Veljan's reputation as the designer and manufacturer of fluid power products of utmost reliable quality is an established fact for over 45years now.
With the back-up of up-to-date & state-of-the-art production facilities and a clear-cut focus on design engineering and product development, Veljan effectively meets the demand for a very wide spectrum of applications, such as in :

- MACHINE TOOLS
- MOBILE MACHINERY
- MARINE EQUIPMENT
- STEEL MILL EQUIPMENT
- PACKAGING MACHINERY
- CONSTRUCTION MACHINERY
- MINING EQUIPMENT
- POWER PROJECTS EQUIPMENT
- STABILISERS AND STEERING GEARS
- FORGE AND FOUNDRY EQUIPMENT
- PLASTIC MACHINERY
- AMUSEMENT PARKS, ETC.

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Besides hydraulic and pneumatic cylinders for every conceivable application, Veljan continues to engineer, manufacture and market a wide range of pneumatic products.
To achieve, maintain and provide a "single source system" facility, Veljan's joint venture company manufactures high performance Hydraulic Pumps, Motors, Valves and Systems. This has enabled Veljan products and services to be reckoned as the benchmarks for quality.

While this catalogue is intended as a brief guide to the selection of standard Veljan Hydraulic Cylinders, Veljan also offers customised equipment and the specials needed by its valued and satisfied customers drawn from various sectors of the industry who have been regularly sourcing their requirements of these cylinders and other fluid power products from Veljan.

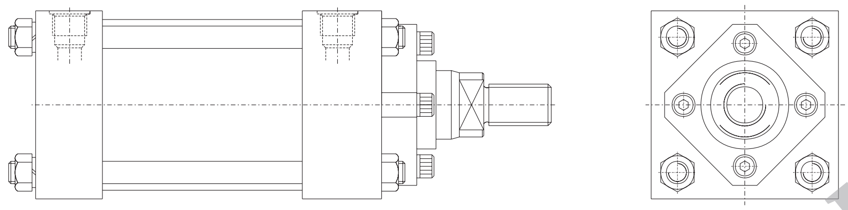
Veljan, with its proven track record, technical expertise, design and engineering capabilities in the realm of high quality products and prompt services is confident of satisfying the exacting demands of all its customers.

VELJAN

Veljan offers various types of Hydraulic Cylinders for different pressure ratings and applications :

Series-HT

Compact tie-rod square type construction Hydraulic Cylinders rated for 160 bar with mounting dimensions conforming to ISO:6020 part 2 for 40 to 200 mm bore and ISO:6020 part 3 for 250 and 320 mm bore sizes.

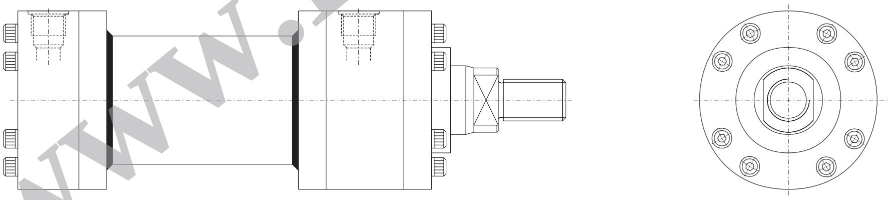


Series-HR

Non-tie-rod welded round type construction of 160 bar medium series Hydraulic Cylinders with mounting dimensions conforming to ISO:6020 - part 1, in bore sizes from 40 to 320 mm.
The above HT and HR series cylinders are also suitable for use at working pressures upto 210 bar depending on the rod-end and mounting considerations.

Series-HH

Heavy duty Hydraulic Cylinders rated for 250 bar pressure with mounting dimensions conforming to ISO:6022, in bore sizes from 50 to 320mm.



Specials

Special Cylinders such as duplex, tandem, telescopic and other custom-designed types are regularly produced for various applications and pressures upto 500 bar and bores upto 800mm dia.
Veljan also manufactures a wide range of pneumatic cylinders rated for pressures upto 17 bar in bore sizes ranging from 8 to 800 mm.

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Veljan offers the following variety of seals to suit different applications :

PISTON SEALS

ELASTOMERIC Piston seals with integral anti-extrusion Rings are fitted as a standard for 160 bar application.Compact seals with bearing rings conforming to ISO:6547 dimensions and leak-tight under normal operating conditions are optional. These are suitable for speeds upto 0.5 m/s and holding loads in position.

LOW FRICTION Piston Seals conforming to ISO:7425-1 grooves employ an elastomer energised PTFE ring and may be used for piston speed upto 5m/s. These are best suited where very low friction and an absence of stick-slip are needed, such as in Servo cylinders. These permit fine control of position, velocity and acceleration. However they are not suitable for load holding applications.

SPRING LOADED PTFE U-CUPS are suitable for low as well as high temperatures. For maximum dynamic sealing and to prevent turning or rolling, these seals are mechnically locked in place and pressed against tubing ID.

CAST IRON PISTON RINGS offer exceptional durability and are recommended for high temperature application. Leakage inherent in this design can result in slip, drift and varying feed rates and hence are not suitable for holding loads in position.

ROD SEALS

POLYURETHANE internally lubricated Rod Seals with hardness of 90^0 Shore A, are compatible with a broad range of temperature and fluids. They have low compression set and excellent abrasion resistance. They are designed to install easily and function well in normal applications and are fitted as standard. Rod seals conforming to ISO 5597 are optional.

LOW FRICTION Rod Seals to suit ISO:7425-2 grooves, employ an elastomer energised PTFE ring and may be used for piston speeds upto 5m/s. These are used in conjunction with similar Piston Seals indicated alongside.

PTFE Rod Seals are pressure-energized and wear compensating, mechanically locked to prevent blowout and will endure temperatures upto 230^0 F. They are compatible with most hydraulic fluids including fire-resistant types.

ROD WIPER protects the Rod Seal and bush from damage caused by dirt adhering to the rod. The lip of the wiper removes the finest dirt from the piston rod.

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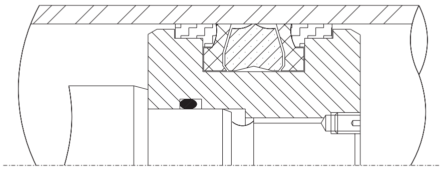
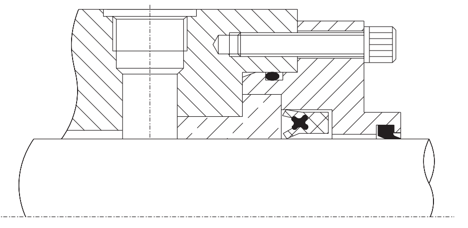
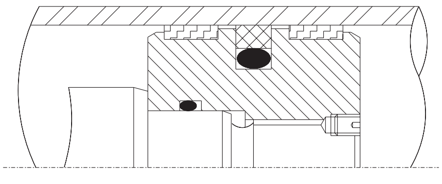
ELASTOMERIC PISTON SEAL



