \frac{P_{in}\ (kW) \times 9550}{N\ (rpm)}$$

Step 4 - Linear Actuator Start-Up Torque

$$T_{ins} = \frac{\text{Load (kN) x Pitch (mm) x N° of Starts on Lifting Screw}}{2 \times \pi \times \eta_s \times \text{Gear Ratio}}$$

η_s = Static Actuator Efficiency

Note: Screw Lead = Pitch x No of Starts

Step 5 - Mechanical Power and Torque Check

Check whether the linear actuator power and torque required for the application is not greater than the maximum allowable mechanical input power ($P_{mechanical}$) and Start-Up Torque at Full Load (T_s) values specified in the linear actuator performance tables.

If $P_{mechanical} > P_{in}$ & $T_s > T_{ins}$ then the linear actuator selected is acceptable for power requirements.

Example Selection

Application Constraints

- Load on Linear Actuator = 15 kN in Tension
- Linear Speed required = 100 mm/min

Consider all application constraints then choose a linear actuator that looks suitable for the application with a load rating equal to or greater than the maximum working load. For this example, a 25 kN POWERAM (refer P30) with 6:1 gear ratio, single start lifting screw (6 mm lead).

Calculate Power and Torque Requirements

Step 1 - Linear Actuator Input Speed

$$N\ (rpm) = \frac{100\ (mm/min) \times 6\ (Gear\ Ratio)}{6\ (mm) \times 1\ (N°\ of\ starts\ on\ Lifting\ Screw)}$$

N = 100 rpm
Input speed should not exceed 1800 rpm.

Step 2 - Operating Input Power (kW), P_{in}

$$P_{in}(kW) = \frac{15\ (kN) \times 100\ (mm/min)}{60000 \times 0.264}$$

η_d = 0.264 (Refer P60)
P_{in} = 0.095 kW

Step 3 - Operating Input Torque

$$T_{ino}\ (Nm) = \frac{0.095\ (kW) \times 9550}{100\ (rpm)}$$

T_{ino} = 9.1 Nm

Step 4 - Linear Actuator Start-Up Torque

$$T_{ins} = \frac{15\ (kN) \times 6\ (mm) \times 1\ (N°\ of\ starts\ on\ Lifting\ Screw)}{2 \times \pi \times 0.201 \times 6\ (Gear\ Ratio)}$$

T_{ins} = 11.9 Nm
η_s = 0.201 (refer P60)

Step 5 - Mechanical Power and Torque Check

Find the linear actuators mechanical power and torque rating from the performance data tables (refer P30).

$P_{mechanical}$ = 1.5 kW > P_{in} and T_s = 19 Nm > T_{ins}

Therefore the linear actuator selected is suitable for application for initial constraints tested, further analysis may be required to ensure the linear actuator is suitable for all application conditions. Continue with further selection calculations or consult Power Jacks Ltd.

Linear Actuator Constraints for Detailed Selection

Lifting Screw Column Strength

For compressive loads on the linear actuator ram column strength calculations are required to check for buckling. As a linear actuator selection guide use the following process:

1. Determine the maximum column strength (L) for the linear actuator being considered.
2. Referring to the relevant column buckling chart determine the permissible compressive load (Wp) corresponding to the column length (L) for the appropriate end constraints. This permissible compressive load is the maximum load (inclusive of shock loads) which may be applied to the linear actuator for a given column length.
3. Where an application involves human cargo or there is a risk to personnel, it is highly recommended that the permissible compressive load (as calculated above) be factored by 0.7 to enhance working safety. (Equivalent to a column strength safety factor of 5).

$W_{phc} = W_p \times 0.7$ **(Permissible compressive load for personnel risk applications)**

Note *1. For detailed analysis of linear actuators and their systems consult Power Jacks.*
2. Safety factor of 3.5 for column strength's used for normal industrial cargo.

Linear Actuator Input Torque

Start up/static torque values are listed in all performance tables. Whereas dynamic torque values are either calculated using the tabulated dynamic efficiencies or taken direct from torque tables where listed. For detailed linear actuator analysis consult Power Jacks Ltd.

Side Loads on Linear Actuators

It is recommended that all side loads (F_{sl}) are carried by guides in your arrangement and not by the actuators ram. If there are any side loads on the linear actuator, they must not exceed those tabulated in the Engineering Guide, Side Load Rating Section, and it must be noted that any such loads will adversely affect the life of the ram and the lifting screw, nut and guides inside.

Radial Forces on Linear Actuator Worm Shaft

For applications where a linear actuator is belt driven, radial force (F_R) values exerted on the worm shaft must not exceed those tabulated in the Engineering Guide Section. Values are tabulated for the both machine screw and ball screw linear actuators. The values are maximum values for the linear actuators at rated load regardless of worm speed or load direction.

Linear Actuator Self-Locking

Approximately 50% of linear actuators with machine screw drive are self-locking either in the gearbox or the lifting screw, however to ensure there is no self-lowering and to reduce drift due to the motor slowing, a brake is recommended. Standard motor frame size brakes will be suitable for most applications with only slight vibration and thermal fluctuation present. Motor selection as normal. For dynamic braking consult Power Jacks.

Linear actuators with ball screw drive always require a brake as their high efficiency makes them self-lowering.

Use the closest standard brake size that is greater or equal to the motor brake torque required.

Note 1. Self lowering can occur in any actuator (jacking) system not fitted with a brake, where high levels of vibration are present in the application.
2. Power Jacks recommend the use of a brake on single linear actuator applications in the vertical position.

Linear Actuator (Jacking) System Power Input

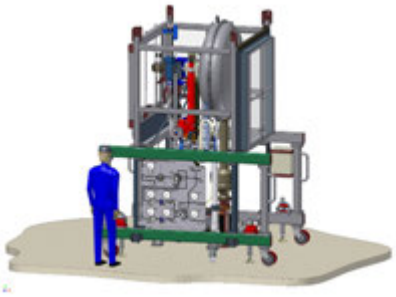
Total Input Power for Linear Actuator Systems (kW), P_s:

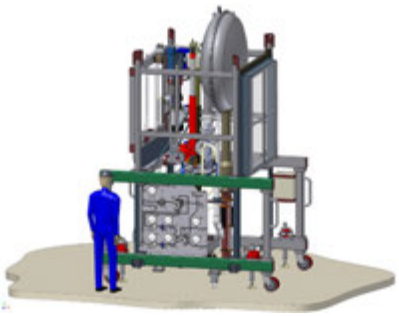
$$P_s = \frac{\text{Input Power per Linear Actuator (kW) x Number of Linear Actuators}}{\text{Arrangement Efficiency x Gearbox Efficiency}}$$

Number of Linear Actuators in System	2	3	4	6-8
Linear Actuator (Jacking) System Efficiency	0.95	0.90	0.85	0.80

Gearbox Efficiency = Bevel Gearbox Efficiency x Reduction Gearbox Efficiency
Bevel Gearbox Efficiency = 0.95 typical
Reduction Gearbox Efficiency = Consult unit details, if no reduction gearbox present assume efficiency of 1.

Note
For Linear Actuators connected in-line, the worm shaft can transmit up to 3 times the torque for a single linear actuator at its maximum capacity, except the L--0200 (200kN) Unit which can transmit 1.5 times the torque.



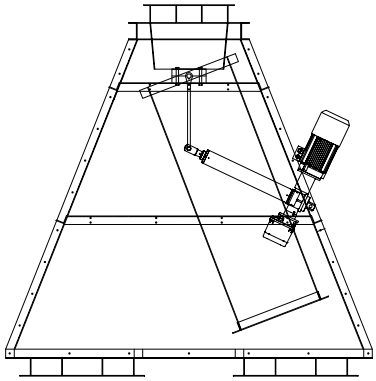


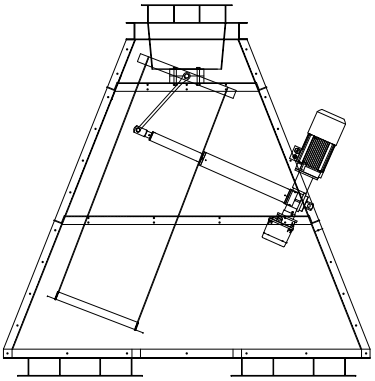
NUCLEAR CORE INSPECTION FOR REACTOR STANDPIPE

Reactor core inspections of nuclear reactors is an essential function of operating a nuclear power station that must achieve the highest quality to ensure continued power supply with the best plant safety and efficiency. A key part of the maintenance program is the inspection of the nuclear reactor cores. To perform this operation a specialist machine with TV inspection and bore measuring is used. The machine is lowered to engage with the reactor standpipes by a bespoke POWERAM electric linear actuator.

The linear actuator is designed to lift and lower a 20kN load over a stroke of 525mm with the end of travel signalled by electro-mechanical limit switches Maintaining rigidity of the ram over its stroke is very important so there are two internal guidance mechanisms for the ram. One guides the outer diameter of the ram and the other guides the internal bore of the ram. This combined with the machine screw and nut drive provides a very stable actuation column.

As a safety feature the ram is fitted with a proprietary clutch to act, as a mechanical fail safe, to prevent an overload condition should the external control systems fail. Powering the actuator is a 3-phase 0.75kW AC motor with integral brake for position holding and an auxiliary hand drive shaft should manual operation be required.





DEWATERED SLUDGE CAKE DISCHARGE CHUTES

Sewage treatment is an important part of any urban development for both the environment and habitation. One of the largest sewage treatment works in the world is on Stonecutters Island in Hong Kong. The works is 10 hectares in size and is built on reclaimed land that is part of the harbour area. It provides Chemically Enhanced Primary Treatment and has a capacity flow of 2.4 million m^3 per day.
Part of the works is the Sludge Treatment Facility where; after being pumped into holding tanks, the settled sludge is mixed with a polymer for dewatering by centrifuge until it reaches a minimum dryness of 30%. The dewatered sludge is then transported in sealed containers for disposal in landfill. The sludge dewatering is driven by 14 centrifuges, which have a combined capacity of 1200 Tonnes of sludge per day. On exiting the centrifuges, the sludge is directed down chutes for containerisation. Control of which chute the sludge cake goes to from each centrifuge is controlled by a POWERAM electric linear actuator.

The 14 POWERAM actuators used are LMA0025 units rated for operation at 10kN in both tension or compression at a speed of 2800 mm/min over a 400mm stroke. The actuator features a fully stainless steel ram for anti-corrosion properties. The positioning of the ram is controlled by an RLS-51 rotary cam limit switch integrated to the actuator. This unit has 4 limit switches, each of which is fully adjusted for any position over the actuators entire stroke. Drive is provided by an AC induction brake motor. A brake being used to guarantee positioning holding for any vibration levels in the chute.

For an accurate, repeatable and reliable chute diversion the POWERAM is the solution.

POWERAM - Machine Screw

IDEAL FOR INTERMITTENT DUTY ACTUATION, LIFTING & POSITIONING.

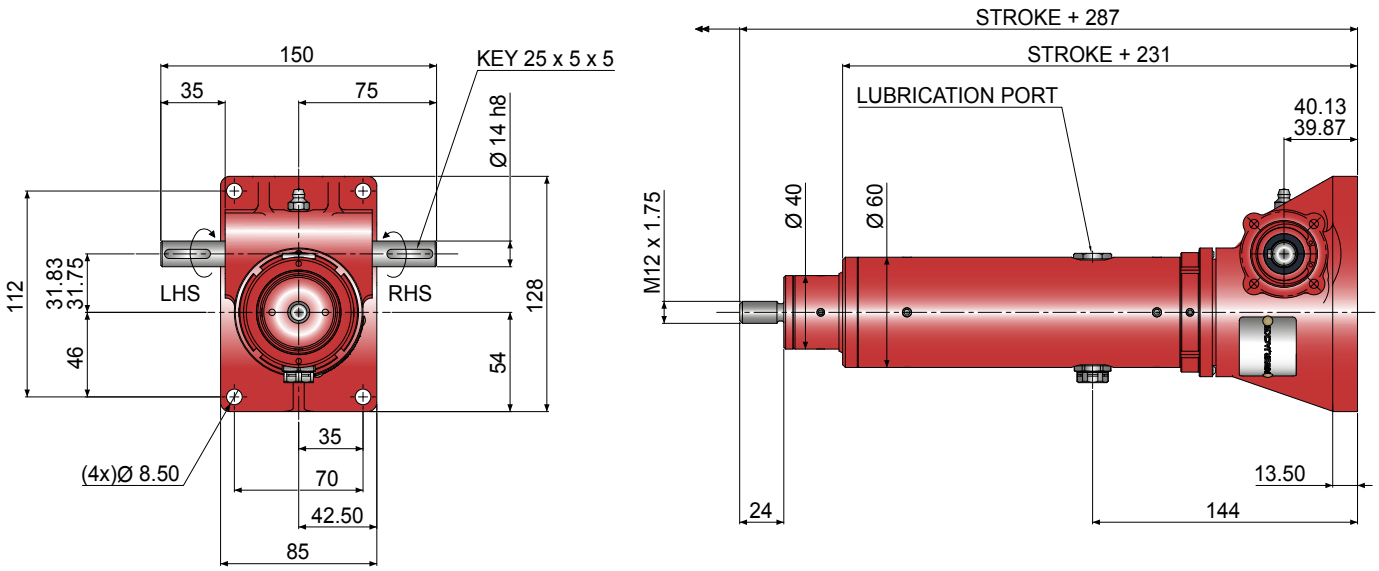
POWERAM Actuator - Machine Screw - Standard Performance

Model			LMA0010		LMA0025		LMA0050		LMA0100		LMA0200	
Capacity	kN		10		25		50		100		200	
Lifting Screw[1]	mm		20		30		40		55		65	
	Lead	Option	1	2	1	2	1	2	1	2	1	2
		mm	5	10	6	12	9	18	12	24	12	24
Gear Ratios	Option 1		5:1		6:1		6:1		8:1		8:1	
	Option 2		20:1		24:1		24:01:00		24:1		24:1	
Turn of worm for travel of ram	Ratio Option 1	1 Turn	1mm	2mm	1mm	2mm	1.5mm	3mm	1.5mm	3mm	1.5mm	3mm
	Ratio Option 2	4 Turn	1mm	2mm	1mm	2mm	1.5mm	3mm	2mm	4mm	2mm	4mm
Max. Input Power (kW)	Gear Ratio Option 1		0.375		1.5		3.0		3.75		3.75	
	Gear Ratio Option 2		0.19		0.375		0.55		1.125		1.125	
Start up torque at full load (Nm)[2]	Gear Ratio Option 1		6.8	9.4	19.8	26.3	56	76	115.9	156.5	263.8	343
	Gear Ratio Option 2		3	4.2	8.7	11.6	25.5	34.7	60.5	81.8	137	179
Maximum Through Torque (Nm)[7]			20		59		168		347		396	
Ram Restraining Torque (Nm)[5]			22	30	76	102	210	34.7	575	780	1300	1705
Worm Shaft Maximum Radial Load (N)[6]			325		380		740		1000		1600	
Maximum Input Speed (rpm)			1800		1800		1800		1800		1800	
Gear Case Material			Aluminium		SG Iron		SG Iron		SG Iron		SG Iron	
Weight (kg) - stroke = 150mm			5.63		14.1		25		43.6		78.8	
Weight (kg) per extra 25mm			0.32		0.57		0.78		1.3		2	
Gear Ratio Option 1	Gear Ratio		5:1		6:1		6:1		8:1		8:1	
	Actuator Static Efficiency		0.233	0.339	0.201	0.302	0.213	0.314	0.206	0.305	0.181	0.279
	Actuator Jack Dynamic Efficiency		0.306	0.424	0.264	0.383	0.281	0.398	0.272	0.388	0.242	0.357
Gear Ratio Option 2	Gear Ratio		20:1		24:1		24:1		24:1		24:1	
	Actuator Jack Static Efficiency		0.130	0.192	0.115	0.171	0.117	0.172	0.132	0.195	0.116	0.178
	Actuator Jack Dynamic Efficiency		0.194	0.268	0.167	0.242	0.172	0244	0.190	0.271	0.169	0.250

Notes

1. Efficiency values for standard grease lubricated worm gear box and lifting screw.
2. For loads of 25% to 100% of actuator capacity, torque requirements are approximately proportional to the load.
3. Efficiency values for standard grease lubricated worm gear box and lifting screw.
4. All actuators have grease lubricated gearbox and lead screw as standard.
5. Torque required to prevent the ram from rotating if no anti-rotation device fitted to actuator.
6. Radial force applied midway along worm shaft key at 90° to key.
7. Maximum transmittable torque through worm shaft, not through gear set.

LMA0010 Actuator

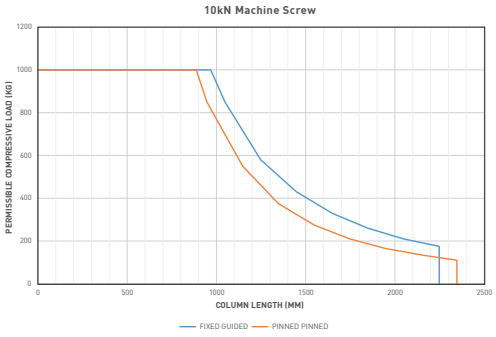


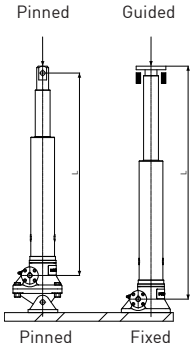
Performance

Model			LMA0010	
Capacity	kN		10	
Lifting Screw	Diameter (mm)		20	
	Lead	Option	1	2
		mm	5	10
Gear Ratio Option 1	Gear Ratio		5:1	
	Static Efficiency		0.233	0.339
	Dynamic Efficiency		0.306	0.424
Gear Ratio Option 2	Gear Ratio		20:1	
	Static Efficiency		0.130	0.192
	Dynamic Efficiency		0.194	0.268
Max. Input power (kW)	Gear Ratio Option 1		0.375	
	Gear Ratio Option 2		0.19	

Model			LMA0010	
Capacity	kN		10	
Lifting Screw Lead (mm)			5	10
Start up torque at full load (Nm)	Gear Ratio Option 1		6.8	9.4
	Gear Ratio Option 2		3	4.2
Turn of worm for travel of ram	Gear Ratio 1	1 Turn	1mm	2mm
	Gear Ratio 2	4 Turn	1mm	2mm
Maximum Through Torque (Nm)			20	
Ram Restraining Torque (Nm)			22	30
Worm Shaft Maximum Radial Load (N)			325	
Maximum Input Speed (rpm)			1800	
Weight (kg) - stroke = 100mm			5.63	
Weight (kg) - per extra 25mm stroke			0.32	

Column Strength



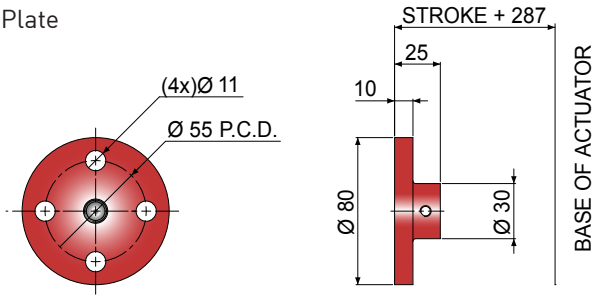


Standard Stroke & Weights

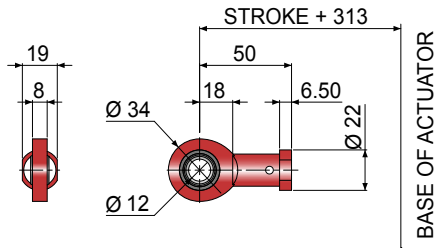
Model		LMA0010
Capacity	kN	10
Stroke = 100 mm		5.63kg
Stroke = 200 mm		6.91kg
Stroke = 300 mm		8.19kg
Stroke = 500 mm		10.75kg
Stroke = 750 mm		13.95kg
Stroke = 1000 mm		17.15kg

LMA0010 Ram End Fittings

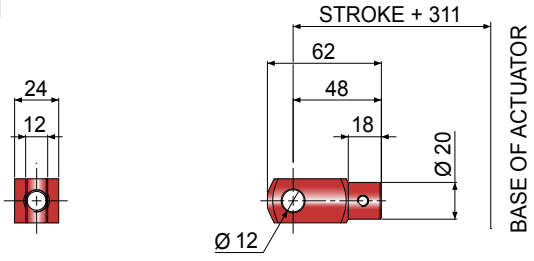
Top Plate



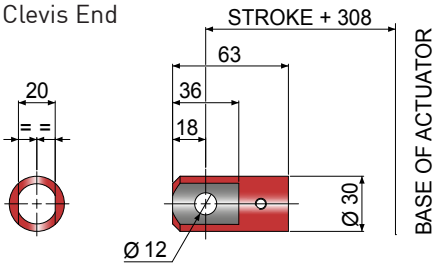
Rod End



Fork End

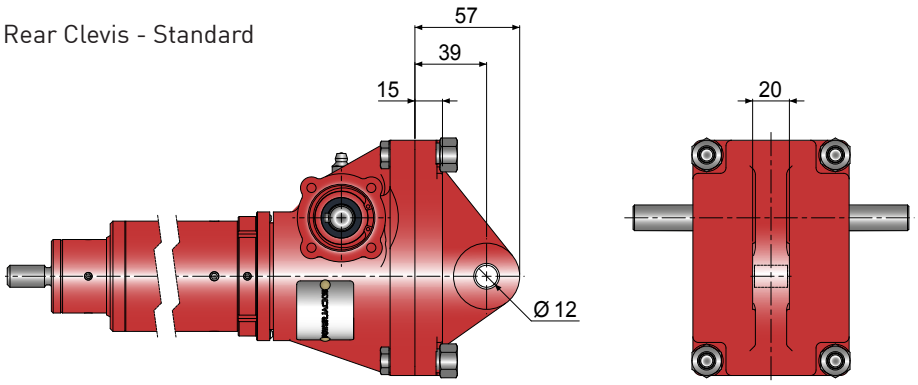


Clevis End

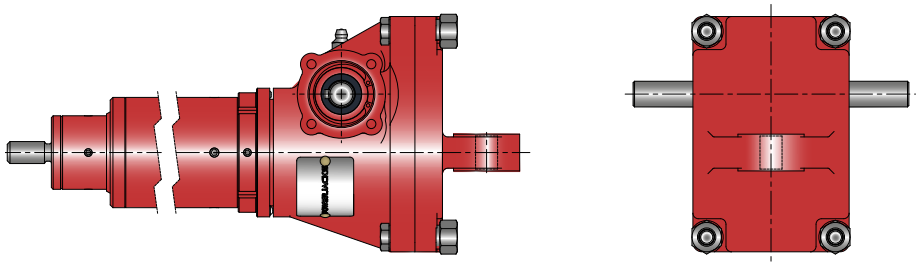


LMA0010 Rear End Fittings

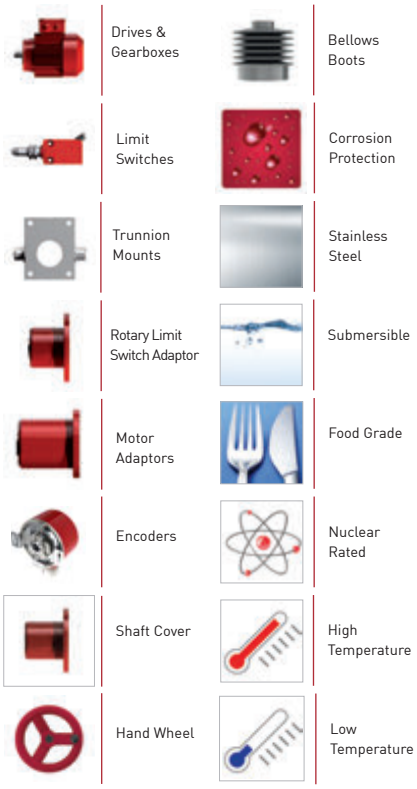
Rear Clevis - Standard



Rear Clevis - 90°



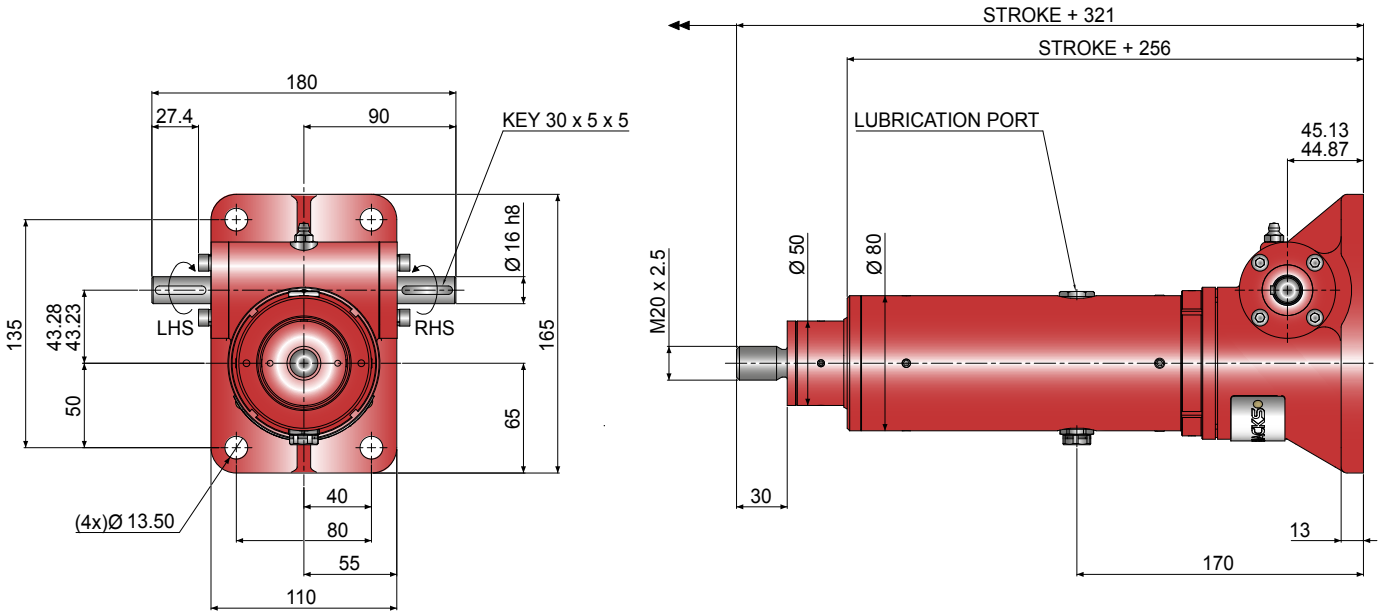
Accessories & Options



Note:

1 Designs subject to change without notice.
2 All colours for illustrative purposes only.
3 Dimensions in millimetres unless otherwise stated.

LMA0025 Actuator

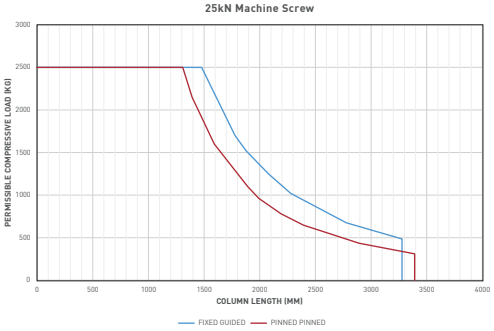


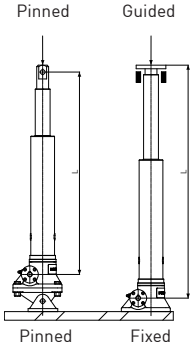
Performance

Model			LMA0025	
Capacity	kN		25	
Lifting Screw	Diameter (mm)		30	
	Lead	Option	1	2
		mm	6	12
Gear Ratio Option 1	Gear Ratio		6:1	
	Static Efficiency		0.201	0.302
	Dynamic Efficiency		0.264	0.383
Gear Ratio Option 2	Gear Ratio		24:1	
	Static Efficiency		0.115	0.171
	Dynamic Efficiency		0.167	0.242
Max. Input power (kW)	Gear Ratio Option 1		1.5	
	Gear Ratio Option 2		0.375	

Model			LMA0025	
Capacity	kN		25	
Lifting Screw Lead (mm)			6	12
Start up torque at full load (Nm)	Gear Ratio Option 1		19.8	26.3
	Gear Ratio Option 2		8.7	11.6
Turn of worm for travel of ram	Gear Ratio 1	1 Turn	1mm	2mm
	Gear Ratio 2	4 Turn	1mm	2mm
Maximum Through Torque (Nm)			59	
Ram Restraining Torque (Nm)			76	102
Worm Shaft Maximum Radial Load (N)			380	
Maximum Input Speed (rpm)			1800	
Weight (kg) - stroke = 100mm			14.1	
Weight (kg) - per extra 25mm stroke			0.57	

Column Strength



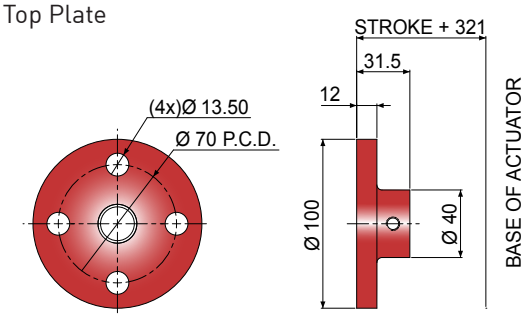


Standard Stroke & Weights

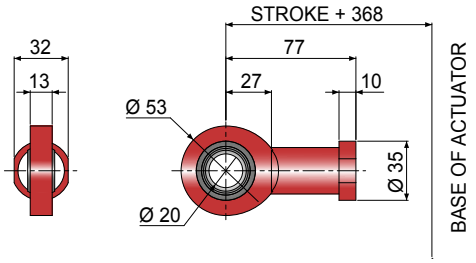
Model		LMA0025
Capacity	kN	25
Stroke = 100 mm		14.1kg
Stroke = 250 mm		17.52kg
Stroke = 500 mm		23.22kg
Stroke = 750 mm		28.92kg
Stroke = 1000 mm		34.62kg
Stroke = 1500 mm		46.02kg

LMA0025 Ram End Fittings

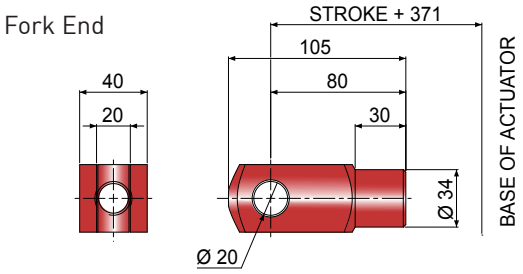
Top Plate



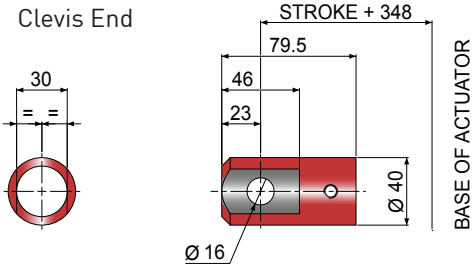
Rod End



Fork End

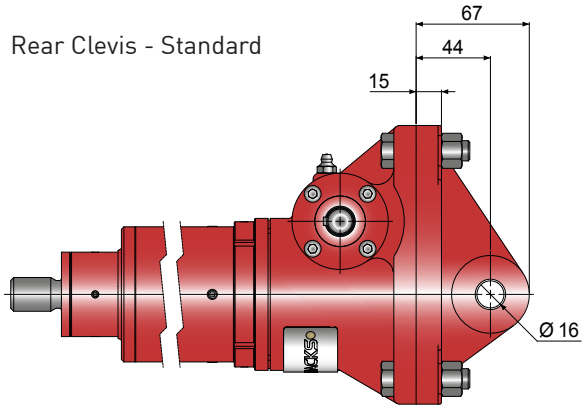


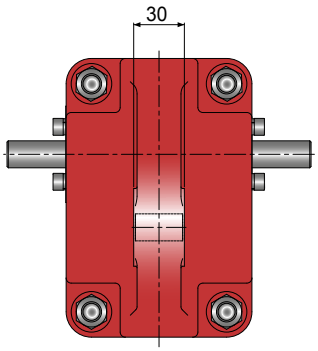
Clevis End



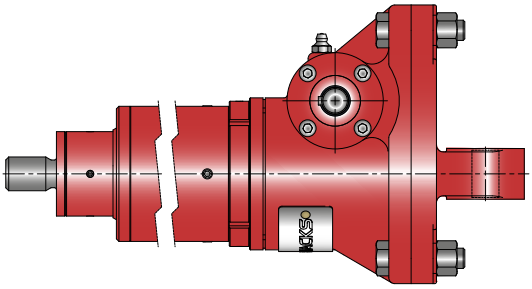
LMA0025 Rear End Fittings

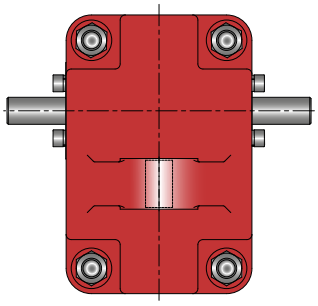
Rear Clevis - Standard



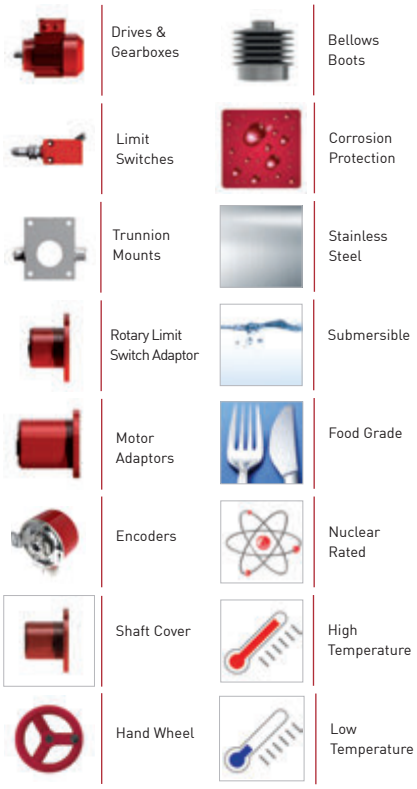


Rear Clevis - 90°





Accessories & Options



Note:
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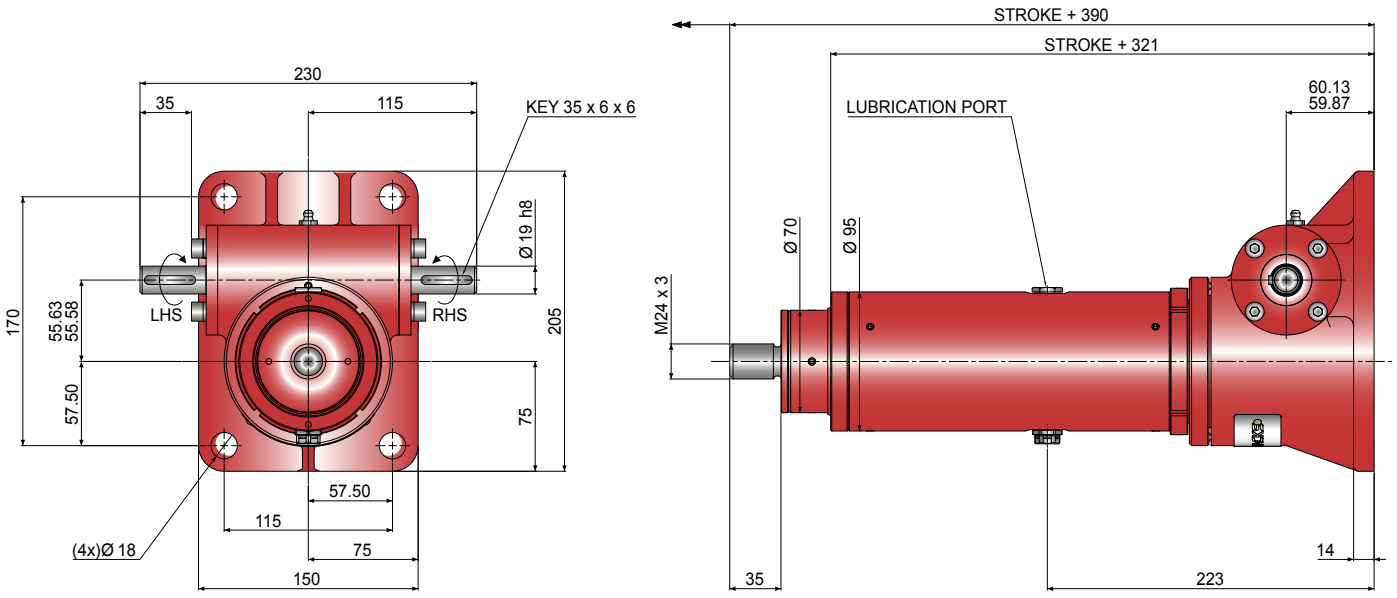
2 All colours for illustrative purposes only.
3 Dimensions in millimetres unless otherwise stated.

LMA0050 Actuator

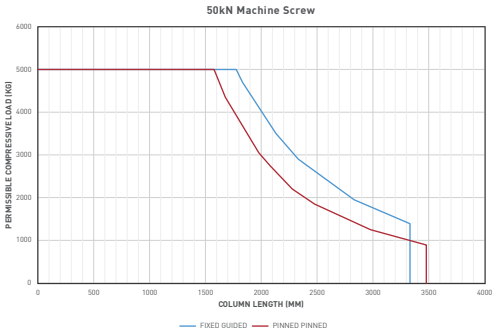


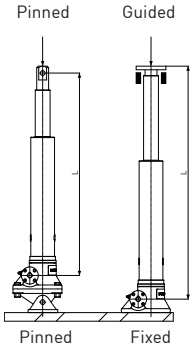
Performance

Model			LMA0050	
Capacity	kN		50	
Lifting Screw	Diameter (mm)		40	
	Lead	Option	1	2
		mm	9	18
Gear Ratio Option 1	Gear Ratio		6:1	
	Static Efficiency		0.213	0.314
	Dynamic Efficiency		0.281	0.398
Gear Ratio Option 2	Gear Ratio		24:1	
	Static Efficiency		0.117	0.172
	Dynamic Efficiency		0.172	0.244
Max. Input power (kW)	Gear Ratio Option 1		3.0	
	Gear Ratio Option 2		0.55	

Model			LMA0050	
Capacity	kN		50	
Lifting Screw Lead (mm)			9	18
Start up torque at full load (Nm)	Gear Ratio Option 1		56	76
	Gear Ratio Option 2		25.5	34.7
Turn of worm for travel of ram	Gear Ratio 1	1 Turn	1.5mm	3mm
	Gear Ratio 2	4 Turn	1.5mm	3mm
Maximum Through Torque (Nm)			168	
Ram Restraining Torque (Nm)			210	290
Worm Shaft Maximum Radial Load (N)			740	
Maximum Input Speed (rpm)			1800	
Weight (kg) - stroke = 100mm			25	
Weight (kg) - per extra 25mm stroke			0.78	

Column Strength



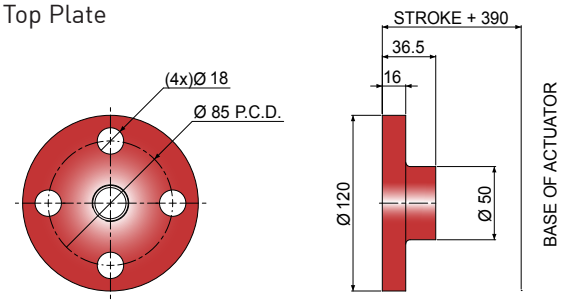


Standard Stroke & Weights

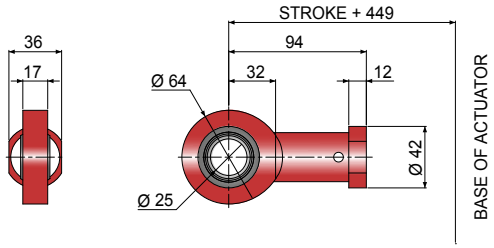
Model		LMA0050
Capacity	kN	50
Stroke = 100 mm		25.0kg
Stroke = 250 mm		29.68kg
Stroke = 500 mm		37.48kg
Stroke = 750 mm		45.28kg
Stroke = 1000 mm		53.08kg
Stroke = 1500 mm		68.68kg

LMA0050 Ram End Fittings

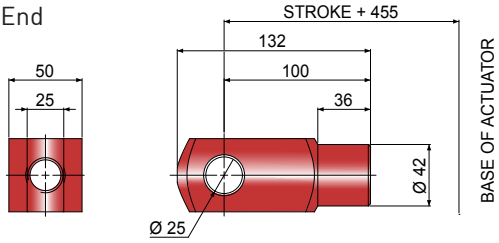
Top Plate



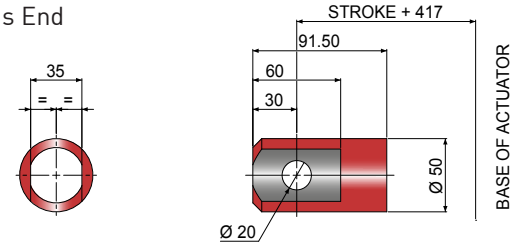
Rod End



Fork End

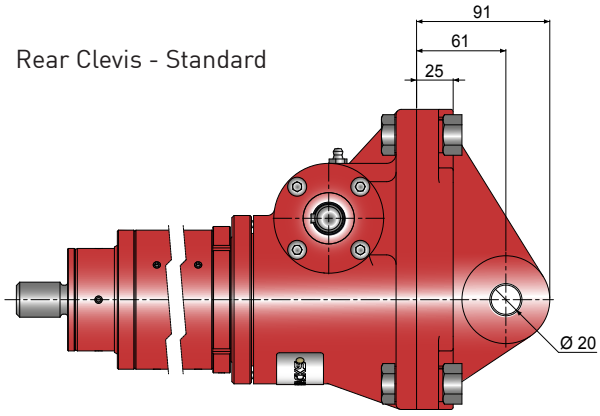


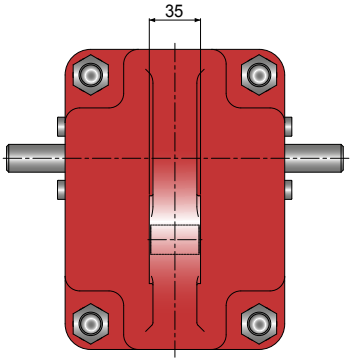
Clevis End



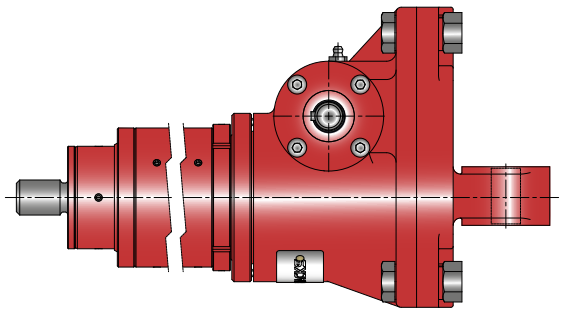
LMA0050 Rear End Fittings

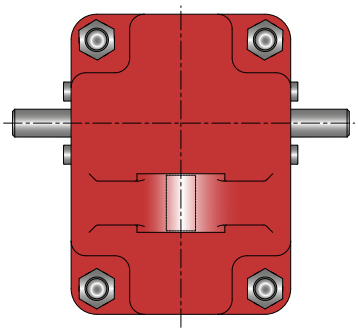
Rear Clevis - Standard





Rear Clevis - 90°





Accessories & Options

Note:

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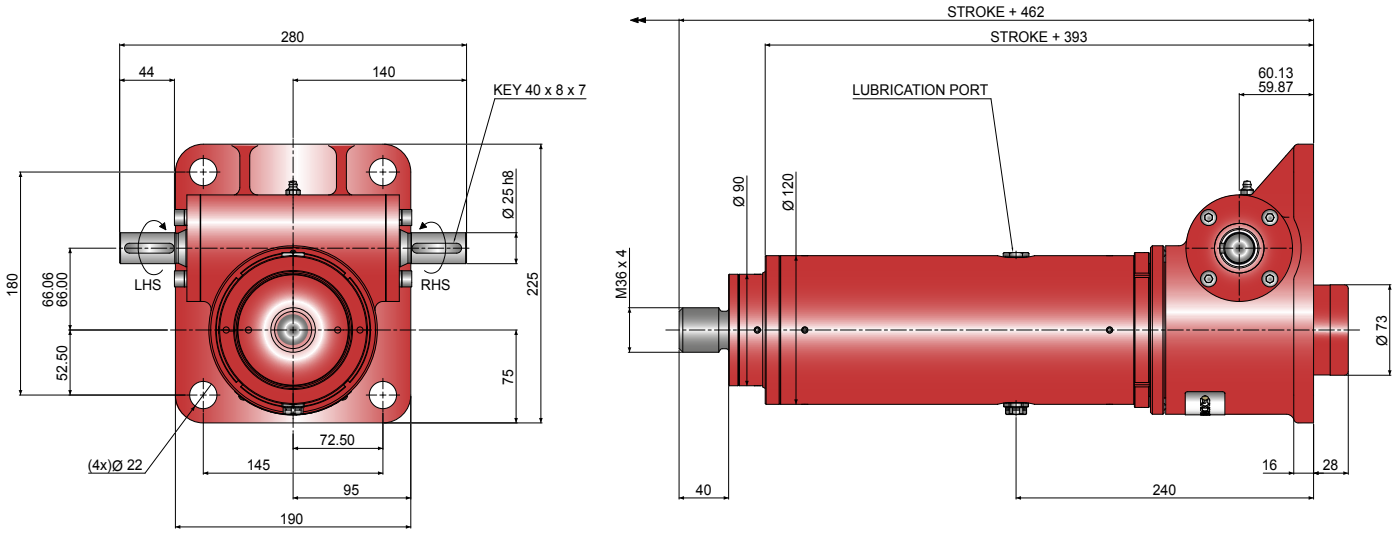
3 Dimensions in millimetres unless otherwise stated.

