

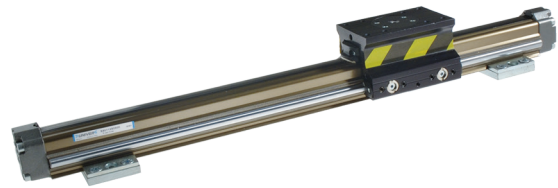
SERIES S1

Standard version rodless cylinders



SERIES S5

Rodless cylinders with integrated guides



SERIES VL1

Rodless cylinders with 90° integrated guides





EXAMINATION AND VERIFICATION OF THE CUSHIONING

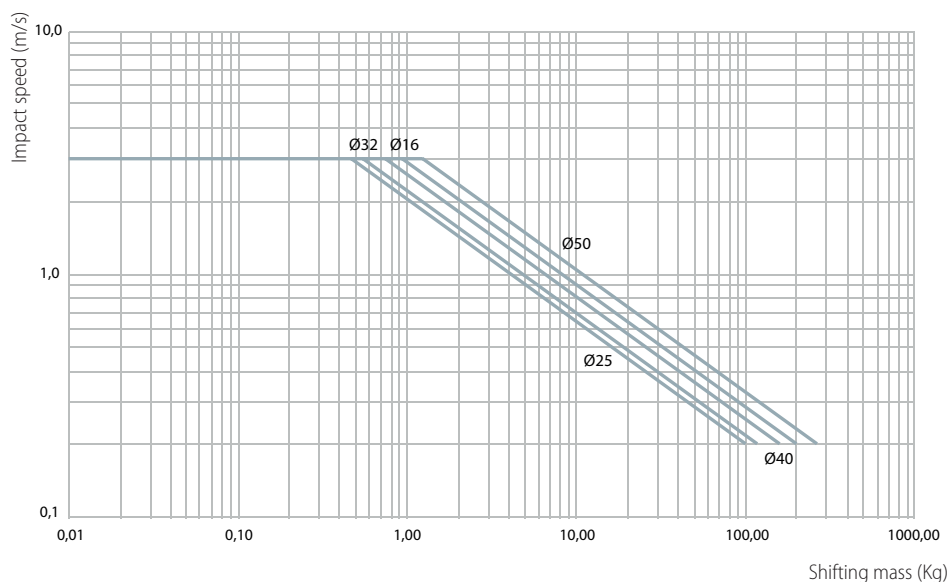
In a system with moving masses, as in the case of rodless cylinders, it is essential to control the dissipation of the system's kinetic energy as it is brought to a stop. First of all, it is necessary to establish and verify the most suitable method for cushioning the system, in order to avoid the moving mass (carriage with load) striking against the end-caps and compromising the life of the cylinder.

If the point corresponding to a given load and speed lies beneath the appropriate curve, the cushioning is able to absorb the kinetic energy of the system.

Vice versa if the point lies above the curve, the cushioning is not able to absorb the kinetic energy. In that case you must:

- decrease the load and maintain the translation speed
- decrease the speed and maintain the load
- select a cylinder with a bigger bore or with twin chambers