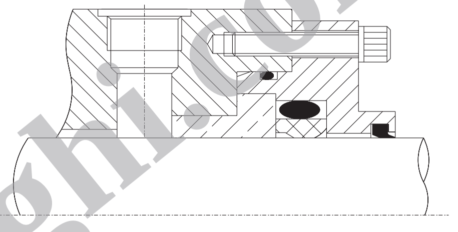
POLYURETHANE ROD SEAL



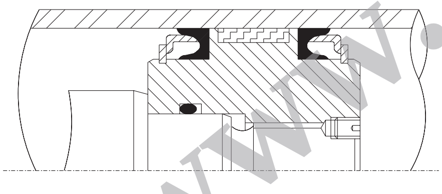
LOW FRICTION PISTON SEAL



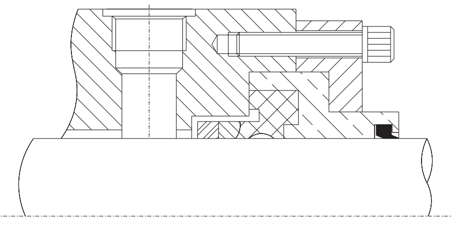
LOW FRICTION ROD SEAL



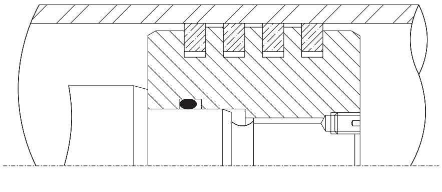
PTFE U-CUPS



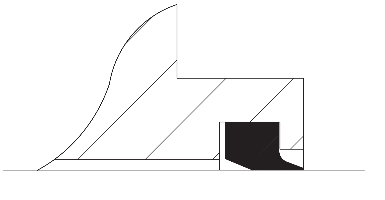
PTFE SEAL



CAST IRON PISTON RINGS



ROD WIPER



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The following simple steps ensure that principal factors are considered while selecting the cylinder :

1. First Establish :
   -Force (F) needed or weight to be moved
   -Stroke or distance to be travelled.
2. Based on the available or selected system pressure P, calculate the cylinder areas required by using the formula F=P A for push as well as pull applications.
3. Referring to the table below, choose the minimum bore & rod combination to provide calculated areas.

AREAS IN DIFFERENT BORE ROD COMBINATION

Bore mm	Cap end area for push cm^2	Rod dia mm	Head end area for Pull cm^2
40	12.57	18	10.02
		22	08.77
		28	06.41
50	19.63	22	15.83
		28	13.48
		36	09.46
63	31.17	28	25.02
		36	21.00
		45	15.27
80	50.27	36	40.09
		45	34.36
		56	25.64
100	78.54	45	62.64
		56	53.91
		70	40.06

Bore mm	Cap end area for Push cm^2	Rod dia mm	Headend area for Pull cm^2
125	122.72	56	98. 09
		70	84. 23
		90	59. 10
160	201.06	70	162. 58
		90	137. 44
		110	106. 03
200	314.16	90	250. 54
		110	219. 13
		140	160. 22
250	490.87	140	336. 94
		160	289. 81
		180	236. 40
320	804.25	180	549. 78
		200	490. 09
		220	424. 12

4. Check the rod diameter for column strength to resist push force in case of long stroke cylinders (refer page 14), and also the speed ratio between the return and forward strokes, etc.
5. Select the mounting style and the rod end/ cap end accessories to fit your installation needs. (refer pages 20 to 33)
6. Application considerations may require changes in your selection, and for assistance refer the following Application Engineering section.

APPLICATION ENGINEERING

Application	Check the following
Acceleration and Decelaration	Check whether the calculated force is sufficient to accelerate/ decelerate the load within prescribed distance. Check back-pressure rise during cushioning is within limits.
Piston speed	Check whether the standard port size permits sufficient oil flow to meet speed requirements.
Long stroke horizontal mounting	Check whether a stop tube is needed to prevent excess bearing load & wear.
High column loading	Check whether standard piston rod is strong enough in buckling.
High or low temperature	Below 0^0 C or above 80^0 C, spring loaded PTFE/ Viton seals are to be opted. For very high temperature, piston rings can be used if leakage is permitted.
Non-petroleum based fluids	PTFE seals are compatible with most fire-resistant and petroleum-based fluids. Other seals are available for high water base and other fluids.

VARIATIONS FROM STANDARD

1. Ports : BSP ports are standard. Other types like BSPT, NPT, `O' ring seal ports, SAE flanged ports, manifold ports, etc., can be optionally provided. Also refer 'Piston speed' on Page 15.
2. Cushion Adjustments : Ball check and adjusting screws can be interchanged without affecting port locations.
3. Mixed mounting for special or constrained installations.
4. Heavy chrome plated or stainless steel piston rods for corrosive environments.
5. Longer rod extensions as desired.
6. Rod-end threads : Shouldered male threads in metric sizes are standard as listed in the basic cylinder dimensions table. These threads have turndown of approximately 50% of the Piston rod area. The screwing of the mating part is done upto the shoulder, eliminating the need for locknut. Two variations are possible as follows :

(i) Female threads of same size as indicated above - these are useful for connecting mating parts such as rod-eyes having male threads.

(ii) Unshouldered male threads. i.e threads of full diameter as that of rod, useful when adjustment is needed, along with a locknut for locking the attachment.

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It is often necessary to determine the Force F required to accelerate or decelerate a given mass. The maximum velocity `V' attained by a mass `m' over a distance `s' is dependant on the force `F' related as follows : F=ma where $a=\frac{V^2}{2S}$

These forces will help in selecting a proper size cylinder, pump pressure etc. They will also help in checking the safety of various system components by finding out the pressure rise when a moving load is stopped by means of internal cushions. The following examples well help in understanding these. Care should be taken to consider friction in actual applications, since this is neglected here. The frictional force is to be added while determining the acceleration force and subtracted for deceleration force.

EXAMPLE 1: Vertical motion.

For Acceleration downward or Deceleration upward : F=m (a–g).
For Acceleration upward or Deceleration downward : F=m (a+g).

V=15m/min moving down, m = 5000 kg, s=12mm

$$\text{Acceleration, } a= \frac{(15/60)^2}{2x0.012} = 2.604 m/sec^2$$

$$F = \frac{5000\,(2.604-9.81)}{9.81} = -3672 kgf$$

The negative sign indicates gravity alone is sufficient to cause acceleration.

EXAMPLE 2 : Horizontal motion F = m a

Let us consider the same values as above. As acceleration force of 5000* 2.604/9.81=1327 kgf is required to move a mass of 5000 kgs over a distance of 12 mm with a max. velocity of 15m/min.

Assume 160 bar pump is available.
The area of cylinder required = force / pressure = $\frac{1327}{160}$ = 8.294 cm^2 which corresponds to a bore of 32.5 mm. The next higher standard 40 mm bore and 18 mm rod cylinder (cap end area = 12.57 cm^2 and head end area = 10.02cm^2) with pressure rating of 160 bar seems to be sufficient.

There is another factor to be checked - i.e. whether the deceleration forces set up by cushioning inside the cylinder cause any harm to it. Hence it should be determined (1) whether the cylinder is required to stop the mechanism, (2) or whether the mechanism stops the cylinder. The second case is not harmful but in the first case, we have to check whether the back pressure created inside the cylinder is well within the safe limit. To determine this, we shall assume the above weight is to be decelerated over a distance of 16 mm for a horizontal motion.

$$\text{Deceleration rate} = \frac{(15/60)^2}{2x0.012} = 1.953 \ m/sec^2, \quad \text{Deceleration force} = \frac{5000x1.953}{9.81} = -995.5 \ kgf$$

Total force to be created on rod side = 995.5 + 1327 = 2322.5 kgf

$$\text{Back pressure created in the cylinder} = \frac{2322.5}{10.02} = 231.8 kgf/cm^2$$

Thus the back pressure exceeds the pressure rating. Hence the next larger bore ie. 50 bore and 22 dia rod cylinder with head end area of 15.83 cm^2 which gives a back pressure of 146.71 kgf / cm^2 is recommended.

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In power cylinders, cushioning means deceleration of moving masses. Cushioning extends cylinder life and reduces undesirable noise and hydraulic shock.

1. When Cushions are required.

Cushioned cylinders should be used whenever the piston is required to move heavy loads or travel at high speeds, say more than 0.1m/sec. Under both these conditions, the piston will pound the head and cap causing heavy damage to the piston and also heavy deceleration forces will be set up on the moving members. To minimise these effects, a back pressure or resisting force must be built up inside the cylinder to bring the piston to a safe and smooth stop during the last portion of its stroke. Cushions built into the cylinder perform exactly this function.