LMA0100 Actuator

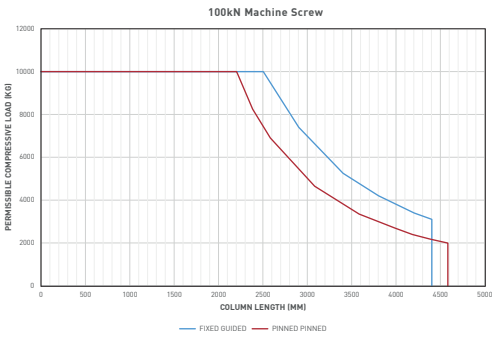


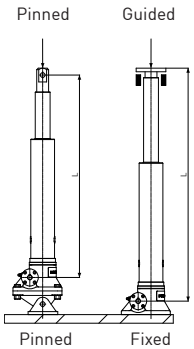
Performance

Model			LMA0100	
Capacity	kN		100	
Lifting Screw	Diameter (mm)		55	
	Lead	Option	1	2
		mm	12	24
Gear Ratio Option 1	Gear Ratio		8:1	
	Static Efficiency		0.206	0.305
	Dynamic Efficiency		0.272	0.388
Gear Ratio Option 2	Gear Ratio		24:1	
	Static Efficiency		0.132	0.195
	Dynamic Efficiency		0.190	0.271
Max. Input power (kW)	Gear Ratio Option 1		3.75	
	Gear Ratio Option 2		1.125	

Model			LMA0100	
Capacity	kN		100	
Lifting Screw Lead (mm)			12	24
Start up torque at full load (Nm)	Gear Ratio Option 1		115.9	156.5
	Gear Ratio Option 2		60.5	81.8
Turn of worm for travel of ram	Gear Ratio 1	1 Turn	1.5mm	3mm
	Gear Ratio 2	4 Turn	2mm	4mm
Maximum Through Torque (Nm)			347	
Ram Restraining Torque (Nm)			575	780
Worm Shaft Maximum Radial Load (N)			1000	
Maximum Input Speed (rpm)			1800	
Weight (kg) - stroke = 100mm			43.6	
Weight (kg) - per extra 25mm stroke			1.3	

Column Strength



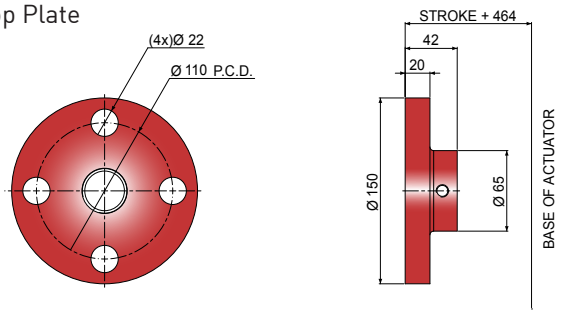


Standard Stroke & Weights

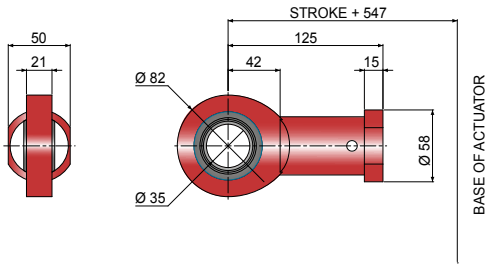
Model		LMA0100
Capacity	kN	100
Stroke = 250 mm		51.4kg
Stroke = 500 mm		64.4kg
Stroke = 750 mm		77.4kg
Stroke = 1000 mm		90.4kg
Stroke = 1500 mm		116.4kg
Stroke = 2000 mm		**142.4kg**

LMA0100 Ram End Fittings

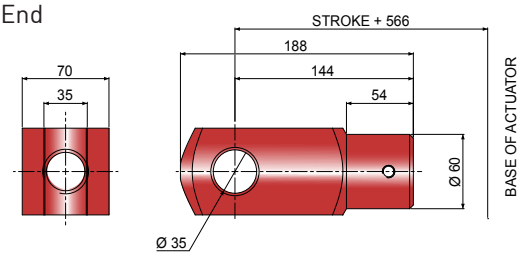
Top Plate



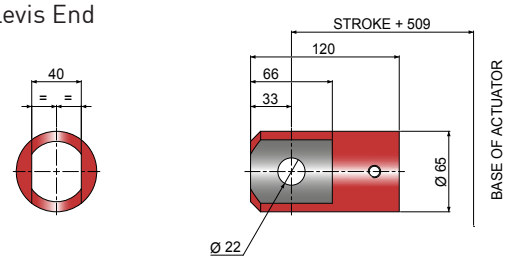
Rod End



Fork End

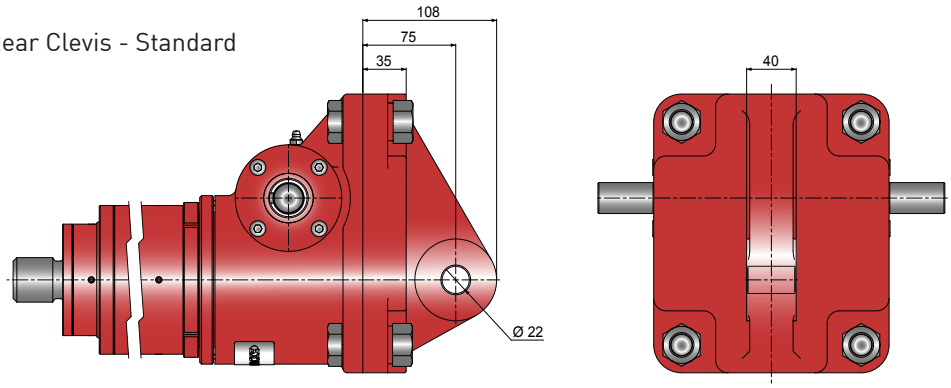


Clevis End

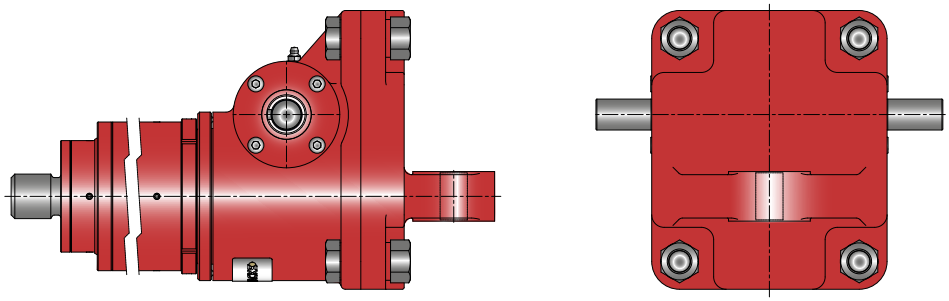


LMA0100 Rear End Fittings

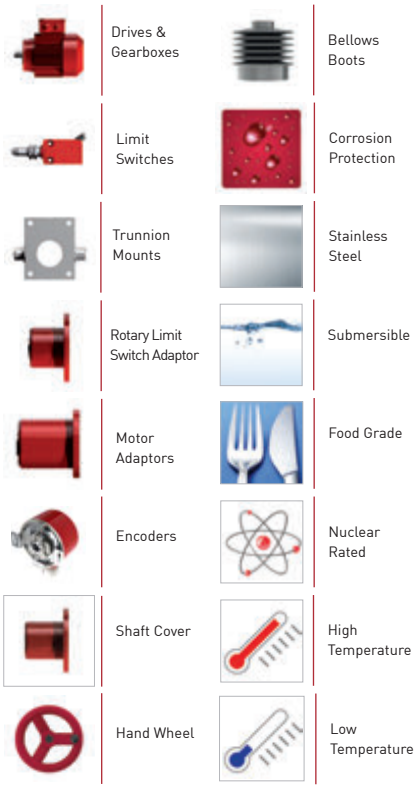
Rear Clevis - Standard



Rear Clevis - 90°



Accessories & Options



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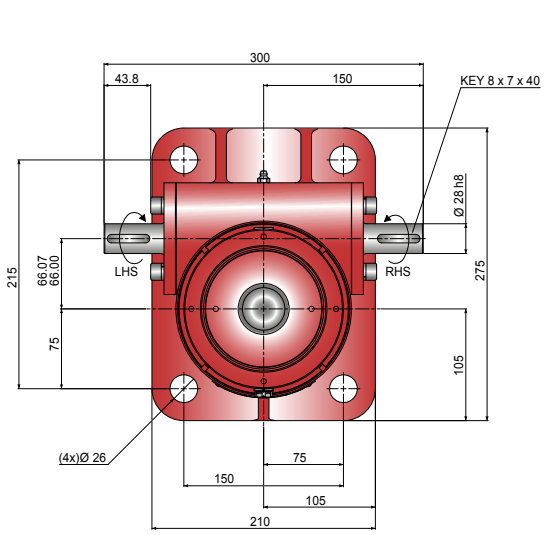
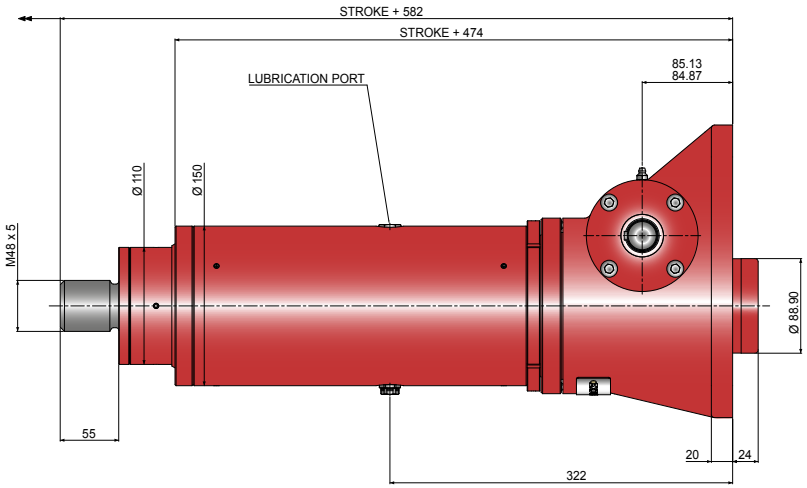
LMA0200 Actuator



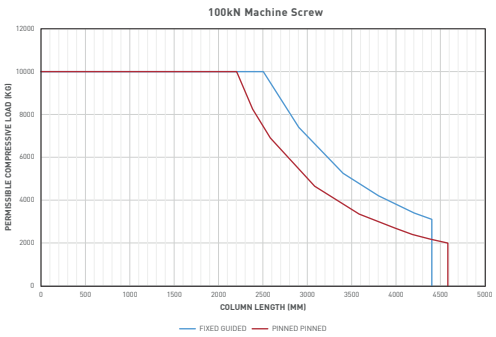


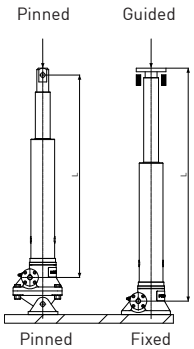
Performance

Model			LMA0200	
Capacity	kN		200	
Lifting Screw	Diameter (mm)		65	
	Lead	Option	1	2
		mm	12	24
Gear Ratio Option 1	Gear Ratio		8:1	
	Static Efficiency		0.181	0.279
	Dynamic Efficiency		0.242	0.357
Gear Ratio Option 2	Gear Ratio		24:1	
	Static Efficiency		0.116	0.178
	Dynamic Efficiency		0.169	0.250
Max. Input power (kW)	Gear Ratio Option 1		3.75	
	Gear Ratio Option 2		1.125	

Model			LMA0200	
Capacity	kN		200	
Lifting Screw Lead (mm)			12	24
Start up torque at full load (Nm)	Gear Ratio Option 1		263.8	343
	Gear Ratio Option 2		137	179
Turn of worm for travel of ram	Gear Ratio 1	1 Turn	1.5mm	3mm
	Gear Ratio 2	4 Turn	2mm	4mm
Maximum Through Torque (Nm)			396	
Ram Restraining Torque (Nm)			1300	1705
Worm Shaft Maximum Radial Load (N)			1600	
Maximum Input Speed (rpm)			1800	
Weight (kg) - stroke = 100mm			78.8	
Weight (kg) - per extra 25mm stroke			2	

Column Strength



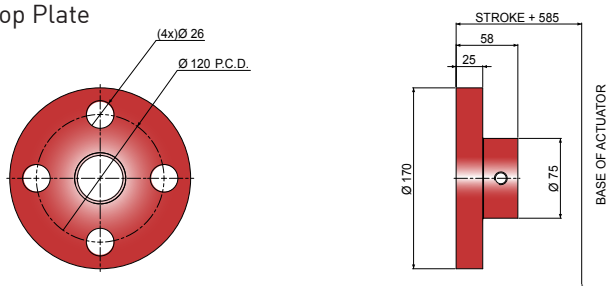


Standard Stroke & Weights

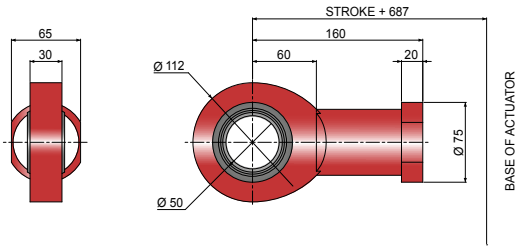
Model		LMA0200
Capacity	kN	200
Stroke = 250 mm		90.8kg
Stroke = 500 mm		110.8kg
Stroke = 750 mm		130.8kg
Stroke = 1000 mm		150.8kg
Stroke = 1500 mm		190.8kg
Stroke = 2000 mm		**230.8**kg

LMA0200 Ram End Fittings

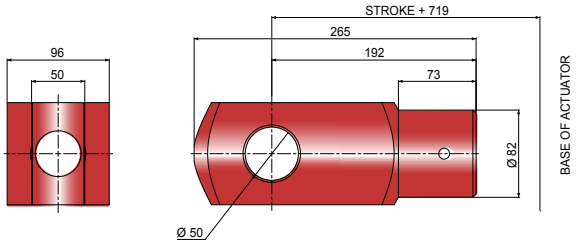
Top Plate



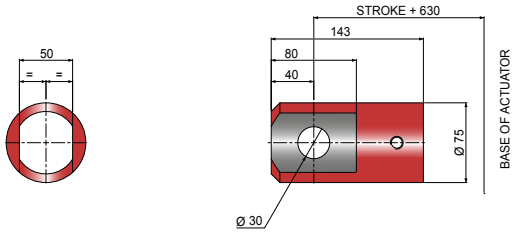
Rod End



Fork End

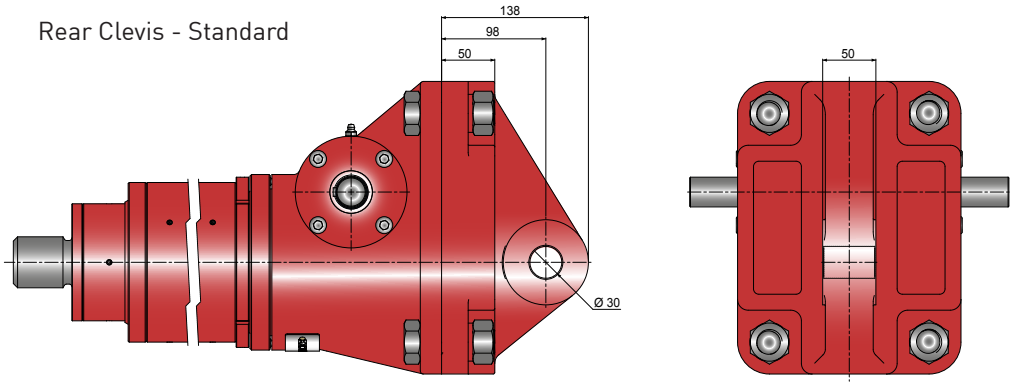


Clevis End

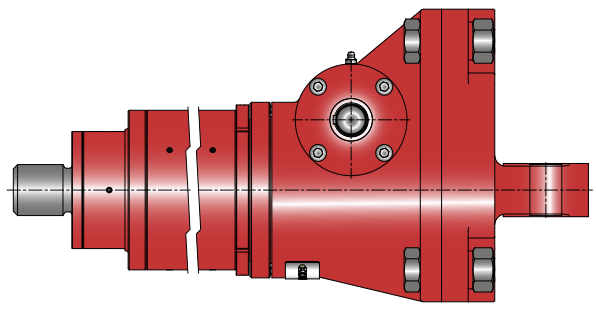


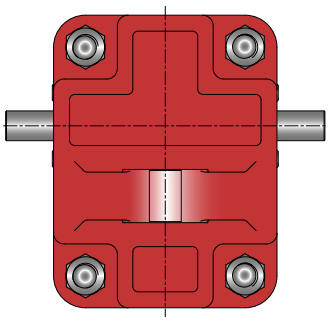
LMA0200 Rear End Fittings

Rear Clevis - Standard

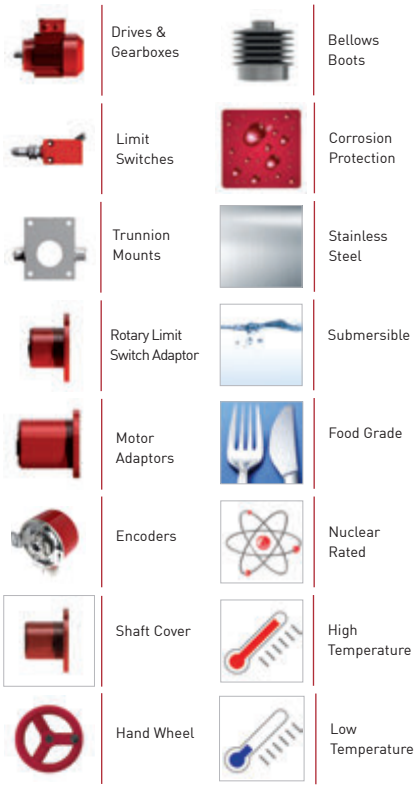


Rear Clevis - 90°





Accessories & Options



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POWERAM - Stainless Steel

HIGH CORROSION PROTECTION FOR EXTREME ENVIRONMENTS.

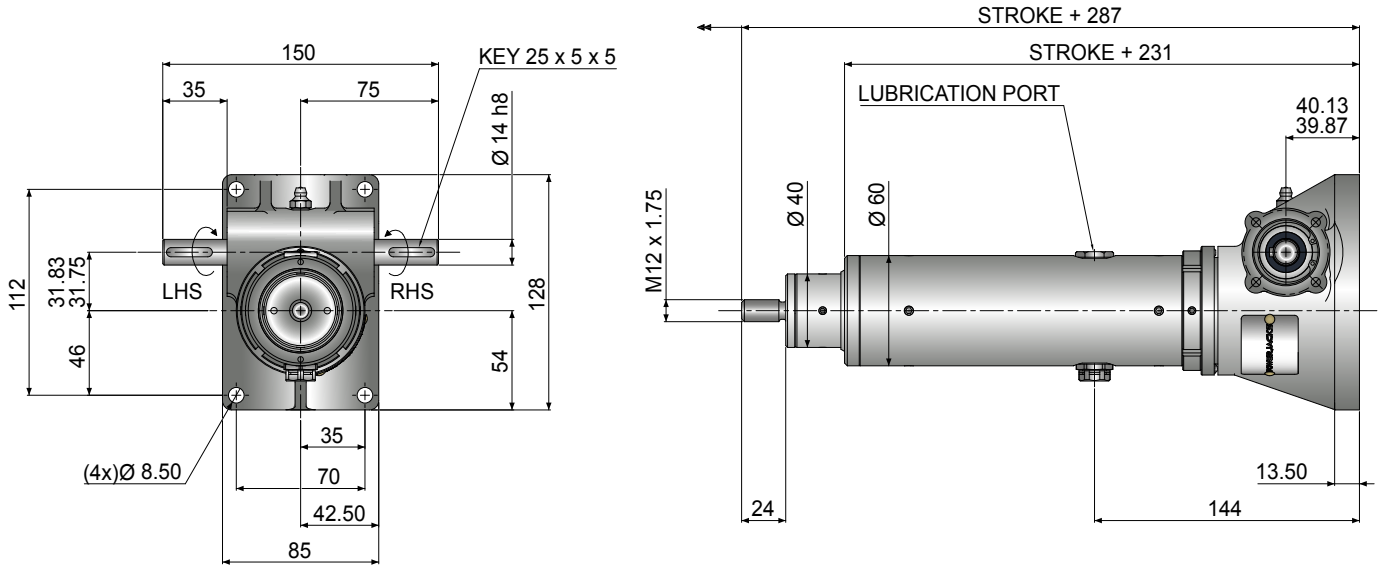
POWERAM Actuator - Stainless Steel - Standard Performance

Model				LMA0010		LMA0025		LMA0050		LMA0100		LMA0200	
Capacity	kN			10		25		50		100		200	
Sustaining Capacity (kN)	Standard 316 Lifting Screw		Tension	6.6		16.5		33		66		132	
			Compression	10		25		50		100		200	
	Duplex Lifting Screw			10		25		50		100		200	
Operating Capacity (kN)	316 Stainless Steel Worm Shaft			3.3		8.25		16.5		33		66	
	Duplex or Plated Worm Shaft with 316 Screw		Tension	6.6		16.5		33		66		132	
			Compression	10		25		50		100		200	
	Duplex or Plated Worm Shaft with Duplex Screw			10		25		50		100		200	
Lifting Screw[1]	mm			20		30		40		55		65	
	Lead	Option		1	2	1	2	1	2	1	2	1	2
		mm		5	10	6	12	9	18	12	24	12	24
Gear Ratios	Option 1			5:1		6:1		6:1		8:1		8:1	
	Option 2			20:1		24:1		24:01:00		24:1		24:1	
Turn of worm for travel of ram	Ratio Option 1	1 Turn		1mm	2mm	1mm	2mm	1.5mm	3mm	1.5mm	3mm	1.5mm	3mm
	Ratio Option 2	4 Turn		1mm	2mm	1mm	2mm	1.5mm	3mm	2mm	4mm	2mm	4mm
Max. Input Power (kW)	Gear Ratio Option 1			0.375		1.5		3.0		3.75		3.75	
	Gear Ratio Option 2			0.19		0.375		0.55		1.125		1.125	
Start up torque at full load (Nm)[2]	Gear Ratio Option 1			6.8	9.4	19.8	26.3	56	76	115.9	156.5	263.8	343
	Gear Ratio Option 2			3	4.2	8.7	11.6	25.5	34.7	60.5	81.8	137	179
Maximum Through Torque (Nm)[7]	316 Worm Shaft			6.8		19.8		56		115.9		132	
	Plated or Duplex Worm Shaft			20		59		168		347		396	
Ram Restraining Torque (Nm)[5]				22	30	76	102	210	34.7	575	780	1300	1705
Maximum Input Speed (rpm)				1800									
Weight (kg) - stroke = 150mm				5.63		14.1		25		43.6		78.8	
Weight (kg) per extra 25mm				0.32		0.57		0.78		1.3		2	
Gear Ratio Option 1	Gear Ratio			5:1		6:1		6:1		8:1		8:1	
	Actuator Static Efficiency			0.233	0.339	0.201	0.302	0.213	0.314	0.206	0.305	0.181	0.279
	Actuator Dynamic Efficiency			0.306	0.424	0.264	0.383	0.281	0.398	0.272	0.388	0.242	0.357
Gear Ratio Option 2	Gear Ratio			20:1		24:1		24:1		24:1		24:1	
	Actuator Static Efficiency			0.130	0.192	0.115	0.171	0.117	0.172	0.132	0.195	0.116	0.178
	Actuator Dynamic Efficiency			0.194	0.268	0.167	0.242	0.172	0244	0.190	0.271	0.169	0.250

Notes 1-3 of 7

1. Efficiency values for standard grease lubricated worm gear box and lifting screw.
2. For loads of 25% to 100% of actuator capacity, torque requirements are approximately proportional to the load.
3. Efficiency values for standard grease lubricated worm gear box and lifting screw.
4. All actuators have grease lubricated gearbox and lead screw as standard.
5. Torque required to prevent the ram from rotating if no anti-rotation device fitted to actuator.
6. Radial force applied midway along worm shaft key at 90° to key.
7. Maximum transmittable torque through worm shaft, not through gear set.

LMA0010 Actuator

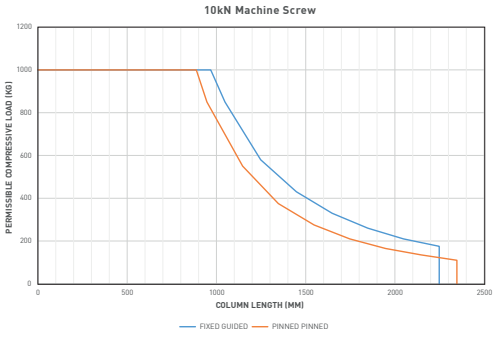


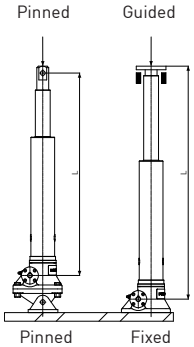
Performance

Model			LMA0010	
Capacity (kN)			10	
Sustaining Capacity (kN)	Standard 316 Lifting Screw	Tension	6.6	
		Compression	10	
	Duplex Lifting Screw		10	
Operating Capacity (kN)	Standard 316 Worm Shaft		3.3	
	Duplex or Plated Worm Shaft with 316 Screw	Tension	6.6	
		Compression	10	
	Duplex or Plated Worm Shaft with Duplex Screw		10	
Lifting Screw	Diameter (mm)		20	
	Lead	Option	1	2
		mm	5	10
Gear Ratio Option 1	Gear Ratio		5:1	
	Static Efficiency		0.233	0.339
	Dynamic Efficiency		0.306	0.424
Gear Ratio Option 2	Gear Ratio		20:1	
	Static Efficiency		0.130	0.192
	Dynamic Efficiency		0.194	0.268

Model			LMA0010	
Capacity	kN		10	
Lifting Screw Lead (mm)			5	10
Max. Input Power (kW)	Gear Ratio 1		0.375	
	Gear Ratio 2		0.19	
Start up torque at full load (Nm)	Gear Ratio 1		6.8	9.4
	Gear Ratio 2		3	4.2
Turn of worm for travel of ram	Gear Ratio 1	1 Turn	1mm	2mm
	Gear Ratio 2	4 Turn	1mm	2mm
Maximum Through Torque (Nm)	316 Worm Shaft		6.8	
	Plated or Duplex Worm Shaft		20	
Ram Restraining Torque (Nm)			22	30
Worm Shaft Maximum Radial Load (N)			325	
Maximum Input Speed (rpm)			1800	
Weight (kg) - 100 mm stroke			5.63	
Weight (kg) - per extra 25mm stroke			0.32	

Column Strength



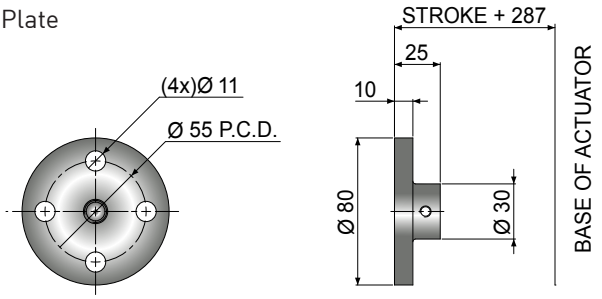


Standard Stroke & Weights

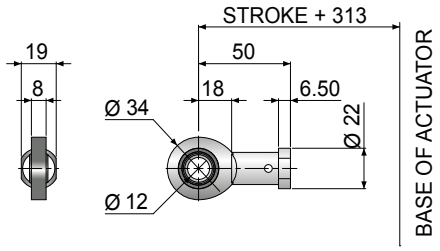
Model		LMA0010
Capacity	kN	10
Stroke = 100 mm		5.63kg
Stroke = 200 mm		6.91kg
Stroke = 300 mm		8.19kg
Stroke = 500 mm		10.75kg
Stroke = 750 mm		13.95kg
Stroke = 1000 mm		17.15kg

LMA0010 Ram End Fittings

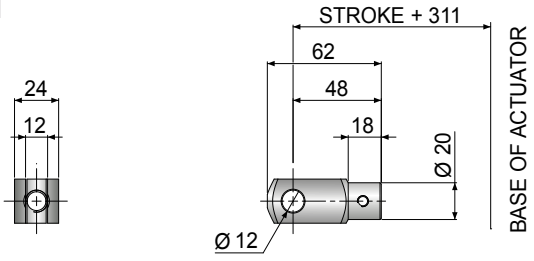
Top Plate



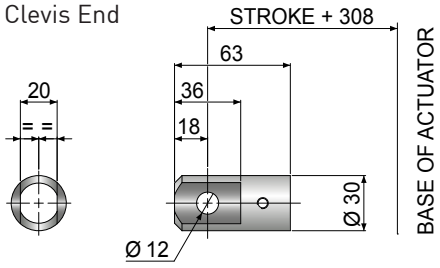
Rod End



Fork End

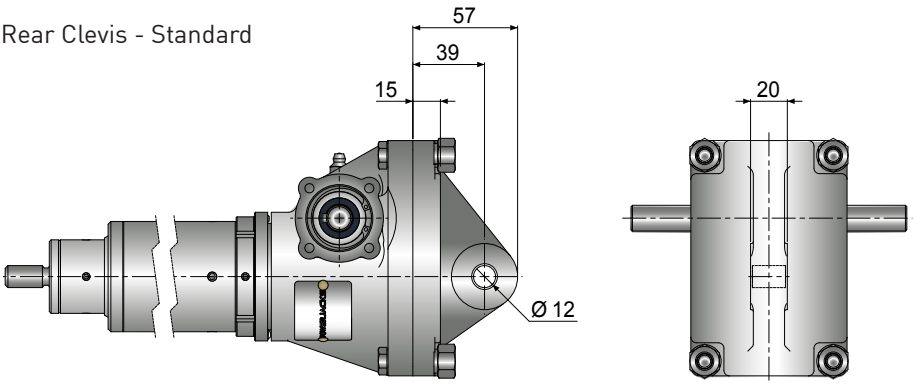


Clevis End

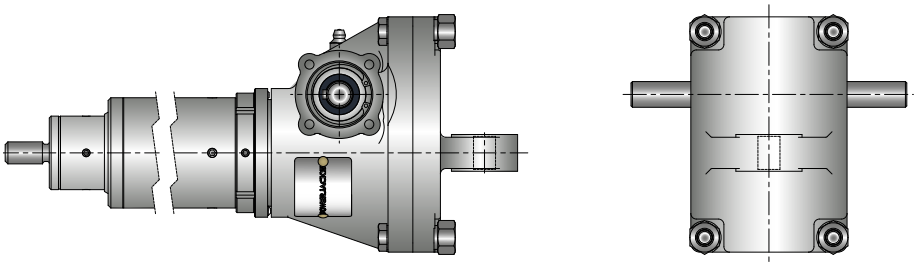


LMA0010 Rear End Fittings

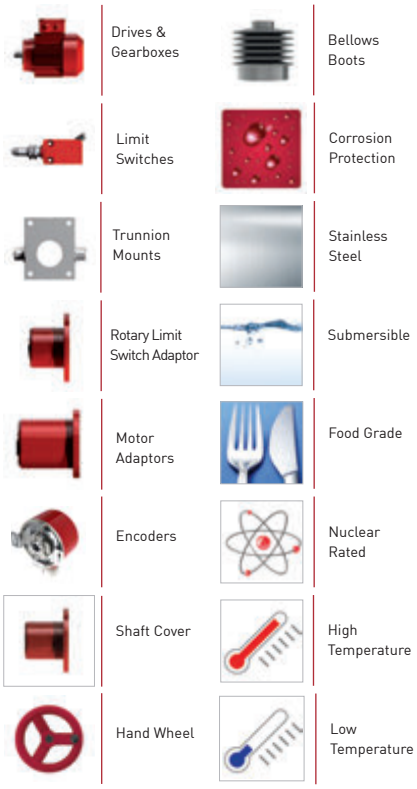
Rear Clevis - Standard



Rear Clevis - 90°

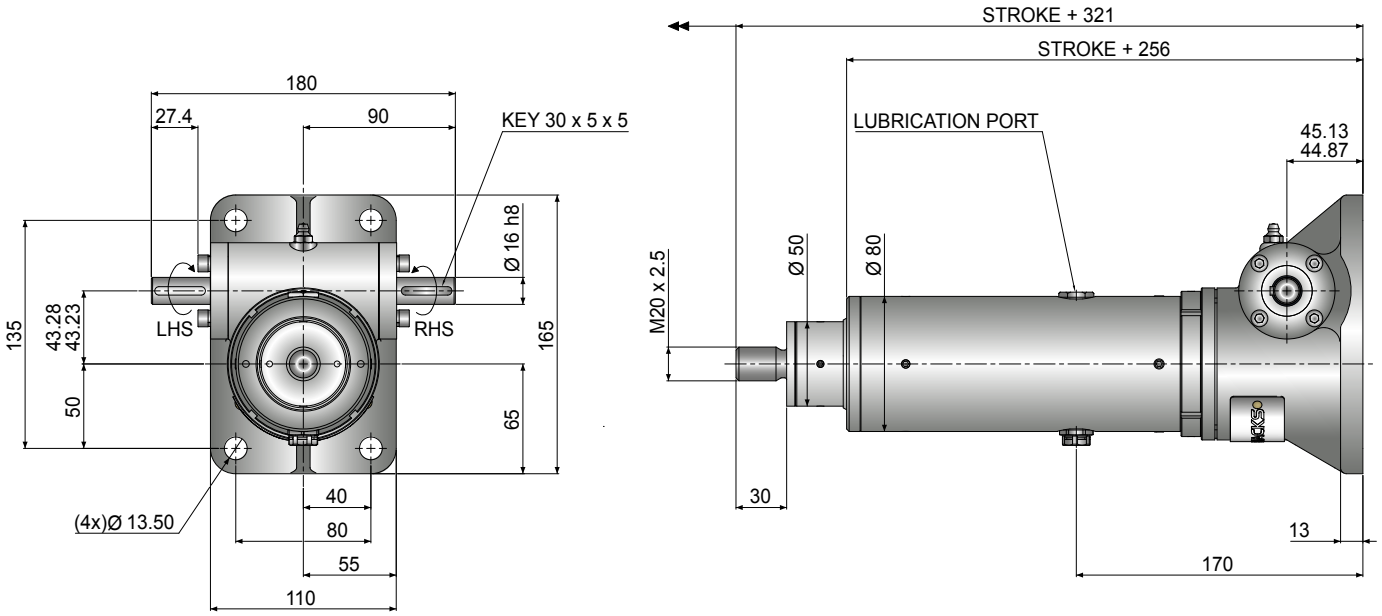


Accessories & Options



Note:
1 Designs subject to change without notice.
2 All colours for illustrative purposes only.
3 Dimensions in millimetres unless otherwise stated.

LMA0025 Actuator

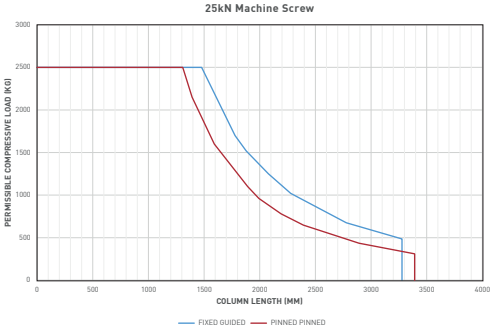


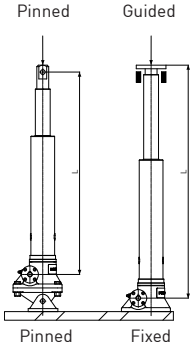
Performance

Model			LMA0025	
Capacity (kN)			25	
Sustaining Capacity (kN)	Standard 316 Lifting Screw	Tension	16.5	
		Compression	25	
	Duplex Lifting Screw		25	
Operating Capacity (kN)	Standard 316 Worm Shaft		8.25	
	Duplex or Plated Worm Shaft with 316 Screw	Tension	16.5	
		Compression	25	
	Duplex or Plated Worm Shaft with Duplex Screw		25	
Lifting Screw	Diameter (mm)		30	
	Lead	Option	1	2
		mm	6	12
Gear Ratio Option 1	Gear Ratio		6:1	
	Static Efficiency		0.201	0.302
	Dynamic Efficiency		0.264	0.383
Gear Ratio Option 2	Gear Ratio		24:1	
	Static Efficiency		0.115	0.171
	Dynamic Efficiency		0.167	0.242

Model			LMA0025	
Capacity	kN		25	
Lifting Screw Lead (mm)			6	12
Max. Input Power (kW)	Gear Ratio 1		1.5	
	Gear Ratio 2		0.375	
Start up torque at full load (Nm)	Gear Ratio 1		19.8	26.3
	Gear Ratio 2		8.7	11.6
Turn of worm for travel of ram	Gear Ratio 1	1 Turn	1mm	2mm
	Gear Ratio 2	4 Turn	1mm	2mm
Maximum Through Torque (Nm)	316 Worm Shaft		19.8	
	Plated or Duplex Worm Shaft		59	
Ram Restraining Torque (Nm)			76	102
Worm Shaft Maximum Radial Load (N)			380	
Maximum Input Speed (rpm)			1800	
Weight (kg) - 100 mm stroke			14.1	
Weight (kg) - per extra 25mm stroke			0.57	

Column Strength



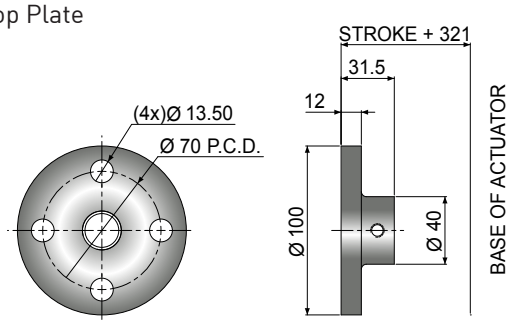


Standard Stroke & Weights

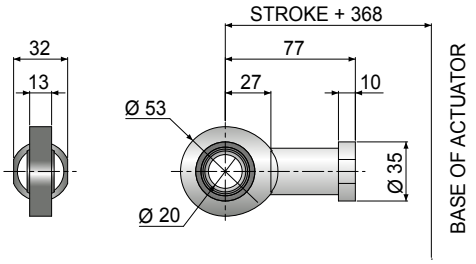
Model		LMA0025
Capacity	kN	25
Stroke = 100 mm		14.1kg
Stroke = 250 mm		17.52kg
Stroke = 500 mm		23.22kg
Stroke = 750 mm		28.92kg
Stroke = 1000 mm		34.62kg
Stroke = 1500 mm		46.02kg

LMA0025 Ram End Fittings

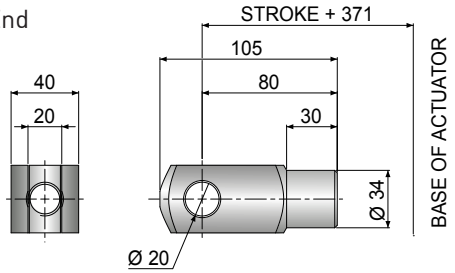
Top Plate



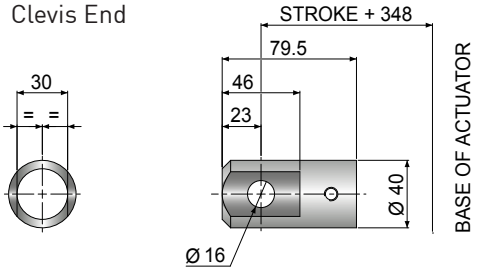
Rod End



Fork End

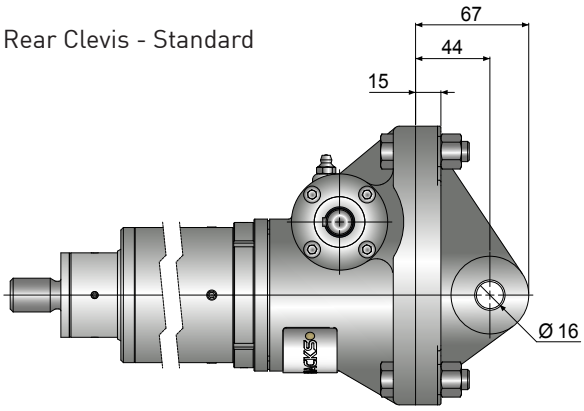


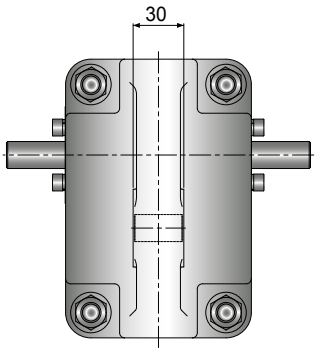
Clevis End



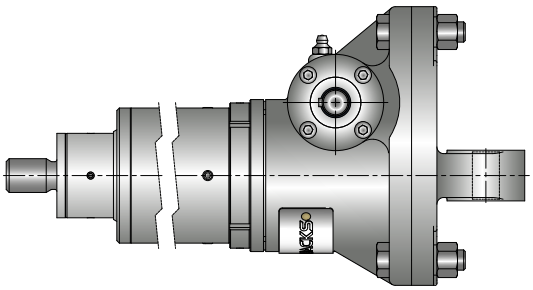
LMA0025 Rear End Fittings

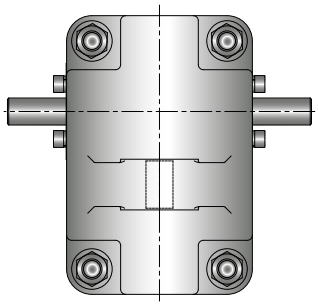
Rear Clevis - Standard



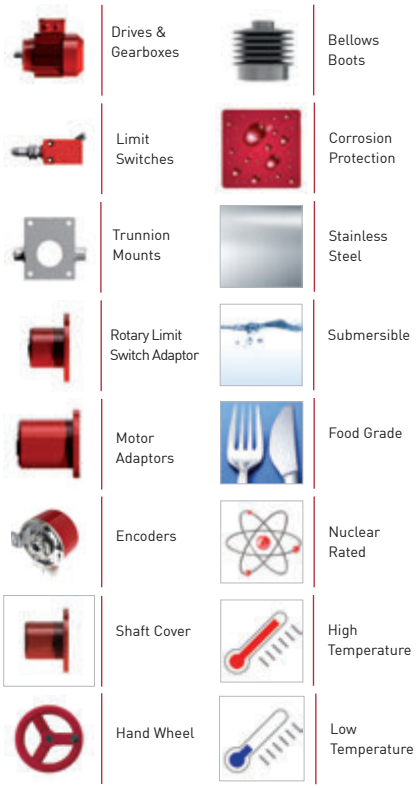


Rear Clevis - 90°





Accessories & Options



Note:
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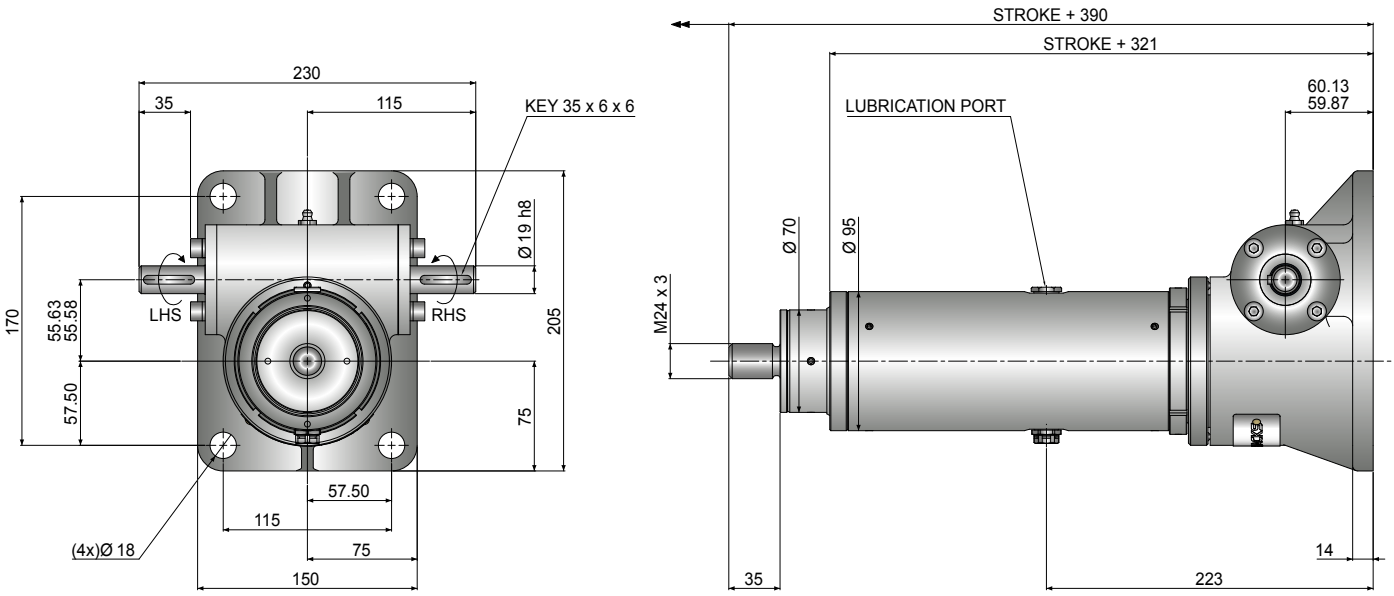
2 All colours for illustrative purposes only.
3 Dimensions in millimetres unless otherwise stated.