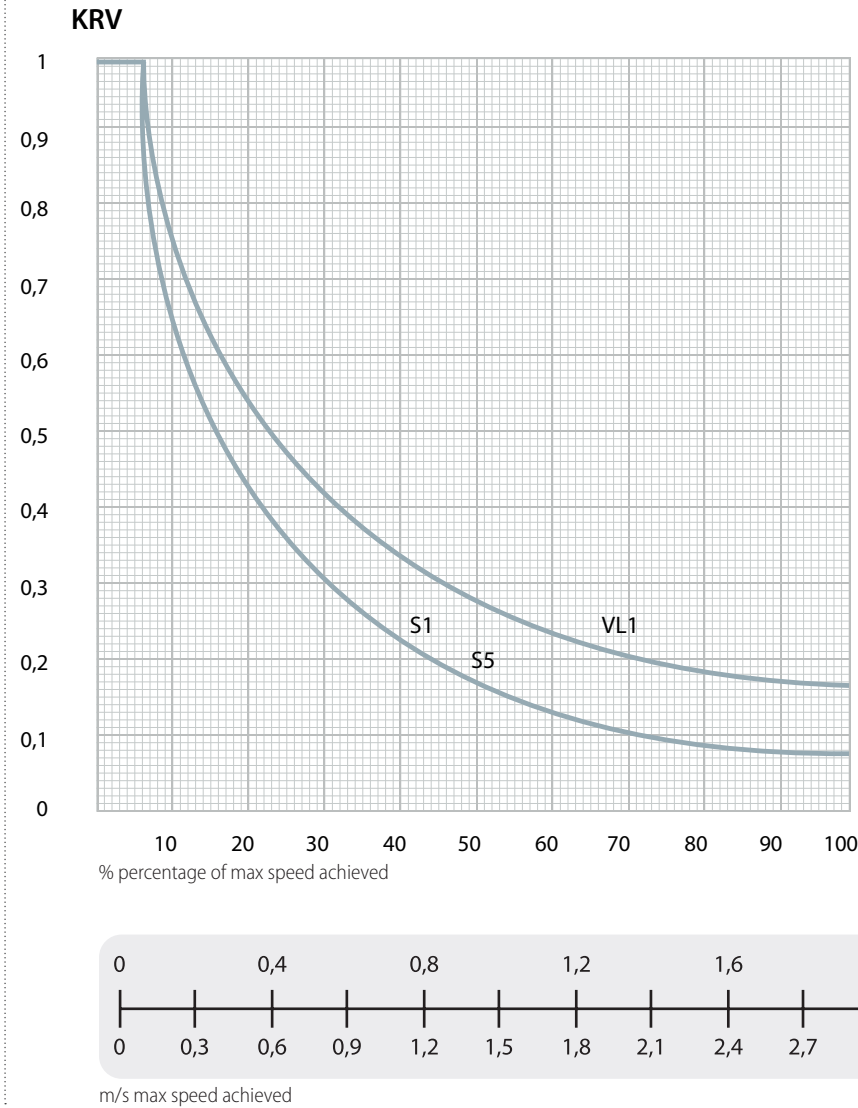
The cushioning capacity is shown in the diagram below, referenced to the final speed as the carriage approaches the end-caps for S1- S5 - VL1 series.



As a result, if cushionings can not absorb the kinetic energy and changing the working parameters is not possible, it is necessary to provide an additional hydraulic shock absorber (YDA / YDR series) to reduce the load speed before the cushionings operate.



DYNAMIC LOAD CAPACITY



1. Calculation of the operational speed percentage in relation to the max allowable speed:

$$\% = \frac{\text{Operational speed (m/s)}}{\text{Max. allowable speed (m/s)}} \cdot 100$$

2. Apply the following formula for the calculation of the max. dynamic load:

$$CD = CM \cdot KRV$$

CD = Max. dynamic load (N)

CM = Max. static load (N). See relevant load tables for the various series

KRV = System coefficient (which acts to reduce the max. load based on the system speed)



CYLINDER SELECTION

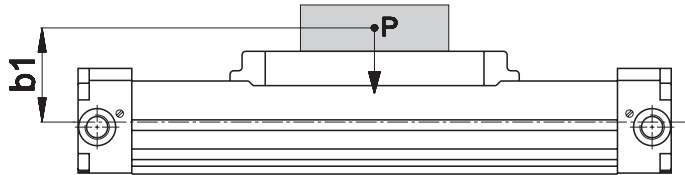
As previously discussed, it is necessary to produce (for a correct use of the cylinder) a gradual deceleration of the moving mass.



CYLINDER WITH LOAD MOUNTED DIRECTLY ON THE CARRIAGE (EXAMPLE A)

Let us consider the case of a S1 series cylinder with a load of 50 N placed on the carriage, at the max. translation speed of 1,2 m/s., as shown in the picture. Verify the cushioning capacity and calculate the capacity of the dynamic load and of the torque and bending moments..

P 50 N
V 1,2 m/s
b1 110 mm



VERIFICATION OF THE CUSHIONING CAPACITY

According to the graph 50 bore size cylinder is able to absorb the developed kinetic energy developed by the application in the picture above, since the intersection point corresponding to the speed and load lies beneath the cushioning curve.