The ability of cylinder to decelerate and stop inertia loads is dependent on : (a) the volume of cushion chamber which is proportional to the length of cushion stroke for a given size of cylinder; (b) pressure developed in cushion chamber; (c) the efficiency with which the fluid is metered.

For normal applications, standard length cushions are sufficient. Where extremely fast moving loads are involved, special cushions are to be devised to bring load to a stop without bounce.

2. When Cushions are not required.

Cushions need not be specified (a) when light loads are moving at low speeds; (b) when external stops are provided thus eliminating the possibility of piston striking the cylinder head and cap; (c) for short stroke (50 mm or less) cylinders, because the short stroke does not allow piston speed to build up enough to sufficiently offset the back pressure built up by the cushion.

3. How Cushioning is achieved.

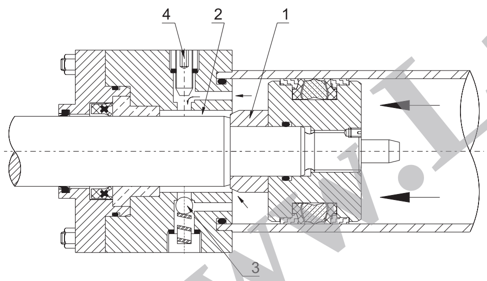

FIGURE 1 : CUSHION IN

Fig. 1 : As the cushion plunger (1) enters the cushion cavity (2) the exhaust fluid is trapped creating back pressure against piston assembly. This back pressure decelerates the movement of piston thus reducing pounding of the piston against head or cap. The degree of cushioning can be obtained as desired by adjusting the screw (4).

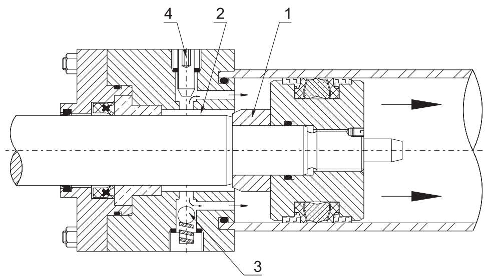

FIGURE 2 : CUSHION OUT

Fig. 2 : When fluid under pressure enters the cylinder head end to move the piston in the opposite direction the fluid moves the Ball check (3) off its seat, opening the passage for more pressure fluid to act against the piston , thus speeding its start-up movement as the cushion plunger (1) is immediately forced out of the cavity (2).

From the above illustrations, the cushioning of a cylinder is obtained by trapping the exhaust fluid as the piston assembly nears the end of its stroke. The cushion capacity of the head end is less than that of the cap end and reduces to zero at high drive pressures owing to the pressure intensification across the piston. The energy absorption capacity of the cushion decreases with drive pressure which, in normal circuits, is the relief setting.

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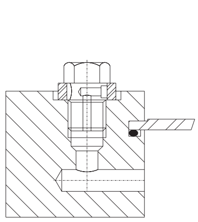
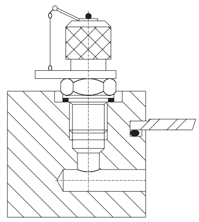
AIR BLEEDS

Hydraulic cylinders vertically mounted or horizontally mounted with ports on top are self bleeding when cycled full stroke and do not require air bleeds. When required or called for, bleed screws can be optionally provided at either end of the cylinder. Location of bleed screws must be specified to suit the accessibility in a particular application. The bleeder port of $^1/_4$" BSP is standardized for cylinders of 50mm bore and above. $^1/_8$" BSP is provided for 40mm bore cylinders. Minimess type bleed screws are optional.

AIR BLEEDS



STANDARD TYPE

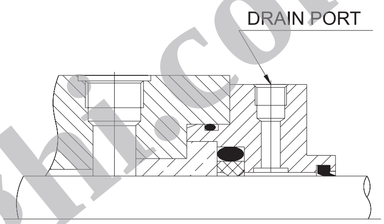


MINIMESS TYPE

GLAND DRAIN

In certain situations like long stroke or high speed operation or cylinders provided with Low Friction rod seal, there is a possibility of oil accumulation in the cavity between the rod seal and wiper. A drain port is provided between the rod seal and wiper seal to evacuate the accumulated oil to the tank of the hydraulic system.

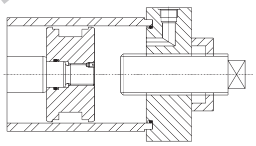
GLAND DRAIN



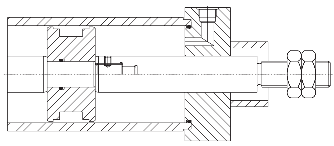
STROKE ADJUSTMENT

Where absolute precision is required in end position, a screwed adjustable stop can be provided. The illustrations alongside show designs suitable for closed position adjustment and for open position adjustment. It may be noted from the figure that for the open position adjustment, one has to go in for a double rod cylinder.

STROKE ADJUSTMENT



FOR CLOSED POSITION

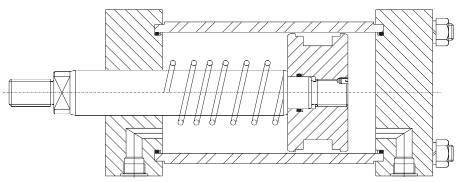


FOR OPEN POSITION

SINGLE ACTING CYLINDERS

Normally double acting cylinders are supplied as standard and they can be used as single acting by applying pressure to one side of the piston. The piston will return to its initial position by means of external force or gravity when the applied pressure is removed. For cylinder designs with internally arranged springs, consult Veljan.

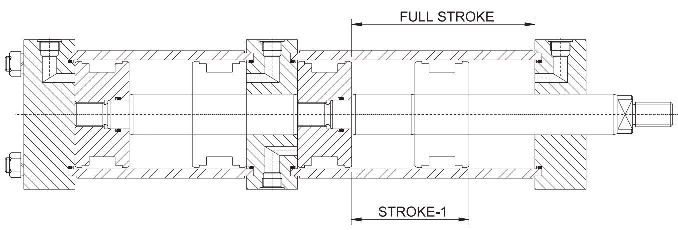
SINGLE ACTING CYLINDERS
WITH SPRING RETURN



MULTIPLE STROKE CYLINDERS

Where definite intermediate stoppings of the piston are required, Veljan offers different designs. One such design with two positions for the piston is shown here.

MULTIPLE STROKE CYLINDERS



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Stop tube is ideal for preventing excessive bearing wear and rod buckling on long push stroke cylinders.

A stop tube is a tubular spacer positioned between the piston and the cylinder head in the extended condition. The increased distance between the piston and the Rod bushing reduces bearing reactions. Stop tubes are useful to prevent buckling of horizontally mounted, long stroke cylinders on push stroke. These are more effective, less costly, and lighter in weight than oversize piston rods.

When to specify stop tubing for your cylinder.

The following simple steps give you the answer :

Step 1: Determine if your cylinder corresponds to any of those illustrated in group A, B or C.

Step 2: If your cylinder is in group A, then stop tube is not required but an oversize-rod may be required (see page 14). If your cylinder is in Group B, a stop tube is recommended as given in step 3 below.
If your cylinder is in group C, calculate the turning movements and loads between piston and rod bushing. Weight of fluid must be included on large bore and/or long stroke cylinders. Determine stop tube length so that load at piston rod bearing does not exceed 15kgs for each square cm. of bearing area. Also check for stop tube length as given in step 3 below and use the longer of the two stop tubes calculated.

Step 3: Determine the value of "L" from instructions in Group B/C. Be sure to include thickness of cylinder head, cap and piston assembly plus 2 x cylinder stroke. If the value of "L" is more than 1000 mm, then 10 mm long stop tube is recommended for each 100 mm of "L" beyond 1000 mm.

Step 4: Add stop tube length to your original "L" dimension to obtain your adjusted "L" dimension.