LMA0050 Actuator

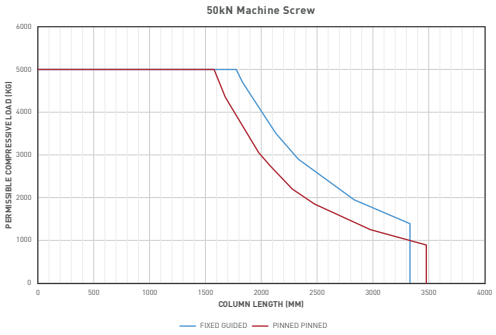


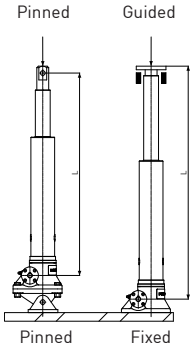
Performance

Model			LMA0050	
Capacity (kN)			50	
Sustaining Capacity (kN)	Standard 316 Lifting Screw	Tension	33	
		Compression	50	
	Duplex Lifting Screw		50	
Operating Capacity (kN)	Standard 316 Worm Shaft		16.5	
	Duplex or Plated Worm Shaft with 316 Screw	Tension	33	
		Compression	50	
	Duplex or Plated Worm Shaft with Duplex Screw		50	
Lifting Screw	Diameter (mm)		30	
	Lead	Option	1	2
		mm	9	18
Gear Ratio Option 1	Gear Ratio		6:1	
	Static Efficiency		0.213	0.314
	Dynamic Efficiency		0.281	0.398
Gear Ratio Option 2	Gear Ratio		24:1	
	Static Efficiency		0.117	0.172
	Dynamic Efficiency		0.172	0.244

Model			LMA0050	
Capacity	kN		25	
Lifting Screw Lead (mm)			9	18
Max. Input Power (kW)	Gear Ratio 1		3.0	
	Gear Ratio 2		0.55	
Start up torque at full load (Nm)	Gear Ratio 1		56	76
	Gear Ratio 2		25.5	34.7
Turn of worm for travel of ram	Gear Ratio 1	1 Turn	1.5mm	3mm
	Gear Ratio 2	4 Turn	1.5mm	3mm
Maximum Through Torque (Nm)	316 Worm Shaft		56	
	Plated or Duplex Worm Shaft		168	
Ram Restraining Torque (Nm)			210	290
Worm Shaft Maximum Radial Load (N)			740	
Maximum Input Speed (rpm)			1800	
Weight (kg) - 100 mm stroke			25	
Weight (kg) - per extra 25mm stroke			0.78	

Column Strength



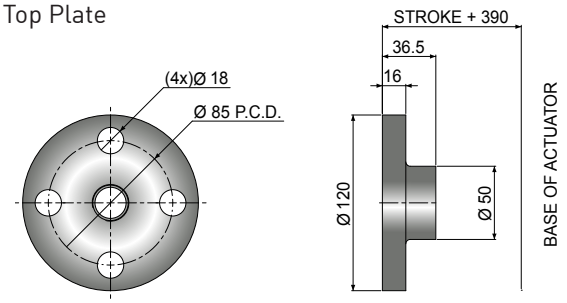


Standard Stroke & Weights

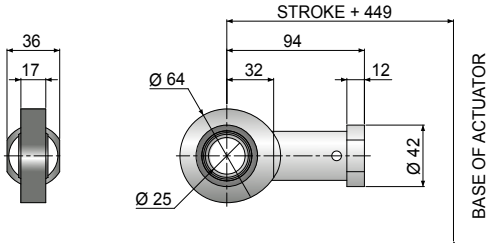
Model		LMA0050
Capacity	kN	50
Stroke = 100 mm		25.0kg
Stroke = 250 mm		29.68kg
Stroke = 500 mm		37.48kg
Stroke = 750 mm		45.28kg
Stroke = 1000 mm		53.08kg
Stroke = 1500 mm		68.68kg

LMA0050 Ram End Fittings

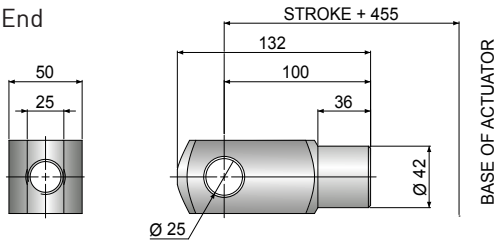
Top Plate



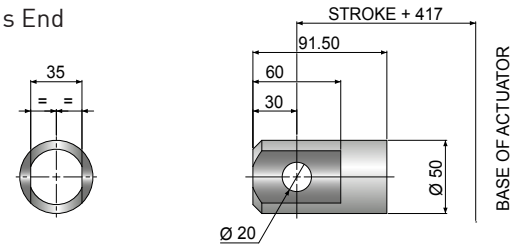
Rod End



Fork End

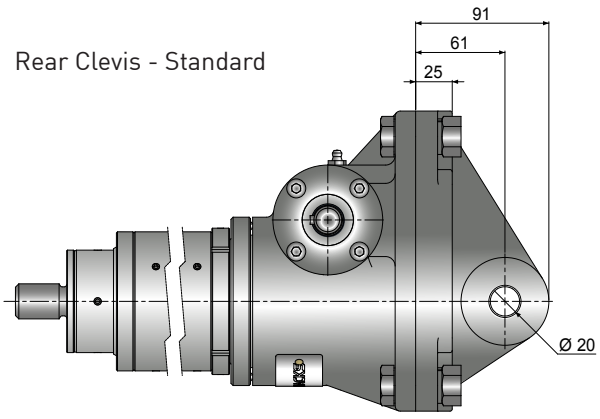


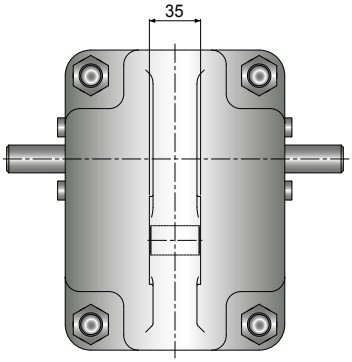
Clevis End



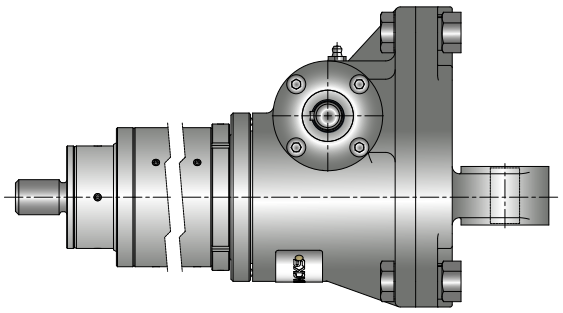
LMA0050 Rear End Fittings

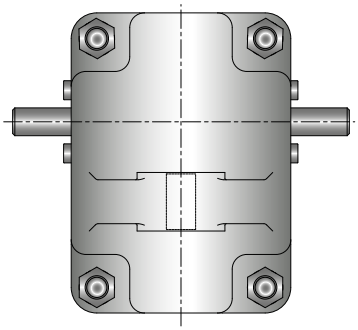
Rear Clevis - Standard



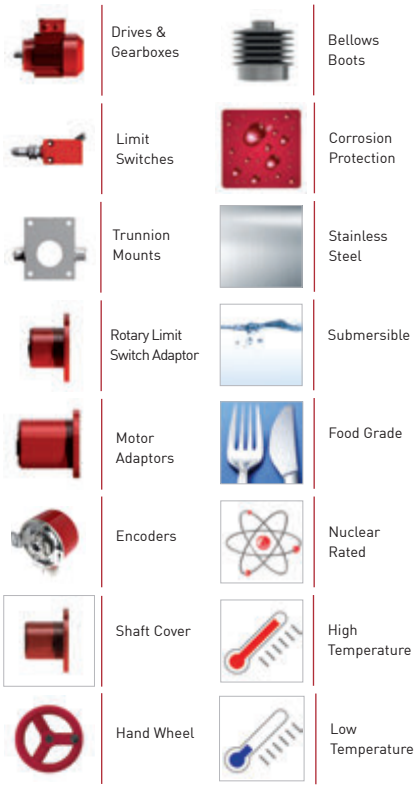


Rear Clevis - 90°





Accessories & Options



Note:
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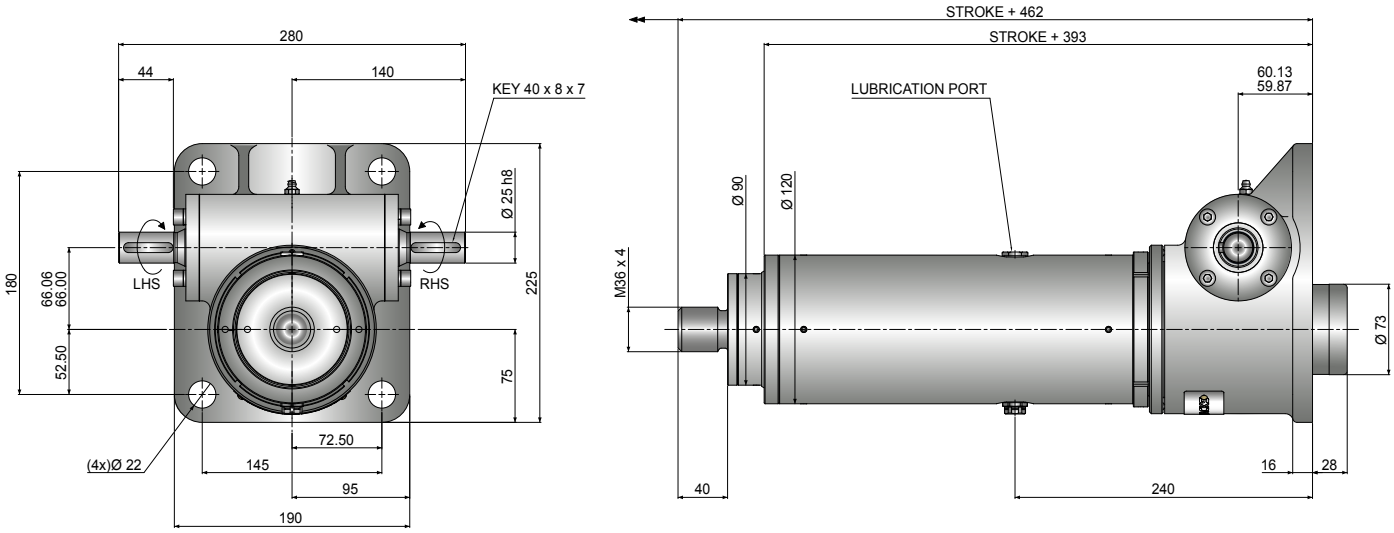
3 Dimensions in millimetres unless otherwise stated.

LMA0100 Actuator

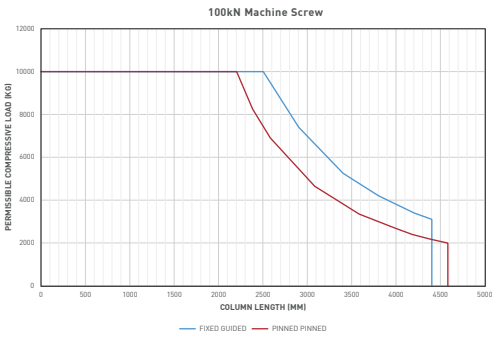


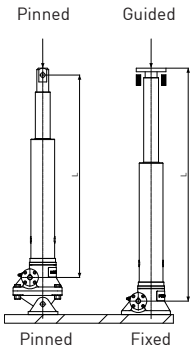
Performance

Model			LMA0100	
Capacity (kN)			100	
Sustaining Capacity (kN)	Standard 316 Lifting Screw	Tension	66	
		Compression	100	
	Duplex Lifting Screw		100	
Operating Capacity (kN)	Standard 316 Worm Shaft		33	
	Duplex or Plated Worm Shaft with 316 Screw	Tension	66	
		Compression	100	
	Duplex or Plated Worm Shaft with Duplex Screw		100	
Lifting Screw	Diameter (mm)		55	
	Lead	Option	1	2
		mm	12	24
Gear Ratio Option 1	Gear Ratio		8:1	
	Static Efficiency		0.206	0.305
	Dynamic Efficiency		0.272	0.388
Gear Ratio Option 2	Gear Ratio		24:1	
	Static Efficiency		0.132	0.195
	Dynamic Efficiency		0.190	0.271

Model			LMA0100	
Capacity	kN		100	
Lifting Screw Lead (mm)			12	24
Max. Input Power (kW)	Gear Ratio 1		3.75	
	Gear Ratio 2		1.125	
Start up torque at full load (Nm)	Gear Ratio 1		115.9	156.5
	Gear Ratio 2		60.5	81.8
Turn of worm for travel of ram	Gear Ratio 1	1 Turn	1.5mm	3mm
	Gear Ratio 2	4 Turn	2mm	4mm
Maximum Through Torque (Nm)	316 Worm Shaft		115.9	
	Plated or Duplex Worm Shaft		347	
Ram Restraining Torque (Nm)			575	780
Worm Shaft Maximum Radial Load (N)			1000	
Maximum Input Speed (rpm)			1800	
Weight (kg) - 100 mm stroke			43.6	
Weight (kg) - per extra 25mm stroke			1.3	

Column Strength



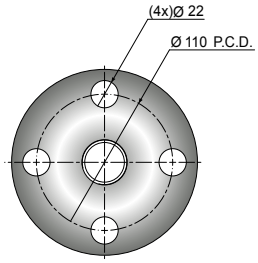


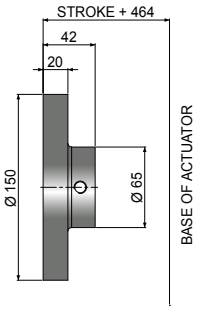
Standard Stroke & Weights

Model		LMA0100
Capacity	kN	100
Stroke = 250 mm		51.4kg
Stroke = 500 mm		64.4kg
Stroke = 750 mm		77.4kg
Stroke = 1000 mm		90.4kg
Stroke = 1500 mm		116.4kg
Stroke = 2000 mm		142.4kg

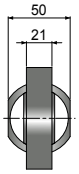
LMA0100 Ram End Fittings

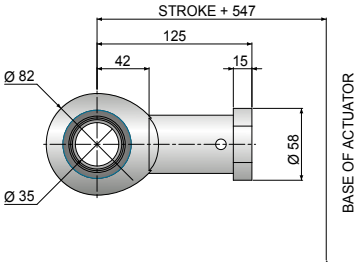
Top Plate



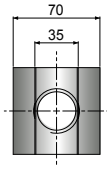


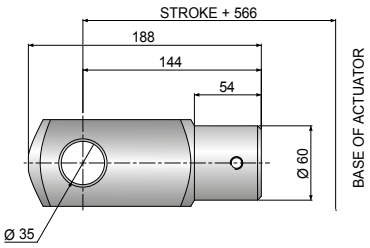
Rod End



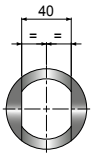


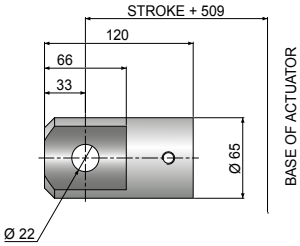
Fork End





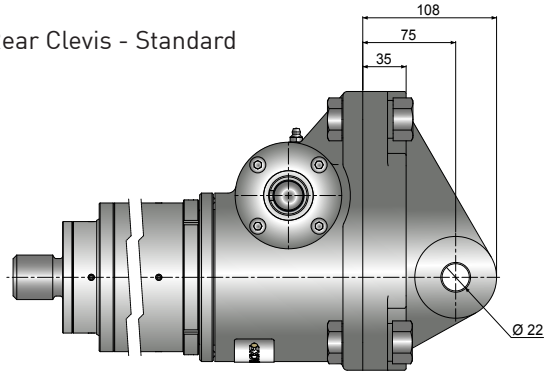
Clevis End

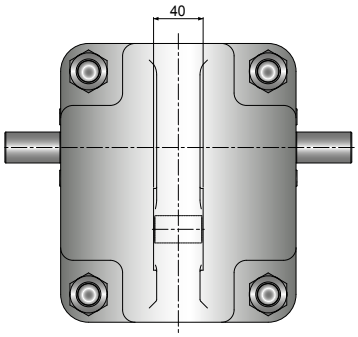




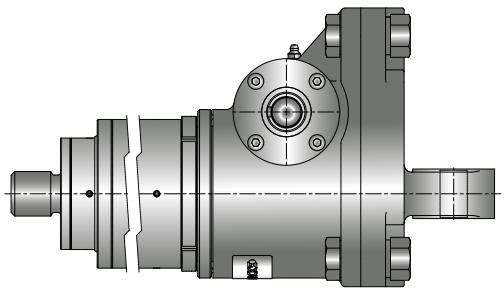
LMA0100 Rear End Fittings

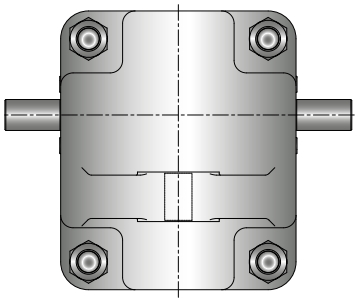
Rear Clevis - Standard



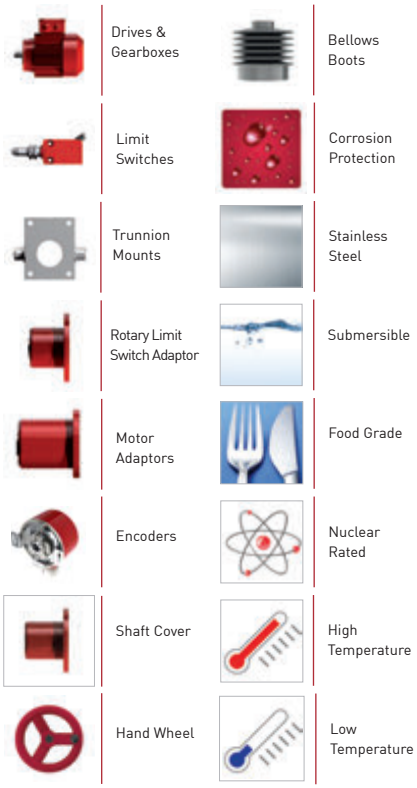


Rear Clevis - 90°





Accessories & Options



Note:
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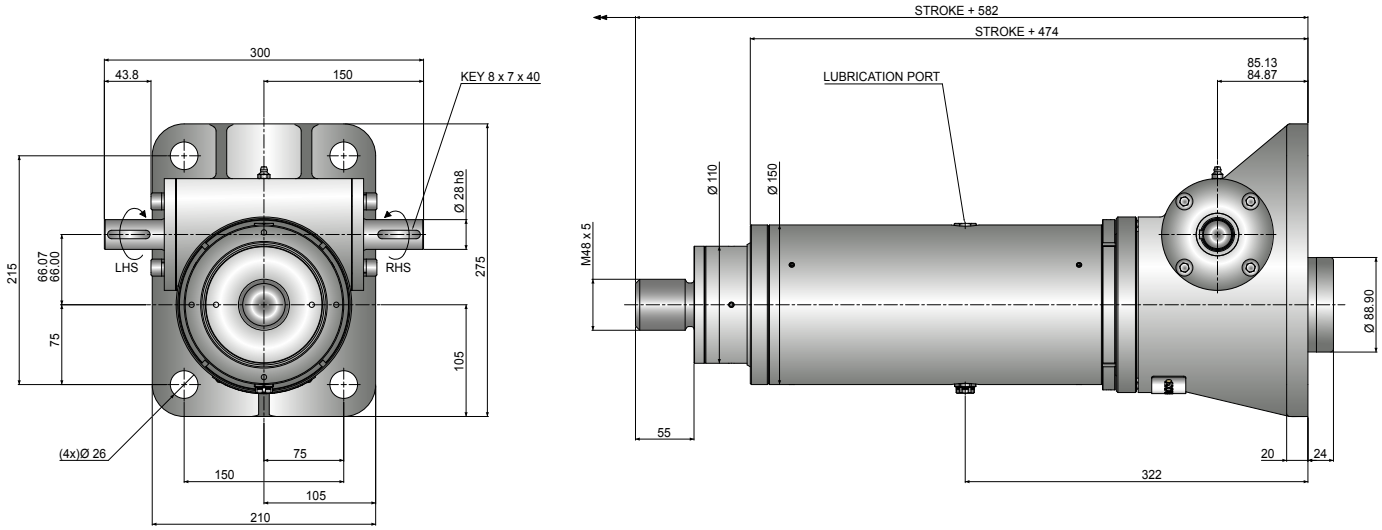
3 Dimensions in millimetres unless otherwise stated.

LMA0200 Actuator

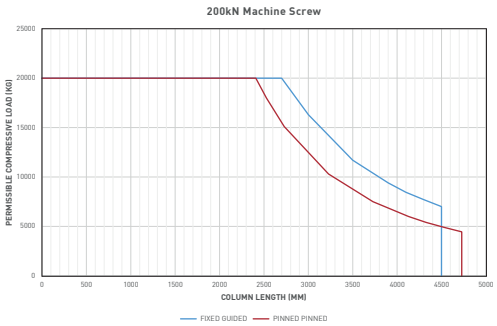


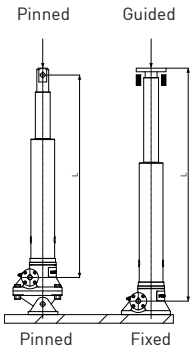
Performance

Model			LMA0200	
Capacity (kN)			200	
Sustaining Capacity (kN)	Standard 316 Lifting Screw	Tension	132	
		Compression	200	
	Duplex Lifting Screw		200	
Operating Capacity (kN)	Standard 316 Worm Shaft		66	
	Duplex or Plated Worm Shaft with 316 Screw	Tension	132	
		Compression	200	
	Duplex or Plated Worm Shaft with Duplex Screw		200	
Lifting Screw	Diameter (mm)		65	
	Lead	Option	1	2
		mm	12	24
Gear Ratio Option 1	Gear Ratio		8:1	
	Static Efficiency		0.181	0.279
	Dynamic Efficiency		0.242	0.357
Gear Ratio Option 2	Gear Ratio		24:1	
	Static Efficiency		0.116	0.178
	Dynamic Efficiency		0.169	0.250

Model			LMA0200	
Capacity	kN		200	
Lifting Screw Lead (mm)			12	24
Max. Input Power (kW)	Gear Ratio 1		3.75	
	Gear Ratio 2		1.125	
Start up torque at full load (Nm)	Gear Ratio 1		263.8	343
	Gear Ratio 2		137	179
Turn of worm for travel of ram	Gear Ratio 1	1 Turn	1.5mm	3mm
	Gear Ratio 2	4 Turn	2mm	4mm
Maximum Through Torque (Nm)	316 Worm Shaft		132	
	Plated or Duplex Worm Shaft		396	
Ram Restraining Torque (Nm)			1300	1705
Worm Shaft Maximum Radial Load (N)			1600	
Maximum Input Speed (rpm)			1800	
Weight (kg) - 100 mm stroke			78.8	
Weight (kg) - per extra 25mm stroke			2	

Column Strength



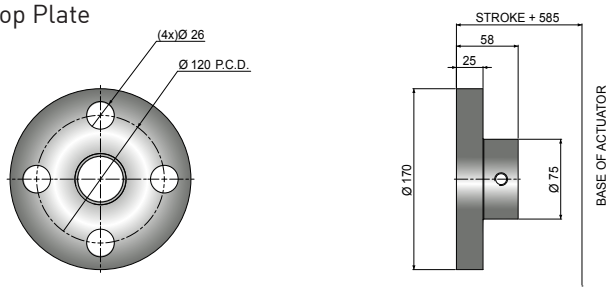


Standard Stroke & Weights

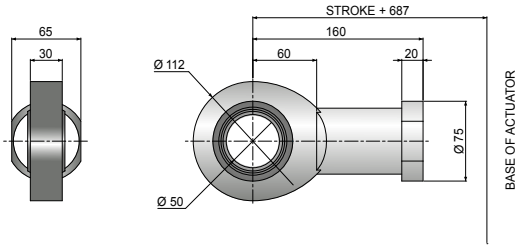
Model		LMA0200
Capacity	kN	200
Stroke = 250 mm		90.8kg
Stroke = 500 mm		110.8kg
Stroke = 750 mm		130.8kg
Stroke = 1000 mm		150.8kg
Stroke = 1500 mm		190.8kg
Stroke = 2000 mm		230.8kg

LMA0200 Ram End Fittings

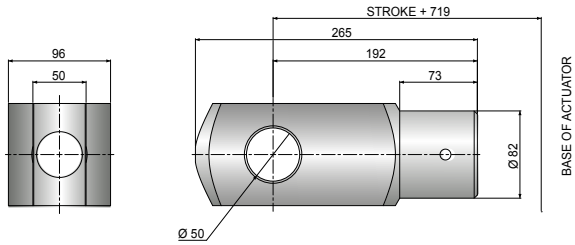
Top Plate



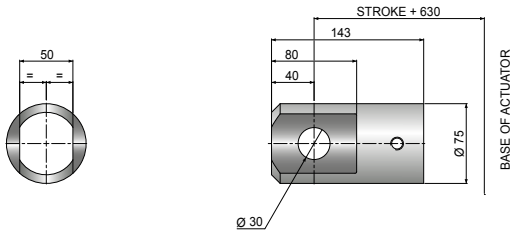
Rod End



Fork End

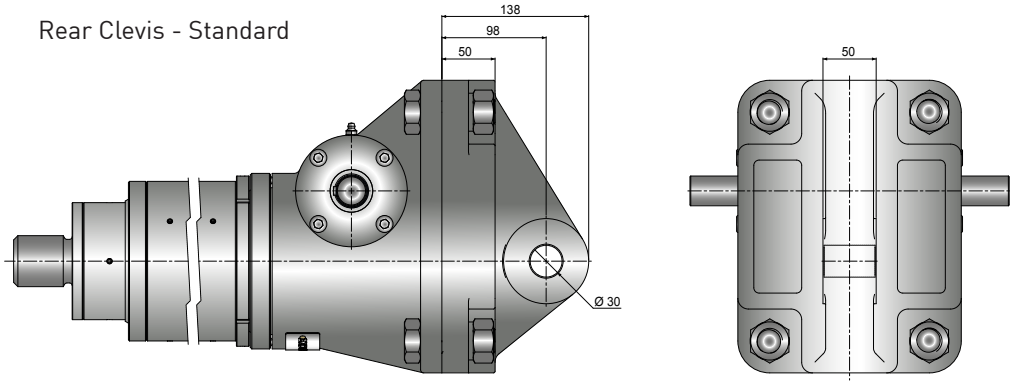


Clevis End

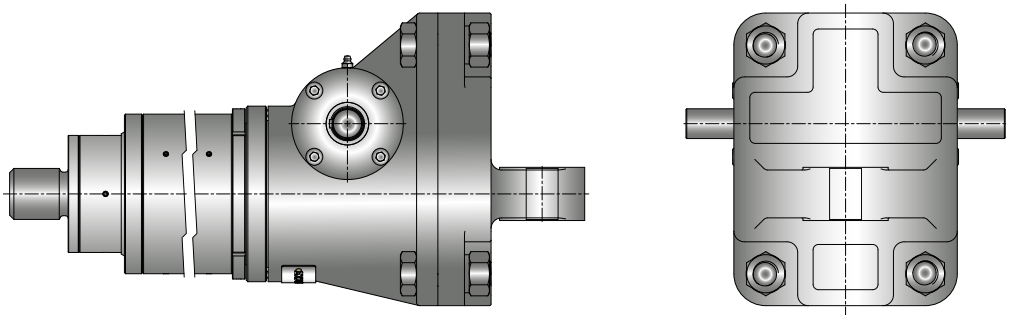


LMA0200 Rear End Fittings

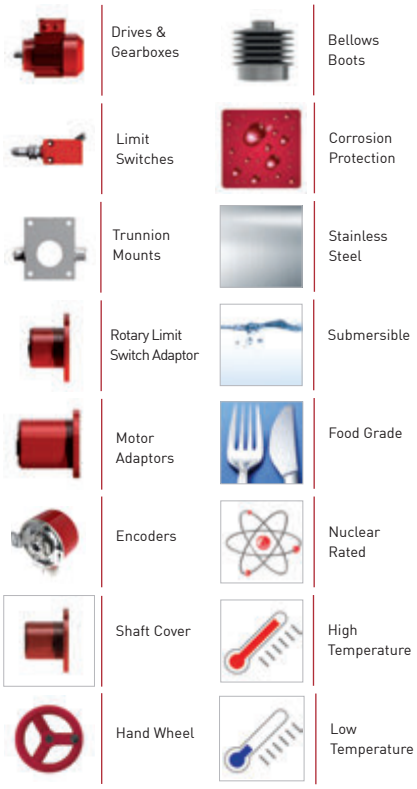
Rear Clevis - Standard



Rear Clevis - 90°



Accessories & Options



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POWERAM - Ball Screw

HIGH EFFICIENCY FOR MEDIUM TO HIGH DUTY OR LOW POWER CONSUMPTION APPLICATIONS.

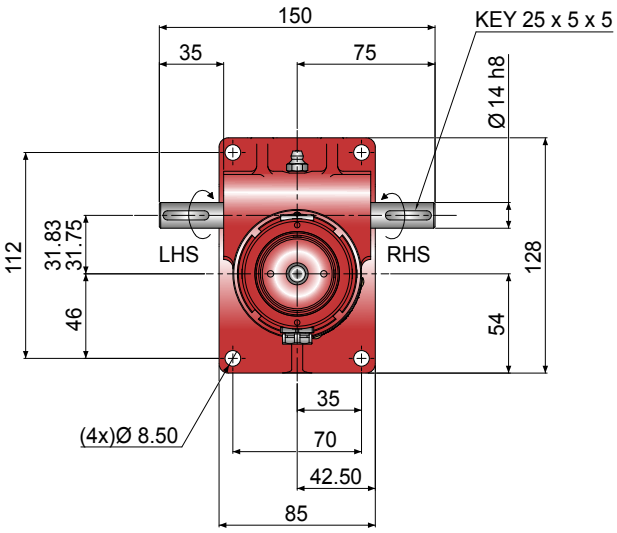
POWERAM Actuator - Ball Screw - Standard Performance

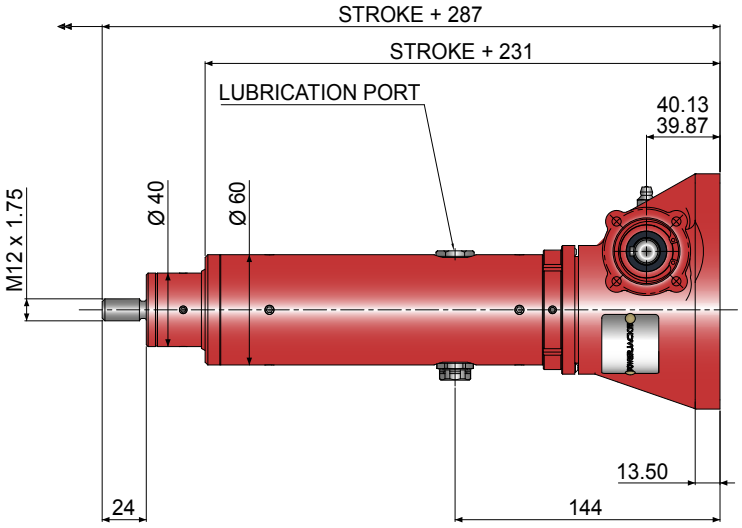
Model				LBA0010	LBA0025		LBA0050		LBA0100		LBA0200	
Capacity	kN			10	25		50		100		200	
Lifting Screw[1]	mm			20	30		40		55		65	
	Lead	Option		1	1	2	1	2	1	2	1	2
		mm		5	5	10	10	20	10	20	10	20
Gear Ratios	Option 1			5:1	6:1		6:1		8:1		8:1	
	Option 2			20:1	24:1		24:01:00		24:1		24:1	
Turn of worm for travel of ram	Ratio Option 1	6 Turn		6mm	5mm	10mm	10mm	20mm	7.5mm	15mm	7.5mm	15mm
	Ratio Option 2	24 Turn		6mm	5mm	0mm	10mm	20mm	10mm	20mm	10mm	20mm
Max. Input Power (kW)	Gear Ratio Option 1			0.375	1.5		3.0		3.75		3.75	
	Gear Ratio Option 2			0.19	0.375		0.55		1.125		1.125	
Start up torque at full load (Nm)[2]	Gear Ratio Option 1			2.7	5.9	11.1	23.4	44.6	36.4	68.5	75.2	139.4
	Gear Ratio Option 2			1.2	2.6	4.9	10.7	20.4	19.1	35.8	39.4	72.9
Maximum Through Torque (Nm)[7]				20	59		168		347		396	
Ram Restraining Torque (Nm)[5]				9	23	43	88	167	181	340	370	690
Worm Shaft Maximum Radial Load (N)[6]				325	380		740		1000		1600	
Maximum Input Speed (rpm)				1800	1800		1800		1800		1800	
Gear Case Material				Aluminium	SG Iron		SG Iron		SG Iron		Steel	
Weight (kg) - stroke = 150mm				5.63	14.1		25		43.6		78.8	
Weight (kg) per extra 25mm				0.32	0.57		0.78		1.3		2	
Gear Ratio Option 1	Gear Ratio			5:1	6:1		6:1		8:1		8:1	
	Actuator Static Efficiency			0.603	0.565	0.600	0.567	0.595	0.546	0.581	0.529	0.571
	Actuator Jack Dynamic Efficiency			0.681	0.662	0.692	0.663	0.687	0.645	0.674	0.631	0.665
Gear Ratio Option 2	Gear Ratio			20:1	24:1		24:1		24:1		24:1	
	Actuator Jack Static Efficiency			0.341	0.320	0.340	0.310	0.325	0.348	0.370	0.337	0.364
	Actuator Jack Dynamic Efficiency			0.429	0.419	0.438	0.407	0.422	0.450	0.470	0.440	0.465

Notes 1-3 of 7

1. Efficiency values for standard grease lubricated worm gear box and ball screw.
2. For loads of 25% to 100% of actuator capacity, torque requirements are approximately proportional to the load.
3. Efficiency values for standard grease lubricated worm gear box and ball screw.
4. All actuators have grease lubricated gearbox and ball screw as standard.
5. Torque required to prevent the ram from rotating if no anti-rotation device fitted to actuator.
6. Radial force applied midway along worm shaft key at 90° to key.
7. Maximum transmittable torque through worm shaft, not through gear set.

LBA0010 Actuator



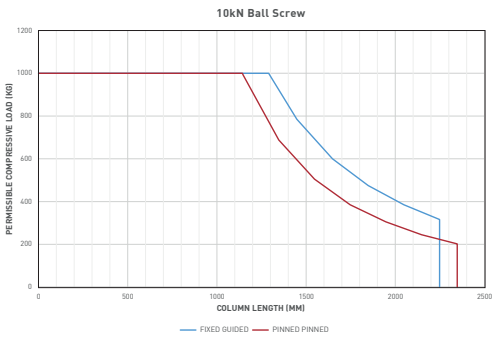


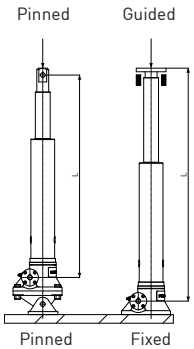
Performance

Model			LBA0010
Capacity	kN		10
Lifting Screw	Diameter (mm)		20
	Lead	Option	1
		mm	5
Gear Ratio Option 1	Gear Ratio		5:1
	Static Efficiency		0.603
	Dynamic Efficiency		0.681
Gear Ratio Option 2	Gear Ratio		20:1
	Static Efficiency		0.341
	Dynamic Efficiency		0.429
Max. Input power (kW)	Gear Ratio Option 1		0.375
	Gear Ratio Option 2		0.18

Model			LBA0010
Capacity	kN		10
Lifting Screw Lead (mm)			5
Start up torque at full load (Nm)	Gear Ratio Option 1		2.7
	Gear Ratio Option 2		1.2
Turn of worm for travel of ram	Gear Ratio 1	6 Turn	6mm
	Gear Ratio 2	24 Turn	6mm
Maximum Through Torque (Nm)			20
Ram Restraining Torque (Nm)			9
Worm Shaft Maximum Radial Load (N)			325
Maximum Input Speed (rpm)			1800
Weight (kg) - stroke = 150mm			5.63
Weight (kg) - per extra 25mm stroke			0.32

Column Strength



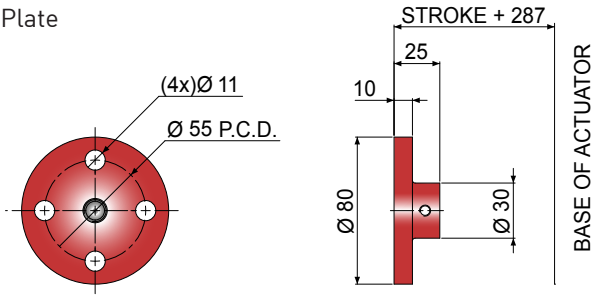


Standard Stroke & Weights

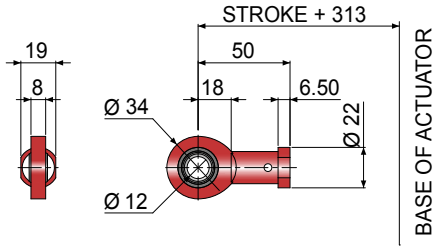
Model		LMA0010
Capacity	kN	10
Stroke = 100 mm		5.63kg
Stroke = 200 mm		6.91kg
Stroke = 300 mm		8.19kg
Stroke = 500 mm		10.75kg
Stroke = 750 mm		13.95kg
Stroke = 1000 mm		17.15kg

LBA0010 Ram End Fittings

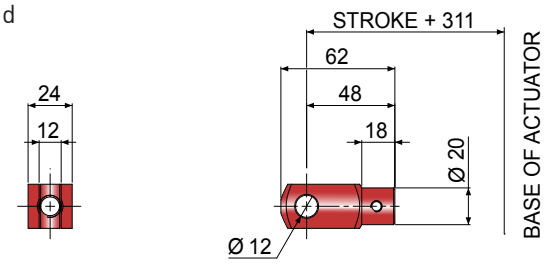
Top Plate



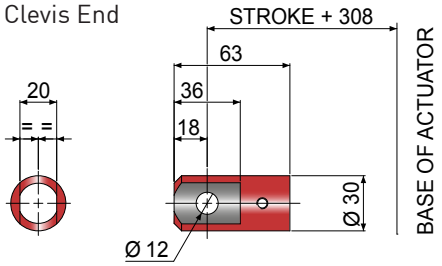
Rod End



Fork End

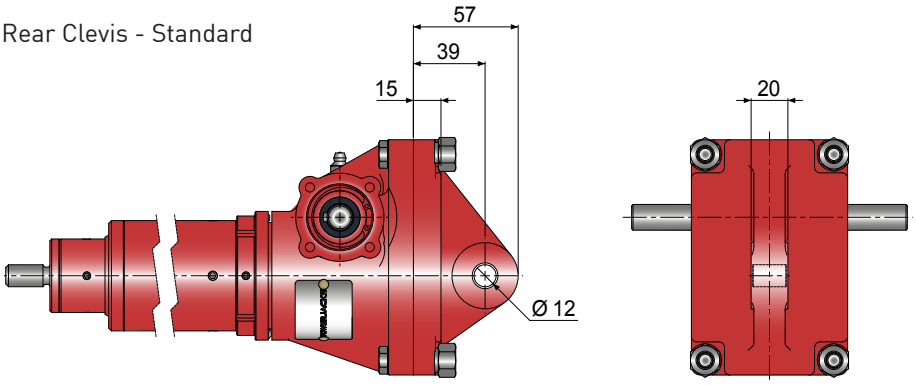


Clevis End

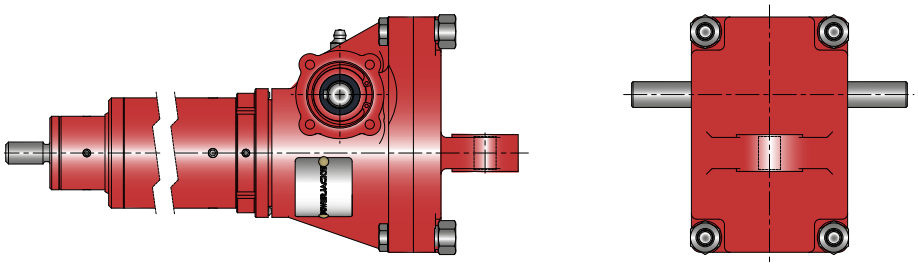


LBA0010 Rear End Fittings

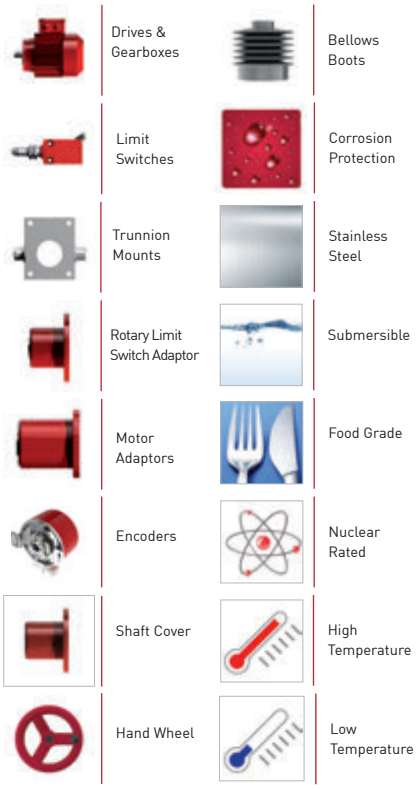
Rear Clevis - Standard



Rear Clevis - 90°



Accessories & Options



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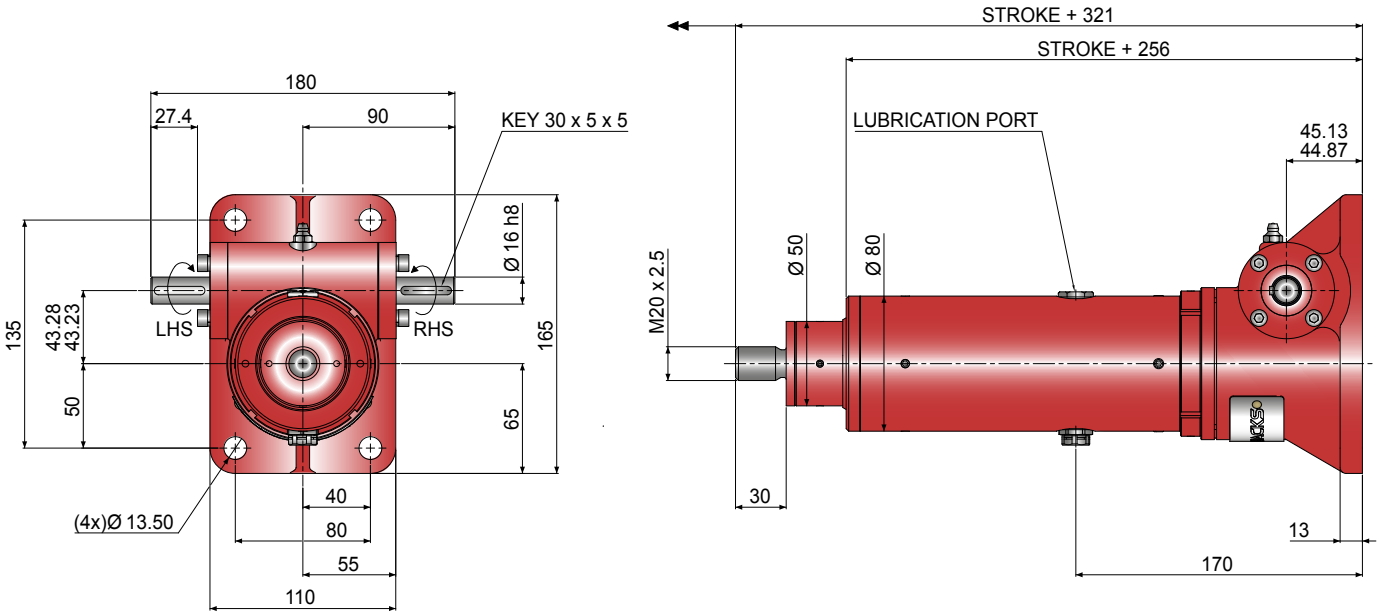
LBA0025 Actuator

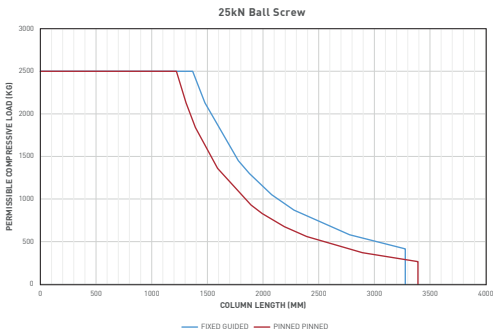


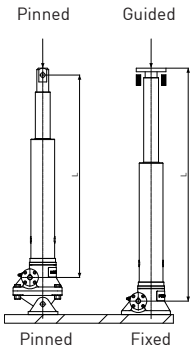
Performance

Model			LBA0025	
Capacity	kN		25	
Lifting Screw	Diameter (mm)		25	
	Lead	Option	1	2
		mm	5	10
Gear Ratio Option 1	Gear Ratio		6:1	
	Static Efficiency		0.565	0.600
	Dynamic Efficiency		0.662	0.692
Gear Ratio Option 2	Gear Ratio		24:1	
	Static Efficiency		0.320	0.340
	Dynamic Efficiency		0.419	0.438
Max. Input power (kW)	Gear Ratio Option 1		1.5	
	Gear Ratio Option 2		0.375	

Model			LBA0025	
Capacity	kN		25	
Lifting Screw Lead (mm)			5	10
Start up torque at full load (Nm)	Gear Ratio Option 1		5.9	11.1
	Gear Ratio Option 2		2.6	4.9
Turn of worm for travel of ram	Gear Ratio 1	6 Turn	5mm	10mm
	Gear Ratio 2	24 Turn	5mm	10mm
Maximum Through Torque (Nm)			59	
Ram Restraining Torque (Nm)			23	43
Worm Shaft Maximum Radial Load (N)			380	
Maximum Input Speed (rpm)			1800	
Weight (kg) - stroke = 100mm			14.1	
Weight (kg) - per extra 25mm stroke			0.57	

Column Strength





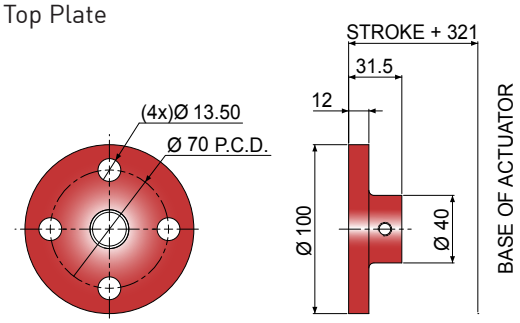
Standard Stroke & Weights

Model		LMA0025
Capacity	kN	25
Stroke = 100 mm		14.1kg
Stroke = 250 mm		17.52kg
Stroke = 500 mm		23.22kg
Stroke = 750 mm		28.92kg
Stroke = 1000 mm		34.62kg
Stroke = 1500 mm		46.02kg

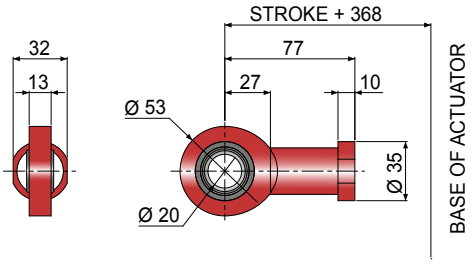
Note: For 25mm Dia x 10mm lead column strength chart refer to Engineering Guide.

LBA0025 Ram End Fittings

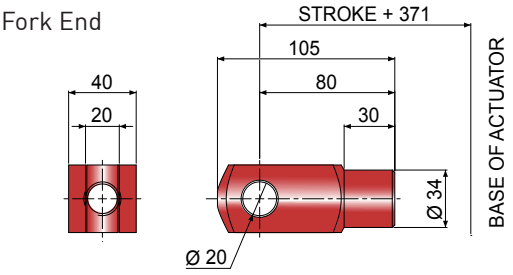
Top Plate



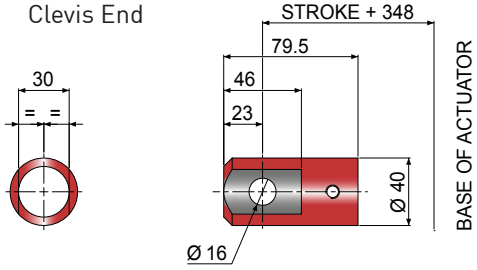
Rod End



Fork End

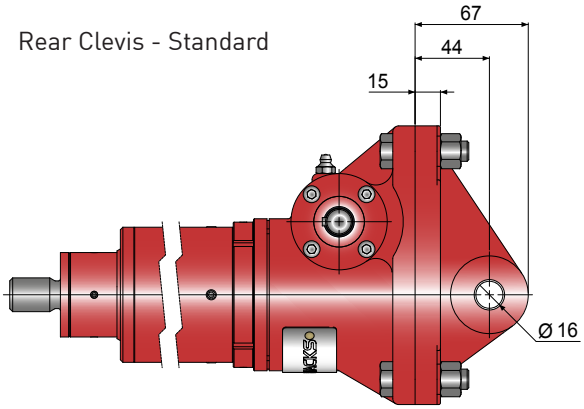


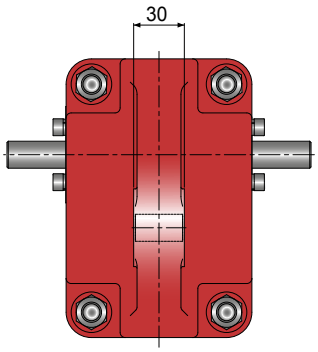
Clevis End



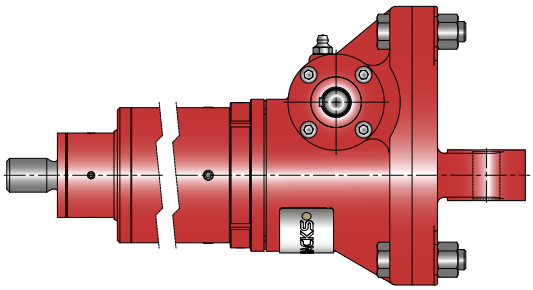
LBA0025 Rear End Fittings

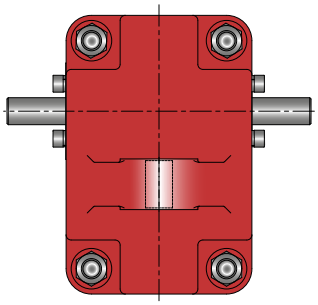
Rear Clevis - Standard



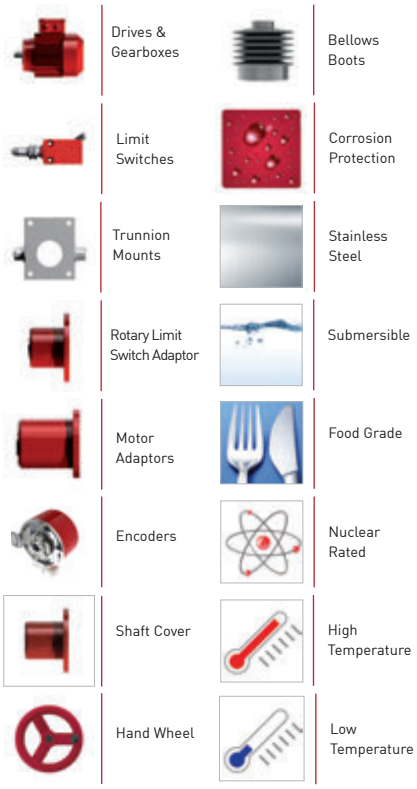


Rear Clevis - 90°





Accessories & Options



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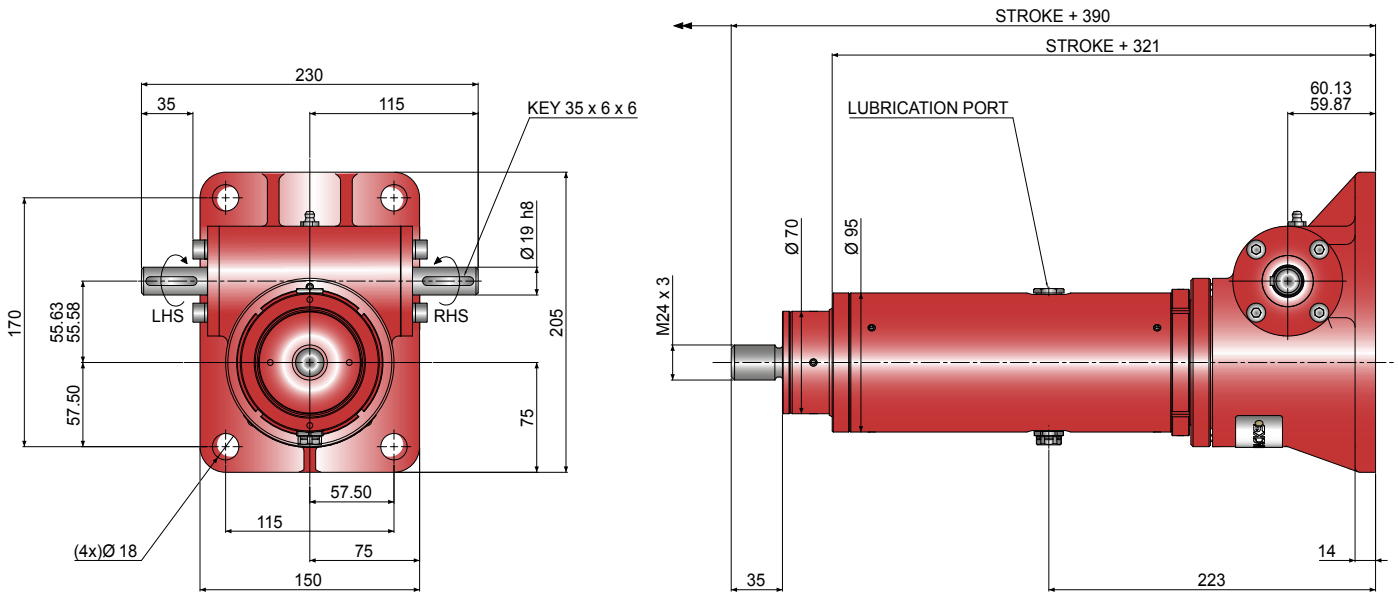
LBA0050 Actuator

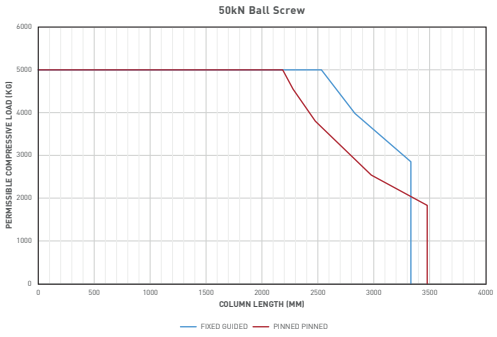


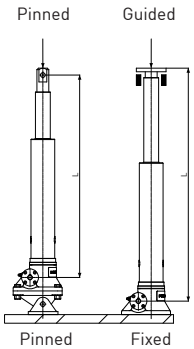
Performance

Model			LBA0050	
Capacity	kN		50	
Lifting Screw	Diameter (mm)		40	
	Lead	Option	1	2
		mm	10	20
Gear Ratio Option 1	Gear Ratio		6:1	
	Static Efficiency		0.567	0.595
	Dynamic Efficiency		0.633	0.687
Gear Ratio Option 2	Gear Ratio		24:1	
	Static Efficiency		0.310	0.325
	Dynamic Efficiency		0.407	0.422
Max. Input power (kW)	Gear Ratio Option 1		3.0	
	Gear Ratio Option 2		0.55	

Model			LBA0050	
Capacity	kN		50	
Lifting Screw Lead (mm)			10	20
Start up torque at full load (Nm)	Gear Ratio Option 1		23.4	44.6
	Gear Ratio Option 2		10.7	20.4
Turn of worm for travel of ram	Gear Ratio 1	6 Turn	10mm	20mm
	Gear Ratio 2	24 Turn	10mm	20mm
Maximum Through Torque (Nm)			168	
Ram Restraining Torque (Nm)			88	167
Worm Shaft Maximum Radial Load (N)			740	
Maximum Input Speed (rpm)			1800	
Weight (kg) - stroke = 100mm			25	
Weight (kg) - per extra 25mm stroke			0.78	

Column Strength





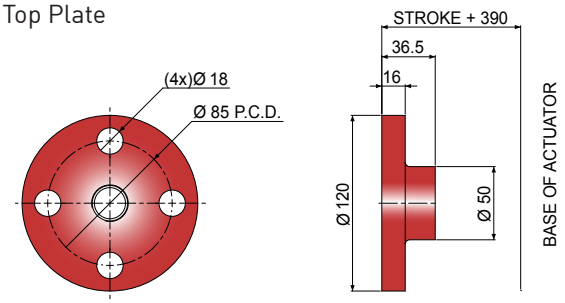
Standard Stroke & Weights

Model		LMA0050
Capacity	kN	50
Stroke = 100 mm		25.0kg
Stroke = 250 mm		29.68kg
Stroke = 500 mm		37.48kg
Stroke = 750 mm		45.28kg
Stroke = 1000 mm		53.08kg
Stroke = 1500 mm		68.68kg

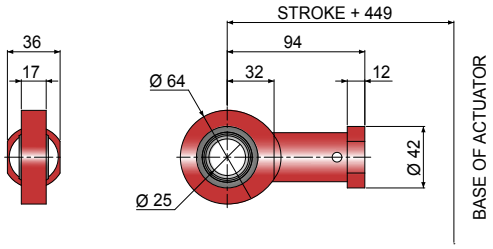
Note: For 40mm Dia x 20mm lead column strength chart refer to Engineering Guide.

LBA0050 Ram End Fittings

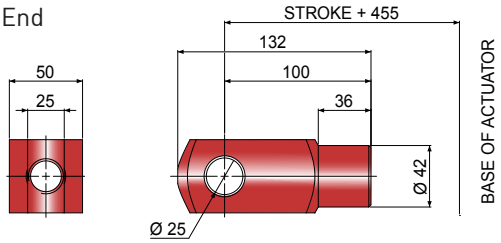
Top Plate



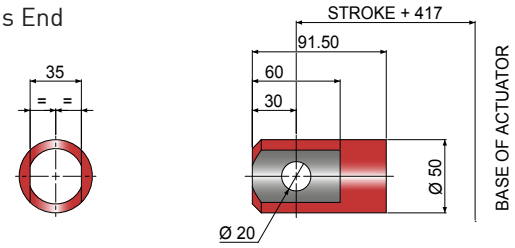
Rod End



Fork End

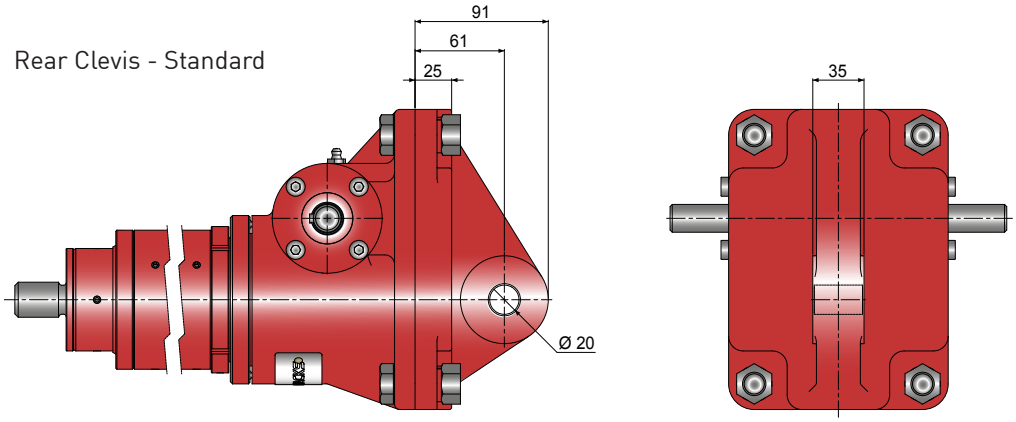


Clevis End

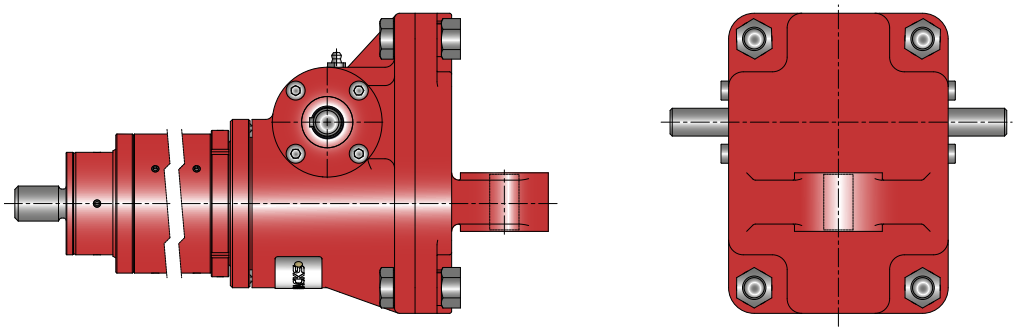


LBA0050 Rear End Fittings

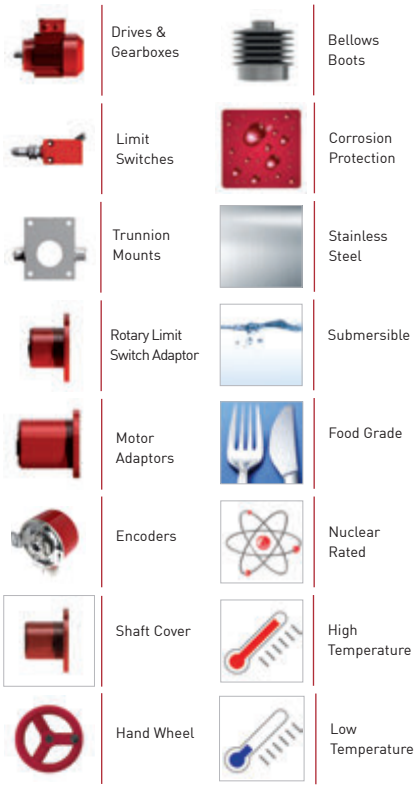
Rear Clevis - Standard



Rear Clevis - 90°



Accessories & Options



Note:
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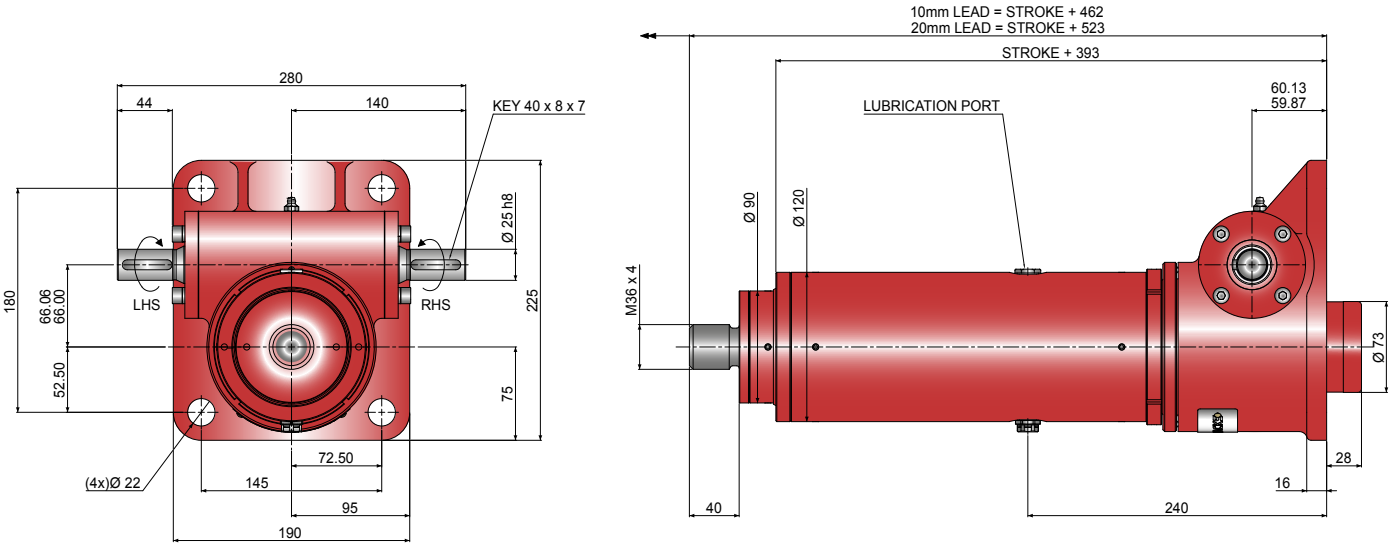
2 All colours for illustrative purposes only.
3 Dimensions in millimetres unless otherwise stated.

LBA0100 Actuator

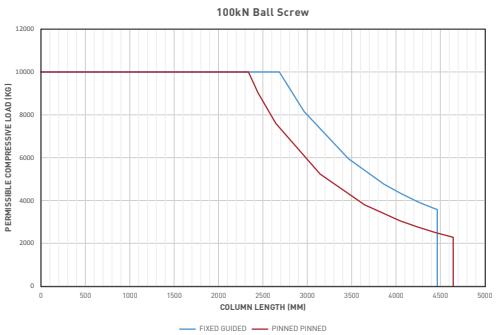


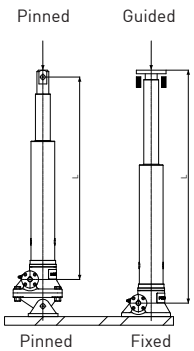
Performance

Model			LBA0100	
Capacity	kN		100	
Lifting Screw	Diameter (mm)		50	
	Lead	Option	1	2
		mm	10	20
Gear Ratio Option 1	Gear Ratio		8:1	
	Static Efficiency		0.546	0.581
	Dynamic Efficiency		0.645	0.674
Gear Ratio Option 2	Gear Ratio		24:1	
	Static Efficiency		0.348	0.370
	Dynamic Efficiency		0.450	0.470
Max. Input power (kW)	Gear Ratio Option 1		3.75	
	Gear Ratio Option 2		1.125	

Model			LBA0100	
Capacity	kN		100	
Lifting Screw Lead (mm)			10	20
Start up torque at full load (Nm)	Gear Ratio Option 1		36.4	68.5
	Gear Ratio Option 2		19.1	35.8
Turn of worm for travel of ram	Gear Ratio 1	6 Turn	7.5mm	15mm
	Gear Ratio 2	24 Turn	10mm	20mm
Maximum Through Torque (Nm)			347	
Ram Restraining Torque (Nm)			181	340
Worm Shaft Maximum Radial Load (N)			1000	
Maximum Input Speed (rpm)			1800	
Weight (kg) - stroke = 100mm			43.6	
Weight (kg) - per extra 25mm stroke			1.3	

Column Strength





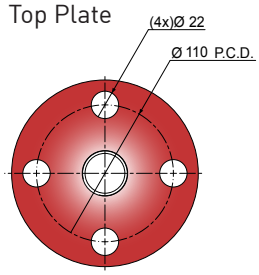
Standard Stroke & Weights

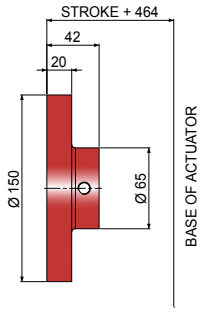
Model		LMA0100
Capacity	kN	100
Stroke = 250 mm		51.4kg
Stroke = 500 mm		64.4kg
Stroke = 750 mm		77.4kg
Stroke = 1000 mm		90.4kg
Stroke = 1500 mm		116.4kg
Stroke = 2000 mm		142.4kg

Note: For 50mm Dia x 20mm lead column strength chart refer to Engineering Guide.

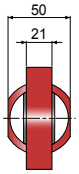
LBA0100 Ram End Fittings

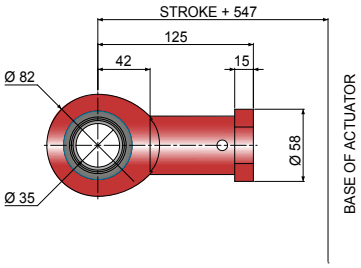
Top Plate



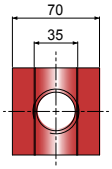


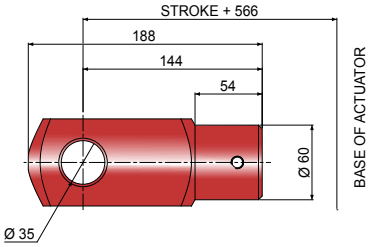
Rod End



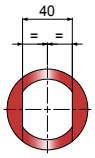


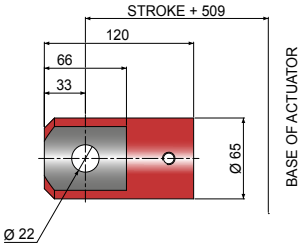
Fork End





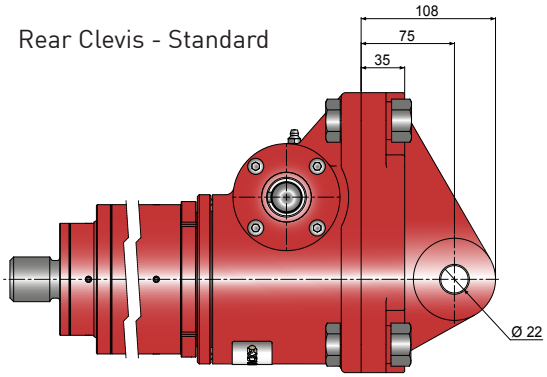
Clevis End

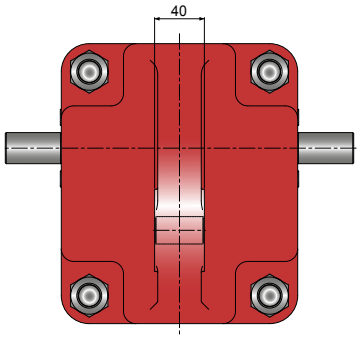




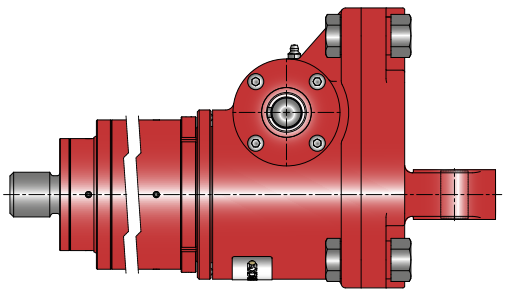
LBA0100 Rear End Fittings

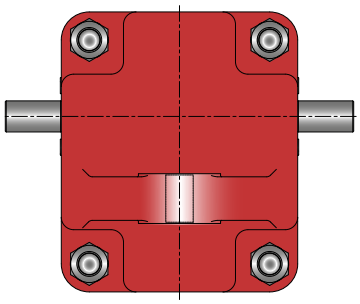
Rear Clevis - Standard



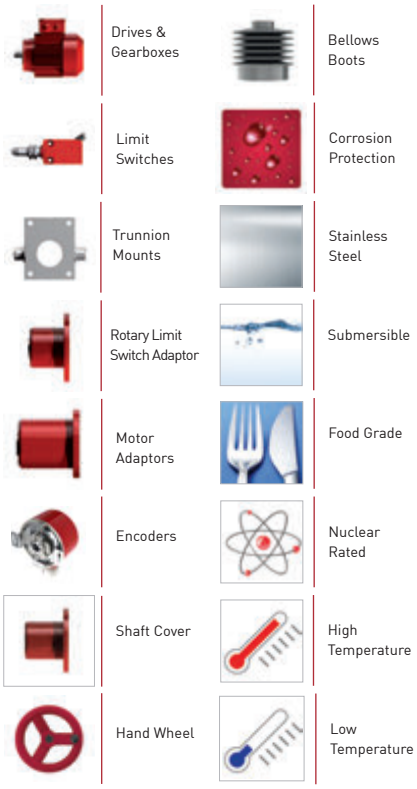


Rear Clevis - 90°





Accessories & Options



Note:
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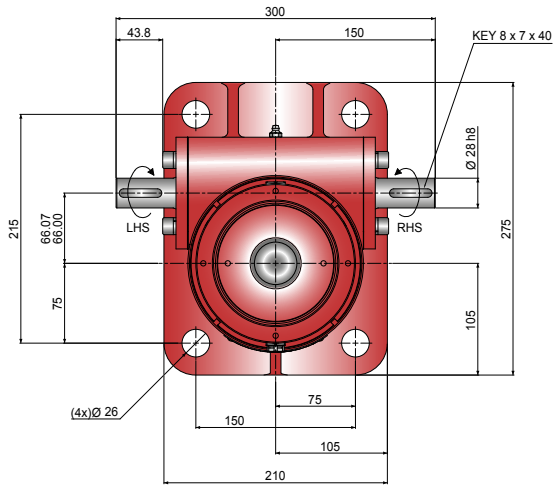
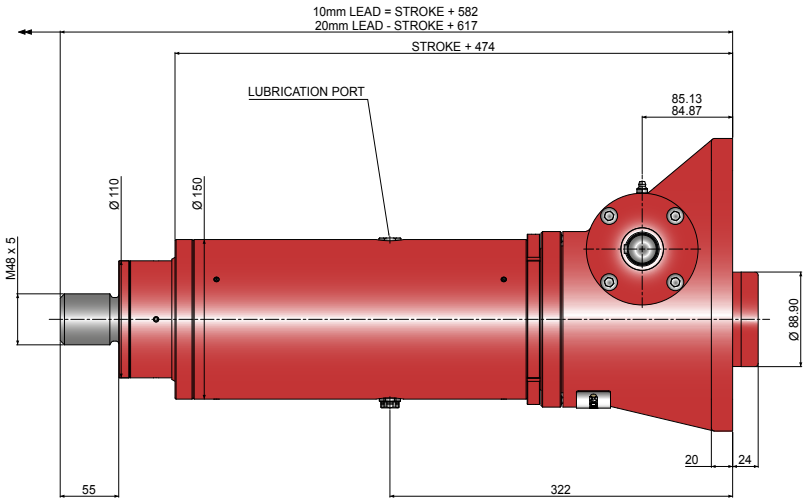
2 All colours for illustrative purposes only.
3 Dimensions in millimetres unless otherwise stated.

LBA0200 Actuator



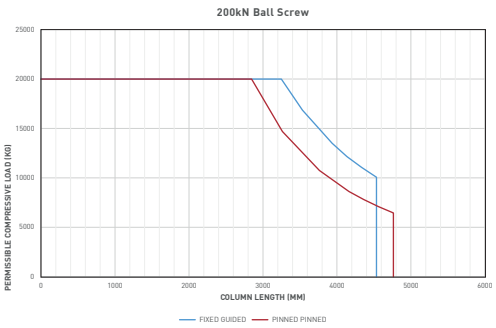


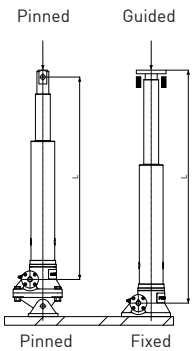
Performance

Model			LBA0200	
Capacity	kN		200	
Lifting Screw	Diameter (mm)		63	
	Lead	Option	1	2
		mm	10	20
Gear Ratio Option 1	Gear Ratio		8:1	
	Static Efficiency		0.529	0.571
	Dynamic Efficiency		0.631	0.665
Gear Ratio Option 2	Gear Ratio		24:1	
	Static Efficiency		0.337	0.364
	Dynamic Efficiency		0.440	0.465
Max. Input power (kW)	Gear Ratio Option 1		3.75	
	Gear Ratio Option 2		1.125	

Model				LBA0200	
Capacity	kN			200	
Lifting Screw Lead (mm)				10	20
Start up torque at full load (Nm)	Gear Ratio Option 1			75.2	139.4
	Gear Ratio Option 2			39.4	72.9
Turn of worm for travel of ram	Gear Ratio 1	6 Turn		7.5mm	15mm
	Gear Ratio 2	24 Turn		10mm	20mm
Maximum Through Torque (Nm)				396	
Ram Restraining Torque (Nm)				370	690
Worm Shaft Maximum Radial Load (N)				1600	
Maximum Input Speed (rpm)				1800	
Weight (kg) - stroke = 100mm				78.8	
Weight (kg) - per extra 25mm stroke				2	

Column Strength





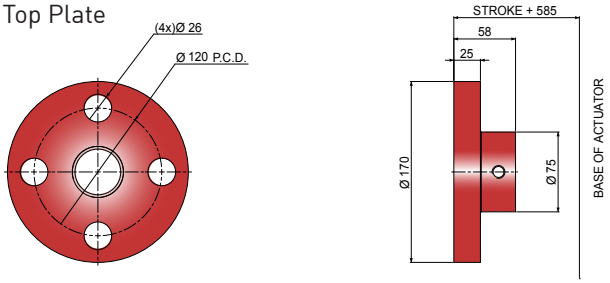
Standard Stroke & Weights

Model		LMA0200
Capacity	kN	200
Stroke = 250 mm		90.8kg
Stroke = 500 mm		110.8kg
Stroke = 750 mm		130.8kg
Stroke = 1000 mm		150.8kg
Stroke = 1500 mm		190.8kg
Stroke = 2000 mm		**230.8**kg

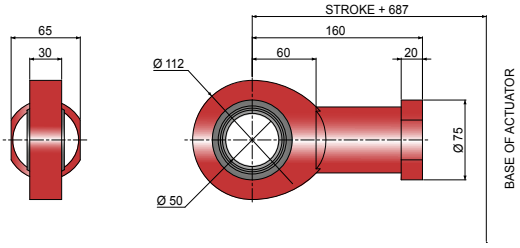
Note: For 63mm Dia x 20mm lead column strength chart refer to Engineering Guide.

LBA0200 Ram End Fittings

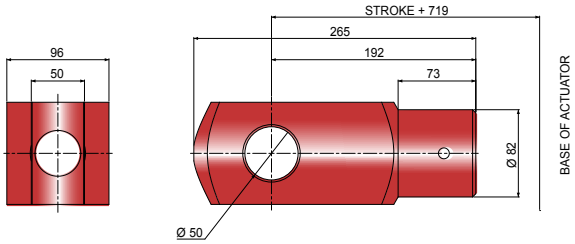
Top Plate



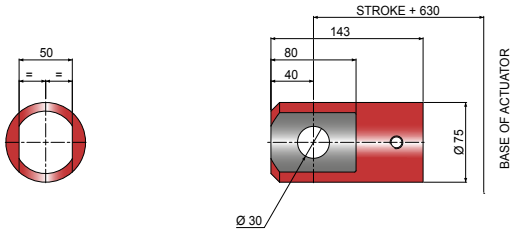
Rod End



Fork End

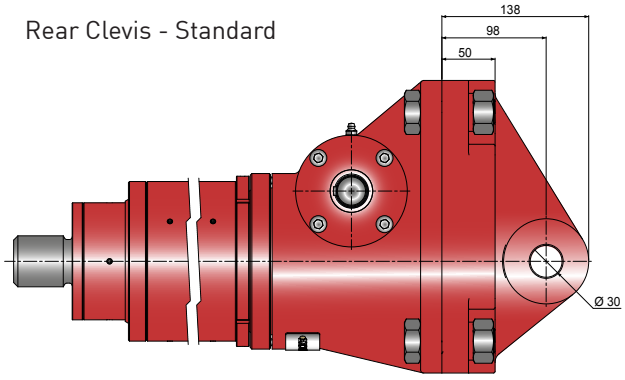


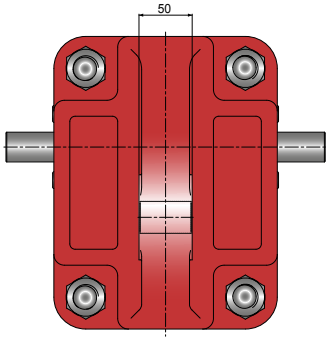
Clevis End



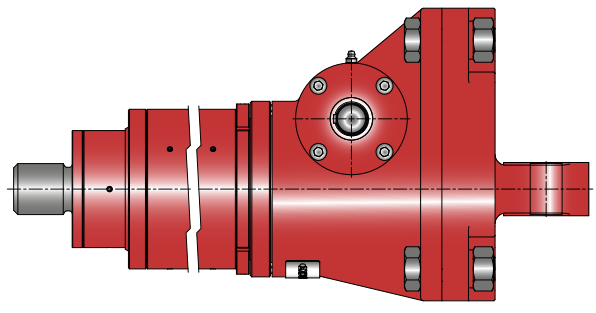
LBA0200 Rear End Fittings

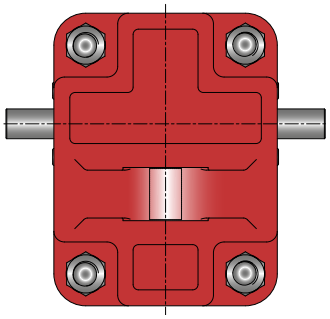
Rear Clevis - Standard



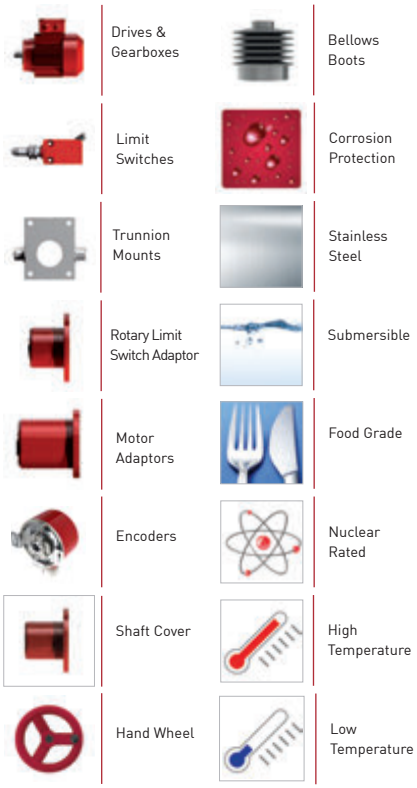


Rear Clevis - 90°





Accessories & Options



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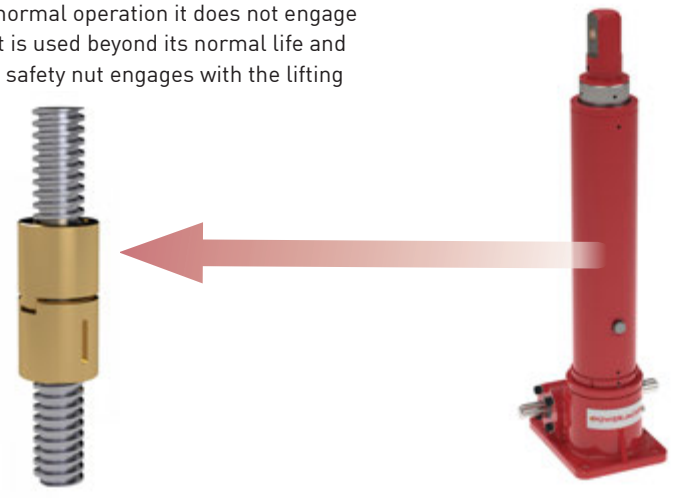
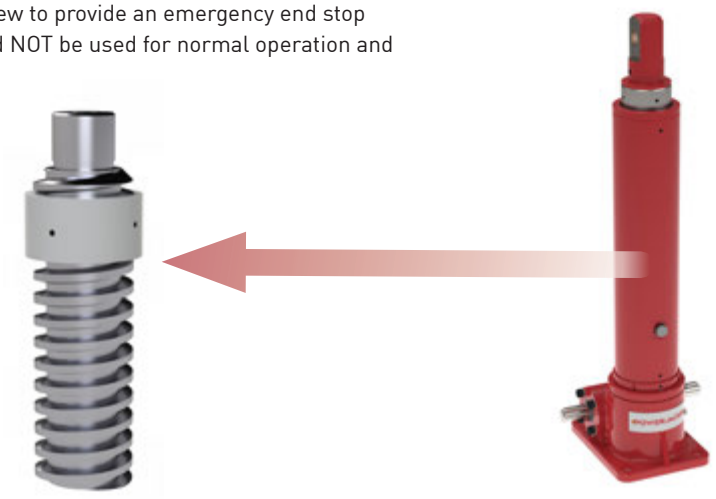
POWERAM with Safety Nut

A safety nut is installed in-line with the main lifting nut. During normal operation it does not engage with the screw thread under load. However if the main lifting nut is used beyond its normal life and worn out or if there is an unexpected damage or failure then the safety nut engages with the lifting screw thread to maintain full load holding and drive.



POWERAM with Full Power Stop Nut

A full power stop nut is installed at the end of the lifting screw to provide an emergency end stop rated for the full power of the actuator. This end stop should NOT be used for normal operation and should only be used in emergencies.



POWERAM with Limit Switches on Ram

Limit Switches (proximity or electro-mechanical) can be mounted on the actuators ram to signal end of stroke position. They can be supplied as a fixed design or with a small amount of linear adjustment e.g. +/-5mm. For limit switches that are adjustable over the full length of the actuators stroke it is recommended that the RLS-51 rotary cam limit switch is used.

Note
Units are not to scale on illustration

POWERAM with Bellows Boot

For extra protection of the ram bellows boots can be installed on the end of the actuator.

POWERAM with Brake

On requirement a safety brake can be fitted to an actuators free worm shaft. If your actuator has an electric motor drive fitted then we recommend the brake is installed on the end of the electric motor.

POWERAM with Torque Limiter

A torque limiter can be fitted to an actuators free worm shaft for connection to an external drive shaft or between a directly mounted electric motor drive and the worm shaft. Both options limit the torque to the actuator.

POWERAM with Anti-Rotation Ram

An Anti-Rotation mechanism can be fitted to the actuators ram. The type of anti-rotation mechanism provided will depend on the load, speed and duty cycle at which the actuator operates. Both internal and external ant rotation mechanisms can be provided.

Note
Units are not to scale on illustration

POWERAM with Spherical Bearing in Clevis on Ram

The clevis end on the actuators ram can be fitted with a spherical bearing on request. Depending on the load and pin hole requirements the clevis end may increase in size to accommodate the spherical bearing.

POWERAM with Spherical Bearing in Rear Clevis on Gearbox

The rear clevis end on the actuators gearbox can be fitted with a spherical bearing on request. Depending on the load and pin hole requirements the clevis end may change to a special design of a different size to accommodate the spherical bearing. The design to mount the clevis to the gearbox may also change.

POWERAM with Rear Fork on Gearbox

A rear fork end can be fitted to the actuators gearbox.

POWERAM with Trunnion Mount on Ram

A trunnion mount can be provided on the outer tube of the ram at a defined position. The outer tube is strengthened for load carrying capability and the trunnion mount is welded in position.

POWERAM with Ram with Flange Mount

A flange mounting plate can be provided fixed to the end of the rams outer tube. The outer tube is strengthened for load carrying capability and the flange mount is welded in position. Flange mounts typically have a round profile, but can also be square or rectangular to suit application requirements.

Note
Units are not to scale on illustration

POWERAM with Geared Motor Drive

The actuators can be fitted with an geared motor directly mounted on the actuators free worm shaft. Right-angled, In-Line and Parallel Shaft geared motors can all be mounted to the actuator.

POWERAM with Servo Motor

A servo motor can be mounted to the actuators worm shaft via a special motor adapter to suit the specific servo motor.

Note
Units are not to scale on illustration

POWERAM Available in Other Capacity Sizes

The POWERAM actuators are available in other capacity sizes up to 2000kN.

So if you need to "go large" we've got the capability.

Below we see a size comparison of a LMA1000 (1000kN) POWERAM actuator that was supplied to a customer in the USA compared to that of a standard LMA0050 (50kN) actuator.

LMA1000 (1000kN)

LMA0050 (50kN)

POWERAM Subsea

Subsea versions of the POWERAM actuators are available for both flooded and pressure compensated designs suitable for depths down to 3000m subsea.

Technology that is tried and tested and regularly used by clients going offshore over 30 years.

Other submersible variants also available for other sectors such as wind, nuclear, defence and more.

Complimented for system building with U-Series subsea bevel gearboxes.

Note
Units are not to scale on illustration

POWERAM Linear Actuators

ACCESSORIES AND SYSTEM COMPONENTS FOR ALL MACHINE SCREW, STAINLESS STEEL AND BALL SCREW POWERAM ACTUATORS

POWERAM Linear Actuator Trunnion Mounts

Base mounted trunnions are an ideal bolt-on accessory for a linear actuator to add a pivot point to the gearbox of the linear actuator. These base mounted trunnions can be used for all types of POWERAM electric linear actuators.

Available in both male or female designs with the option to add standard trunnion feet. All designs offer trunnions in 2 mounting positions.

If you need trunnions fitted at another position on a actuator then please contact us as we can provide customised trunnion mounts to suit your exact applications needs e.g. trunnion mounts on outer tube of actuator ram.