For example, consider a situation with "L"=1800 mm.&
Stop tube =80mm Adjusted "L"=1800+80 mm = 1880 mm

From the illustrations, it is clear that for a given size of cylinder, a pivot mounted arrangement requires longer stop tube compared to the fixed mounting. In specifying a cylinder with a stop tube, please state the net stroke and the length of stop tube. The addition of the two dimensions will be the gross stroke of the cylinder, which shall be used for arriving at the overall dimension.

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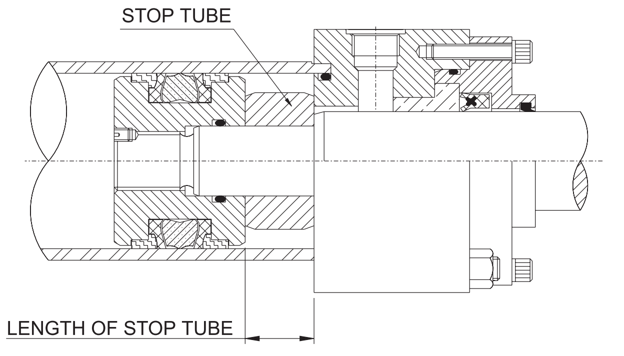
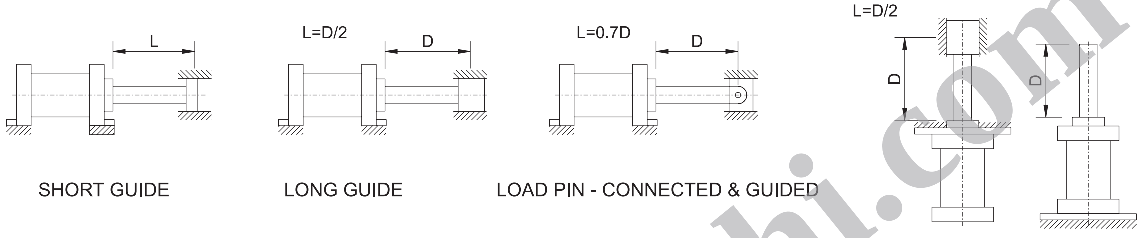


GROUP A

STOP TUBE IS NOT REQUIRED. TO CHECK FOR ROD DIAMETER



SHORT GUIDE

LONG GUIDE

LOAD PIN - CONNECTED & GUIDED

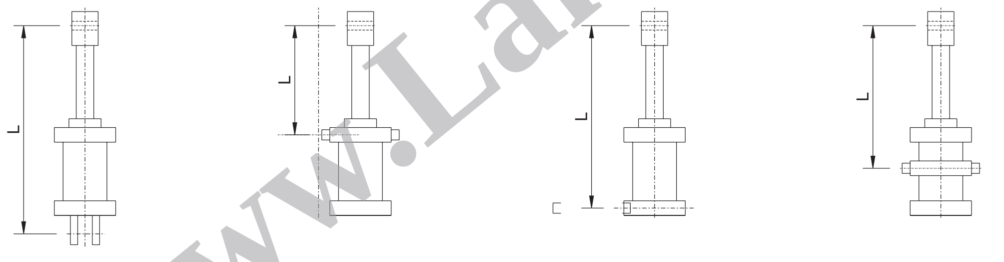
LOAD SUPPORTED & GUIDED

VERTICAL ME5 & ME6

ANY FIXED/MIXED MOUNTING (HORIZONTAL/VERTICAL)

GROUP B

VERTICAL MOUNTINGS



MP1,MP3,MP5

MT1

MT2

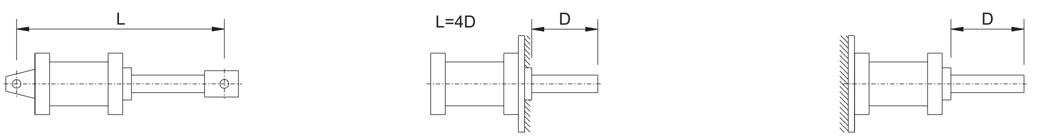
MT4

GROUP C

HORIZONTAL MOUNTINGS

L=2D GUIDED

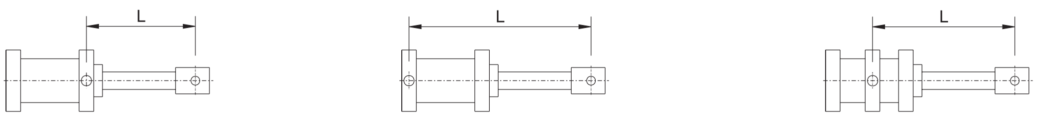
L=4D UNGUIDED



MP1,MP3,MP5

ME5,MX1
CAP TO BE SUPPORTED
ON LONG STROKES

ME6,MX2
HEAD TO BE SUPPORTED
ON LONG STROKES



MT1

MT2

MT4

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Special considerations like piston rod sag in long stroke cylinders, or column strength in long PUSH stroke applications, or speed of piston retraction require oversize piston rods.

It may be noted with caution that higher rigidity of oversize rods will not obsorb side loads, whereas greater flexibility of the smaller standard diameter rod transmits less of the undesirable side loading back to the piston rod bushing.

To determine oversize rod diameter required for PUSH stroke application, follow these simple steps :

STEP 1. Referring to groups A to C of the previous section, determine the value of "L" for your cylinder or use the adjusted value of "L" dimension calculated from step 4 of that section.

STEP 2. From your cylinder bore size and maximum operating pressure, calculate PUSH force = pressure x area.

STEP 3. In the table below, find your PUSH force in the left column and locate your "L" dimension or your adjusted value of "L" dimension in the same horizontal line to the right (if your exact "L" or adjusted value of "L" dimension is not shown, move to the right to the next larger number). Read vertically up from this number to the rod diameter shown. This is the recommended rod diameter for your application.

VALUES OF "L" FOR DIFFERENT FORCE & ROD SIZE COMBINATIONS :

Value of F in Kgf in this column	PISTON ROD DIAMETERS														
	18	22	28	36	45	56	63	70	80	90	110	125	140	180	220
250	1033	1544	2500	4134											
500	731	1092	1768	2923	4567	7073	8952								
750	596	891	1444	2387	1391	5775	7310	9023							
1000	517	772	1250	2067	3229	5001	6330	7815							
2500	327	488	791	1307	2042	3163	4003	4942	6455	8170					
5000	231	345	559	924	1444	2236	2831	3495	4565	5777	8630				
7500		282	456	754	1179	1826	2311	2853	3727	4717	7046	9100			
10000			395	653	1021	1582	2002	2471	3228	4085	6102	7880	9885		
12500				584	913	1414	1790	2210	2887	3654	5458	7048	8841		
1500				533	834	1291	1634	2018	2635	3335	4982	6434	8071	13341	
20000				462	722	1118	1415	1747	2282	2888	4315	5572	6990	11554	
25000					646	1000	1266	1563	2041	2584	3860	4984	6252	10334	
30000					590	913	1156	1428	1863	2358	3523	4550	5707	9434	14093
35000					545	845	1070	1321	1725	2184	3262	4212	5283	8734	13047
40000						791	1000	1235	1614	2042	3051	3940	4942	8170	12205
50000						707	895	1105	1442	1823	2729	3524	4420	7307	10916
75000								902	1178	1492	2228	2877	3609	5966	8913
100000									1020	1291	1930	2492	3126	5167	7719
150000											1576	2034	2552	4219	6302
200000												1762	2210	3653	5458
250000												1576	1977	3268	4882

Notes : The above table is prepared using "Euler" formula for bucking and a factor of safety of 4. For values of "L" less than those shown, the slenderness ratio (length/radius of gyration) is less than 50. Thus the compressive strength formula is to be used rather than the column strength formula on which this table is based. For very low slenderness ratios (below 20), compressive strength formula with factor of safety of 2 is satisfactory. For slenderness ratios between 20 and 50, use compressive strength formula with proportionate factors of safety between 2 and 5.