Trunnion
Standard

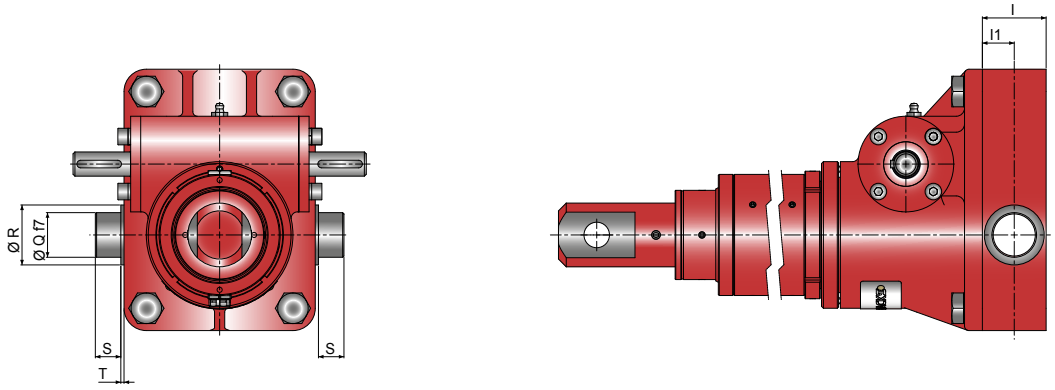
Trunnion
90°

Trunnion
Female

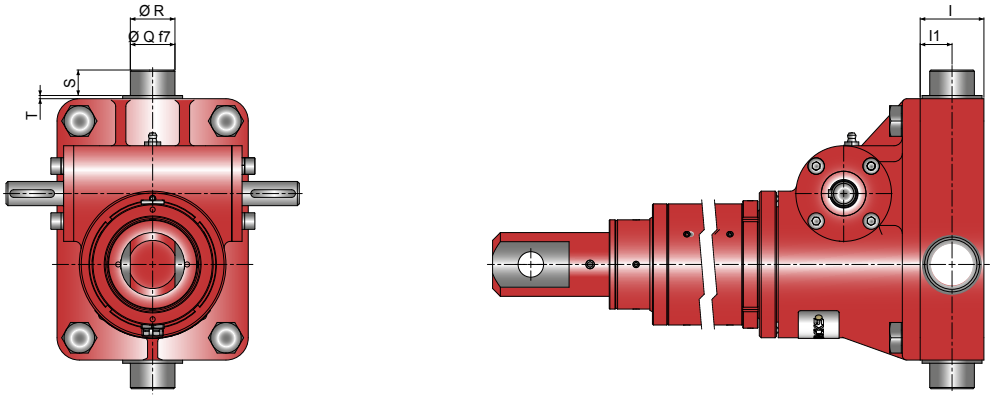
Trunnion
Standard with Feet

10kN to 200kN Trunnion Mounts

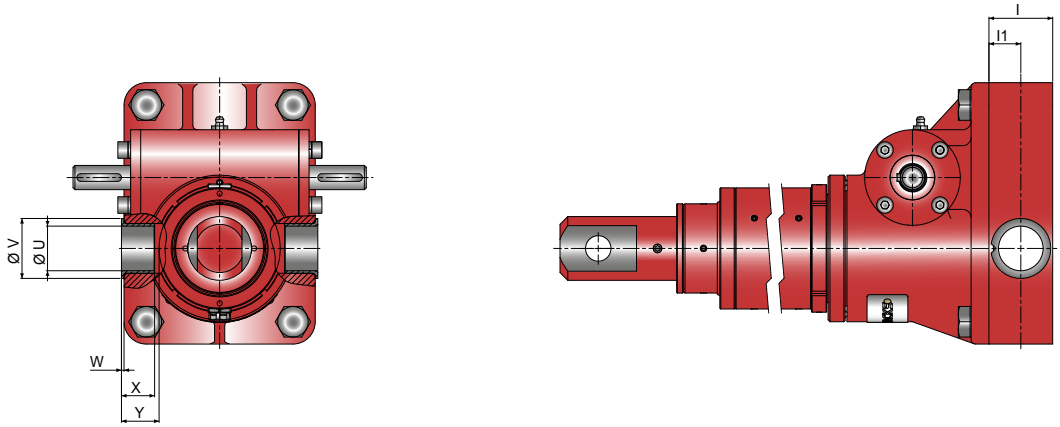
Trunnion Standard



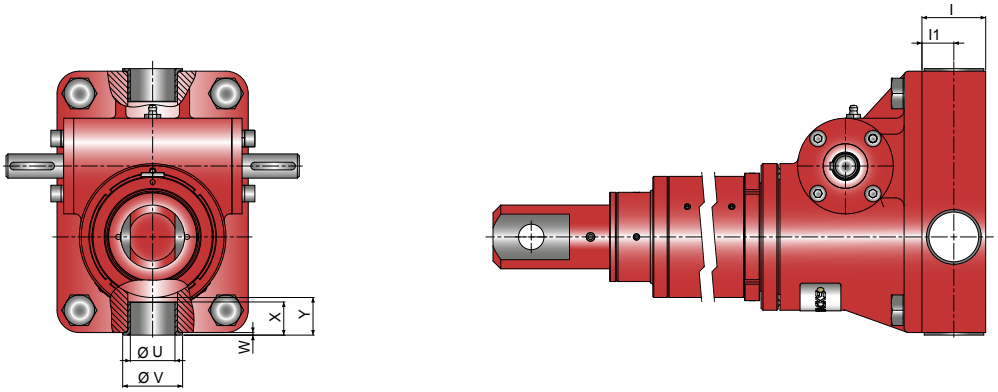
Trunnion 90°



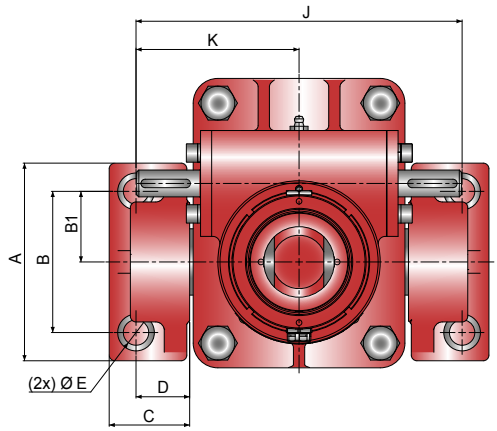
Trunnion Female



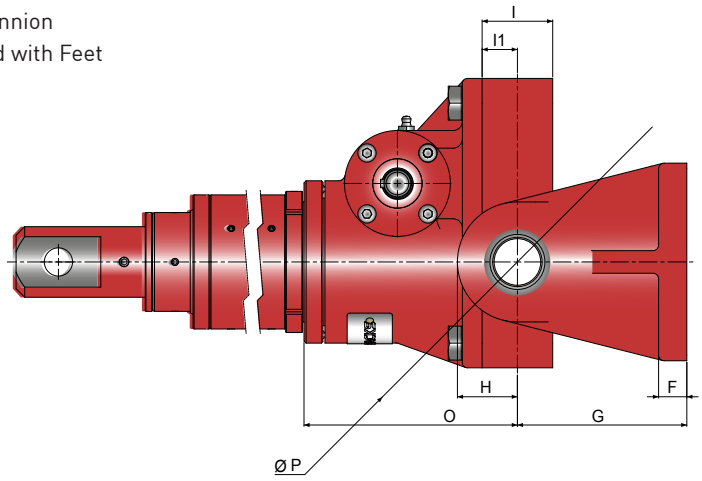
Trunnion Female 90°

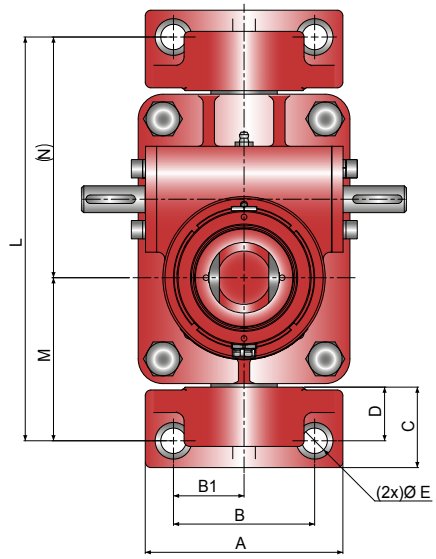


10kN to 200kN Trunnion Mounts

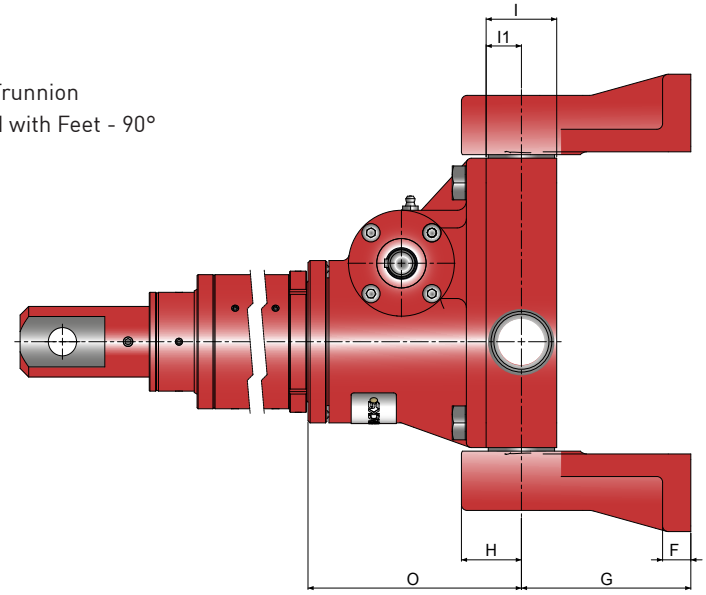


Trunnion
Standard with Feet





Trunnion
Standard with Feet - 90°



Capacity	A	B	B1	C	D	ØE	F	G	H	I	I1	J	K	L
10kN	70	42	21	34	21	11	12	65	20	30	15	134	67	177
25kN	100	70	35	40	26	13.5	14	85	30	36	18	171	85.5	226
50kN	140	100	50	55	35.5	18	20	120	42.5	50	25	233	116.5	288
100kN	170	120	60	70	43.5	22	25	130	47.5	60	30	292	146	327
200kN	220	150	75	90	61	33	25	170	59	85	42.5	344	172	409

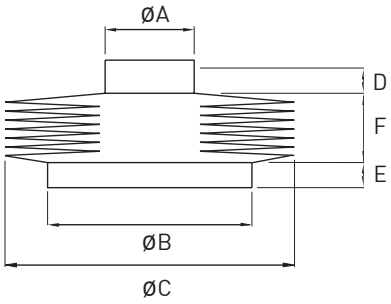
Capacity	M	N	O	P	ØQ (f7)	R	S	T	U	V	W	X	Y
10kN	78.5	98.5	101	159	20	30	20	2.5	20	30	1.5	16.5	19.5
25kN	95.5	130.5	121.5	208	25	35	20	2.5	25	35	1.5	16.5	26
50kN	116.5	171.5	163	270	35	47	20	2.5	35	47	2	26	39
100kN	126	201	177	312	45	58	35	5	45	74	2	32	40
200kN	172	237	238	361	60	75	45	5	60	78	2	42	45

Features

- Protects the actuators ram from dust, dirt, debris, water, chemicals & other airborne items.
- Guards against moisture and corrosive contaminants
- Helps maintain the proper lubrication and sealing.
- Boots are made of P.V.C. coated nylon with sewn construction. Other materials are available for applications involving high temperatures, highly corrosive atmospheres and other special conditions.

Boot Dimensions

Model	A	B	C	D	E
L-A0010	40	60	130	15	15
L-A0025	50	80	140	15	15
L-A0050	70	95	160	15	15
L-A0100	90	120	180	15	15
L-A0200	110	150	200	15	15



Model		L-A0010	L-A0025	L-A0050	L-A0100	L-A0200
F	Stroke 100mm	17	20	19	-	-
	Stroke 200mm	17	-	-	-	-
	Stroke 250mm	-	20	19	75	73
	Stroke 300mm	17	-	-	-	-
	Stroke 500mm	24	25	25	75	73
	Stroke 750mm	30	32	32	75	73
	Stroke 1000mm	55	55	55	75	73
	Stroke 1500mm	-	90	90	90	90
	Stroke 2000mm	-	-	-	108	108

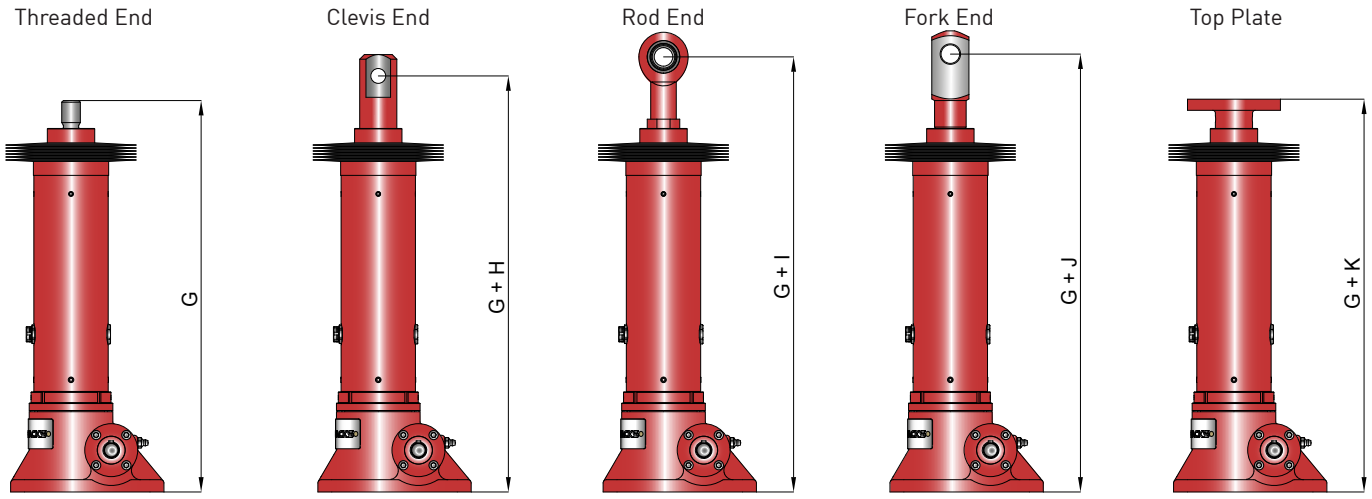
F = Bellows boot minimum closed thickness, - = Not applicable

For POWERAM actuator lengths (closed heights) with bellows boots please see next page.

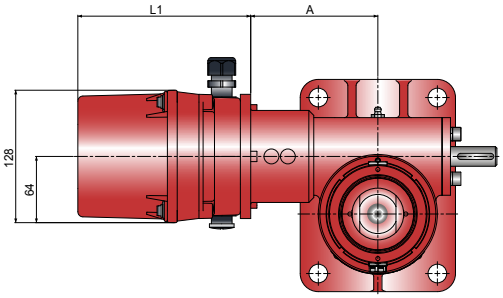
Notes for all linear actuators with bellows boots:

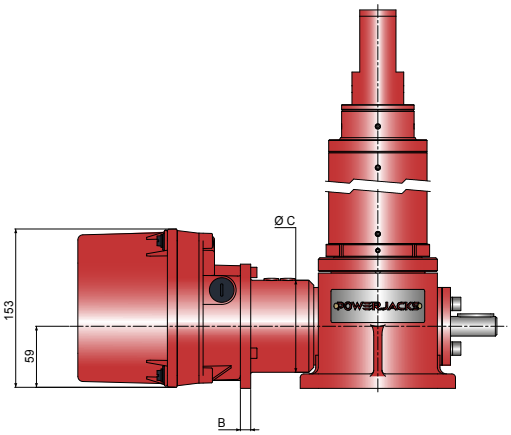
1. Supplied complete with a set of corrosion-resistant 'jubilee' clips (2) suitable for fitting over collar diameters.
2. For other sizes, strokes and materials please consult Power Jacks Ltd.
3. All dimensions in millimetres unless otherwise stated.
4. Dimensions subject to change without notice.
5. All colours for illustrative purposes only.

Closed Height (Retracted Ram) for all POWERAM Actuators



Model		L-A0010	L-A0025	L-A0050	L-A0100		L-A0200	
Types		All	All	All	Machine Screw Stainless Steel Ball Screw Lead-1	Ball Screw Lead-2	Machine Screw Stainless Steel Ball Screw Lead-1	Ball Screw Lead-2
G	Stroke 100mm	387	421	490	-	-	-	-
	Stroke 200mm	487	-	-	-	-	-	-
	Stroke 250mm	-	571	640	712	773	832	867
	Stroke 300mm	587	-	-	-	-	-	-
	Stroke 500mm	794	826	896	973	1023	1082	1117
	Stroke 750mm	1050	1083	1153	1230	1273	1332	1367
	Stroke 1000mm	1325	1356	1426	1503	1523	1599	1617
	Stroke 1500mm	-	1891	1961	2038	2038	2114	2134
	Stroke 2000mm	-	-	-	2556	2556	2652	2652
H	Extra Closed Height for Clevis End	21	27	27	47	47	48	48
I	Extra Closed Height for Fork End	24	50	65	104	104	137	137
J	Extra Closed Height for Rod End	26	47	59	85	85	105	105
K	Extra Closed Height for Top Plate	-	-	-	2	2	3	3





Rotary limit switches can be used as end of travel limit switches, with the option of intermediate switches as well. These units are mounted onto a linear actuators free worm shaft. Up to 8 limit switches can be accommodated in one enclosure (IP66). Operating temperature -40°C to +80°C.

Full RLS-51 rotary limit switch details in System Components section.

Linear Actuator Capacity (kN)				
	10kN			
Adapter Mounting	Std. Part	A	B	ØC
B5	×	-	-	-
B14	✓	106.5	10	86

Linear Actuator Capacity (kN)								
	25				50			
Adapter Mounting	Std. Part	A	B	ØC	Std. Part	A	B	ØC
B5	×	-	-	-	×	-	-	-
B14	✓	117	10	70	✓	133	10	89

Linear Actuator Capacity (kN)								
	100				200			
Adapter Mounting	Std. Part	A	B	ØC	Std. Part	A	B	ØC
B5	✓	150	13	98	✓	174	13	125
B14	×	-	-	-	×	-	-	-

The mounting kit includes the flexible coupling and drive adapter.

Gear Size	Usable revs. selected	Usable revs. theoretical with 15° cam discs	Gear Ratio	1 rev. of the drive shaft - corresp. to an ang. motion of cam disc =°	Change - over contact reset rev. at driving shaft	Max drive speed (RPM)	Min drive shaft speed (only for change - over contact)	L1 (mm) Limit Switches			
								2	4	6	8
1	4.1	4.16	4.285	84	0.00714	1000	0.67	132	132	157	157
	6.5	6.88	7.083	50.8	0.0118	1200	1.1				
	11	11.23	11.56	31.14	0.0193	1500	1.8				
2	17.5	17.84	18.361	19.6	0.0306	1800	2.9	132	132	157	182
	29	29.5	30.35	11.86	0.0505	1800	4.7				
	48	48.13	49.538	7.27	0.0825	1800	7.7				
3	75	76.45	78.678	4.57	0.131	1800	12.2	132	132	157	182
	125	126.39	130.054	2.77	0.2166	1800	20.2				
	205	206.26	212.272	1.69	0.3536	1800	33				
4	323	327.6	337.135	1.06	0.5616	1800	52	132	157	182	207
	540	541.5	557.284	0.65	0.9284	1800	87				
	880	883.8	909.59	0.4	1.515	1800	141				
5	1384	1403.7	1444.62	0.25	2.406	1800	224	132	157	182	207
	2288	2320.2	2387.96	0.15	3.978	1800	371				
	3735	3787.1	3897.58	0.09	6.493	1800	606				
6	5900	6014.77	6190.204	0.06	10.313	1800	*	157	157	182	207
	9800	9942.2	10232.407	0.04	17.047	1800	*				
	16000	16227.6	16701.17	0.02	27.824	1800	*				

Note
1. More than 8 contacts on request.
2. Dimensions with more than 8 contacts and with special executions, eg. potentiometer, on request.
3. RLS-51 B5 Flange thickness = 4mm.
4. Options available include Anti-condensation heaters, potentiometer, pulse transmitter, encoder, aluminium housing and VBG-70 STAGE technology.

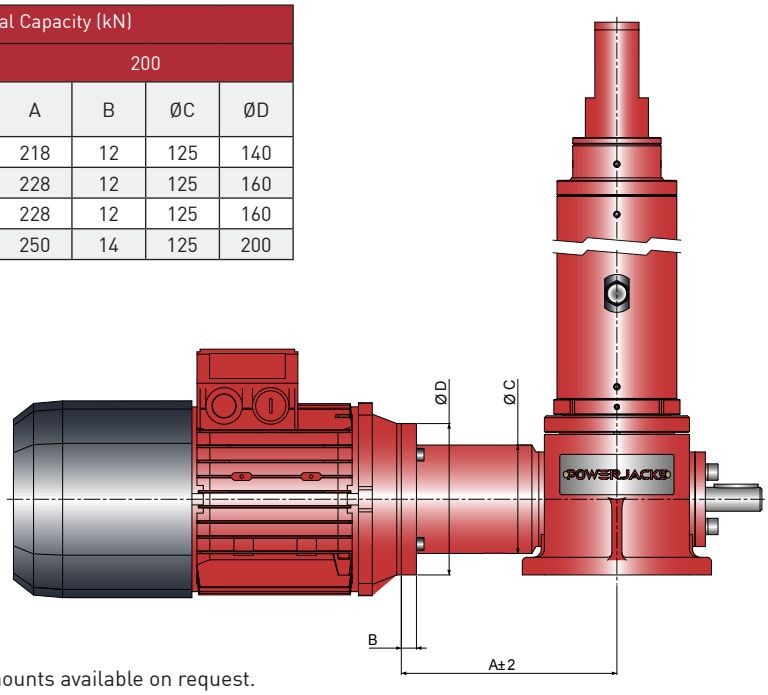
- Standard adapters for 10 kN - 200 kN POWERAM electric linear actuators.
- Designed for standard IEC frame sizes.
- Allows direct motor coupling on either side of the linear actuator input shaft.
- Complete with drive coupling and mounting hardware.

Note

- When direct coupling a motor to a linear actuator, it is necessary to match motor power to linear actuator load so the motor does not exceed the maximum power for the linear actuator gear set.

Motor Adapters		Actuator Nominal Capacity (kN)											
		10				25				50			
Frame Size	Motor Mounting	A	B	ØC	ØD	A	B	ØC	ØD	A	B	ØC	ØD
63	B14 C90	120	10	65	90	-	-	-	-	-	-	-	-
71	B14 C105	120	10	65	105	142.5	10	71	105	-	-	-	-
80	B14 C120	120	12	65	120	146.5	12	81	120	171	12	86	120
90	B14 C140	-	-	-	-	157.5	12	81	140	183	12	88	140
100	B14 C160	-	-	-	-	168	12	81	160	193	12	88	160
112	B14 C190	-	-	-	-	168	12	81	160	193	12	88	160
132	B14 C200	-	-	-	-	-	-	-	-	218	14	95	200

Motor Adapters		Actuator Nominal Capacity (kN)							
		100				200			
Frame Size	Motor Mounting	A	B	ØC	ØD	A	B	ØC	ØD
90	B14 C140	208	12	98	140	218	12	125	140
100	B14 C160	218	12	98	160	228	12	125	160
112	B14 C190	218	12	98	160	228	12	125	160
132	B14 C200	240	14	98	200	250	14	125	200



Notes:

1. Motor Adapters for IEC Frames with B5 Flange mounts available on request.
2. Motor Adapters for actuators of other capacities are available on request.
3. Adapters for geared motors are available on request for all types of geared motor or gear head.
4. Motor Adapters for Servo Motors available on request.
5. Motor Adapters for NEMA Frame motors are available on request.
6. All dimensions in millimetres unless otherwise stated.
7. Dimensions subject to change without notice.
8. All colours for illustrative purposes only.

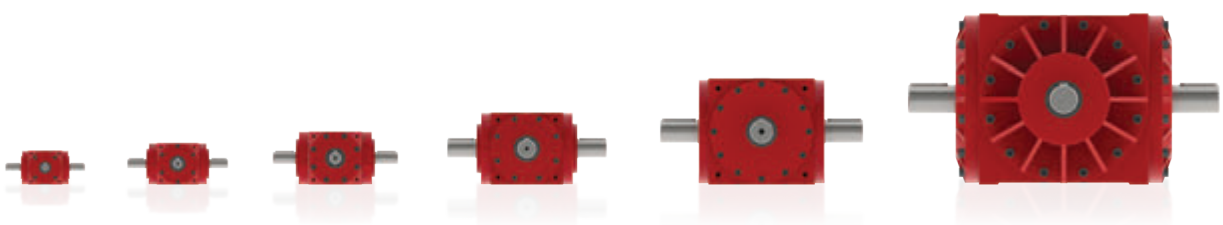
Power Jacks design and manufacture an extensive range of Spiral Bevel Gearboxes for use in all sectors.

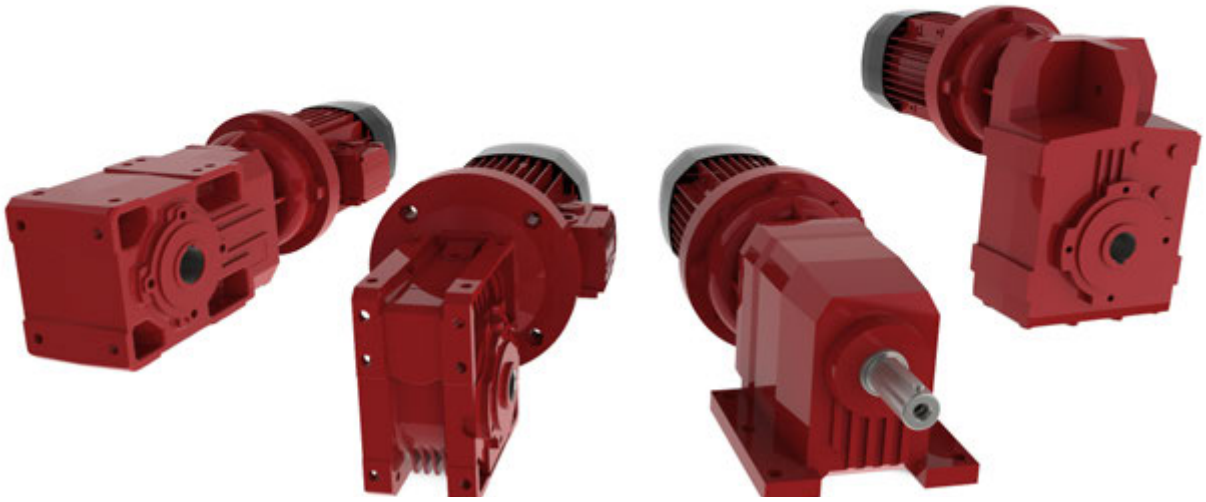
Bevel Gearbox Overview

Bevel gearboxes in compact designs built for performance and efficiency in transmitting and distributing mechanical power. Available in 3 ranges and 6 sizes with 5 gear ratios. The standard designs are suitable for most applications
but we also design & manufacture customised units
to meet arduous conditions for all industry sectors.

- Range-C – Cubic Compact Gearboxes with 6 Side Mounting
- Range-N – Ultra Compact Gearboxes with 2 Side Mounting
- Range-U – Subsea Gearboxes to Depths of 3000m as Standard
- 2-way, 3-way & 4-way Configurations
- Solid Shaft & Hollow Shaft
- Gear Ratios: 1:1, 1.5:1, 2:1, 3:1 & 4:1
- Precision Spiral Bevel Gears.
- Torque Ratings up to 7000 Nm as Standard
  and 20000Nm on request.
- 6 Gearbox sizes & 14 Configurations per size as Standard.
- Robust SG Iron Housing as Standard.
- Plug-In Motor Adapter Available
- Subsea ROV Drive Interfaces Available
- Full Stainless Steel Design Available
- Special Custom Designs Available
- Special Gear Ratios Available

Series	35	37	38	39	40	42*





Right Angled - Helical

Torque Range
100 Nm to 14000 Nm

Power Rating
0.22 kW to 150 kW (at 1400 rpm input)

Gear Ratios
5.4:1 to 1715:1

Output
Foot and shaft mount
Solid or Hollow shaft

Input
IEC, NEMA & Servo adaptors
Solid input shaft

Main gear options
Backstop
Reinforced bearings
Reduced backlash
Taconite seals

AC Motors
Integral motors and brake motors
IEC motors and brake motors
DC or AC Brakes
Thermistors & thermostat sensors
Forced ventilation
Incremental encoder

Right Angled - Worm

Torque Range
13 Nm to 71000 Nm

Power Rating
0.04 kW to 75 kW (at 1400 rpm input)

Gear Ratios
7:1 to 10000:1

Output
Keyed hollow shaft
Plug-in solid output shaft
Torque limiter as an option

Input
IEC motor adaptors
Solid input shaft

AC Motors
Integral motors and brake motors
IEC motors and brake motors
DC or AC Brakes
Thermistors & thermostat sensors
Forced ventilation
Incremental encoder

In-Line - Helical

Torque Range
140 Nm to 14000 Nm

Power Rating
0.17 kW to 125 kW (at 1400 rpm input)

Gear Ratios
6.4:1 to 2099:1

Output
Foot and shaft mount
Solid or Hollow shaft

Input
IEC, NEMA & Servo adaptors
Solid input shaft

AC Motors
Integral motors and brake motors
IEC motors and brake motors
DC or AC Brakes
Thermistors & thermostat sensors
Forced ventilation
Incremental encoder

Parallel Shaft - Helical

Torque Range
45 Nm to 12000 Nm

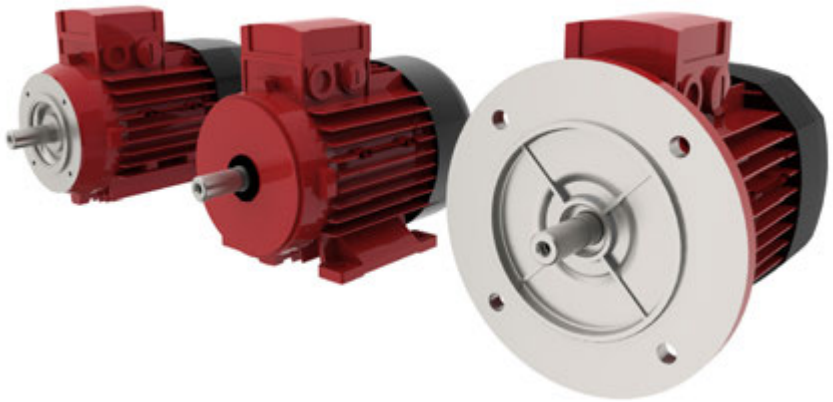
Power Rating
0.08 kW to 213 kW (at 1400 rpm input)

Gear Ratios
2.6:1 to 1481:1

Output
Foot and shaft mount
Solid or Hollow shaft

Input
IEC, NEMA & Servo adaptors
Solid input shaft

AC Motors
Integral motors and brake motors
IEC motors and brake motors
DC or AC Brakes
Thermistors & thermostat sensors
Forced ventilation
Incremental encoder



Power Jacks can supply electric motors for all applications whether AC or DC motors are required. Detailed in this section of the Design Guide are some of the most popular motors used in industrial applications.

AC Induction Motors

Standard Specification

- 3 Phase, 50 Hz / 60Hz.
- Voltages:
  - IEC Frame 56 - 132
  - 230 / 400 V - Δ / Y - 50 Hz (standard)
  - 400 / 690 V - Δ / Y - 50 Hz (on request)
  - 460 V - Y - 60 Hz (standard)
  - IEC Frame 160 - 200
  - 400 / 690 V - Δ / Y - 50 Hz (standard)
  - 460 V - Δ - 60 Hz (standard
- B3 Foot, B5 Flange and B14 Face Mounting. (or a combination).
- 2 Pole (3000 rpm)
- 4 Pole (1500 rpm)
- 6 Pole (1000 rpm)
- 8 Pole (750 rpm)
- IEC Frame Sizes 63 to 200.
- Enclosure IP55, TEFV.
- S1 Continuous rating.

Optional

- Brake motors - AC or DC units.
- 2 and 8 Pole 3 phase AC motors.
- Single phase AC motors.
- DC motors - permanent magnet or servo.
- Cast Iron or Steel construction motors.
- High altitude and high temperature options.
- Integral AC inverter.
- Integral Incremental or Absolute encoder.
- Forced ventilation.
- Enclosures IP56 to IP68.
- Tropicalised motors.
- NEMA and Japanese standard units.
- Marine motors.
- Explosion proof motors, including ATEX motors.
- Anti-Condensation Heaters
- Thermistors
- H-Class Insulation
- Brake hand release
- Plug-in connectors
- Second output shaft.

Features

- Standard Efficiency of IE1. Other efficiency ratings of IE2, IE3 and IE4 are available on request.
- Low noise levels.
- High power factors.
- High torque with smooth acceleration and low current.
- Aluminium construction for light weight and corrosion resistance.

Brake Motor

The brake units are a single disc type mounted on the non-drive end-shield of the motor and can be either DC or AC types. They are spring applied electrically released units, which provide fail to safe operating characteristics such that on interruption, or failure of power supply, the brake will engage and arrest the load.

With DC brakes, the brake coil is fed via a rectifier in the motor terminal box and is automatically switched with the AC motor supply. AC brakes are connected directly to the motor terminals. They can however be separately energised form their own AC supply, in the case of inverter drives and/or where very fast brake operation is required.

The enclosure ratings for brake motors are IP54 as standard and IP55 on request. More enclosure ratings are available on request e.g. IP56.

Symbols	Units of Measure	Description
$\cos\phi$	-	Power Factor
η	-	Efficiency
f_m	-	Power adjusting factor
I	-	Cyclic duration factor
I_N	(A)	Rated current
I_S	(A)	Locked rotor current
Jc	(Kgm^2)	Load moment of inertia
J_M	(Kgm^2)	Moment of inertia
K_c	-	Torque factor
K_d	-	Load factor
K_J	-	Inertia factor
M_A	(Nm)	Mean breakaway torque
M_B	(Nm)	Brake torque
M_N	(Nm)	Rated torque
M_L	(Nm)	Counter-torque during acceleration
M_s	(Nm)	Starting torque

Symbols	Units of Measure	Description
n	(min^{-1})	Rated Speed
P_B	(W)	Power drawn by the brake at 20°C
P_N	(kW)	Motor rated power
P_r	(kW)	Required power
t_1	(ms)	Brake response time with one-way rectifier
t_{1S}	(ms)	Brake response time with electronic-controlled rectifier
t_2	(ms)	Brake reaction time with a.c. disconnect
t_{2C}	(ms)	Brake reaction time with a.c. disconnect
t_a	°C	Ambient temperature
t_f	(min)	Work time constant load
t_r	(min)	Rest Time
W	(J)	Braking work between service interval
W_{MAX}	(J)	Maximum brake work for each braking
Z	(1/h)	Permissible starting frequency, loaded
Z_0	(1/h)	Max. permissible unloaded starting frequency (I=50%)

Motor Rating - 2 Pole Motors (3000 rpm)

2P			3000 min^{-1} - S1																	50Hz				
															d.c. brake						a.c. brake				
															FD						FA				
P_n kW			n min^{-1}	M_n Nm	IE1	η (100%) %	η (75%) %	η (50%) %	cosφ	In 400V A	Is / In	Ms / Mn	Ma / Mn	J_m x 10^{-4} kgm^2	1M B5 Kg	Type	Mb Nm	Z_o 1/h NB	Z_o 1/h SB	J_m x 10^{-4} kgm^2	1M B5 Kg	Type	Mb Nm	Z_o 1/h	J_m x 10^{-4} kgm^2	1M B5 Kg
0.18	BN 63A	2	2730	0.63	N/A	59.9	56.9	51.9	0.77	0.56	3.0	2.1	2.0	2.0	3.5	FD-02	1.75	3900	4800	2.6	5.2	FA-02	1.75	4800	2.6	5.0
0.25	BN 63B	2	2740	0.87	N/A	66.0	64.8	64.8	0.76	0.72	3.3	2.3	2.3	2.3	3.9	FD-02	1.75	3900	4800	3.0	5.6	FA-02	1.75	4800	3.0	5.4
0.37	BN 63C	2	2800	1.26	N/A	69.1	66.8	66.8	0.78	0.99	3.9	2.6	2.6	3.3	5.1	FD-02	3.5	3600	4500	3.9	6.8	FA-02	3.5	4500	3.9	6.6
0.37	BN 71A	2	2820	1.25	N/A	73.8	73.0	70.6	0.76	0.95	4.8	2.8	2.6	3.5	5.4	FD-03	3.5	3000	4100	4.6	8.1	FA-03	3.5	4200	4.6	7.8
0.55	BN 71B	2	2820	1.86	N/A	76.0	75.8	74.8	0.76	1.37	5.0	2.9	2.8	4.1	6.2	FD-03	5	2900	4200	5.3	8.9	FA-03	5	4200	5.3	8.6
0.75	BN 71C	2	2810	2.6	N/A	76.6	76.2	76.2	0.76	1.86	5.1	3.1	2.8	5.0	7.3	FD-03	5	1900	3300	6.1	10.0	FA-03	5	3600	6.1	9.7
0.75	BN 80A	2	2810	2.6	✓	76.2	75.5	68.3	0.81	1.75	4.8	2.6	2.6	7.8	8.6	FD-04	5	1700	3200	9.4	12.5	FA-04	5	3200	9.4	12.4
1.1	BN 80B	2	2800	3.8	✓	76.4	76.2	75.0	0.81	2.57	4.8	2.8	2.8	9.0	9.5	FD-04	10	1500	3000	13.4	13.4	FA-04	10	3000	10.6	13.3
1.5	BN S0C	2	2800	5.1	✓	79.1	79.5	77.2	0.81	3.4	4.9	2.7	2.8	11.4	11.3	FD-04	15	1300	2600	15.2	15.2	FA-04	15	2600	13.0	15.1
1.5	BN 90SA	2	2870	5.0	✓	82.0	81.5	78.1	0.80	3.4	5.9	2.7	2.6	12.5	12.3	FD-14	15	900	2200	14.1	16.5	FA-14	15	2200	14.1	16.4
1.85	BN 90SB	2	2880	6.1	✓	82.5	82.0	75.4	0.80	4.0	6.2	2.9	2.6	16.7	14	FD-14	15	900	2200	18.3	18.2	FA-14	15	2200	18.3	18.1
2.2	BN 90L	2	2880	7.3	✓	82.7	82.1	80.8	0.80	4.8	6.3	2.9	2.7	16.7	14	FD-05	26	900	2200	21	20	FA-05	26	2200	21	20.7
3	BN 100L	2	2860	10.0	✓	81.5	81.3	77.4	0.79	6.7	5.6	2.6	2.6	31	20	FD-15	26	700	1600	35	26	FA-15	26	1600	35	27
4	BN 100LB	2	2870	13.3	✓	83.1	83.0	77.8	0.80	6.7	5.8	2.7	2.5	39	23	FD-15	40	450	900	43	29	FA-15	40	1000	43	30
4	BN 112M	2	2900	13.2	✓	85.5	84.5	83.0	0.82	8.2	6.9	3.0	2.9	57	28	FD-06S	40	-	950	66	39	FA-06S	40	950	66	40
5.5	BN 132SA	2	2890	18.2	✓	84.7	84.5	81.2	0.84	11.2	5.9	2.6	2.2	101	35	FD-06	50	-	600	112	48	FA-06	50	600	112	49
7.5	BN 132SB	2	2900	25	✓	86.5	86.3	84.4	0.85	14.7	6.4	2.6	2.2	145	42	FD-06	50	-	550	154	55	FA-06	50	550	154	56
9.2	BN 132M	2	2930	30	✓	87.0	86.5	83.6	0.86	17.7	6.7	2.8	2.3	178	53	FD-56	75	-	430	189	66	FA-06	75	430	189	67
11	BN 160MR	2	2920	36	✓	87.6	87.0	86.0	0.88	20.6	6.9	2.9	2.5	210	65											
15	BN 160MB	2	2930	49	✓	89.6	89.4	88.0	86.0	28.1	7.1	2.6	2.3	340	84											
18.5	BN 160L	2	2930	60	✓	90.4	90.1	89.0	86.0	34	7.6	2.7	2.3	420	97											
22	BN 180M	2	2930	72	✓	89.9	89.7	89.5	0.88	40	7.8	2.6	2.4	490	109											
30	BN 200LA	2	2930	98	✓	90.7	90.1	87.6	0.89	54	7.8	2.7	2.9	770	140											

Motor Rating - 4 Pole Motors (1500 rpm)

4P			1500 min^{-1} - S1														d.c. brake FD						a.c. brake FA					50Hz	
P_n kW			n min^{-1}	M_n Nm	IE1	η (100%) %	η (75%) %	η (50%) %	cosφp	In 400V A	Is / In	Ms / Mn	Ma / Mn	J_m x 10^{-4} kgm^2	1M B5 Kg	Type	Mb Nm	Z_o 1/h NB	Z_o 1/h SB	J_m x 10^{-4} kgm^2	1M B5 Kg	Type	Mb Nm	Z_o 1/h	J_m x 10^{-4} kgm^2	1M B5 Kg		
0.06	BN 56A	4	1340	0.43	N/A	46.8	44.2	41.3	0.65	0.28	2.6	2.3	2.0	1.5	3.1													
0.09	BN 568	4	1350	0.64	N/A	51.7	47.6	42.9	0.60	0.42	2.6	2.5	2.4	1.5	3.1													
0.12	BN 63A	4	1350	0.85	N/A	59.8	56.2	47.0	0.62	0.47	2.6	1.9	1.8	2.0	3.5	FD-02	1.75	10000	13000	2.6	5.2	FD-02	1.75	13000	2.6	5.0		
0.18	BN 638	4	1320	1.30	N/A	54.8	52.9	52.5	0.67	0.71	2.6	2.2	2.0	2.3	3.9	FD-02	3.5	10000	13000	3.0	5.6	FD-02	3.5	13000	3.0	5.4		
0.25	BN 63C	4	1340	1.78	N/A	65.3	65.0	57.9	0.69	0.80	2.7	2.1	1.9	3.3	5.1	FD-02	3.5	7800	10000	3.9	6.8	FD-02	3.5	10000	3.9	6.6		
0.25	BN 71A	4	1380	1.73	N/A	63.7	62.2	59.1	0.73	0.78	3.3	1.9	1.7	5.8	5.1	FD-03	3.5	7700	11000	6.9	7.8	FD-03	3.5	11000	6.9	7.5		
0.37	BN 71B	4	1370	2.6	N/A	66.8	66.7	63.0	0.76	1.05	3.7	2.0	1.9	6.9	5.9	FD-03	5	6000	9400	8.0	8.6	FD-03	5.0	9400	8.0	8.3		
0.55	BN 71C	4	1380	3.8	N/A	69.0	68.9	68.8	0.74	1.55	4.1	2.3	2.3	9.1	7.3	FD-53	7.5	4300	8700	10.2	10.0	FD-03	7.5	8700	10.2	9.7		
0.55	BN 80A	4	1390	3.8	N/A	72.0	71.3	69.7	0.77	1.43	4.1	2.3	2.0	15	8.2	FD-04	10	4100	8000	16.6	12.1	FD-04	10	8000	16.6	12.0		
0.75	BN 80B	4	1400	5.1	✓	75.0	74.5	69.3	0.78	1.85	4.9	2.7	2.5	20	9.9	FD-04	15	4100	7800	22	13.8	FD-04	15	7800	22	13.7		
1.1	BN 80C	4	1400	7.5	✓	75.5	76.2	70.4	0.78	2.7	5.1	2.8	2.5	25	11.3	FD-04	15	2600	5300	27	15.2	FD-04	15	5300	27	15.1		
1.1	BN 90S	4	1390	7.6	✓	76.5	76.2	72.2	0.77	2.70	4.6	2.6	2.2	21	12.2	FD-14	15	4800	8000	23	16.4	FD-14	15	8000	23	16.3		
1.5	BN 90LA	4	1410	10.2	✓	78.7	78.5	74.9	0.77	3.6	5.3	2.8	2.4	28	13.6	FD-05	26	3400	6000	32	19.6	FD-05	26	6000	32	20.3		
1.85	BN 90LB	4	1390	12.7	✓	78.6	78.9	77.2	0.79	4.3	5.1	2.8	2.6	30	15.1	FD-05	26	3200	5900	34	21.1	FD-05	26	5900	34	21.8		
2.2	BN 100LA	4	1410	14.9	✓	81.1	81.4	79.9	0.75	5.2	4.5	2.2	2.0	40	18	FD-15	40	2600	4700	44	25	FD-15	40	4700	44	25		
3	BN 100LB	4	1410	20	✓	82.6	83.8	83.7	0.77	6.8	5.0	2.3	2.2	54	22	FD-15	40	2400	4400	58	28	FD-15	40	4400	58	29		
4	BN 112M	4	1430	27	✓	84.4	84.2	81.6	0.81	8.4	5.6	2.7	2.5	98	30	FD-06S	60	-	1400	107	40	FD-06S	60	2100	107	42		
5.5	BN 132S	4	1440	36	✓	84.7	84.8	82.5	0.81	11.6	5.5	2.3	2.2	213	44	FD-56	75	-	1050	223	57	FD-06	75	1200	223	58		
7.5	BN 132MA	4	1440	50	✓	86.0	86.3	85.3	0.81	15.5	5.7	2.5	2.4	270	53	FD-06	100	-	950	280	66	FD-07	100	1000	280	71		
9.2	BN 132MB	4	1440	61	✓	88.4	88.6	87.5	0.81	18.8	5.9	2.7	2.5	319	59	FD-07	150	-	900	342	75	FD-07	150	900	342	77		
11	BN 160MR	4	1440	73	✓	87.6	87.8	86.0	0.81	22.4	6.0	2.7	2.5	360	70	FD-07	150	-	800	382	86	FD-07	150	850	382	88		
15	BN 160L	4	1460	98	✓	88.7	88.5	88.4	0.81	30	6.0	2.3	2.1	650	99	FD-08	200	-	750	725	129	FD-08	200	750	710	128		
18.5	BN 180M	4	1460	121	✓	89.3	89.5	89.2	0.81	37	6.2	2.6	2.5	790	115	FD-08	250	-	700	865	145	FD-08	250	700	850	144		
22	BN 180L	4	1460	144	✓	89.9	90.0	90.0	0.80	44	6.4	2.5	2.5	1250	135	FD-09	300	-	400	1450	175							
30	BN 200L	4	1460	196	✓	91.4	91.7	91.0	0.80	59	7.1	2.7	2.8	1650	157	FD-09	400	-	300	1850	197							

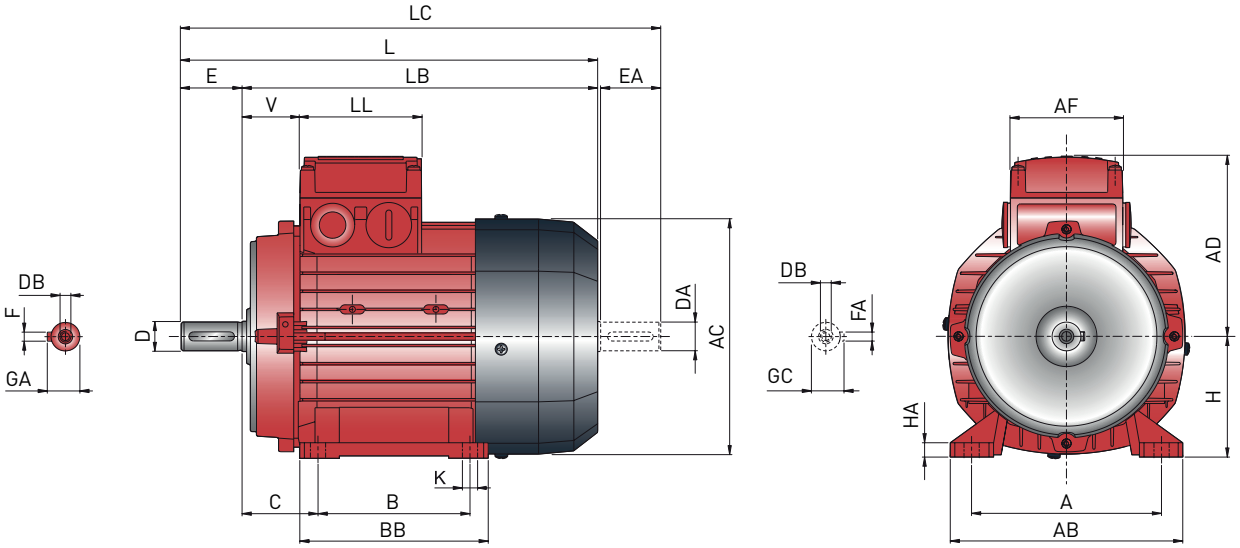
Motor Rating - 6 Pole Motors (1000 rpm)