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The operating speed of the piston in a hydraulic cylinder depends on fluid flow rate in the connecting pipe lines. The flow is generally expressed in liters per minute, introduced to or expelled from the cap end port. Fluid velocity in connection lines is normally limited to 5 metres per second to minimize fluid turbulence and pressure loss.

The table below gives piston speed in metres per minute, for standard and oversize ports, when the velocity of fluid flow in standard weight pipe is 5 metres per second. If the piston velocity is greater than the tabulated value, then consider the use of larger pipes up to cylinder port, with two ports per cap connected to provide the fluid flow required. Alternatively specify the oversize ports listed in the table. Special over size thickness cap will be required in such a case.

Cyl. Bore in mm	Catalog standard port			Oversize Port (optional)		
	Port size (BSP) inch	lpm flow at 5m/s	Piston speed m/min	Port size (BSP) inch	lpm flow at 5m/s	Piston speed m/min
40	$^1/_2$	40	31.8	$^3/_4$	53	42.1
50	$^1/_2$	40	20.4	$^3/_4$	53	27.0
63	$^3/_4$	53	16.8	1	85	26.7
80	$^3/_4$	53	10.8	1	85	17.0
100	1	85	10.8	$1^1/_4$	136	17.3
125	1	85	7.2	$1^1/_4$	136	11.1
160	$1^1/_4$	136	6.8	$1^1/_2$	212	10.5
200	$1^1/_4$	136	4.3	$1^1/_2$	212	6.7
250	$1^1/_2$	212	4.3	2	305	6.2
320	$1^1/_2$	212	2.6	2	305	3.8

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To suit your requirements, Cylinders can be mounted in a variety of ways and the selection of correct mounting is an important factor for optimum working. The different mounting arrangements used in Fluid Power Cylinders are indicated by Style Nos. consisting of two alphabets followed by one numeral as referred in the text and table alongside.

Cylinder mountings are broadly classified as Fixed mountings-where the end point moves in a straight line and Pivot mountings - where the end point moves in an arc.

Fixed Mountings : These mountings are rigid, strong and provide good support. Fixed mountings can be subdivided as (a) centre-line mountings and (b) off-centre mountings.

Centre-Line Mountings : All Flange mountings (ME5, ME6, MF1, MF2, MF3, MF4, MF5, MF6) Extended tie rod mountings (MX1, MX2, MX3) fall into this category. These mountings keep fixing bolts either in simple tension or shear without principal stress and tolerate misalignment to some extent However, they cannot tolerate constant misalignment and in such case, introduce side loads on bearings. For long stroke cylinders, combination of fixed mountings can be used such as front flange and also foot lugs at the back. Front flange mounting is ideal for tensile load whereas rear flange is ideal for compression loads. Tie rod mountings though require least mounting space are less stronger than the flange mountings.

Off-Centre Mountings : Foot or side-lug mounting (MS2) and side-tapped or side flush mounting (MS4) come under this category. These are used where cylinders are to be mounted onto surfaces, parallel to axis of cylinders. These mountings try to sway or bend under heavy loads and as such subject the cylinders and also the mounting to principal stress.

One method of eliminating this problem is the use of shear keys or dowel pins so that bolts are relieved of compound stresses. Cylinders with integral key, not only takes shear loads but also provides accurate alignment of the cylinder and simplified installation. In case of tensile loads, location of key should be at head-end plate and in case of compressive load, the key should be at the cap-end plate. Only one shear key is to be put either on cap end or head end but not at both ends. This accommodates cylinder strain under pressure and temperature variations.

Pivot Mountings : In this type of mountings, the cylinder body swings in a plane perpendicular to the pivot axis. These are further divided as follows depending on the pivot location :

Clevis/Eye Mountings : (MP1, MP3, MP5) : Here the pivot goes outside the body of the cylinder. Its advantage is felt in using cylinders in linkage mechanisms. MP1 and MP3 mounting tolerate misalignments in one plane. If misalignment is anticipated in all planes, then spherical bearings are to be used at the ends of the cylinders as shown in MP5 mounting.

Trunnion Mountings : (MT1, MT2, MT4): Trunnion support can be at the head end, cap end or at any intermediate position, However, in long stroke cylinders, head end trunnion is recommended so that small size piston rod can be used. Trunnion pins are designed to be under shear load and hence they should not be supported on spherical bearings, as they introduce principal stresses.

The mounting styles covered in different dimensional standards is indicated by Y in the table below.

Mounting arrangement	Style No.	ISO : 6020			ISO: 6022
		Part1	Part2	Part3	
Head Rectangular	ME 5		Y		
Cap Rectangular	ME 6		Y		
Rectangular Flange, Head	MF 1	Y			
Rectangular Flange, Cap	MF 2	Y			
Circular Flange, Head	MF 3	Y			Y
Circular Flange, Cap	MF 4	Y			Y
Square Flange, Head	MF 5				
Square Flange, Cap	MF 6				
Fixed Clevis , Head	MP 1		Y	Y	
Fixed Eye, Cap	MP 3	Y	Y	Y	Y
Fixed Eye with Spherical Bearings	MP 5	Y	Y	Y	Y
Side Lug	MS 2		Y		
Centre Line Lug	MS 3				
Side Tapped	MS 4				
Male Trunnion, Head	MT 1	Y	Y	Y	
Male Trunnion, Cap	MT 2	Y	Y	Y	
Male Trunnion, Central	MT 3				
Male Trunnion, Interm.	MT 4	Y	Y	Y	Y
Tie Rods, Extended both ends	MX 1		Y		
Cap Studs / Tie Rods Extended	MX 2		Y		
Head Studs / Tie Rods Extended	MX 3		Y		

For specific applications, Veljan offers Non-ISO type special mountings like Circular Flange at Head/ Cap, Square or Rectangular Flange at Head/Cap, Side flush mounting, etc.

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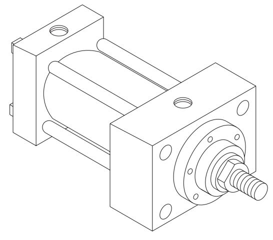
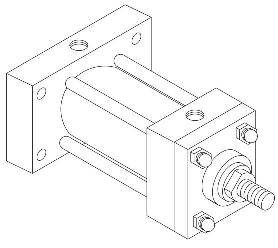
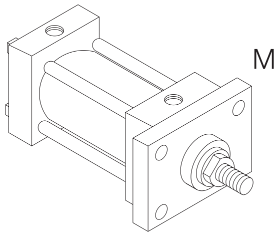
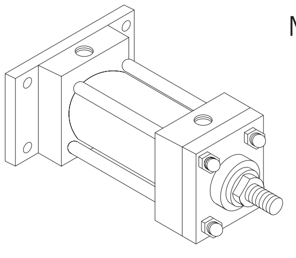
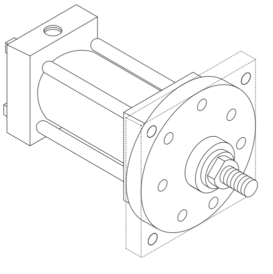
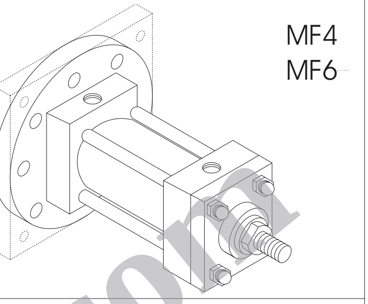
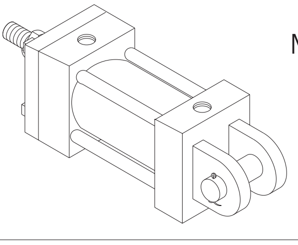
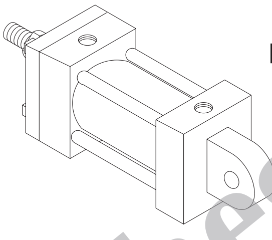
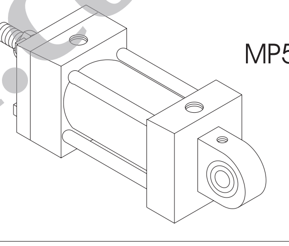
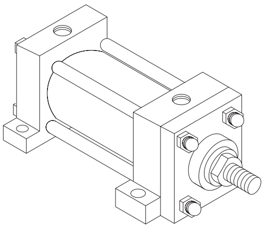
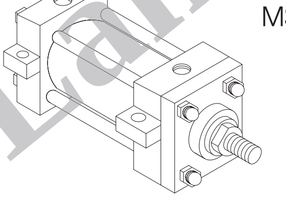
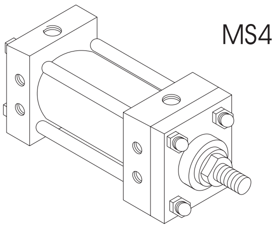
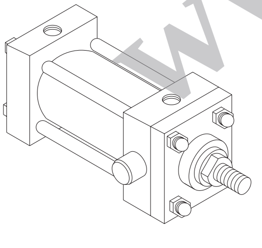
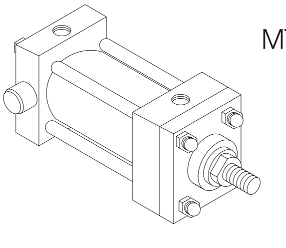
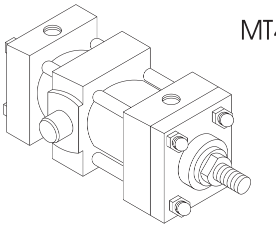
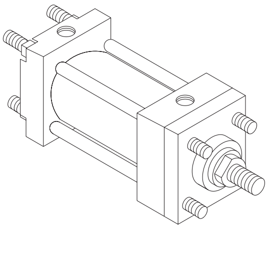
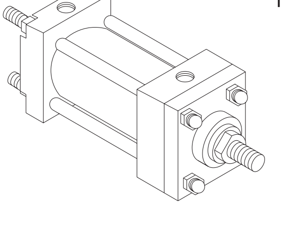
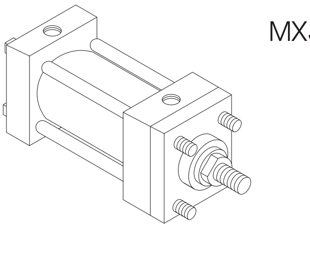
 ME5	 ME6	 MF1
 MF2	 MF3 MF5	 MF4 MF6
 MP1	 MP3	 MP5
 MS2	 MS3	 MS4
 MT1	 MT2	 MT4
 MX1	 MX2	 MX3

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PISTON ROD
High tensile carbon steel, induction hardened to provide a dent-resistant surface, precision ground and hard chrome plated to extend bushing and seal life.

ROD SEAL RETAINER
Facilitates easy replacement of Rod Seal.

HEAD & CAP
Round construction, machined out of solid steel

ROD BUSH
High bearing strength phosphor Bronze rod guide of adequate bearing area.

BALL-CHECK ASSEMBLY
Interchangeable with cushion adjusting screw.

TUBE END SEAL
`O' Ring with Anti-Extrusion Back-up Ring.

FLANGES
Machined steel flanges welded to tube to which end covers are bolted using high tensile fastners.

CUSHIONING
Deceleration at cap-end is provided by a polished plunger integral with the piston rod and a floating bush. The axial float of the bush helps in faster acceleration in the push stroke.

PORTS
Larger size ports for higher speeds.

CAP

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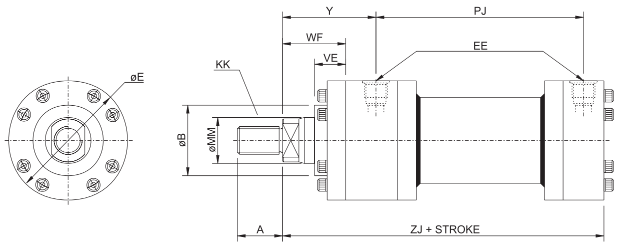
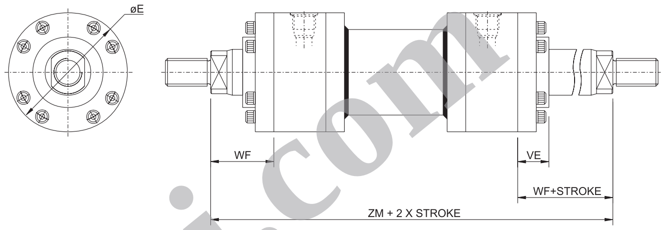
BASIC DIMENSIONS

BORE	ROD ØMM	KK	A	EE BSP	VE	WF	ØB	ØE	Y	PJ	ZJ	ZM
50	36	M27X2.0	36	1/2″	29	47	63	108	95	125	240	315
63	45	M33X2.0	45	3/4″	32	53	75	122	105	140	270	350
80	56	M42X2.0	56	3/4″	36	60	90	145	122	152	300	396
100	70	M48X2.0	63	1″	41	68	110	175	135	170	335	440
125	90	M64X3.0	85	1″	45	76	132	215	165	190	390	520
160	110	M80X3.0	95	1 1/4″	50	85	160	270	190	230	460	610
200	140	M100X3.0	112	1 1/4″	61	101	200	330	225	270	540	720
250	180	M125X4	125	1 1/2″	71	113	250	390	260	325	640	845
320	220	M160X4	160	2″	88	136	320	460	310	350	750	970

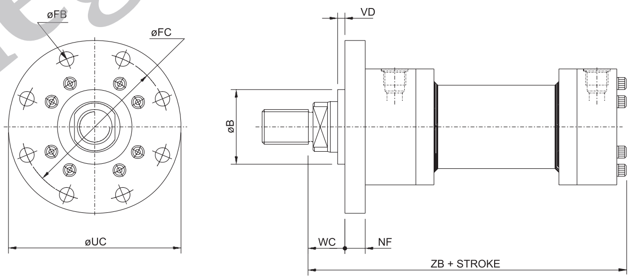


SINGLE ROD END

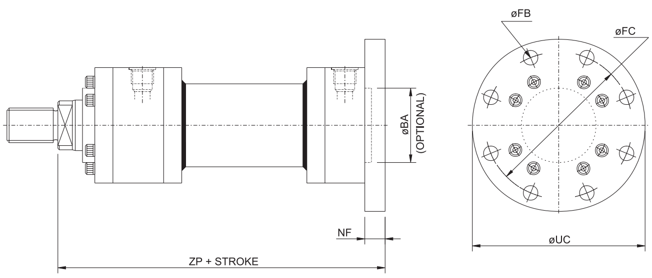


DOUBLE ROD END (NON ISO)

BORE	VD MIN	WC	FB	FC Js13	NF	ØB ØBA	ØUC	ZB MAX	ZP
50	4	22	8 X Ø 13.5	132	25	63	155	244	265
63	4	25	8 X Ø 13.5	150	28	75	175	274	298
80	4	28	8 X Ø 17.5	180	32	90	210	305	332
100	5	32	8 X Ø 22	212	36	110	250	340	371
125	5	36	8 X Ø 22	250	40	132	290	396	430
160	5	40	8 X Ø 26	315	45	160	360	467	505
200	5	45	8 X Ø 33	385	56	200	440	550	596
250	8	50	8 X Ø 39	475	63	250	540	652	703
320	8	56	8 X Ø 45	600	80	320	675	764	830