6P			1000 min-1 - S1																		50Hz				
															d.c. brake						a.c. brake				
															FD						FA				
P_n kW			n min-1	M_n Nm	IE1	η (100%) %	η (75%) %	η (50%) %	cosφp	In 400V A	Is/In	Ms/Mn	Ma/Mn	$J_m x 10^{-4}$ kgm²	1M B5 Kg	Type	Mb Nm	Z_o 1/h NB	Z_o 1/h SB	$J_m x 10^{-4}$ kgm²	1M B5 Kg	Type	Mb Nm	Z_o 1/h	$J_m x 10^{-4}$ kgm²	1M B5 Kg
0.09	BN 63A	6	880	0.98	N/A	41.0	41.0	32.9	0.53	0.60	2.1	2.1	1.8	3.4	4.6	FD-02	3.5	9000	14000	4.0	6.3	FD-02	3.5	14000	4.0	6.1
0.12	BN 63B	6	870	1.32	N/A	45.0	44.0	41.8	0.53	0.64	2.1	1.9	1.7	3.7	4.9	FD-02	3.5	9000	14000	4.3	6.6	FD-02	3.5	14000	4.3	6.4
0.18	BN 71A	6	900	1.91	N/A	55.0	55.5	51.0	0.69	0.68	2.6	1.9	1.7	8.4	5.5	FD-03	5	8100	13500	9.5	8.2	FD-03	5.0	13500	9.5	7.9
0.25	BN 71B	6	900	2.70	N/A	62.0	58.5	51.4	0.71	0.82	2.6	1.9	1.7	10.9	6.7	FD-03	5	7800	13000	12	9.4	FD-03	5.0	13000	12	9.1
0.37	BN 71C	6	910	3.9	N/A	66.0	60.0	53.3	0.69	1.17	3.0	2.4	2.0	12.9	7.7	FD-53	7.5	5100	9500	14	10.4	FD-03	7.5	9500	14	10.1
0.37	BN 80A	6	910	3.9	N/A	68.0	67.4	63.3	0.68	1.15	3.2	2.2	2.0	21	9.9	FD-04	10	5200	8500	23	13.8	FD-04	10	8500	23	13.7
0.55	BN 80B	6	920	5.7	N/A	70.0	69.8	64.3	0.68	1.67	3.9	26	2.2	25	11.3	FD-04	15	4800	7200	27	15.2	FD-04	15	7200	27	15.1
0.75	BN 80C	6	920	7.8	✓	70.0	70.0	64.4	0.65	2.38	3.8	2.5	2.2	28	12.2	FD-04	15	3400	6400	30	16.1	FD-04	15	6400	30	16.0
0.75	BN 90S	6	920	7.8	✓	70.0	69.0	64.2	0.68	2.27	3.8	2.4	2.2	26	12.6	FD-14	15	3400	6500	28	16.8	FD-14	15	6500	28	16.7
1.1	BN 80B	6	920	11.4	✓	72.9	72.6	69.1	0.69		3.9	2.3	2.0	33	15	FD-05	26	2700	5000	37	21	FD-01	26	7800	37	22
1.5	BN 100LA	6	940	15.2	✓	75.2	74.2	70.3	0.72	4.0	4.1	2.1	2.0	82	22	FD-15	40	1900	4100	86	28	FD-15	40	4100	86	29
1.85	BN 100LB	6	930	19.0	✓	76.6	72.8	62.6	0.73	4.8	4.6	2.1	2.0	95	24	FD-15	40	1700	3600	99	30	FD-15	40	3600	99	31
2.2	BN 112M	6	940	22	✓	78.5	79.0	76.5	0.81	5.5	4.8	2.2	2.0	168	32	FD-06S	60	-	2100	177	42	FD-06S	60	2100	177	44
3	BN 132S	6	940	30	✓	79.7	77.0	75.1	0.76	7.1	5.1	1.9	1.8	216	36	FD-56	75	-	1400	226	49	FD-06	75	1400	226	50
4	BN 132MA	6	950	40	✓	81.4	81.5	79.5	0.77	9.2	5.5	2.0	1.8	295	45	FD-06	100	-	1200	305	58	FD-07	100	1200	318	63
5.5	BN 132MB	6	945	56	✓	83.1	80.9	79.1	0.78	12.2	6.1	2.1	1.9	383	56	FD-07	150	-	1050	406	72	FD-07	150	1050	406	74
11	BN 160M	6	955	75	✓	85.0	85.0	84.8	0.81	15.7	5.9	2.2	2.0	740	83	FD-08	170	-	900	815	112	FD-08	170	900	815	113
15	BN 160L	6	960	109	✓	86.4	86.5	85.9	0.81	22.7	6.6	2.5	2.3	970	103	FD-08	200	-	800	1045	133	FD-08	200	800	1045	133
18.5	BN 180L	6	970	148	✓	87.7	88.0	87.3	0.82	30	6.2	2.0	2.4	1550	130	FD-09	300	-	600	1750	170					
30	BN 200LA	6	960	184	✓	88.6	88.0	87.3	0.81	37	5.9	2.0	2.3	1700	145	FD-09	400	-	450	1900	185					

Motor Rating - 8 Pole Motors (750 rpm)

8P			750 min^{-1} - S1											d.c. brake						a.c. brake				50Hz
														FD						FA				
P_n kW			n min^{-1}	M_n Nm	η %	cosφp	In 400V A	Is / In	Ms / Mn	Ma / Mn	$J_m \times 10^{-4}$ kgm^2	1M B5 Kg	Type	Mb Nm	Z_o 1/h NB	Z_o 1/h SB	$J_m \times 10^{-4}$ kgm^2	1M B5 Kg	Type	Mb Nm	Z_o 1/h	$J_m \times 10^{-4}$ kgm^2	1M B5 Kg
0.09	BN 71A	8	680	1.26	47	0.59	0.47	2.3	2.4	2.3	10.9	6.7	FD-03	3.5	9000	16000	12.0	9.4	FD-03	3.5	16000	12.0	9.1
0.12	BN 71B	8	680	1.69	51	0.59	0.58	2.1	2.3	2.2	12.9	7.7	FD-03	5.0	9000	16000	14.0	10.4	FD-03	5.0	16000	14.0	10.1
0.18	BN 80A	8	690	2.49	51	0.60	0.85	2.4	2.2	2.2	15	8.2	FD-04	5.0	6500	11000	16.6	12.1	FD-04	5.0	11000	16.6	12.0
0.25	BN 80B	8	680	3.51	54	0.63	1.06	2.4	2.0	1.9	20	9.9	FD-04	10.0	6000	10000	22	13.8	FD-04	10.0	10000	23	13.7
0.37	BN 90S	8	675	5.2	58	0.60	1.53	2.6	2.3	2.1	26	12.6	FD-14	15.0	4800	7500	28	16.8	FD-14	15.0	7500	28	16.7
0.55	BN 90L	8	670	7.8	62	0.60	2.13	2.6	2.2	2.0	33	15	FD-05	26	4000	6400	37	21	FD-05	26	6400	37	22
0.75	BN 100LA	8	700	10.2	68	0.63	2.53	3.4	1.9	1.7	82	22	FD-15	26	2800	4800	86	28	FD-15	26	4800	86	29
1.1	BN 100LB	8	700	15.0	68	0.64	3.65	3.2	1.7	1.7	95	24	FD-15	40	2500	4000	99	30	FD-15	40	4000	99	31
1.5	BN 112M	8	710	20.2	71	0.66	4.6	3.7	1.8	1.9	168	32	FD-06S	60	-	3000	177	42	FD-06S	60	3000	177	44
2.2	BN 132S	8	710	29.6	75	0.66	6.4	3.8	1.8	2.0	295	45	FD-56	75	-	2300	305	58	FD-06	75	2300	305	56
3	BN 132MA	8	710	40.4	76	0.69	8.3	3.9	1.6	1.8	370	53	FD-06	100	-	1900	394	69	FD-07	100	1900	406	74

Motor Dimensions - Standard - B3 Foot Mount

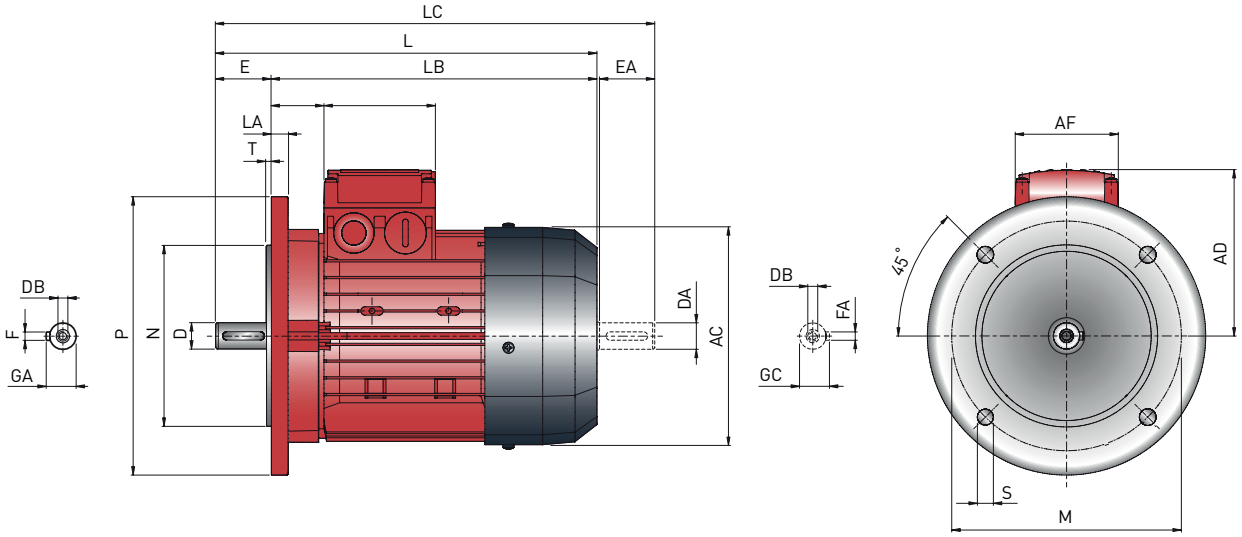


FRAME SIZE	SHAFT					HOUSING						MOTOR									
	D DA	E EA	DB	GA GC	F FA	B	A	HA	BB	AB	K	C	HC	AC	L	LB	LC	AD	AF	LL	V
BN 63	11	23	M4	12	4	80	100	8	96	120	7	40	63	121	207	184	232	95	74	80	30
BN 71	14	30	M5	16	5	90	112	8	112	135		45	71	138	249	219	281	108			37
BN 80	19	40	M6	21.5	6	100	125	8	124	153	10	50	80	156	273	233	315	119			38
BN 90S	24	50	M8	27	8		140	8	155	174		56	90	176	326	276	378	133	98	98	44
BN 90L						125															
BN 100	28	60	M10	31	8	140	160	10	175	192	12	63	100	195	366	306	429	142			50
BN 112							190			224		70	112	219	385	325	448	157			52
BN 132S	38	80	M12	41	10		216	12	218	254		89	132	260	493	413	576	193	118	118	58
BN 132M						178															
BN 160M	42 38 (1)	110 80 (1)	M16 M12 (1)	45 41 (1)	12 10 (1)	210	254	25	264	319	14.5	108	160	310	596	486	680	245	187	187	51
BN 160L						254			304						640	530	724				
BN 180L	48 42 (1)	110 110 (1)	M16 M16 (1)	51.5 45 (1)	14 12 (1)	279	279	26	329	359	14	121	180	348	708	598	823	261			52
BN 200L	55 42 (1)		M20 M16 (1)	59 45 (1)	16 12 (1)	305	318		355	398	18	133	200		722	612	837				64

Note

1. These values refer to the rear shaft end.

Motor Dimensions - Standard - B5 Flange Mount

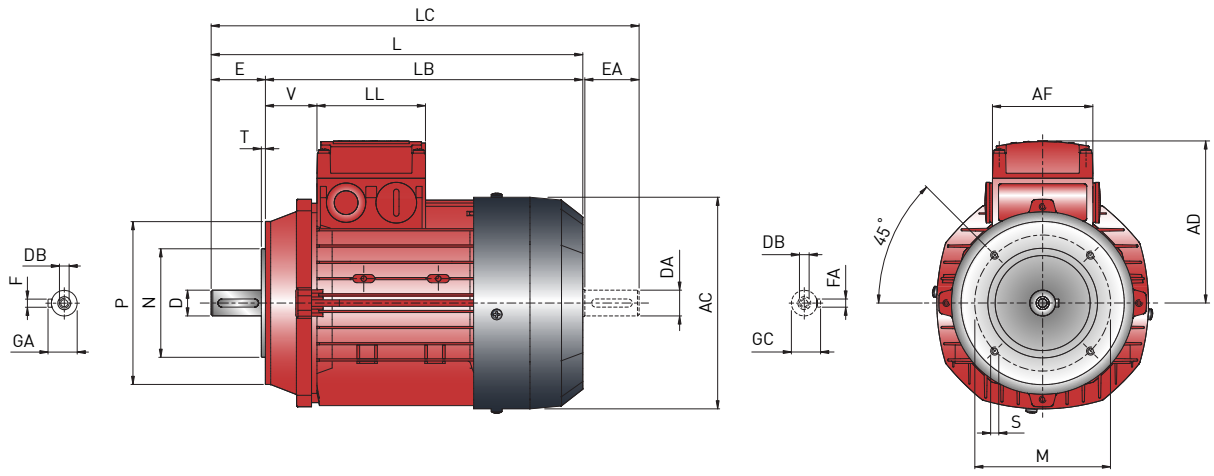


FRAME SIZE	SHAFT					FLANGE						MOTOR							
	D DA	E EA	DB	GA GC	F FA	M	N	P	S	T	LA	AC	L	LB	LC	AD	AF	LL	V
BN 56	9	20	M3	10.2	3	100	80	120	7	3	8	110	185	165	207	91	74	80	34
BN 63	11	23	M4	12.5	4	115	95	140	9.5		10	121	207	184	232	95			26
BN 71	14	30	M5	16	5	130	110	160		3.5		138	249	219	281	108			37
BN 80	19	40	M6	21.5	6	165	130	200	11.5		11.5	156	274	234	315	119			38
BN 90	24	50	M8	27	8							176	326	276	378	133	98	98	44
BN 100	28	60	M10	31		125	180	250	14	4	14	63	367	307	429	142			50
BN 112											15	219	385	325	448	157			52
BN 132	38	80	M12	41	10	265	230	300			20	258	493	413	576	193	118	118	58
BN 160 MR	42 38 (1)	110 80 (1)	M16 M12 (1)	45 41 (1)	12 10 (1)	300	250	350	18.5	5	15		562	452	645				218
BN 160 M												310	596	486	680	245	187	187	51
BN 160 L																			
BN 180 M	48 38 (1)	110 110 (1)	M16 M12 (1)	51.5 41 (1)	14 10 (1)							310	640	530	724				
BN 180 L	48 42 (1)		M16 M16 (1)	51.5 45 (1)	14 12 (1)						18	348	708	598	823	261			52
BN 200 L	55 42 (1)		M20 M16 (1)	59 45 (1)	16 12 (1)	350	300	400					722	612	837				66

Note

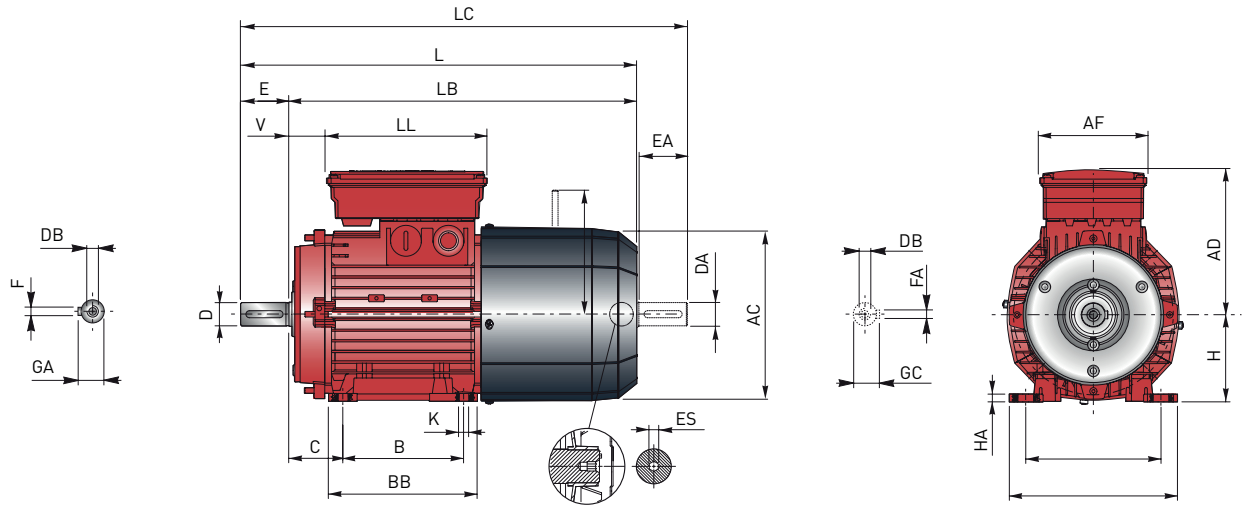
1. These values refer to the rear shaft end.

Motor Dimensions - Standard - B14 Face Mount



FRAME SIZE	SHAFT					FLANGE					MOTOR							
	D DA	E EA	DB	GA GC	F FA	M	N	P	S	T	AC	L	LB	LC	AD	AF	LL	V
BN 56	9	20	M3	10.2	3	65	50	80	M5	2.5	110	185	165	207	91	74	80	34
BN 63	11	23	M4	12.5	4	75	60	90			121	207	184	232	95			26
BN 71	14	30	M5	16	5	85	70	105	M6		138	249	219	281	108			37
BN 80	19	40	M6	21.5	6	100	105	120		3	156	274	234	315	119			38
BN 90	24	50	M8	27	8	115	120	140	M8		176	326	276	378	133	98	98	44
BN 100	28	60	M10	31		130	110	160		3.5	195	367	307	429	142			50
BN 112											219	385	325	448	157			52
BN 132	38	80	M12	41	10	165	130	200	M10	4	258	493	413	576	193	118	118	58

Motor Dimensions - Brake Motor - DC Brake - B3 Foot Mount

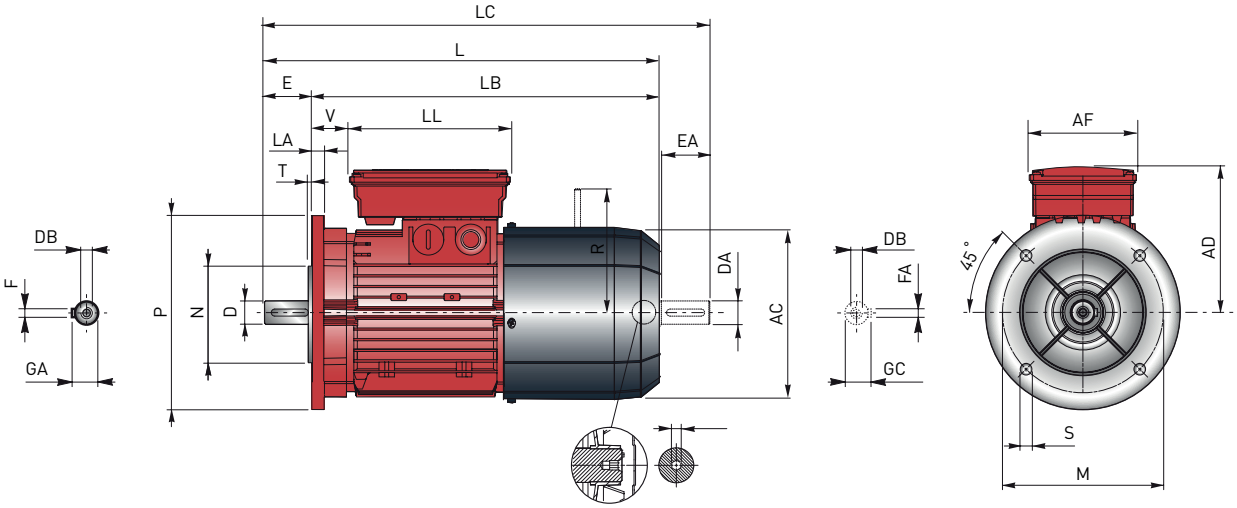


FRAME SIZE	SHAFT					HOUSING						MOTOR											
	D DA	E EA	DB	GA GC	F FA	B	A	HA	BB	AB	K	C	H	AC	L	LB	LC	AD	AF	LL	V	R	S
BN 63	11	23	M4	12	4	80	100	8	96	120	7	40	63	121	272	249	297	122	98	133	14	96	5
BN 71	14	30	M5	16	5	90	112	8	112	135		45	71	138	310	280	342	135			25	103	
BN 80	19	40	M6	21.5	6	100	125	8	124	153	10	50	80	156	346	306	388	146			41	129	
BN 90S	24	50	M8	27	8		140	8	155	174		56	90	176	409	359	461	149	110	165	15		6
BN 90L						125															39	160	
BN 100	28	60	M10	31	8	140	160	10	175	192	12	63	100	195	458	398	521	158			62		
BN 112							190			224		70	112	219	484	424	547	173			73	199	
BN 132S	38	80	M12	41	10		216	12	218	254		89	132	260	603	523	686	210	140	188	46	204 (2)	
BN 132M						178																	
BN 160M	42 38 (1)	110 80 (1)	M16 M12 (1)	45 41 (1)	12 10 (1)	210	254	25	264	319	14.5	108	160	310	736	626	820	245	187	187	51	266	–
BN 160L						254			304						780	670	884						
BN 180L	48 42 (1)	110 110 (1)	M16 M16 (1)	51.5 45 (1)	14 12 (1)	279	279	26	329	359	14	121	180	348	886	756	981	261			52	305	
BN 200L	55 42 (1)		M20 M16 (1)	59 45 (1)	16 12 (1)	305	318		355	398	18	133	200		878	768	993				64		

Note

1. These values refer to the rear shaft end.
2. For FD07 high torque brake value R=226 (consult Power Jacks for more details).

Motor Dimensions - Brake Motor - DC Brake - B5 Flange Mount

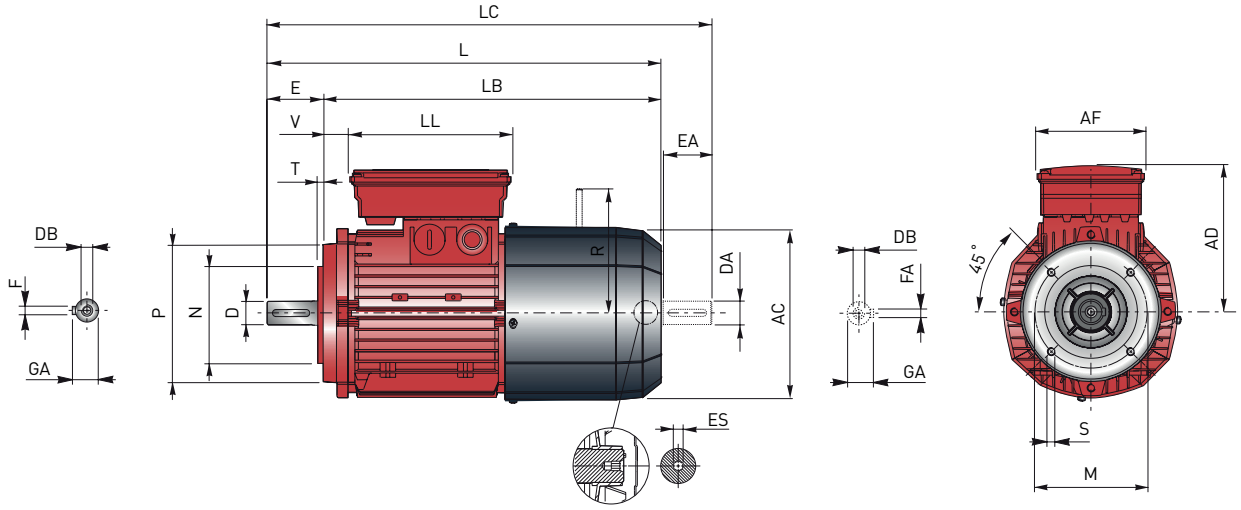


FRAME SIZE	SHAFT					FLANGE						MOTOR									
	D DA	E EA	DB	GA GC	F FA	M	N	P	S	T	LA	AC	L	LB	LC	AD	AF	LL	V	R	ES
BN 63	11	23	M4	12	4	115	95	140	9.5	3	10	121	272	249	297	122	98	133	14	96	5
BN 71	14	30	M5	16	5	130	110	160	9.5	3.5		138	310	280	342	135			25	103	
BN 80	19	40	M6	21.5	6	165	130	200	11.5		11.5	156	346	156	388	146			41	129	
BN 90S	24	50	M8	27	8							176	409	176	461	149	110	165	39		6
BN 90L																146				160	
BN 100	28	60	M10	31		215	215	215	14	4	14	195	458	195	521	158		165	62		
BN 112											15	219	484	219	547	173		165	73	199	
BN 132	38	80	M12	41	10	265	230	300			20	258	603	523	686	210	140	188	46	204 (2)	
BN 160MR	42 38 (1)	110 80 (1)	M16 M12 (1)	45 M41 (1)	12 10 (1)	300	250	350	18.5	5	15		672	562	755				161	226	
BN 160M												310	736	626	820	245	187	187	51	266	–
BN 160L	42 38 (1)	110 80 (1)	M16 M12 (1)	45 41 (1)	12 10 (1)																
BN 180M	48 38 (1)			51.5 41 (1)	14 10 (1)								780	670	864						
BN 180L	48 42 (1)	110 110 (1)	M16 M16 (1)	51.5 45 (1)	14 12 (1)						18	348	866	756	981	261			52	305	
BN 200L	55 42 (1)		M20 M16 (1)	59 45 (1)	16 12 (1)	350	300	400	18.5				878	768	722				64		

Note

1. These values refer to the rear shaft end.
2. For FD07 high torque brake value R=226 (consult Power Jacks for more details).

Motor Dimensions - Brake Motor - DC Brake - B14 Face Mount



FRAME SIZE	SHAFT					FLANGE					MOTOR									
	D DA	E EA	DB	GA GC	F FA	M	N	P	S	T	AC	L	LB	LC	AD	AF	LL	V	R	ES
BN 63	11	23	M4	12.5	4	75	60	90	M5	2.5	121	272	249	297	122	98	133	14	96	5
BN 71	14	30	M5	16	5	85	70	105	M6		138	310	280	342	135			25	103	
BN 80	19	40	M6	21.5	6	100	105	120		3	156	346	306	388	146			41	129	
BN 90 S	24	50	M8	27	8	115	120	140	M8		176	409	359	461	149	110	165	39	129	6
BN 90 L															146				160	
BN 100	28	60	M10	31		130	110	160		3.5	195	458	398	521	158			62		
BN 112											219	484	424	547	173			73	199	
BN 132	38	80	M12	41	10	165	130	200	M10	4	258	603	523	686	210	140	188	46	204 (1)	

Note

1. For FD07 high torque brake value R=226 (consult Power Jacks for more details).

Flexible Couplings

Selection of Coupling Type

The selection of coupling type depends on the installation and the type of misalignment. The three main types of misalignment encountered are:-

1. Angular Misalignment is usually present to some extent on all applications, typical values 1° - 2°. Sometimes higher values are necessary.
2. Parallel (Radial) Misalignment is also nearly always present. A well aligned installation might have values below 0.25 mm.
3. Axial Misalignment (End Float) sometimes caused by thermal expansion or as a result of machine design.

Other considerations include:

- Backlash Free Couplings are either one part couplings or have bolted joints. These are effective for precise positioning and to avoid wear on reversing drives.
- Torsional rigidity of couplings depends on the joining method. Types with rubber or plastic elements can be considered as torsionally soft and will have an amount of twist at rated torque.

Procedure:

1. Decide if the coupling should be torsionally soft or rigid.
2. Consider whether a small amount of backlash is acceptable.
3. Calculate the required coupling torque.
4. Make a provisional selection.
5. Check that the coupling's maximum speed is sufficient.
6. Check that the coupling's dimensions are acceptable.
7. Contact Power Jacks with your order or technical enquiry

Selection of Coupling Size:

$$\textbf{Coupling Torque, T(Nm)} = \frac{9550 * \text{Power Transmitted (kW)} * S}{\text{RPM}}$$

where S = Service Factor - dependant on drive conditions (refer to each coupling) Select the coupling which is rated above the calculated torque. If a brake is present in the system the coupling should be based on either the brake torque or the transmitted torque whichever is greater.

Note

1. Maximum misalignment values are extremes and should not be combined. As operating misalignment approaches the maximum, torque and power ratings should be reduced to maintain life.
2. Gear couplings accommodate parallel misalignment by converting it to angular misalignment at the gear meshes in the flexible halves of the coupling.
3. The maximum axial misalignment values apply when the coupling is aligned. If axial misalignment greater than the listed maximum is required, consult Power Jacks.
4. The inertia values includes shafts through the bores.
5. When ordering please quote the coupling size and type, specify the bore and keyway sizes, and advise if puller holes or set-screws are required.
6. For maximum performance, the actuators, shafts, Gearboxes and motor should be carefully aligned.
7. Imperial couplings on request.

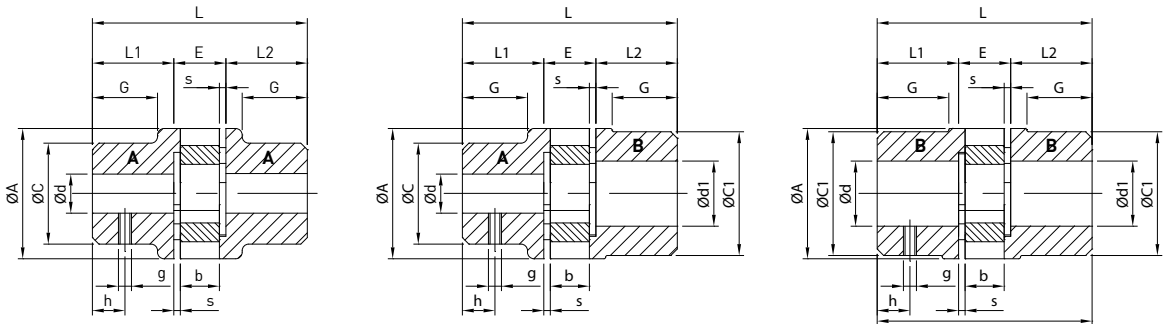
Keyways	Metric	Imperial
Standard Bores	B.S. 4500 1969 H7	B.S. 1916 Part 1 1953 K7
Standard Keyways	B.S. 4235 Part 1 1967 P9	B.S. 46 Part 1 1958

Jaw Type Flexible Coupling

- Curved jaw design.
- No need for lubrication.
- Quick and simple to install.
- Reliable, rugged and compact.
- Smooth, silent action.
- High power transmission density.
- 4 Standard spider types available.
- Elastomeric element resistant to heat (-40°C to +90°C), grease, oil and chemical agents.
- Hubs in aluminium and sintered iron.

Size		14	19/24	24/30	28/38	38/45	42/55	48/60	55/70	65/75	75/90	90/100	100/110
Torque (Nm)	Nominal, T_{kn}	P	10	35	95	190	265	310	375	425	975	2400	3300
	Max T_{kmax}	P	20	70	190	380	530	620	750	850	1950	4800	6600
	Vibrating T_{kw} (10Hz)	P	2.6	9	25	49	69	81	93	111	254	624	858
Misalignment Valves	Axial (mm)	P	1.2	1.4	1.5	1.8	2	2.1	2.2	2.6	3	3.4	3.8
	Angular (deg)	P	0.9	0.9	0.9	1	1	1.1	1.1	1.2	1.2	1.2	1.2
	Radial (mm)	P	0.2	0.22	0.25	0.28	0.32	0.36	0.38	0.42	0.48	0.5	0.52
Speed	Max (rpm)	P	14000	10600	8500	7100	6000	5600	4750	4250	3550	2800	2500

Note All couplings use 92 Shore elastomeric element (white) as standard. 80, 98 and 95 available on request.
Maximum torque must not be exceeded during start-up operation.
More accurate alignment will increase coupling life and reduce vibration. Dimensions "E" and "L" must be observed.
P = Consult Power Jacks for more details.



Type	Hub 'A'			Hub 'B'			Dimensions (mm)												
	Pre Bore	Min Bore	Max Bore	Pre Bore	Min Bore	Max Bore	A	C	C1	L	L1& L2	E	s	b	G	F	g	h	Weight kg
Aluminimum Hub Couplings																			
19/24	6	6	19	18	20	24	40	31	38	66	25	16	2	12	20	18	M5	10	0.11
24/30	6	8	24	22	25	30	55	39	48	78	30	18	2	14	24	27	M5	10	0.24
28/38	9	10	28	26	30	38	65	46	61	90	35	20	2.5	15	28	30	M6	15	0.42
38/45	12	14	38	36	40	45	80	64	75	114	45	24	3	18	38	38	M6	15	0.86
Cast Iron Hub Couplings																			
19/24	-	-	-	-	6	24	40	-	40	66	25	16	2	12	-	18	M5	10	0.34
24/30	-	-	-	-	8	32	55	-	55	78	30	18	2	14	-	27	M5	10	0.9
28/38	-	-	-	-	10	38	65	-	65	90	35	20	2.5	15	-	30	M6	15	1.5
38/45	-	14	38	-	40	45	80	66	78	114	45	24	3	18	37	38	M8	15	2.35
42/55	-	16	42	-	45	55	95	75	93	126	50	26	3	20	40	46	M8	20	3.55
48/60	-	19	48	-	50	60	105	85	103	140	56	28	3.5	21	45	51	M8	20	4.85
55/70	-	22	55	53	60	70	120	98	118	160	65	30	4	22	52	60	M10	20	7.4
65/75	-	25	65	63	70	75	135	115	133	185	75	35	4.5	26	61	68	M10	20	10.8
75/90	-	30	75	73	80	90	160	135	158	210	85	40	5	30	69	80	M10	25	17.7
90/100	-	-	-	-	45	100	200	-	170	245	100	45	5.5	34	81	100	M10	25	29.6
100/110	-	-	-	-	45	110	225	-	180	270	110	50	6	38	89	113	M12	30	39

Note Weight of min. bored coupling with standard A/B hub combination. All couplings metric bored and keyed as standard.
Consult Power Jacks for standard bore sizes and specials.

Service Factor S = Ft * Fz * Fs

Temperature (°C)	-30°C to +30°C	40°C	60°C	80°C
Temperature Factor (Ft)	1	1.2	1.4	1.8

Starts/Day	0 to 10	101 to 200	201 to 400	401 to 800
Temperature Factor (Ft)	1	1.2	1.4	1.8

Shock Type	None	Light	Medium	High
Shock Factor (Fs)	1	1.2	1.8	2.5

Flexible Spacer Couplings (Self-Supporting Drive Shafts)

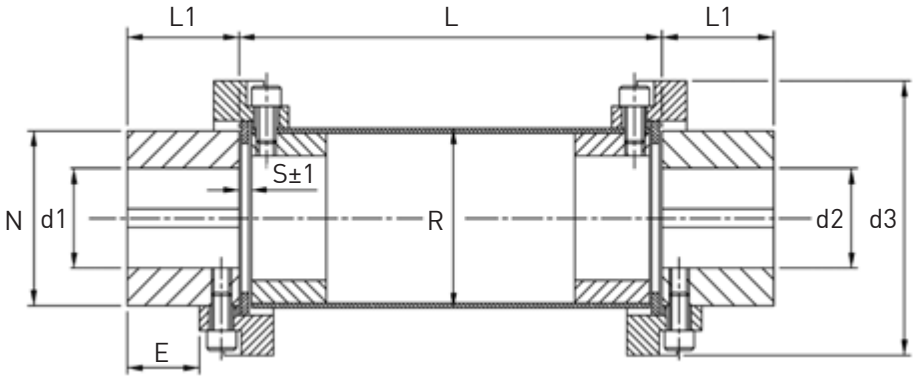
- Compact, light, robust, safe in operation, long service life.
- Two identical hubs and one flexible element.
- Hubs of high tensile steel.
- Large permissible bores, various hub lengths.
- Driving dogs have smooth surface, high durability.
- Generously proportioned compression-stressed flexible inserts.
- Damps vibrations and shocks, compensates for axial, radial and angular misalignment.

Elastomeric Element features:

- Inserts made of "90 Shore A" Polyurethane (G) as standard or tough "55 Shore D" Hytrel (H).
- Operating temperature range: -40°C to +80°C as standard
- Elastomeric element is resistant to oil and grease.

Coupling Performance

Type	B-G			B-H-G			Max Speed Nmax (rpm) Elastomeric Element
Size	Nominal Torque TKN (Nm)	Maximum Torque TKmax (Nm)	Torsional Angle (deg) at TKN	Nominal Torque TKN (Nm)	Maximum Torque TKmax (Nm)	Torsional Angle (deg) at TKN	
72	32	64	4	45	80	2.5	10000
76	63	125	4	90	125	2.5	9000
98	125	250	4	175	280	2.5	7500
120	250	500	4	350	560	2.5	6000
138	400	800	4	560	900	2.5	5000
165	600	1200	4	850	1700	2.5	4000
185	1000	2000	4	1400	2800	2.5	3600



Coupling Dimensions

Size	d min (d1, d2)	d max (d1, d2)	d3	E	L1	N	R	S +/- 1	Model	L (minimum)
72	9	30	72	14	28	50	45	6	CF - B - (H) - 72 - G - L = *	100
76	12	30	76	16	30	50	45	6	CF - B - (H) - 76 - G - L = *	100
98	12	38	98	24	42	61	60	6	CF - B - (H) - 98 - G - L = *	100
120	15	48	120	28	50	71	70	6	CF - B - (H) - 120 - G - L = *	100
138	15	55	138	30	55	86	85	6	CF - B - (H) - 138 - G - L = *	140
165	20	65	165	36	65	100	100	8	CF - B - (H) - 165 - G - L = *	180
185	30	80	185	45	80	115	115	10	CF - B - (H) - 185 - G - L = *	180

* Insert length, L here in millimetres.

Misalignment

Element Type	Radial (mm)	Axial (mm)	Angular (deg)
B-Standard	0.5	+/- 1	1
H-Hytrel	0.25	+/- 1	0.5

Note
The best possible alignment will result in the best coupling performance.

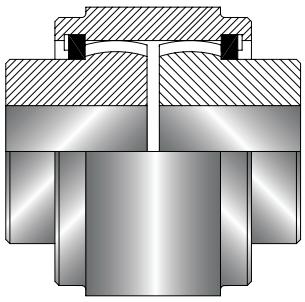
Service Factor
The service factor must be chosen according to working conditions between 1 (light duty) and 3 (arduous duty).

Critical Speed & Spacer length
Spacer coupling lengths can be provided up to a maximum of 6m depending on rotational speed.
For advice on the critical speed of a given coupling consult Power Jacks.

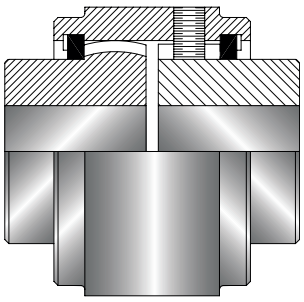
Steel Gear Couplings

Continuous Sleeve Steel Gear Coupling

- Vari-crown tooth form for improved torque transmission and longer life.
- Strong compact design.
- High transmittable torque ratings.
- Low inertia and high maximum speeds.
- Steel reinforced high misalignment seals.
- Spacer couplings available on request.



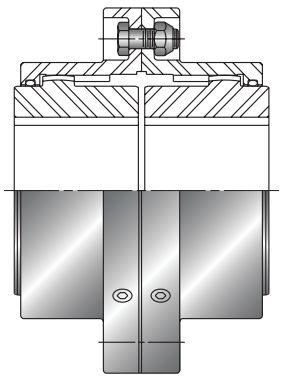
Full-Flex Gear Coupling
Two flexible hubs and sleeve assembly. Accommodates angular, parallel and axial misalignments.



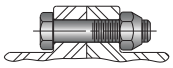
Flex-Rigid Gear Coupling
Flexible and rigid hub assembly. The flexible hub is standard and the rigid hub is splined into the sleeve. Accommodates angular and axial misalignment only.

Flanged Sleeve Steel Gear Coupling

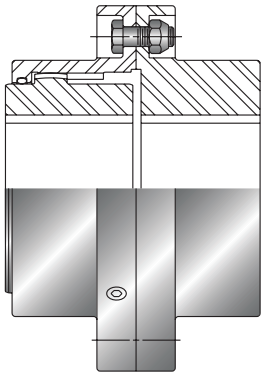
- High transmittable torque ratings and high maximum speeds.
- Accommodates angular, parallel and axial misalignment.
- Strong forged steel hubs and sleeves
- Vari-crown tooth from improved torque transmission and longer life.
- Several mounting options available by reversing th hubs.
- Spacer gear couplings available. Consult Power Jacks



Full-Flex Gear Coupling
Two flexible hubs and sleeve assembly. Accommodates angular, parallel and axial misalignments.



Exposed bolt design also available.



Flex-Rigid Gear Coupling
Flexible and rigid hub assembly. Accommodates angular and axial misalignment only.

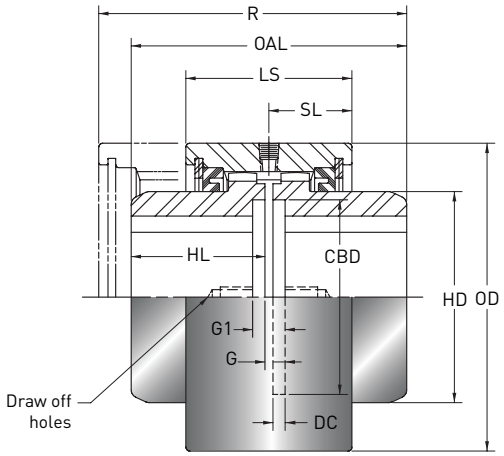
Service Factors for Gear Couplings

Nature of Load on Unit	Uniform	Light Shock	Medium Shock	Heavy Shock
Service Factor, S	1.0	1.25	1.5	2.0

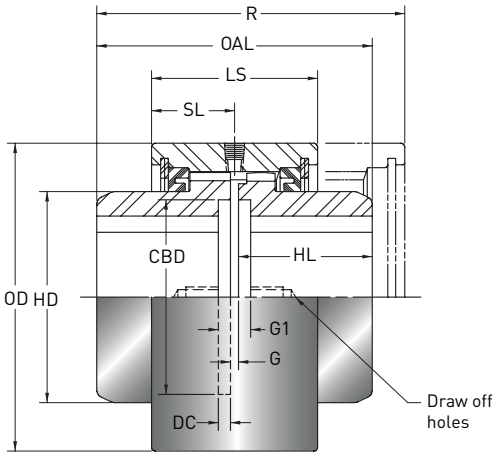
Note

1. All dimensions in millimetres.
2. These couplings are designed for grease lubrication. A list of suggested lubricants and quantities is detailed in the installation manual supplied with each full coupling.
3. Where a coupling is exposed to sustained temperatures above 100°C (212°F) a coupling with high temperature seals must be used, consult Power Jacks Ltd.

Steel Gear Couplings - Continuous Sleeve



Full-Flex Gear Coupling



Flex-Rigid Gear Coupling

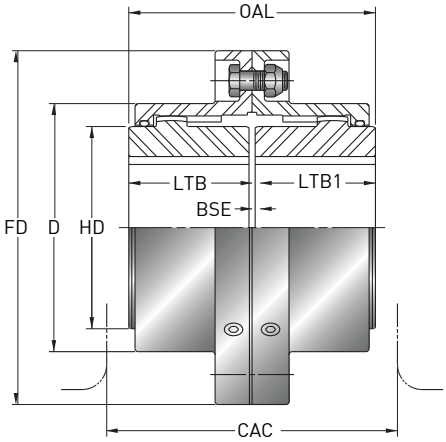
Coupling Size and Type		Full-Flex	CFF022	CFF038	CFF050	CFF065	CFF075	CFF090	CFF100	CFF115
		Flex-Rigid	CFR022	CFR038	CFR050	CFR065	CFR075	CFR090	CFR100	CFR115
Rated Torque (Nm)			285	854	2278	3417	5695	9967	14238	20787
Rated Power (kW/100 rpm)			3	8.9	23.8	35.8	59.6	104.4	149	217.7
Maximum Speed Unbalanced * (rpm)			6000	5000	4200	3750	3000	2800	2400	2200
Full Flex	Maximum Misalignment	Parallel	0.13	0.18	0.18	0.25	0.30	0.30	0.18	0.18
		Angular	1°	1°	1°	1°	1°	1°	1°	1°
		Axial (+/-)	0.3	0.3	0.3	0.6	0.6	0.6	0.6	0.6
Flex Rigid	Maximum Misalignment	Parallel	0.5°	0.5°	0.5°	0.5°	0.5°	0.5°	0.5°	0.5°
		Angular	0.3	0.3	0.3	0.6	0.6	0.6	0.6	0.6
Inertia		(kg m^2)	0.002	0.004	0.010	0.022	0.053	0.112	0.225	0.376
Weight (Rough Bore)		(kg)	2.3	3.6	5.9	9.1	15	29	41	57
Maximum	Bore		31	42	56	70	84	97	111	130
	Keyway	(b x h)	8 x7	12 x 8	16 x 10	20 x 12	22 x 14	28 x 16	28 x 16	32 x 18
Rough Bore			11	15	18	22	30	32	44	60
DD			84	95	121	140	168	191	222	241
HD			51	60	83	100	121	137	159	184
HL			38	46	52	57	67	108	111	127
G			3	3	3	6	6	6	6	6
G1			10	13	13	19	19	19	19	19
OAL			80	95	108	121	140	222	229	260
R			95	117	124	145	175	235	241	264
LS			51	64	65	78	95	102	118	124
DC			3	5	5	6	6	6	6	6
CBD			49	57	76	95	121	140	165	184
SL			25	32	33	39	48	51	59	62

Note *Balanced speed approximately 3 times higher. Draw off holes are optional, consult Power Jacks.
All dimensions in millimetres.