MF3 : HEAD END CIRCULAR FLANGE MOUNTING



MF4 : CAP END CIRCULAR FLANGE MOUNTING

ALL UNSPECIFIED DIMENSIONS ARE IN mm

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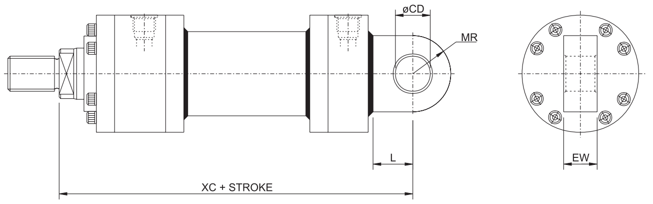
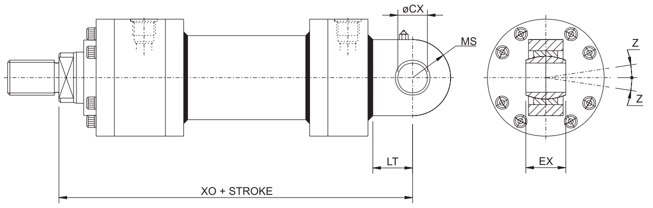
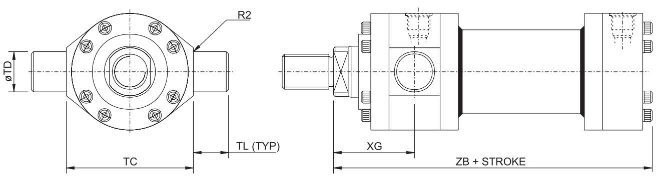


MP3 : CAP FIXED EYE MOUNTING



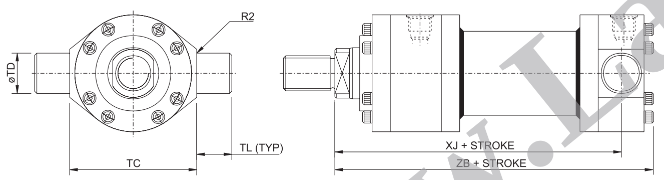
MP5 : CAP FIXED EYE WITH SPHERICAL PLAIN BEARING MOUNTING

BORE	ØCD	ØCX	EX or EW MIN	L/LT MAX	MR/MS	XC/XO	Z
50	32	32	32	40	40	305	
63	40	40	40	50	50	348	
80	50	50	50	63	63	395	
100	63	63	63	71	71	442	4°
125	80	80	80	90	90	520	
160	100	100	100	112	112	617	
200	125	125	125	160	160	756	
250	160	160	160	200	200	903	
320	200	200	200	250	250	1080	



MT1 : HEAD END TRUNNION MOUNTING

BORE	TD f8	TL J16	TC h12	XG	XJ	ZB MAX
50	32	25	112	82	220	244
63	40	32	125	92	245	274
80	50	40	150	104	274	305
100	63	50	180	118	312	340
125	80	63	224	138	364	396
160	100	80	280	158	434	467
200	125	100	335	186	516	550
250	160	125	425	214	620	652
320	200	160	530	268	680	764



MT2 : CAP END TRUNNION MOUNTING

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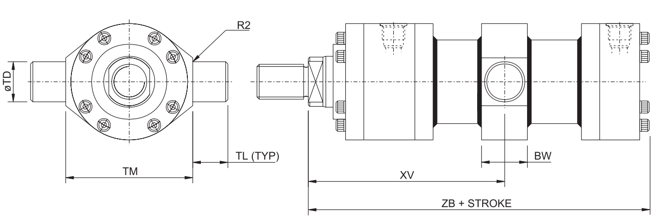
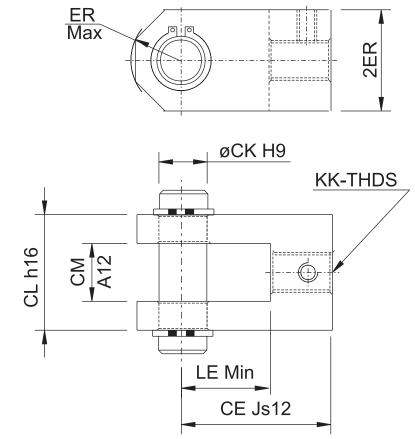


MT4 : INTERMEDIATE TRUNNION MOUNTING

BORE	TD f8	TL J16	TM h12	XV MIN	XV MAX *	BW	ZB MAX	STROKE
50	32	25	112	178	138	38	244	40
63	40	32	125	198	153	48	274	45
80	50	40	150	223	173	58	305	50
100	63	50	180	264	177	73	340	87
125	80	63	224	311	209	88	396	102
160	100	80	280	364	246	108	467	118
200	125	100	335	424	296	113	550	128
250	160	125	425	525	320	180	652	205
320	200	160	530	630	340	220	764	290

ALL UNSPECIFIED DIMENSIONS ARE IN mm



ROD CLEVIS
(WITH PIVOT PIN)
(ISO : 8132-1986)

TYPE	FORCE NEWTONS	KK-THDS	CL	CE	CK	CM	LE	ER
20	20,000	M16X1.5	45	52	20	20	27	25
25	32,000	M20X1.5	56	65	25	25	34	32
32	50,000	M27X2	70	80	32	32	42	40
40	80,000	M33X2	90	97	40	40	52	50
50	125,000	M42X2	110	120	50	50	64	63
63	200,000	M48X2	140	140	63	63	75	71
80	320,000	M64X3	170	180	80	80	94	90

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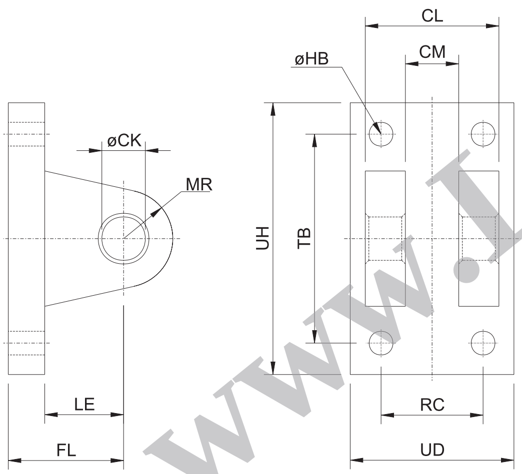
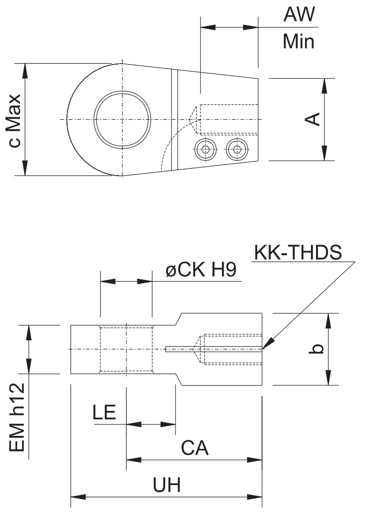


CLEVIS BRACKET
(ISO : 8132-1986)

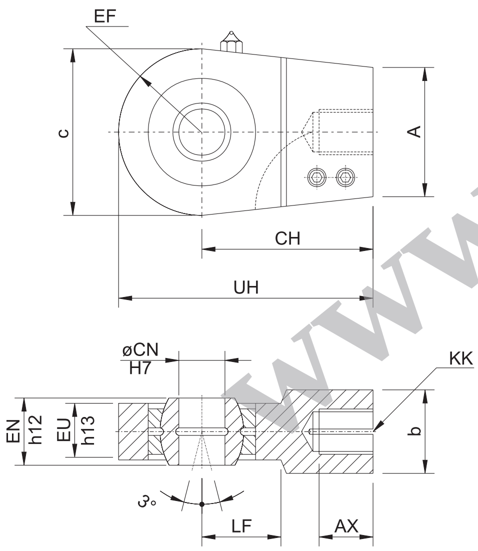
TYPE	NOMINAL FORCE NEWTONS	CK H9	FL Js12	LE MIN	HB H13	MR MAX	CM A12	TB Js14	CL h16	RC Js14	UD MAX	UH MAX
20	20,000	20	45	30	11	20	20	75	45	32	58	98
25	32,000	25	55	37	13.5	25	25	85	56	40	70	113
32	50,000	32	65	43	17.5	32	32	110	70	50	85	143
40	80,000	40	76	52	22	40	40	130	90	65	108	170
50	125,000	50	95	65	26	50	50	170	110	80	130	220
63	200,000	63	112	75	33	63	63	210	140	100	160	270
80	320,000	80	140	95	39	80	80	250	170	125	210	320

Note : These dimensions are valid for operation at 160 bar of cylinders with bore size of 40 mm (type 20) upto and including 160 mm (type 80); they are also valid for operation at 250 bar of cylinders with bore size of 50 mm(type 32) upto and including 125 mm (type 80).