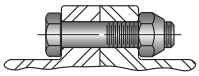
Note

1. Dimension 'R 'and 'CAC' are the clearance required to align the coupling when installing.

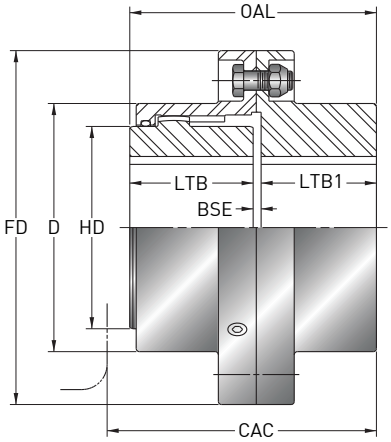
Steel Gear Couplings - Flanged Sleeve



Full-Flex Gear Coupling



Exposed bolt design also available.



Flex-Rigid Gear Coupling

Coupling Size and Type			Full-Flex	FFF022	FFF038	FFF050	FFF065	FFF075	FFF090	FFF100
			Full-Rigid	FFR022	FFR038	FFR050	FFR065	FFR075	FFR090	FFR100
Rated Torque (Nm)				859	2136	3560	6407	10679	17086	24917
Rated Power (kW/100 rpm)				8.9	22.3	37.3	67.1	111.9	179	261
Maximum Speed Unbalanced * (rpm)				6000	5500	5000	4400	4000	3500	3000
Full Flex	Maximum Misalignment		Parallel	1.4	1.5	2.2	2.7	2.9	3.3	3.8
			Angular	3°	3°	3°	3°	3°	3°	3°
			Axial (per hub)	1.5	1.5	1.5	2.2	2.2	2.2	3.3
Full Rigid	Maximum Misalignment		Angular	1.5°	1.5°	1.5°	1.5°	1.5°	1.5°	1.5°
			Axial (per hub)	1.5	1.5	1.5	2.2	2.2	2.2	3.3
Inertia (kg m^2)			Full Flex	0.006	0.019	0.044	0.100	0.192	0.435	0.80
			Flex Rigid	0.006	0.020	0.044	0.106	0.203	0.446	0.831
Weight (Rough Bore) (kg)			Full Flex	4	9	15	25	36	59	86
			Flex Rigid	4	8	15	25	39	61	89
Maximum (Flexible Ends)	Bore			42	56	73	88	107	124	147
	Keyway	(b x h)		12 x 8	16 x 10	20 x 12	25 x 14	28 x 16	32 x 18	36 x 20
Maximum (Rigid Ends)	Bore			56	76	95	114	134	150	176
	Keyway	(b x h)		16 x 10	20 x 12	25 x 14	32 x 18	36 x 20	36 x 20	45 x 25
Rough Bore			FFF	11	18	24	22	37	46	62
			FFR	Solid with Centre						
OAL				89	102	127	159	187	219	248
FD				116	152	178	213	240	279	318
D				78	101	125	150	176	201	235
HD				59	76	102	118	143	165	191
LBT				43	49	62	77	91	106	121
LTB 1				40	47	58	74	87	101	113
BSE			FFF	3	3	3	5	5	6	6
			FFR	4	4	4	5	5	6	8
OAL			FFF	89	102	127	159	187	219	248
			FFR	87	100	124	156	183	213	241
CAC			FFF	106	121	152	181	207	238	260
			FFR	95	109	137	167	192	222	248
Flange Thickness per Hub				14	19	19	22.5	22.5	29	29

Note *Balanced speed approximately 3 times higher. Draw off holes are optional, consult Power Jacks.
All dimensions in millimetres.

Solid Drive Shafts

There are three standard drive shaft sizes offered by Power Jacks with ends machined to suit actuator system couplings however drive shafts can be supplied to customer sizes with specific end designs

Standard Drive Shafts	Rated Torque (Nm)	Rated Angle of Twist per Metre (Degrees)
20mm Diameter	85	4
30mm Diameter	285	2.6
40mm Diameter	675	2

Note

1. For other drive shaft types and sizes consult Power Jacks Ltd.
2. For detailed analysis consult Power Jacks Ltd.
3. Dimensions subject to change without notice.

Select Drive Shaft Diameter

Select a standard drive shaft from the drive shaft table and check its torque rating and angle of twist rating against the application requirements.

If Transmitted Torque (Nm) < Maximum Drive Shaft Torque (Nm)
&
If Acceptable Angle of Twist (Deg.) for shaft length < Rated Angle of Twist for Drive Shaft (Deg.)
Then drive shaft diameter selected is acceptable.

Shaft Check Drive Shaft Critical Speed

For the unsupported shaft length calculate the drive shaft critical speed for the support conditions required.
If Shaft Speed (rpm) < Drive Shaft Critical Speed (rpm) then drive shaft selection and configuration is acceptable.

Plummer Block Selection

If the drive shaft selected is not suitable due to the critical speed reduce the unsupported drive shaft length using plummer blocks. e.g. one plummer block at each end of the drive shaft and one in the middle, reducing the unsupported length to half the total drive shaft length.
Select a plummer block from the table relating to the appropriate shaft diameter size.
Re-calculate the critical speed for the new unsupported length and check for acceptability.
If space constraints restrict the number of plummer blocks and the drive shaft fails on the critical speed try increasing the shaft diameter to the next size up or consult Power Jacks for detailed analysis.

Note

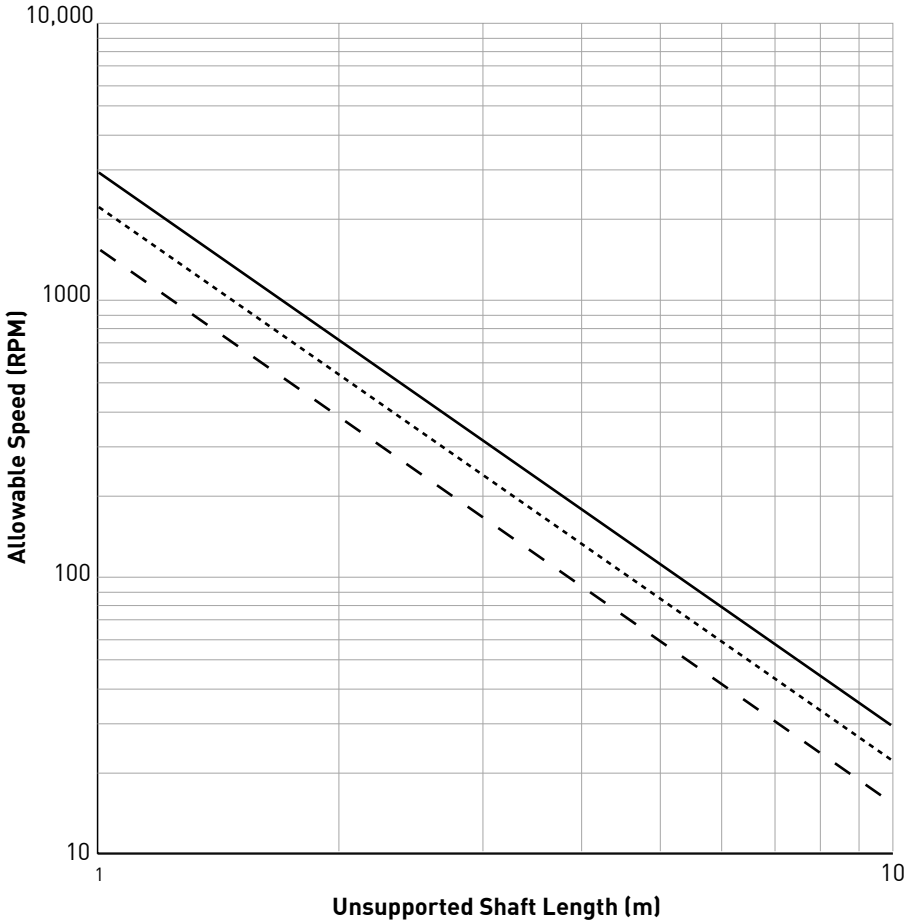
1. For other shaft and plummer block sizes and styles consult Power Jacks Ltd.
2. For detailed shaft analysis and selection consult Power Jacks Ltd.

Solid Drive Shafts

Drive Shaft Critical Speed Factors, F_{dcs}

$$\text{Allowable Drive Shaft Speed (rpm)} = \frac{\text{Critical Speed (rpm) for}}{\text{Unsupported Length "L" (from chart below)}} \times F_{dcs}$$

Drive Shaft Critical Speed Graph
(Shaft Whirling)

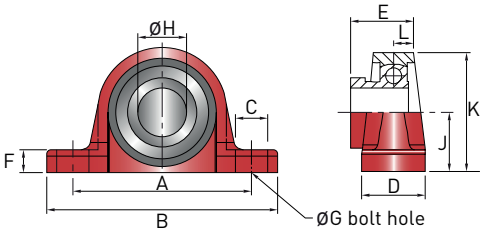


Based on simply supported both ends and 70% of the critical speed.
(The factor of safety allows for couplings and slight misalignment)

20mm Diameter 30 mm Diameter 40 mm Diameter

Plummer Blocks

One Piece Housing Plummer Block



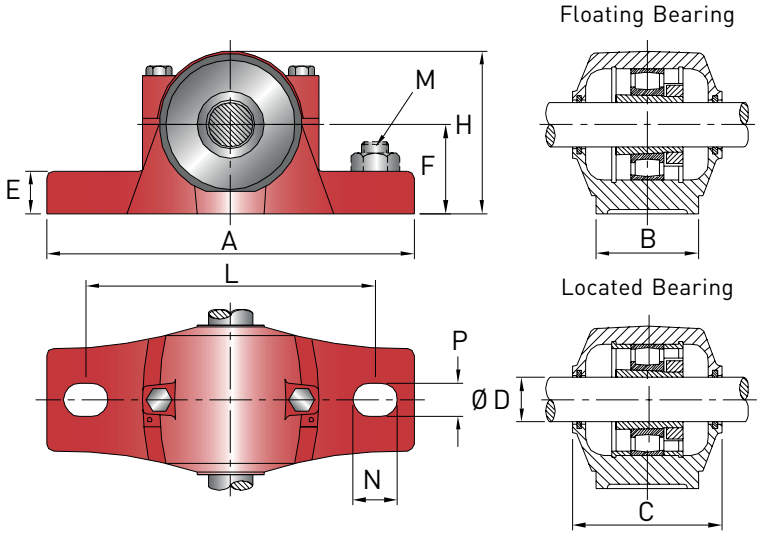
Model	A	B	C	D	E	F	G	H	J	K	L	Weight (kg)
PB1-20	96	127	20.5	32	34	14	10	20	33.33	65	10.5	0.6
PB1-30	121	152	23.5	40	39.2	17	12	30	42.9	82.5	12.5	1.1
PB1-40	136	175	24.5	48	47.7	19	12	40	49.2	99	15	1.9
PB1-50	159	203	26	54	49.7	22	16	50	57.2	115	17	2.8
PB1-60	186	240	29.5	60	60.5	26.5	16	60	69.9	138	21	4.5

Note

1. All dimensions in mm.
2. Bore diameter tolerances: (H6+H7)/2.
3. Material: Cast Iron housing with eccentric locking ring.
4. Dimensions are subject to change without notice.
5. For other styles and sizes of Plummer Blocks consult Power Jacks Ltd.

Split Housing Plummer Block

Plummer blocks are to DIN736 with anti-friction bearings with tapered bores and adapter sleeve. The housings are made of cast iron and are sealed with felt strips on both sides. The housings are designed to allow floating or located bearings (bearing position set with one or two locating rings). It is recommended when arranging drive systems only one plummer block with located bearing is used in one drive line, to avoid distortion of the drive.

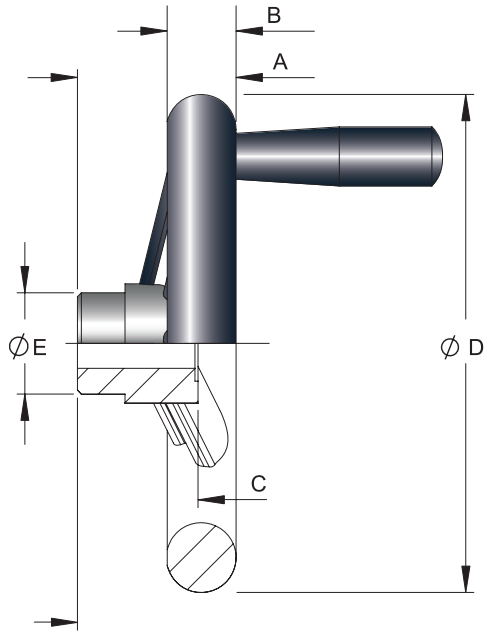


Model	ØD	A	B	C	E	F	H	L	M	N	P	Weight (kg)
PB-20	20	165	46	67	19	40	72	130	M12	20	15	1.4
PB-30	30	185	52	80	22	50	92	150	M12	20	15	2
PB-40	40	205	60	82	25	60	109	170	M12	20	15	2.9

Note

1. All dimensions in mm.
2. For other styles and sizes of Plummer Blocks consult Power Jacks Ltd.
3. Dimensions are subject to change without notice.

Hand Wheels



Model	A	B	C	D	E	H7 Bore
HW 005	40	14	36	98	24	Ø10
HW 010	50	22	38	157	32	Ø14
HW 025	56	24	43	198	40	Ø16
HW 050	56	24	43	198	40	Ø19
HW 100	66	30	44	247	49	Ø25
HW 200	78	32	56	288	58	Ø28
HW 300	108	40	77	375	58	Ø35
HW 500	108	40	77	375	58	Ø40

Notes:

1. Hand wheels HW010, HW025, HW050, HW100, HW200 are suitable for fitment to POWERAM actuator worm shafts with the corresponding bore size.
2. Material: Polished aluminium casting and rotating handle
3. Bored and keyed to BS4235 Part 1
4. All dimensions in millimetres unless otherwise stated
5. Other types of hand wheels are available on request. Consult Power Jacks.

RLS-51 Geared Cam Limit Switches

Rotary CAM Limit Switches allow a set of limit switches to be fitted to POWERAM linear actuators by mounting them directly to the actuators worm shaft or in-directly via connecting shafts or gearboxes linking to the actuators worm shaft. These limit switches are fully adjustable for position over the entire length of the actuators stroke. RLS-51 limit switch features include:-

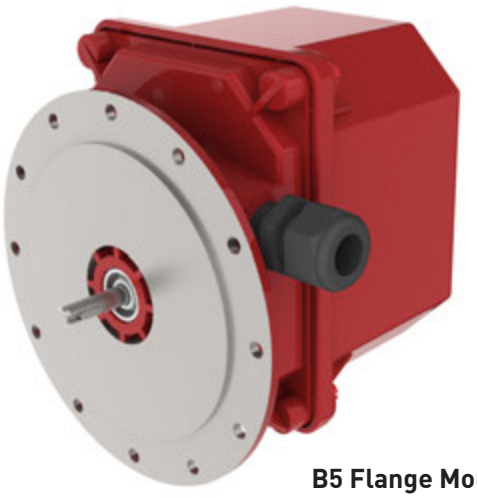
- Usable revolutions from 4.1 to 16,000
- 2 to 8 position limit switch units
- Enclosure IP66 as standard
- Mounting options for B5 Flange, B14 Face and B3 Foot mounted
- Available in three voltages 250V AC, 24V DC & 80V DC
- Modular design to allow a variety of options
- Operating Temperature: -40°C to +80°C

Illustrated Examples

All units shown are of the 2 limit switch type.

B14 Face Mount

B3 Foot Mount



B5 Flange Mount

RLS-51 Features

The RLS-51 geared cam limit switches are universal mechanical switching devices that have been designed for use in conjunction with cam discs based on a specific angle of rotation for indication of a large number of shaft revolutions. These cam discs serve to operate mechanical contacts.

Design features include:-

Low friction planetary gearing with irreversible, self-locking worm adjustment of the cam discs.

Fixed cam adjustment in the housing. The adjusting worms of the cam discs are arranged so that they can be accessed from the same direction as the contact connections for optimal accessibility in confined conditions. Adjustment is possible during operation. The simplicity and accuracy of the cam adjustment is unsurpassed.

Block adjustment of all switching contacts jointly is made possible by a single adjusting worm (black) without the switching points of the individual switching contacts being altered with respect to each other.

Large cam disc diameter for good adjustability and high switching point repeat accuracy.

Reinforced polycarbonate housing as standard with IP66 protection and a wide operating temperature range.

Modular design allows adaptation to suit individual requirements via intermediate pieces.

Options

- Position indicating plate for block adjustment.
- Potentiometer feedback drives (2 available) to suit single and multi-turn potentiometers
- Pulse transmitter with 50 pulses per revolution.
- Anti-condensation heater to prevent condensation and excessively low temperatures in the switches.
- Motor driven contact block adjuster.
- Mounting for encoders (incremental or absolute).
- Extended drive shaft for feedback devices.
- Aluminium housing for harsh environments and the fitment of large and heavy encoders, IP65 enclosure.
- Cam discs with a 40° cam angle can be provided at no extra cost. Other angles can be manufactured at extra cost on request.
- Stage technology tested unit can be provided to V8G 70 with test certificates.

RLS-51 Performance

Gear size	Usable rev's. selected	Usable rev's. theoretical with 15° cam disc's	Gear Ratio	Input/output stage	No of interim stages	1 rev. of the drive shaft - corresp. to an ang. motion of cam disc = °	Change - over contact reset rev. at driving shaft	max drive speed (rpm)	min drive shaft speed (only for change - over contact)
1	4.1	4.16	4.285	-	1 x 4.285	84	0.00714	1000	0.67
	6.5	6.88	7.083	1.653	1 x 4.285	50.8	0.0118	1200	1.1
	11	11.23	11.56	2.698	1 x 4.285	31.14	0.0193	1500	1.8
2	17.5	17.84	18.361	-	2 x 4.285	19.6	0.0306	1800	2.9
	29.0	29.5	30.35	1.653	2 x 4.285	11.86	0.0505	1800	4.7
	48	48.13	49.538	2.698	2 x 4.285	7.27	0.0825	1800	7.7
3	75	76.45	78.678	-	3 x 4.285	4.57	0.131	1800	12.2
	125	126.39	130.054	1.653	3 x 4.285	2.77	0.2166	1800	20.2
	205	206.26	212.272	2.698	3 x 4.285	1.69	0.3536	1800	33
4	323	327.6	337.135	-	4 x 4.285	1.06	0.5616	1800	52
	540	541.5	557.284	1.653	4 x 4.285	0.65	0.9284	18 00	87
	880	883.8	909.59	2.698	4 x 4.285	0.4	1.515	1800	141
5	1384	1403.7	1444.62	-	5 x 4.285	0.25	2.406	1800	224
	2288	2320.2	2387.96	1.653	5 x 4.285	0.15	3.978	1800	371
	3735	3787.1	3897.58	2.698	5 x 4.285	0.09	6.493	1800	606
6	5900	6014.77	6190.204	-	6 x 4.285	0.06	10.313	1800	*
	9800	9942.2	10232.407	1.653	6 x 4.285	0.04	17.047	1800	*
	16000	16227.6	16701.17	2.698	6 x 4.285	0.02	27.824	1800	*

*__Caution!__ Due to the slow actuation speed of the switching contacts caused by the high gear reductions, the change-over behaviour of the contacts is affected negatively. From gear size 6 it is therefore recommended to use only the normally - closed contacts of the switches. Before using analog feedback systems (eg. potentiometer) please consult our technical department.

Note: Maximum permissible relative humidity 60%

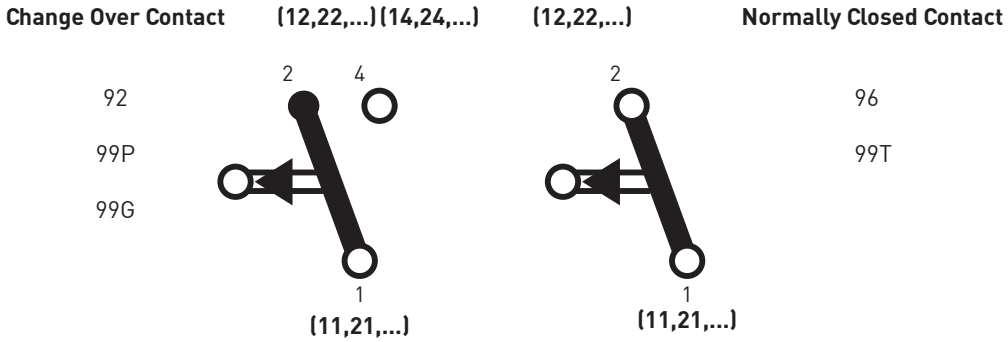
RLS-51 Switching Contacts

The contacts can either be connected through screw terminals for a cable cross section of 0.75mm² to 1.5mm² or through flat plugs 6.3 x 0.8mm or through a printed card with cage tension spring terminals for a cross section of 0.14 to 2.5mm². For contacts with flat - plug connection, insulated flat - plug receptacles must be used at voltages above 25V AC and 60V DC.

Contact Designation	Contact Type	Contact Material	Switch Actuation	Type of Connection	Electrical Data				Mechanical life in millions of switching operations
					AC - 15		DC - 13		
					A	V	A	V	
99[1]	Change-Over	Silver	Snap Action	Screw Terminal	1.5	230	0.5	60	10
99P[1]	Change-Over	Silver	Snap Action	Flat plug 6.3					
99G[1] [3]	Change-Over	Gold	Snap Action	Screw Terminal					
92[2]	Change-Over	Silver	Snap Action	Screw Terminal			-	-	
97[2] [3]	Change-Over	Gold	Snap Action	Screw Terminal					
96[2]	Normally Closed Contact	Silver	Push Action	Screw Terminal					
99T[4]							0.5	60	

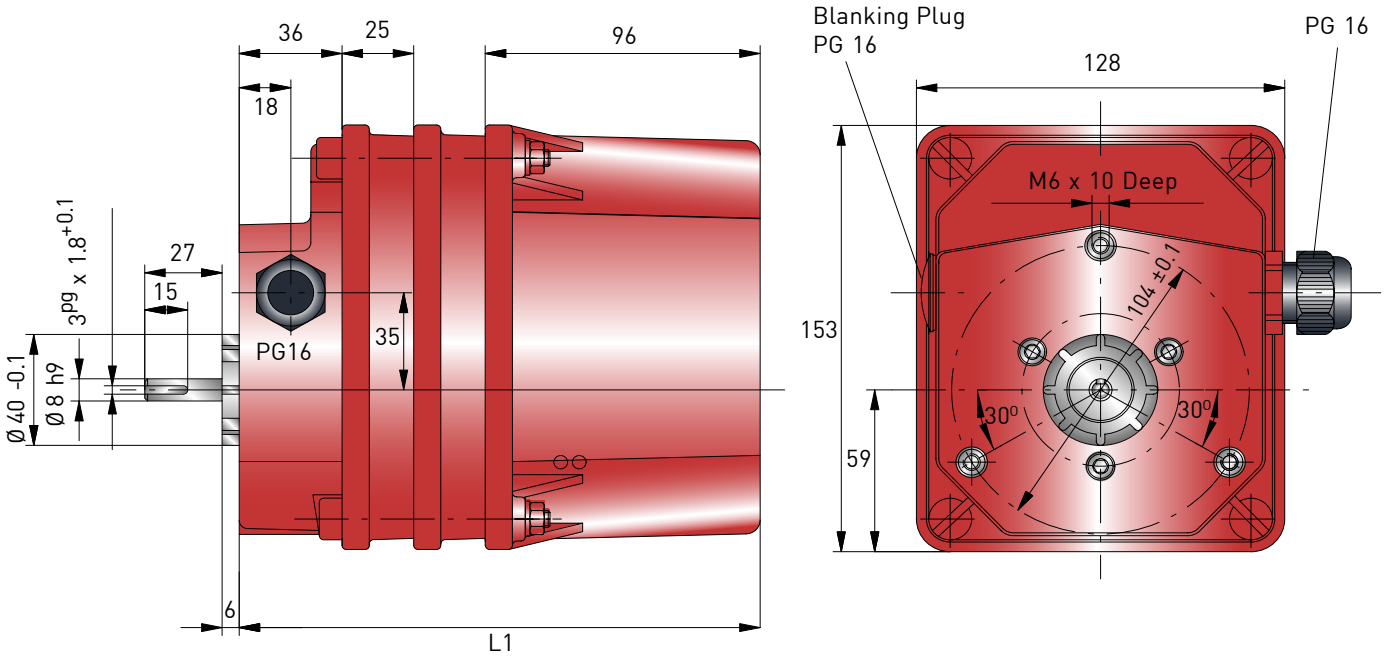
Note

1. Thermal permanent current Ith = 10A; Reference insulation voltage Ui = 250V at pollution degree 3
2. Thermal permanent current Ith = 6A; Reference insulation voltage Ui = 250V at pollution degree 3
3. Contacts 99G and 97 for PLC applications (gold contacts)
4. For screw terminal admissible cable cross section AWG 22 - 16
5. Positive opening to EN60947T5 - 1 & IEC947 - 5 - 1

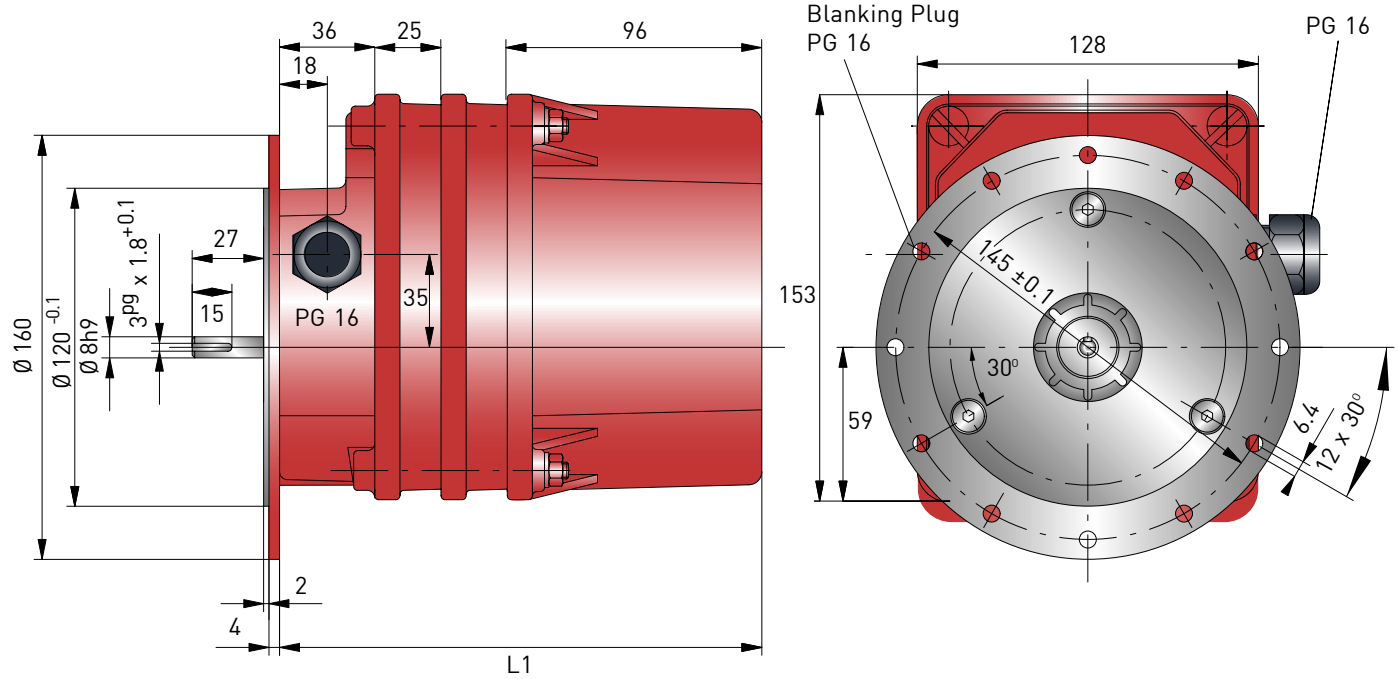


RLS-51 Dimensions

B14, Face Mount

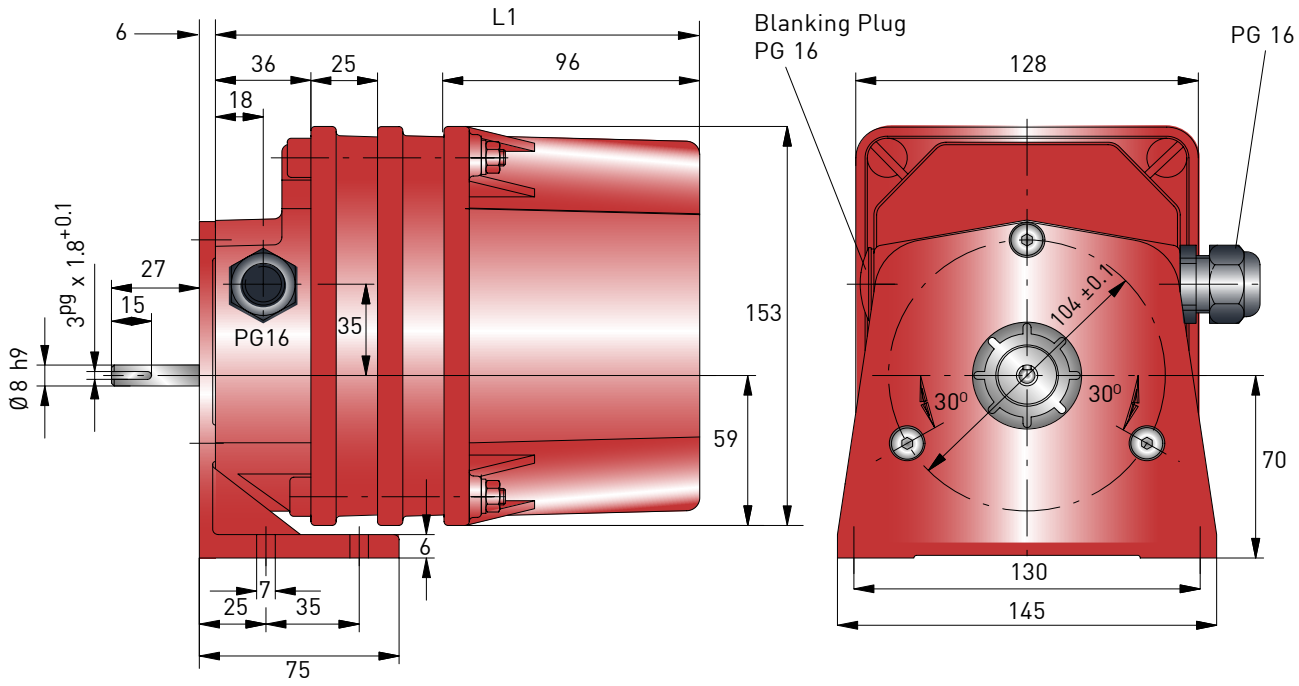


B5, Flange Mount



RLS-51 Dimensions

B3, Foot Mount



Features:
Housing made of glass fibre reinforced polycarbonate with IP66 degree of protection Modular design enables optimal space utilisation. Overall length can be extended as required with 25mm wide intermediate pieces.

Gear Size	Usable Revs	2 Contacts		4 Contacts		6 Contacts		8 Contacts	
		L1 (mm)	No of intermediate pieces	L1 (mm)	No of intermediate pieces	L1 (mm)	No of intermediate pieces	L1 (mm)	No of intermediate pieces
1	4.1 6.5 11	132	0	132	0	157	1	157	1
2	17.5 29 48	132	0	132	0	157	1	182	2
3	75 125 205	132	0	132	0	157	1	182	2
4	323 540 880	132	0	157	1	182	2	207	2
5	1384 2288 3735	132	0	157	1	182	2	207	3
6	5900 9800 16000	157	1	157	1	182	2	207	3

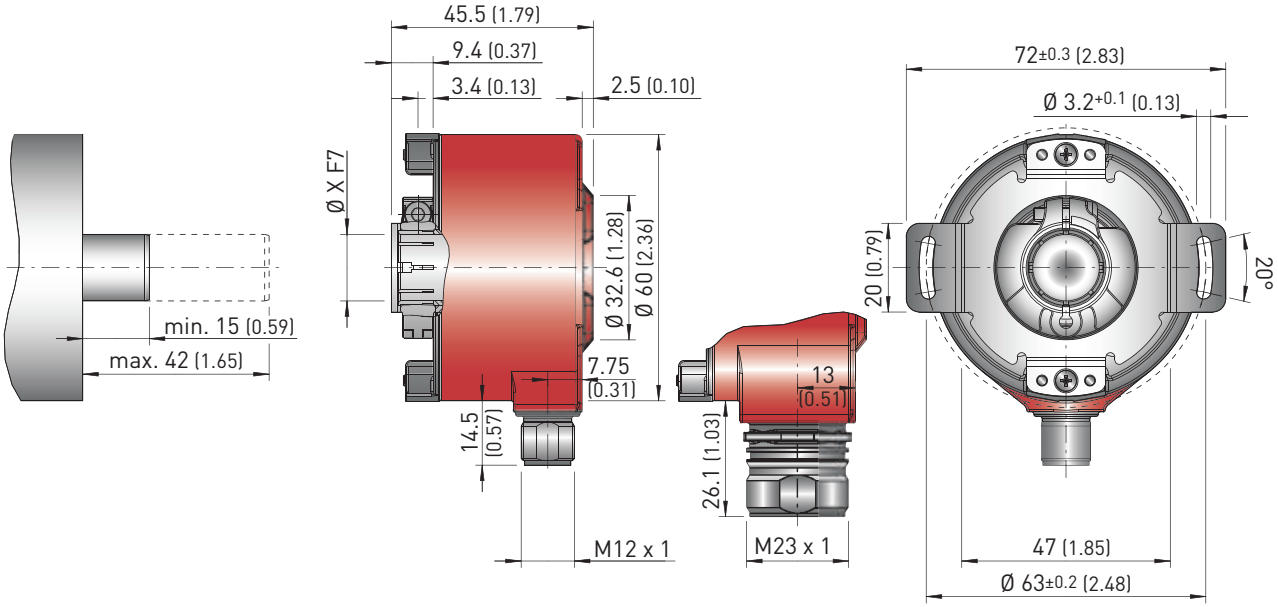
More than 8 contacts on request
Dimensions with more than 8 contacts and with special executions, eg. potentiometer, on request. For any further intermediate piece add 25mm to L1

Incremental Encoders

The DFS60 is a high-resolution incremental encoder in a 60 mm design. The encoder is ideally suited for industrial applications including those with harsh environments due to its high enclosure rating, the large temperature range and robust ball bearing mounts.

- Compact Ø 60 mm design
- High-resolution incremental encoder up to 16 bit
- Programming of output voltage level by customer, zero pulse position, zero pulse width and number of lines from 1 to 65536
- Programming using programming tool or machine controller (RS485)
- Plug-in cable output, radial or axial.
- M23 and M12 connector designs, available axial and radial.
- Designs with face mount or servo flange, blind or through hollow shaft.
- Hollow shaft designs up to Ø15 mm.
- Insulated design available for through hollow shaft.
- Remote zero setting.
- Electrical Interface options include:
  - 4.5 to 5.5 V, TTL/RS422
  - 10 to 32 V, TTL/RS422
  - 10 to 32 V, HTL/push pull
  - 4.5 to 5.5 V, TTL/RS422, with 0-set function on the M23 connector
  - 10 to 32 V, TTL/RS422, with 0-set function on the M23 connector
  - 10 to 32 V, HTL/push pull, with 0-set function on the M23 connector
  - 4.5 to 32 V, TTL/HTL programmable
  - 4.5 to 32 V, TTL/HTL programmable with 0-set function on the M23 connector
- Ambient Temperature Range:
  - Working Temperature – Standard: 0 to +85°C, Optional -30°C to +100°C
  - Working Temperature – Standard: -40°C to +100°C
- Enclosure Rating: IP65 on Shaft and IP67 on housing & connector.
- Standard Shaft Sizes:
  - Blind hollow shaft sizes = 6, 8, 10, 12, 14, 15mm
  - Through hollow shaft sizes = 6, 8, 10, 12, 14, 15mm
  - Solid shaft with flange mount = Ø10 mm
  - Solid shaft with servo flange mount = Ø6 mm

Dimensions – Hollow Blind Shaft

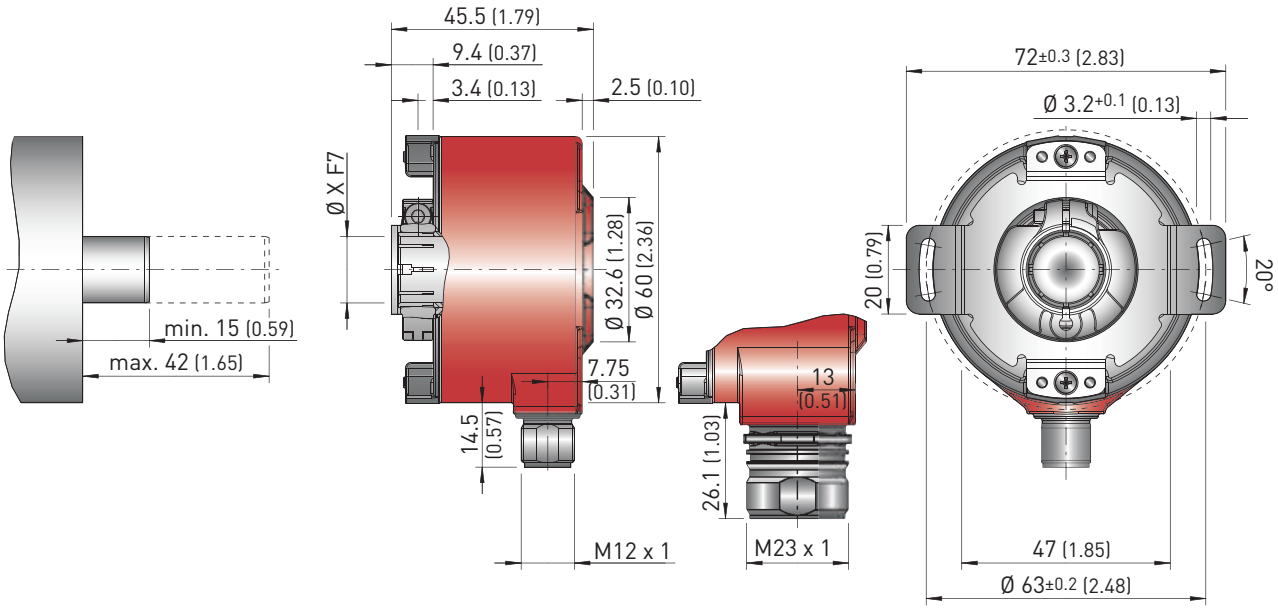


Absolute Encoders

The AFM60 is a high-resolution multi-turn absolute encoder in a 60mm housing design shared with its incremental counterpart. Ideally suited for industrial applications including those with harsh environments due to its high IP enclosure rating, large temperature range and robust ball bearing mounts. The absolute encoders' use the SSI interface as standard but can also be supplied with combined incremental or Sin/Cos interfaces.

- Compact Ø 60 mm design
- High-resolution absolute encoder up to 30 bit
- Up to 262144 steps per revolution
- Up to 4096 revolutions
- SSI / Gray code.
- Programmable resolution and offset (depends on type).
- Programming using programming tool or machine controller.
- Matched programming cable adapter for M12 & M23 connector available.
- Plug-in cable output, radial or axial.
- M23 and M12 connector designs, available axial and radial.
- Designs with face mount or servo flange, blind or through hollow shaft.
- Hollow shaft designs up to Ø15 mm.
- Operating Voltage 4.5 to 32 V
- Ambient Temperature Range:
  - Working Temperature – Standard: 0 to +85°C, Optional -30°C to +100°C
  - Working Temperature – Standard: -40°C to +100°C
- Enclosure Rating: IP65 on Shaft and IP67 on housing & connector.
- Standard Shaft Sizes:
  - Blind hollow shaft sizes = 8, 10, 12, 14, 15mm
  - Through hollow shaft sizes = 8, 10, 12, 14, 15mm
  - Solid shaft with flange mount = Ø10 mm
  - Solid shaft with servo flange mount = Ø6 mm

Dimensions – Hollow Blind Shaft

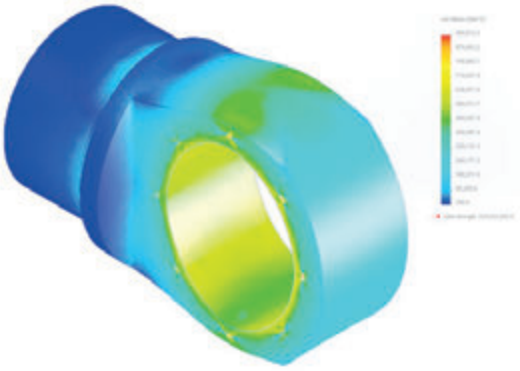


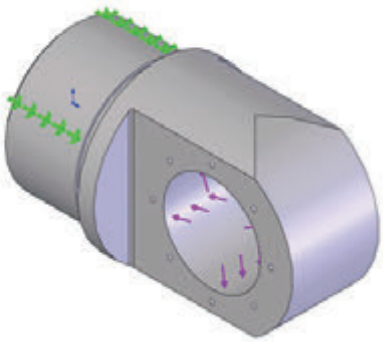
POWERAM

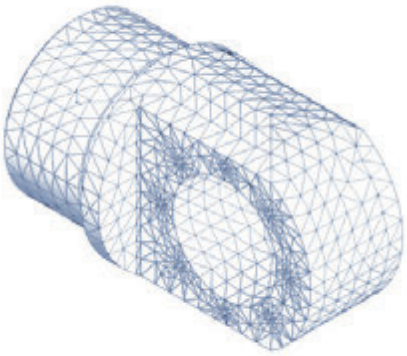
8

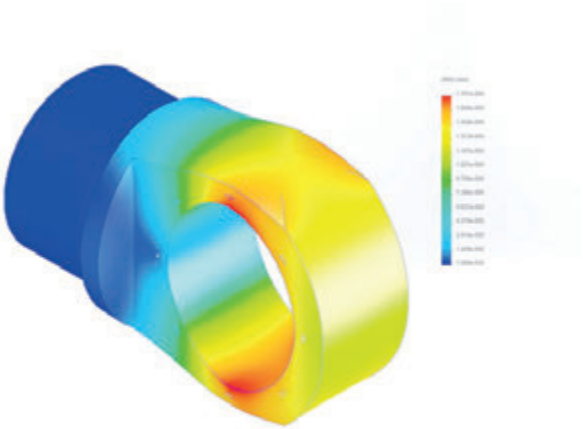
ENGINEERING GUIDE

USEFUL PERFORMANCE & OPERATIONAL DETAIL FOR POWERAM LINEAR ACTUATORS





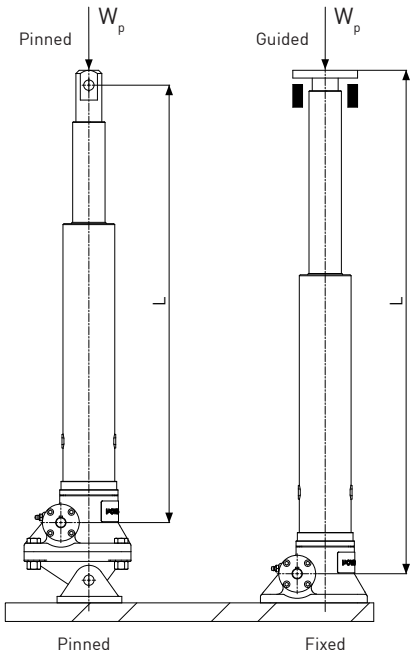


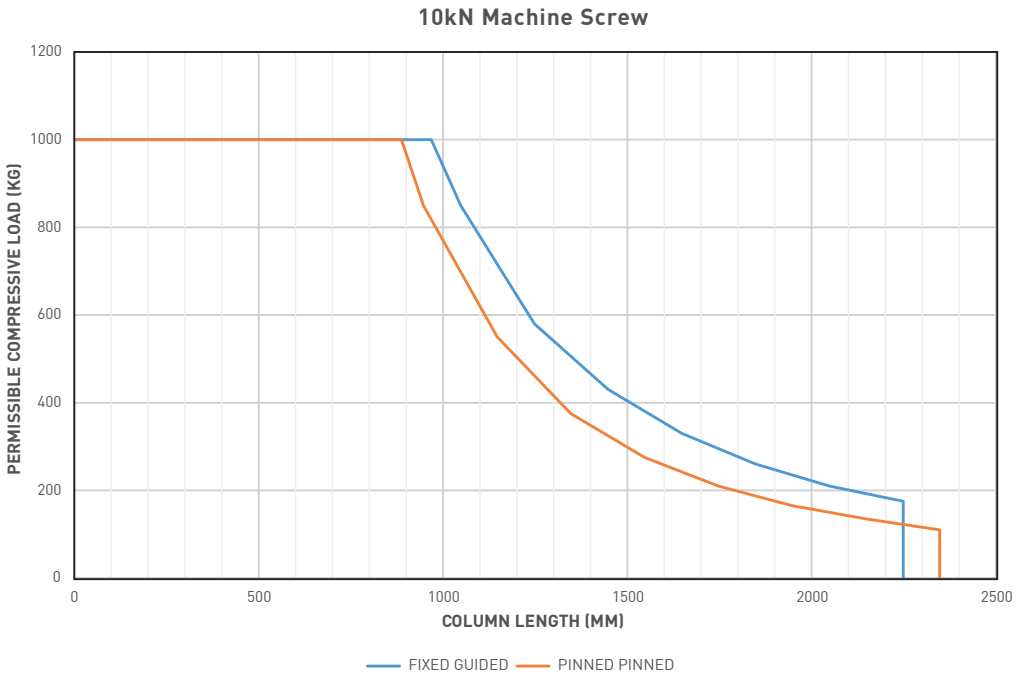


Important Notes

1. All charts are rated for industrial cargo with a safety factor of 3.5.
2. For human cargo a safety factor of 5 is recommended. To alter the permissible compressive load (WP) for human cargo multiply the load selected from the chart by 0.7 e.g. $W_{PHC} = W_P * 0.7$.