ROD EYE
(ISO : 6981-1992)

TYPE	FORCE NEWTONS	KK-THDS	AW	CA	CK	EM	c	b	A	UH	LE
20	20,000	M16X1.5	23	52	20	20	50	25	48	77	22
25	32,000	M20X1.5	29	65	25	25	62	30	54	97	27
32	50,000	M27X2	37	80	32	32	76	38	66	120	32
40	80,000	M33X2	46	97	40	40	97	47	80	147	41
50	125,000	M42X2	57	120	50	50	118	58	96	183	50
63	200,000	M48X2	64	140	63	63	142	70	114	211	62
80	320,000	M64X3	86	180	80	80	180	90	148	270	78
100	500,000	M80X3	96	210	100	100	224	110	178	322	98
125	800,000	M100X3	113	260	125	125	290	135	200	420	120
160	1250,000	M125X4	126	310	160	160	346	165	250	510	150
200	2000,000	M160X4	161	390	200	200	460	215	320	640	195



ROD EYE WITH SPHERICAL BEARING
(ISO : 6982-1992)

TYPE	SOC.HD CAP SCREW	NOMINAL FORCE NEWTONS	CN H7	KK	AX MIN	EN h12	CH	LF	b	A	EU	EF	c MAX	UH
20	M8	20,000	20	M16X1.5	23	20	52	22	25	48	17	25	50	77
25	M8	32,000	25	M20X1.5	29	25	65	27	30	54	21	32	62	97
32	M10	50,000	32	M27X2	37	32	80	32	38	66	27	40	76	120
40	M10	80,000	40	M33X2	46	40	97	41	47	80	32	50	97	147
50	M12	125,000	50	M42X2	57	50	120	50	58	96	40	63	118	183
63	M12	200,00	63	M48X2	64	63	140	62	70	114	52	71	142	211
80	M16	320,000	80	M64X3	86	80	180	78	90	148	66	90	180	270
100	M20	500,000	100	M80X3	96	100	210	98	110	178	84	112	224	322
125	M20	800,000	125	M100X3	113	125	260	120	135	200	102	160	290	420
160	M24	1250,000	160	M125X4	126	160	310	150	165	250	130	200	346	510
200	M30	2000,000	200	M160X4	161	200	390	195	215	320	162	250	460	640

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ALL UNSPECIFIED DIMENSIONS ARE IN mm

VELJAN

In the table below, we indicate the approximate weight of cylinder with zero stroke (Wo). W_{100} indicates the additional weight for each 100mm stroke.

The weight of a cylinder (W) with stroke length Smm is given by

$$W = Wo + \frac{W_{100}\,S}{100}\ \text{kg}$$

		SERIES 'HT'							SERIES 'HR'							SERIES 'HH'					
		Wo in kg for various Mounting styles							Wo in kg for various Mounting styles							Wo in kg for various Mounting styles					
BORE mm	ROD mm	ME5& ME6	MP1 MP3& MP5	MS2	MT1& MT2	MT4	MX1, MX2 & MX3	W_{100} Kg	MF3	MF4	MP3& MP5	MS2	MT1& MT2	MT4	W_{100} kg	MF3	MF4	MP3& MP5	MT1& MT2	MT4	W_{100} kg
40	18	4.7	4.2	4.0	3.9	4.6	3.7	0.9													
	22								6.7	7.0	6.2	6.5	5.8	6.7	1.0						
	28	4.9	4.4	4.2	4.1	4.8	3.9	1.2	6.8	7.1	6.3	6.6	5.9	6.8	1.2						
50	22	7.2	7.0	6.5	6.3	7.9	5.9	1.4													
	28								11.0	11.6	10.2	10.9	9.5	10.8	1.6						
	36	7.6	7.4	6.9	6.7	3.3	6.3	1.8	11.2	11.8	10.4	11.1	9.7	11.0	1.8	15.6	16.6	15.4	13.9	15.9	1.9
63	28	10.2	10.1	9.7	3.9	10.6	8.5	1.9													
	36								17.7	19.0	16.7	18.5	15.5	17.0	2.2						
	45	10.9	10.8	10.4	9.6	11.3	9.2	2.7	18.0	19.3	17.0	18.8	15.8	17.3	2.7	21.1	22.6	21.7	18.9	21.8	2.7
80	36	18.9	19.5	17.3	16.5	20.5	16.0	2.7													
	45								26.6	28.6	25.6	26.2	22.8	24.9	3.0						
	56	20.0	20.6	13.4	17.6	21.5	17.1	3.9	27.3	29.3	26.3	26.9	23.5	25.6	3.6	38.2	40.7	40.6	34.9	39.4	4.2
100	45	25.0	28.0	24.0	22.7	26.0	22.0	4.0													
	56								46.6	49.3	46.8	49.7	41.5	45.8	4.5						
	70	26.9	29.7	25.9	24.6	27.5	23.9	5.8	47.3	50.0	47.5	50.5	42.2	46.5	5.8	59.5	63.5	62.9	54.9	63	6.2
125	56	48.0	53.0	44.0	43.0	48.0	42.0	6.5													
	70								75.1	79.3	78.5	81.1	69.8	78.6	7.2						
	90	51.7	65.7	47.7	46.7	51.7	45.7	9.5	78.0	82.2	81.4	84	72.7	81.5	9.5	106	112	118	101	116	9.8
160	70	78.0	90.0	73.0	71.0	84.0	69.0	10													
	90								125.7	133	137	139	119.5	131	11.5						
	110	83.0	95..0	78.0	76.0	89.0	74.0	14	129.7	137	141	143	123.5	135	14	191	204	217	185	213	14.6
200	90	138	157	129	127	153	122	15													
	110								227	239	254	257	221	247	17						
	140	147	166	138	136	162	131	23	235	247	262	265	229	255	23	335	358	411	325	370	24
250	140	250	270	242	238	265	230	25	414	439	488	466	401	451	25						
	180	269	289	261	257	284	247	37	429	454	503	481	416	466	37	576	610	732	561	662	39
320	180	464	485	455	452	483	444	41	745	785	902	842	730	828	41						
	220	489	510	430	477	303	469	55	773	813	930	870	758	856	55	1016	1070	1312	975	1171	58

HOW TO ORDER VELJAN HYDRAULIC CYLINDERS

HT – 200 – 100 – CC – MF2 – 1000 *

- 200: Bore (mm)
- 100: Rod dia (mm)
- 1000: Stroke (mm)
- *: Further details in Text (See note below)
- MF2: Mounting Style (See. Page 17)
- CC: Cushioning [CC - Cap end, BC - Both Ends HC - Head end, NC - Non- Cushioned]
- HT: Type HT-Tie-rod type 160 bar compact series (ISO 6020-Part 2 & Part 3)
  HR-160 bar medium series (ISO 6020 Part1)
  HH-250 bar series (ISO 6022)

*Note : *Special requirements such as optional seals etc to be mentioned in text at the end of the ordering code.*

NOTE : Product details are liable to change without notice

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