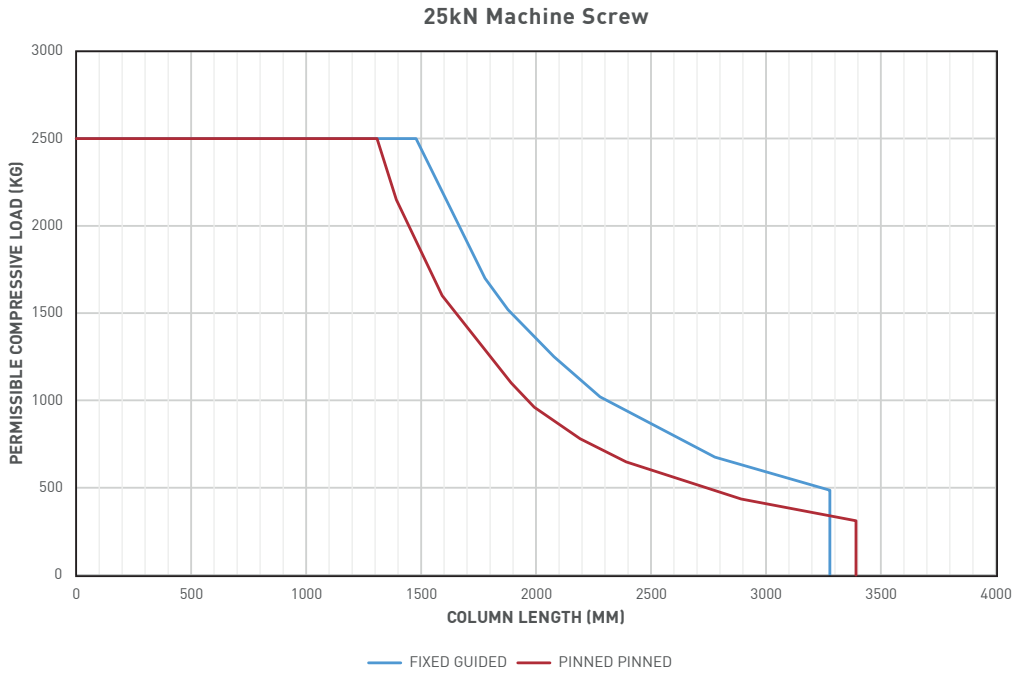
Column Length Correction Factors, F_{cb}

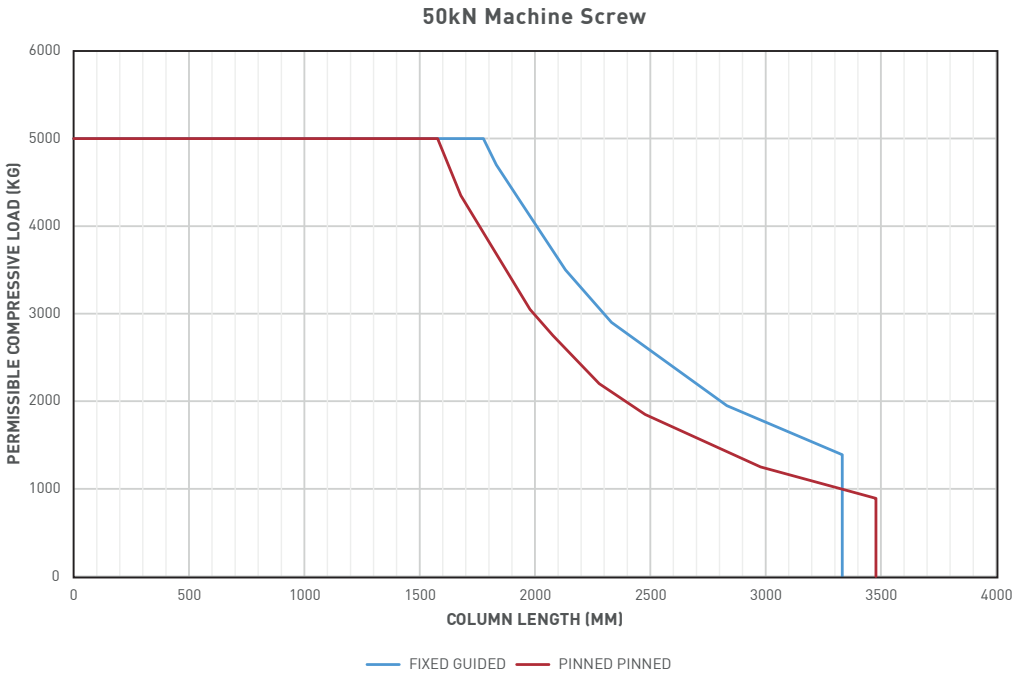




Note

Column end constraints based on A.I.S.C. recommended values
All actuator column strength charts show a Euler buckling curve and three scales for the appropriator end condition for the application under analysis.





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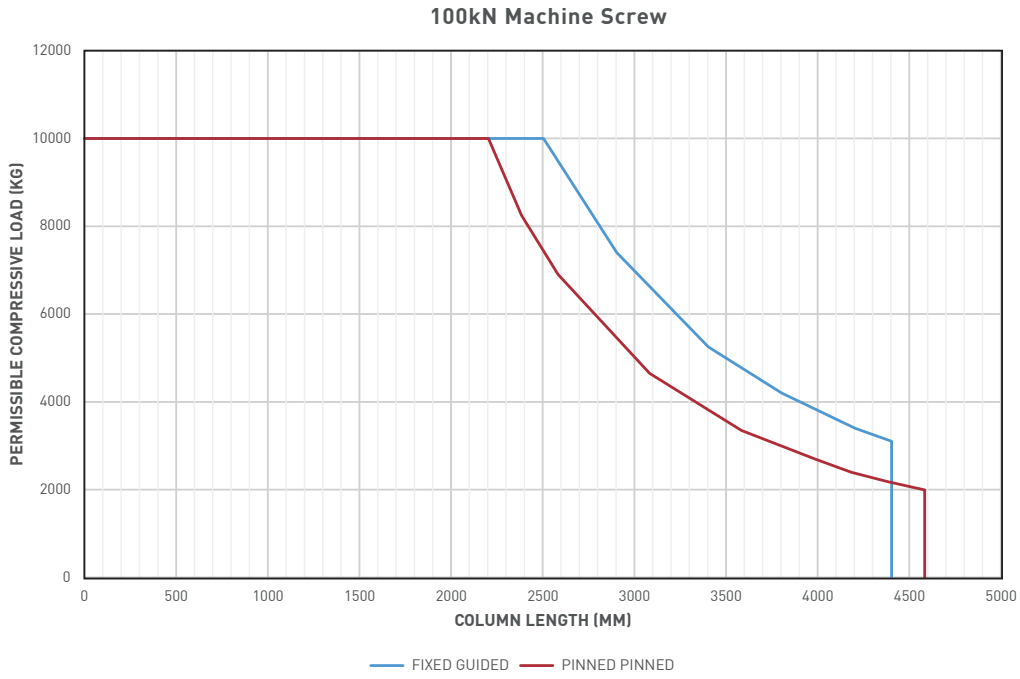

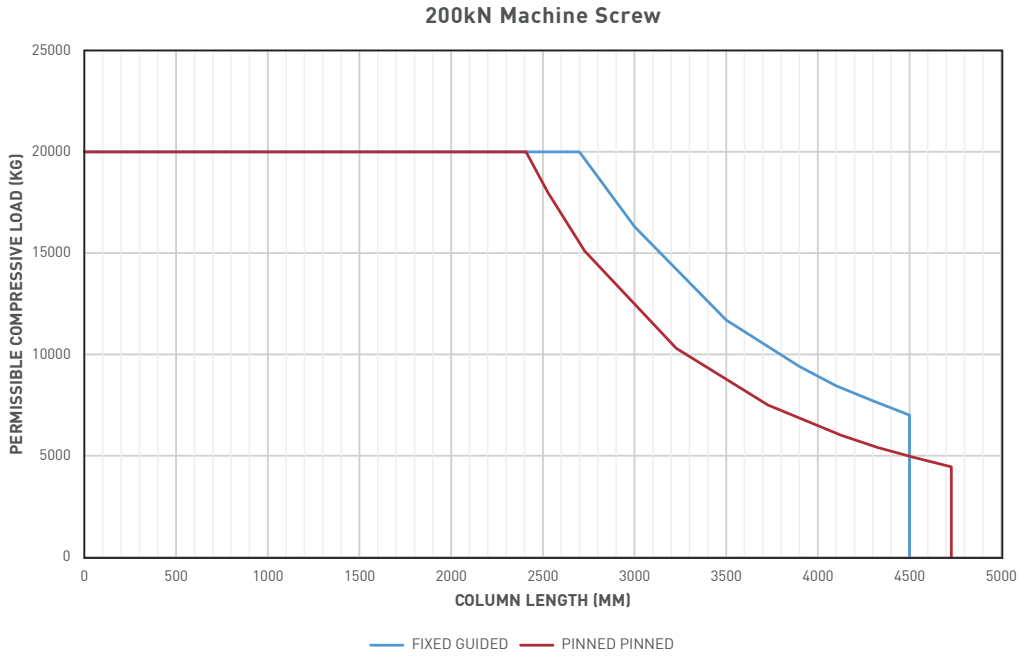

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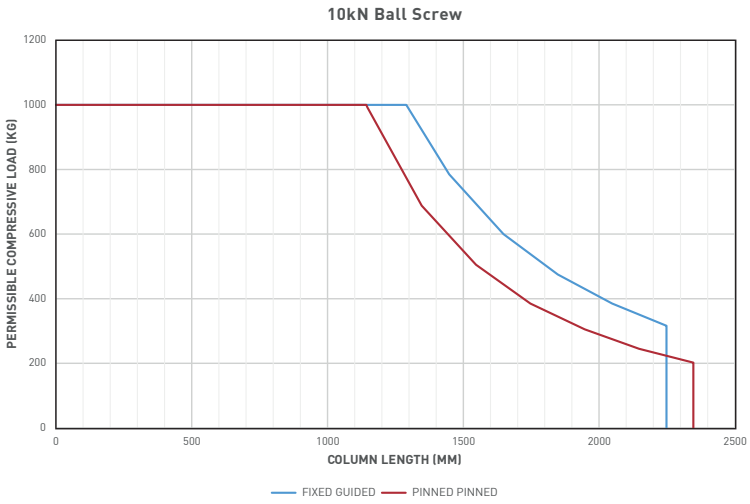

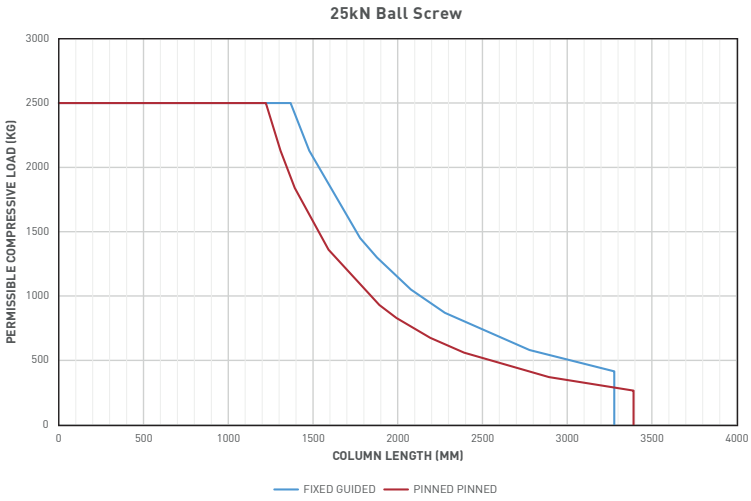

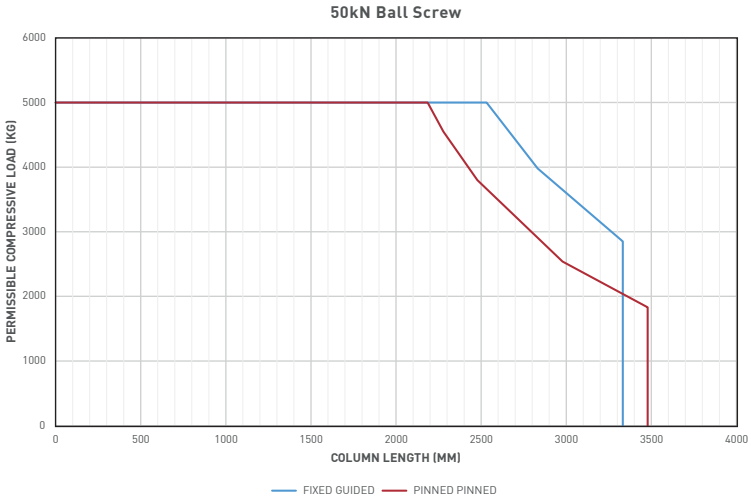

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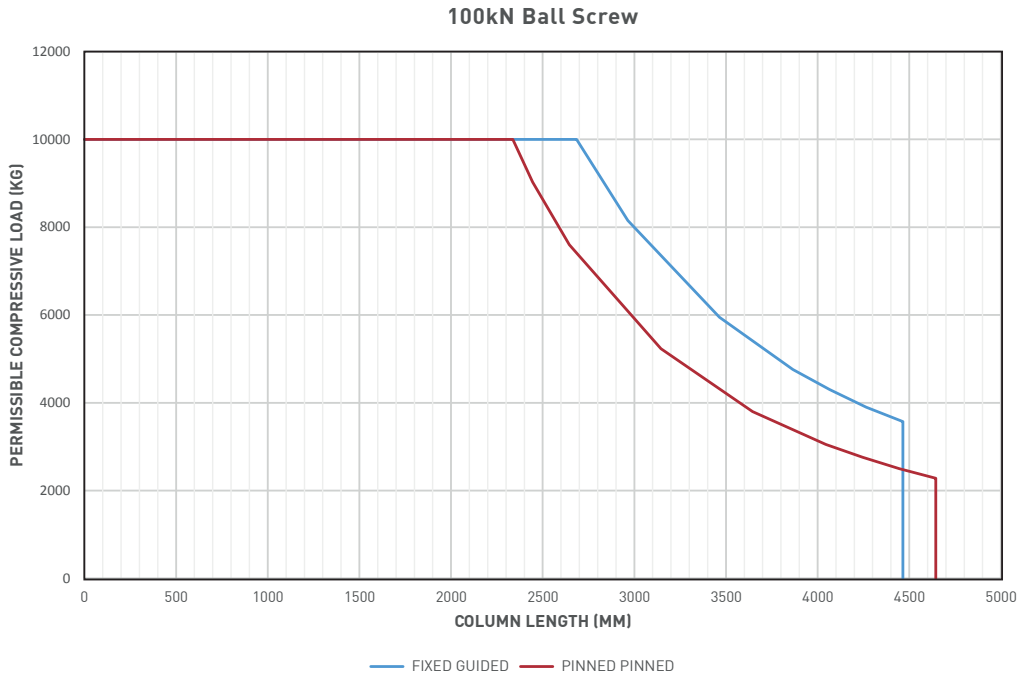
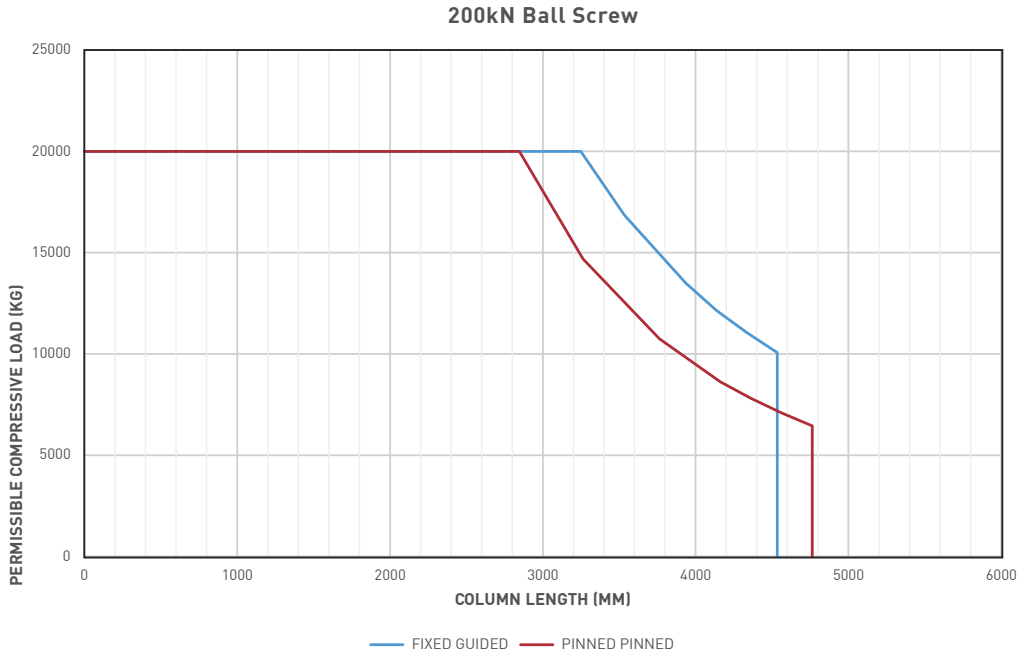




Note

Column end constraints based on A.I.S.C. recommended values
All actuator column strength charts show a Euler buckling curve and
three scales for the appropriator end condition for the application under analysis.

Ball Screw Life

Theoretical service life can be expressed in either L_{10} 10^6 revolutions or $L_h 10^3$ hours or L_d kilometres. As the life of a ball screw is determined by metal fatigue it is not possible to accurately predict life. However, it is practical to suppose that 90% of a sufficiently large number of equally sized ball screws running under equal working conditions will reach L_{10} or L_h without evidence of material fatigue. The L_{10} ball screw life is rated using the Dynamic Capacity, which is the maximum constant axial load that can be applied in running conditions for a life of 1.10^6 revolutions of the ball screw. This can be expressed in linear travel (L_d).

$$\mathbf{L}_d = L_{10} * P$$

Where **L**10= Service Life (millions of revolutions)

$\mathbf{L}_d$= Service Life (km)

P = Pitch of Ball Screw (mm)

Linear Travel L_d in km		Working Load (kN)										
Capacity (kN)	Pitch (mm)	5	10	25	30	50	75	100	150	200	250	300
10	5	20.5	2.5	-	-	-	-	-	-	-	-	-
25	5	381	48	3	-	-	-	-	-	-	-	-
25	10	1 775	222	14	-	-	-	-	-	-	-	-
50	10	11 978	1 497	96	55	12	-	-	-	-	-	-
50	20	17 039	2 130	136	79	17	-	-	-	-	-	-
100	10	32 287	4 036	258	149	32	10	4	-	-	-	-
100	20	38 503	4 813	308	178	39	11	5	-	-	-	-
200	10	162 327	20 291	1 299	752	162	48	20	6	3	-	-
200	20	320 060	40 008	2 560	1 482	320	95	40	12	5	-	-

Use the following formulae to calculate the service life in terms of hours running:

$$L_h = \frac{L_{10} * Gr}{60 * n_m}$$

Where $\mathbf{L}_h$= Service Life (hours)

$\mathbf{L}_{10}$= Service Life (revolutions)

$\mathbf{n}_m$= Mean Actuator Input Speed (rpm)

Gr = Gear Ratio

Note: 1. Ball screw life based on dynamic load calculated according to DIN69051 Part 4.

The ram restraining torque (key torque) is caused by the tendency of the lifting screw to rotate. It is a function of the screw lead, screw efficiency and the load. It is not affected by the linear actuators gear ratio.

Note
The values below are given at rated load. For a smaller load reduce the ram restraining torque in direct proportion.

Machine Screw Actuators

Capacity (kN)	Screw Diam (mm)	Lead (mm)	Key Torque (Nm)
5	16	0.003	8
5	16	0.006	11
10	20	0.005	22
10	20	0.010	30
25	30	0.006	76
25	30	0.012	102
50	40	0.009	210
50	40	0.018	290
100	55	0.012	575
100	55	0.024	780
200	65	0.012	1300
200	65	0.024	1705
300	95	0.016	2805
300	95	0.032	3610
500	120	0.016	5645
500	120	0.032	6975
1000	160	0.020	14890
1000	160	0.040	18220
1500	180	0.020	24610
2000	220	0.024	39995

Ball Screw Actuators

Capacity (kN)	Screw Diam (mm)	Lead (mm)	Key Torque (Nm)
10	20	0.005	9
10	-	-	-
25	25	0.005	23
25	25	0.01	43
50	40	0.01	88
50	40	0.02	167
100	50	0.01	181
100	50	0.02	340
200	63	0.01	370
200	63	0.02	690
300	80	0.02	1030
500	On Request		

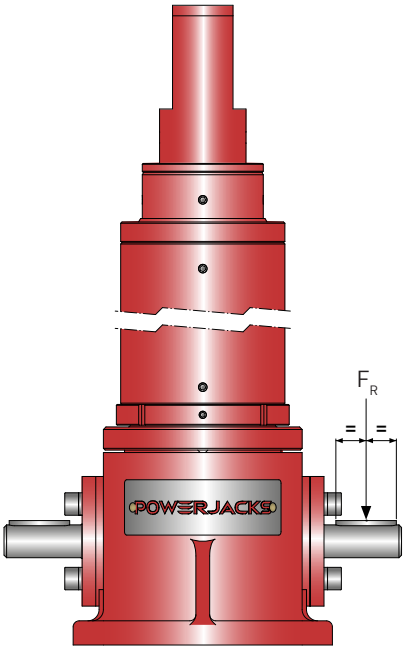
For applications where a POWERAM actuator is belt/chain driven, a calculation must be made to determine the radial force (F_R) and compared to the allowable radial load exerted on the worm shaft, that must not exceed those tabulated below. The values below are maximum values for the actuators at rated load regardless of worm speed or load direction and the radial load applied midway along the key of the worm shaft. For all applications the sprocket, gear etc. Should be positioned as close as possible to the actuator gearbox housing in order to reduce bearing loads and shaft stresses and to prolong life.

$$\textbf{Radial Force, } F_R = \frac{2000 \times T \times K}{D}$$

Where
- $\mathbf{F_R}$ = Radial Load (N)
- $\mathbf{T}$ = Torque applied to the actuators input shaft (Nm)
- $\mathbf{K}$ = Factor from table below
- $\mathbf{D}$ = PCD in mm of gear, sprocket

Transmission Element	Factor K
Chain sprocket	1
Gears (spur or helical pinion)	1.25
V-Belt pulley	1.5
Flatbelt pulley	2.0

POWERAM Actuator					
Capacity (kN)	10	25	50	100	200
Radial Load (N)	325	380	740	1000	1600



Machine Screw Actuators

Component	Normal Backlash
Lifting Screw and Nut	0.12mm → 0.2mm (0.005" → 0.008")
Load Bearings	0.00mm → 0.03mm (0.000" → 0.001")
Total	0.12mm → 0.23mm (0.005" → 0.009")

Note

1. The lifting screw backlash will increase during operation due to wear of threads in the nut
2. Axial play can be reduced by altering the load bearings preload to eliminate bearing play.
3. For exact backlash ratings for an individual unit consult Power Jacks.

Ball Screw Actuators

Component	Normal Backlash
Ball Track and Nut	0.05mm → 0.15mm (0.002" → 0.006")
Load Bearings	0.00mm → 0.03mm (0.000" → 0.003")
Total	0.05mm → 0.18mm (0.0002" → 0.007")

Note

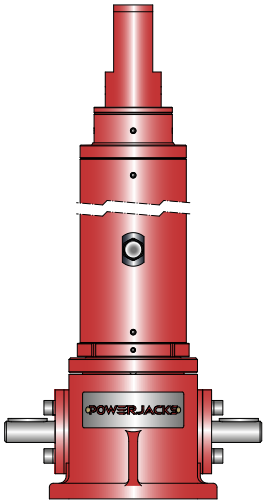
1. For exact backlash ratings for an individual unit consult Power Jacks.
2. Ball nuts can be supplied with zero backlash or with adjustable backlash via a special twin nut assembly (twin nut assembly for rotating screw units only). Consult Power Jacks for details.
3. Altering the load bearings preload to eliminate bearing play can reduce axial play.

Pitch Deviation of Lifting Screw

Lifting Screw	Pitch Deviation
Machine Screw	0.05mm → 0.25mm per 300mm
Ball Screw	0.025mm → 0.050mm per 300mm (DIN Class 5.7)

Note

1. Pitch deviation is cumulative and **NOT** detrimental to the operation of the actuator.
2. The lifting screws are manufactured from material with a straightness tolerance of 0.2 mm per metre
3. Pitch deviation is related to the cutting machines tolerance and the material used.



How a Linear Actuator Works

The rotation of the worm shaft causes the worm gear to rotate. The lead screw (machine screw or ball screw) is fixed to the worm gear and they rotate at the same speed. The lifting nut moves along the lead screw. The lifting nut is connected to the moving inner tube (translating tube) of the actuators ram. As the worm gear turns, the friction forces on the screw thread act to turn the nut & inner tube assembly also. The greater the load on the actuator unit, the greater the tendency of the nut & inner tube assembly to turn. If the nut & inner tube assembly turns with the screw, it will not raise the load. Therefore the nut & inner tube assembly needs to be fixed to a structure to prevent rotation. This can be done using the end fitting on the end of the inner tube (threaded end, clevis end, fork end, rod end or top plate). The ram restraining torque required for the structure, also known as the "lead screw key torque" can be found on the product performance tables in this catalogue or requested from Power Jacks.

Input Torque Required for a Actuator

The input torque for a single actuator depends on the load, the worm gear ratio, type of screw (machine screw or ball screw) and the pitch of the lead screw. Torque values are listed in the individual product specification charts based on capacity loads. For loads from 25% to 100% of actuator model capacity, torque requirements are approximately proportional to the load.

Maximum Input Power & Speed for a Actuator

The input power to the actuators should not exceed the power rating shown in the specifications table. Maximum input speed in rpm (revolutions per minute) to a actuators worm shaft should not exceed 1800 rpm for POWERAM actuators.

Efficiency of a Actuator

Actuator model efficiencies are listed in the individual product specification charts.

Expected Life of a Actuator

The life expectancy of a actuators lead screw, bearings, nut and worm gear set varies considerably due to the extent of lubrication, abrasive or chemical action, overloading, excessive heat, improper maintenance, etc. For detailed life calculations, consult Power Jacks.

Standard Actuators - How To Prevent The Load from Rotating

For multiple actuator systems, fix the ram end fittings (i.e. top plate, clevis end, fork end, threaded end, rod end) to the common member being lifted by all the units. For single actuator applications, bolt the ram end fitting to the load and ensure the load is guided to prevent rotation.

A guided load is always recommended to ensure that the actuator does not receive any side load and so guidance can be scaled suitably for the load without altering the actuator design unnecessarily. Note that an external guidance system can provide a higher ram restraining "key" torque than compared to an anti-rotation mechanism inside an actuator (optional feature, consult Power Jacks for details).

Axial Backlash in an Actuator

Backlash in Standard Machine Screw Actuators

Machine screw actuators have backlash due not only to normal manufacturing tolerances, but to the fact that there must be some clearances to prevent binding and galling when the actuator is under load. Usually, the axial backlash is not a problem unless the load on the actuator unit changes between compression and tension. If a problem does exist, a ball screw actuator either in standard design or a special low or zero backlash design should be considered.

Column Strength of the Actuator

Column strength of a ram and its internal lifting screw is determined by the relationship between the ram and screw length and their diameters. For column strength charts consult product literature or Power Jacks.

Side Loads on a Actuator

Linear actuators are designed primarily to move and position loads and any side loads (loads not acting axially on actuator ram) should be avoided. The units will withstand some side loads, depending on the diameter of the ram and lifting screw and the extended length of the ram. Where side loads are present, the loads should be guided and the guides, rather than the actuators, should take the side loads - particularly when long raises are involved. Even a small side load can exert great force on the housings and bearings and increase the operating torque and reduce the life expectancy.

Allowable Duty Cycle of Actuator

Because of the efficiency of conventional worm gear actuators, the duty cycle is intermittent at rated load. At reduced loading, the duty cycle may be increased. Ball screw actuators are more efficient than machine screw actuators and so can provide a higher duty cycle. In addition Power Jacks have the ROLARAM linear actuator range for high duty cycle linear actuators. For detailed analysis consult Power Jacks Ltd.

Self-Locking of Actuators

Actuators with 24:1 or higher gear ratios are considered self-locking in most cases. Consult Power Jacks for a recommendation specific to your application.

All actuators with multi-start lifting screws are considered not to be self-locking.

All ball screw actuators are considered not to be self-locking.

Actuators considered not self-locking will require a brake or other holding device.

Shock Loads on a Actuator

Shock loads should be eliminated or reduced to a minimum, if they cannot be avoided, the actuator model selected should be rated at twice the required static load.

For severe shock load applications, the load bearings can be replaced with heat-treated steel thrust rings which is an option available from Power Jacks. Note this will increase the input torque by approximately 100%.

Maximum Operating Temperatures For POWERAM Actuators

Normal operation at ambient temperatures of up to 90ºC. Operations above 90ºC will require special lubricants. For temperatures above 90ºC, the life of even special lubricants is limited. Therefore consult Power Jacks on your application. For temperatures above 90ºC, advise Power Jacks of full particulars of the duration of such temperatures. Power Jacks suggest that a lubricant manufacturer be consulted for type of grease and lubrication schedule. As a general rule, the actuator unit should be shielded to keep ambient temperatures to 90ºC or less.

Minimum Temperature For POWERAM Actuators

With the standard lubricant and materials of construction, the actuators are suitable for use at sustained temperatures of -20ºC. Below -20ºC, low temperature lubricant should be used and no shock loads are present. Power Jacks application engineers must be consulted in these instances for a recommendation. Actuators with standard material construction and lubrication may be safely stored at temperatures as low as -55ºC.

Thermal / Heat Build-Up in an Actuator as it is operated

The duty cycle, the length of the screw, the magnitude of the load, and the efficiency of the actuator all have a direct influence on the amount of heat generated within the actuator. Long lifts can cause serious overheating. Note that Power Jacks have ROLARAM linear actuator designs with higher thermal capacities than conventional worm gear actuators (consult Power Jacks for more details).

Linear Actuators to Pivot a Load

A POWERAM Linear Actuator can be built to pivot a load by two methods:

1. Double Clevis Actuator
   The actuator is fitted with a clevis at both ends (commonly referred to as a double clevis actuator). Other pivoting end types of fork end or rod end can also be used at either or both ends of the actuator.

2. Clevis - Trunnion Mounting
   The actuator is fitted with the pivot end fitting (e.g. Clevis, Fork or Rod End) on the ram and a trunnion mount adapter is bolted to the actuators base plate.

The design of the structure in which these types of actuators are to be used must be constructed so that the actuator can pivot at both ends. Use only direct compression or tension loads, thereby eliminating side load conditions.

Corrosion Resistant Properties

Actuators can be supplied with alternative materials and/or paint specifications for high corrosive areas. These options include stainless steel, chrome plating, electro-nickel plating, epoxy paint, etc. Check the unit specification is suitable before installation.

Using Actuators within a Rigid Structure or Press

Power Jacks recommend that the actuator selected has a greater capacity than the rated capacity of the press or of the load capacity of the structure. We also recommend that a torque clutch or similar device be used to prevent overloading of the actuator unit. Unless these precautions are taken, it is possible to overload the actuator without realising it.

Actuator Drift after Drive Motor is Switched Off

The actuator will drift after the motor drive is switched off unless a brake of sufficient capacity is used to prevent it. The amount of drift will depend upon the load on the actuator and the inertia of the rotor in the motor.

For machine screw actuators with no load, the amount of drift will depend upon the size and speed of the motor. For example, a 1500 RPM input directly connected to a actuator without a load will give on average 35mm to 60mm of drift; a 1000 RPM input will give about 1/2 as much drift. Note that the drift varies as the square of the velocity (RPM). The drift of the actuators ram can be controlled by using a magnetic brake on the motor. Variations of drift will also be seen if the motor drives the actuator via a reduction gearbox.

Actuator Operation where Vibration is Present

Actuators will operate in areas with vibration, however the vibration may cause the ram to "creep" or "inch" under load. For applications involving slight vibration, select the higher of the worm gear ratios. If considerable vibration is present, use a motor equipped with a magnetic brake, which will prevent the actuator from creep and/or back-driving.

Use of Actuators Fitted With Emergency Stop Disc

To prevent over travel of the ram a mechanical stop is fitted to the end of the lead screw. These standard stop discs are suitable only for engagement at low speed and load, typically hand wound during commissioning of a machine / system. The standard stop should not be used as a full power stop.

Use of Actuators Fitted With Emergency Stop Nut

For motor driven units, it is possible for the full capacity of the actuator or even a greater force (depending on the power of the motor) to be applied against the stop. These stops are called "full power stop nuts". They must only be used as an emergency device and if such a condition occurs, an assessment made to discover why it happened in order to carry out preventative action. If the full power stop nut is used at full load in an emergency it may have the lifting nut driven into it jamming so tightly that it must be disassembled in order to free it.

It is recommended that external stops are fitted where possible, however they must only be used as a last resort (Note - limit switches are one possible solution to constrain linear actuator movement safely - consult Power Jacks for system advice). Under ideal conditions where a slip clutch or torque limiting device is used, a stop pin or stop nut may be used - but Power Jacks should be consulted.

Linear Actuator System Arrangements

One of the advantages of Power Jacks POWERAM linear actuators is that they can be linked together mechanically, to lift, lower, move or position in unison. Typical mechanical system arrangements link 2, 4, 6 or 8 linear actuators together and are driven by one motor. As an alternative, linear actuators can be individually driven by electric motors and with suitable feedback devices, such as encoders, be synchronised electronically by a control system.

Connecting POWERAM Actuators in Series

The number of POWERAM linear actuators that can be connected in series is limited by input torque requirements on the first worm shaft in the line. For the POWERAM Actuators the torque on the worm shaft of the first actuator should not exceed 300% of its rated full load torque (this does not include the 200kN actuators which are rated at 150%).

Efficiency of a Multiple POWERAM Actuator System

In addition to individual device efficiencies, the efficiency of the linear actuator system arrangement must be taken into consideration. The arrangement efficiency allows for misalignment due to slight deformation of the structure under load, for the losses in couplings, bearings, and for a normal amount of misalignment in positioning the actuators and gearboxes. For efficiency values consult Power Jacks product literature or engineers.

Number of POWERAM Linear Actuators in System	2	3	4	6-8
Actuator System Efficiency	0.95	0.90	0.85	0.80

Actuators Fitted with 3rd Party Accessories

If your actuator is fitted with a device not manufactured by Power Jacks then please consult the provided manual for this device.

Installation and Maintenance Tips

The following installation and maintenance tips are for the POWERAM machine screw and ball screw linear actuators, including stainless steel versions.

General care should be taken to ensure that equipment is sufficient to handle the load.

1. The structure on which the linear actuator is mounted should have ample strength to carry the maximum load, and be rigid enough to prevent undue deflection or distortion of the linear actuator supporting members.
2. It is essential that the linear actuator be carefully aligned during installation so that the actuators' ram is vertically true (or true to operating axis) and the connecting shafts are exactly in line with the worm shafts. After the actuator, shafting, and gear boxes are coupled together, it should be possible to turn the main drive shaft by hand. If there are no signs of binding or misalignment, the actuator system is then ready for normal operation.
3. The linear actuator should have a greater stroke than is needed in the actuator installation. If it is necessary to operate the actuator at the extreme limits of travel, it should be done with caution.

CAUTION: Do not allow ram travel below catalogue closed height (fully retracted height) or above fully extended travel of the actuator or serious damage to internal mechanism may result. Refer to table specifications for closed height and end of stroke lengths of respective units.

4. The input power should not exceed the power rating shown in the specification table. Maximum RPM should not exceed 1800.
5. The ram should not be permitted to accumulate dust, grit, debris or other substances on the inner tube (translating tube) surface. If possible, the linear actuators ram should be returned to the closed position (retracted) when not in use.
6. The ball screws in the ball screw actuators should be checked periodically for excessive backlash and spalling of raceways. A periodic check of backlash of the machine screw thread is recommended to check wear of the lifting nut internal threads on the machine screw actuator models. Backlash in excess of 50% of the thread thickness indicates the need to replace the lifting nut.
7. Unless otherwise specified, linear actuators are shipped packed with grease which should be sufficient for one month of normal operation. For normal operation, the actuators should be lubricated about once a month, using one of the following extreme pressure greases or their equivalent:

Shell	Gadus S2V220AC2 (Alvania WR2)
BP	Energrease LC2
Castrol	Spheerol EPL2
Mobil	Mobilux EP2

For severe conditions, the linear actuators should be lubricated more frequently, using one of the above greases (daily to weekly depending on conditions). If duty is heavy, an automatic lubrication system is strongly recommended. If ambient temperatures exceed 90°C (194°F) consult Power Jacks.

8. On ball screw actuator applications, periodically lubricate the ball screw and nut with a good grade 10W30 oil for most applications. An instrument grade oil should be used in dirty and heavy duty environments, and bearing grease for environments at extremely high temperatures. Extreme temperature and other environmental conditions should be referred to Power Jacks for recommended lubricating procedures.

CAUTION: Where there is high levels of airborne dirt, dust, debris, chemicals, etc., bellows boots should be used to further protect the moving surface of the rams' inner tube. Inspect frequently at regular intervals to be certain no damage has occurred and the seal at the end of the ram is intact.

9. Due to the high efficiency of the ball screw actuator design, a brake must be used either in conjunction with a motor, as part of a brake motor or an individual brake to maintain position when stationary.

Useful Formulae for Linear Actuator Calculations

Lifting Screw Lead

Lifting Screw lead (mm) = Screw Pitch (mm) *Number of Starts on Lifting Screw

Calculation of the Linear Speed

When the worm shaft speed is known, the linear speed can be determined with this formula:

$$\text{Linear Speed (mm/min)} = \frac{\text{RPM of Worm Shaft x Lifting Screw Lead (mm)}}{\text{Gear Ratio}}$$

or alternatively

$$\text{Linear Speed (mm/min)} = \frac{\text{RPM of Worm Shaft}}{\text{Turns of Worm for 1mm Travel}}$$

Calculation of Linear Actuator Input Torque

$$\text{Input Torque (Nm)} = \frac{\text{Load (kN) x Lifting Screw Lead (mm)}}{2 \times \pi \times \text{Efficiency x Gear Ratio}}$$

or alternatively

$$\text{Input Torque (Nm)} = \frac{\text{Input Power (kW) x 9550}}{\text{Input Speed (rpm)}}$$

Calculation of Linear Actuator Input Power

$$\text{Input Power (kW)} = \frac{\text{Load (kN) x Lifting Screw Lead (mm) x Input Speed (rpm)}}{60000 \text{ x Efficiency x Gear Ratio}}$$

or alternatively

$$\text{Input Power (kW)} = \frac{\text{Load (kN) x Linear Speed (mm/min)}}{60000 \text{ x Efficiency}}$$

Useful Formulae for Linear Actuator Calculations

Power	**Metric**	**Imperial**
Lifting Motion	$P = \frac{m \times g \times v}{\eta \times 1000}$	$P = \frac{w \times v}{\eta \times 33000}$
Linear Motion	$P = \frac{F_R \times v}{1000}$	$P = \frac{F_R \times v}{33000}$
	$F_R = \mu \times m \times g$	$F_R = \mu \times w$
Rotary Motion	$P = \frac{T \times n}{9550}$	$P = \frac{T \times n}{63000}$
Torque		
	$T = F_R \times r$	$T = T \times r$
Linear Motion	$T = \frac{P \times 9550}{n}$	$T = \frac{P \times 6300}{n}$

Symbol	Quantity	Metric Units	Imperial Units
P	Power	kW	HP
T	Torque	Nm	lbf.in
F_R	Resistance due to Friction	N	lbf
m	Mass	kg	-
W	Weight	-	lb
g	Gravitational Acceleration	9.81 ms^{-2}	32.185 ft^{-2}
v	Velocity	ms^{-1}	ft/min
η	Efficiency	decimals	decimals
μ	Coefficient of Friction	decimals	decimals
n	Rotational Speed	rpm	rpm
r	Radius	m	in

Useful Formulae for Linear Actuator Calculations

Moment of Inertia	**Metric**	**Imperial**
Solid Cylinder	$J = \frac{1}{2} \times m \times r_{od}^2$	$WK^2 = \frac{1}{2} \times W \times r_{od}^2$
Hollow Cylinder	$J = \frac{1}{32} \times \pi \times \rho \times d_{od}^4$	$WK^2 = \frac{\pi}{32} r \times l \times d_{od}^4$
	$J = 0.098 \times \rho \times l \times d_{od}^4$	$WK^2 = 0.1 \times \rho \times l \times d_{od}^4$
Hollow Cylinder	$J = \frac{1}{2} \times m \times (r_{od}^2 - r_{id}^2)$	$WK^2 = \frac{1}{2} \times W \times (r_{od}^2 - r_{id}^2)$
	$J = \frac{1}{32} \times \pi \times \rho \times l \times (d_{od}^4 - d_{id}^4)$	$WK^2 = \frac{\pi}{32} \times \rho \times l \times (d_{od}^4 - d_{id}^4)$
	$J = 0.098 \times \rho \times l \times (d_{od}^4 - d_{id}^4)$	$WK^2 = 0.1 \times \rho \times l \times (d_{od}^4 - d_{id}^4)$

Acceleration or Braking Time

$$T_{acc} = \frac{J \times n}{9.55 \times T_{acc}} \qquad T_{acc} = \frac{WK^2 \times n}{308 \times T_{acc}}$$

Symbol	Quantity	Metric Units	Imperial Units
J	Moment of Inertia (metric)	kgm^2	-
WK^2	Moment of Inertia (imperial)	-	$lb.ft^2$
T_{acc}	Torque due to Acceleration or Braking	Nm	lbf.ft
m	Mass	kg	-
W	Weight	m	lb
g	Outer Radius	m	ft
v	Internal Radius	m	ft
η	Outer Diameter	m	ft
μ	Internal Diameter	m	ft
n	Density	kg/m^3	kg/m^3
r	Time for Acceleration or Braking	s	s
r	Rotational Speed	rpm	rpm

Limitation of Responsibility

The ratings given in this catalogue were compiled using standard engineering procedures. The ratings are designed to guide the customer in the selection of a unit. We do not guarantee the ratings in specific applications. Prototype testing of every application is recommended before production. Our engineering facilities are available for consultation at all times. Please ask us for assistance with linear motion and drive application problems. This catalogue is designed to assist in the selection of a suitable linear motion or power transmission product for economical, long and trouble free service.

Due to Power Jacks policy of continuous improvement designs may be subject to change without notice. Please ask for certified drawings.

Warranty Definitions

When used in these conditions the following words have the meanings set out opposite them below:

Company:	Power Jacks Limited
Contract:	The contract between the Company and the Customer for the supply of the Goods.
Customer:	The party to whom the Goods are to be supplied under the Contract
Goods:	The goods to be provided under the Contract
Writing:	Includes facsimile or electronic transmission and comparable means of communication

Warranty Statement

The Company warrants that any Goods sold by it under Power Jacks standard terms and conditions of sale will be free from defects caused by faulty materials or poor workmanship but gives no warranty and makes no representation whatsoever express or implied as to any other matters including without limitation condition merchantability or fitness for any purpose.

The Company shall incur no liability under this warranty unless:

- The Company is promptly notified in Writing upon discovery of any such defects by the Customer and the Customer forthwith ceases to use the defective Goods unless otherwise authorised by the Company; and
- The defective item is immediately returned to the Company, transportation charges being prepaid by the Customer or the Company is, at its option, given the opportunity to remedy any defect.

The Company's warranty as specified above is limited to a period of 12 months from the date of delivery (ex-works Power Jacks) and its liability shall be limited to replacing, repairing or issuing credit at its option for any Goods returned by the Customer within the aforesaid period.

The Company shall not be liable for consequential loss or damage by reason of any defect in (or failure to comply with any written estimate of performance of) Goods supplied by the Company whether original or substituted.

The Customer will indemnify the Company against all third party claims made in respect of the Goods.

POWERJACKS

PRECISION ACTUATION

Power Jacks specialises in the design and manufacture of precision linear actuation, positioning and lifting equipment.

Our products are supplied globally across many sectors including Industrial Automation, Energy, Transport, Defence and Civil.

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MANAGEMENT SYSTEM CERTIFICATION
DNV·GL
ISO 9001 = ISO 14001
ISO 45001

MADE IN BRITAIN