VERIFICATION AND CALCULATION OF THE DYNAMIC LOAD CAPACITY

Using the equation 1, we can calculate the percentage between the operation speed and allowable speed.

$$\% = \frac{\text{Operational speed (m/s)}}{\text{Max. allowable speed (m/s)}} \cdot 100 = \frac{1,2 \text{ m/s}}{3 \text{ m/s}} \cdot 100 = 40\%$$

From the graph we can determine the KRV (coefficient of speed reduction)

$$\text{KRV} = 0,24$$

Applying the equation 2 we can determine the max. permitted dynamic load.

$$\text{CD} = \text{CM} \cdot \text{KRV}$$

CD = Dynamic load

CM = Static load 500 N (see table for S1 50mm cylinder series - P1)

$$\text{CD} = 500 \cdot 0,24 = 120 \text{ N}$$

As P (50 N) < CD (120 N) the S1 series 50 bore cylinder is suitable for the application

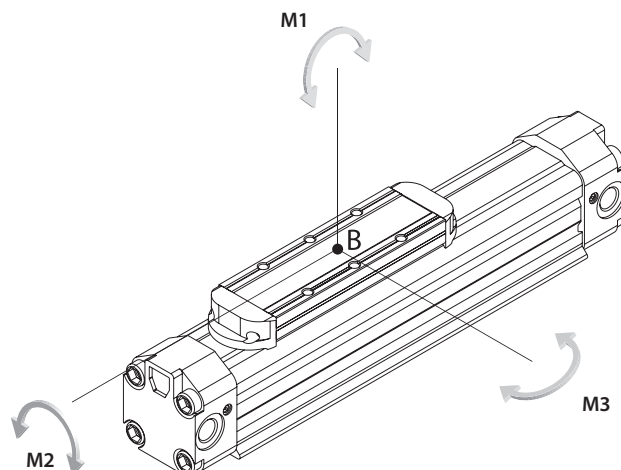


CARRIAGE STRESSES

Different load applications have different moments M1 - M2 - M3, which directly influence the life of the cylinder.

By selecting a cylinder that can support off-set loads, we can avoid compromising the cylinder life.

Load must be applied, if possible, so that it acts through the centre point B (see picture).





CALCULATION OF THE TORQUE M1 - M2 - M3

In order to calculate the various moments, which act on the carriage, we must calculate the force, generated by the load, when it is subjected to accelerations and decelerations.

$$a = \frac{V^2}{2L \cdot 10^{-3}} = (\text{m/sec.}^2)$$

$$a = \frac{1,22}{2 \cdot 52 \cdot 10^{-3}} = 13,8 (\text{m/sec.}^2)$$

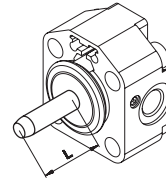
$$F = m \cdot a$$

$$F = \text{Force} \quad m = \text{Mass (P/9,81)}$$

$$F = \frac{50}{9,81} \cdot 13,8 = 70 \text{ N}$$

$$M1 = F \cdot b1$$

CUSHION LENGTH



Ø	L mm
16	16,5
25	25
32	32,5
40	41,5
50	52

a = Acceleration/deceleration

V = Speed in m/s.

L = Cushion length in mm

M1 = Torque

b1 = Distance between the centre of gravity of load P and the centre of gravity through the cylinder centre line.

The **example A** is subjected to the moment M1 as the load decelerates through the cushion.

$$M1 = 70 \cdot 110 = 7700 \text{ N mm} = 7,7 \text{ Nm}$$

The equation gives the following result:

$$M1 = 7,7 \text{ Nm} < 19 \text{ Nm (see table for S1 50mm cylinder series - M1)}$$

Thus S1 series, bore size 50, with standard carriage is suitable for the movement of the load in the given conditions. If the calculated value is equal to or higher than the value given in the table, it is necessary to select a different size of carriage, or a different type of rodless cylinder (e.g with integrated slide)

ATTENTION!

If the translation speed of **example A** is 2 m/s instead of 1,2 m/s, the cushioning capacity of the cylinder, given in the example, will not be enough to absorb the kinetic energy generated by the moving load. Therefore it is necessary to reduce the translation speed before reaching the cushion, by means of shock absorbers until the value is 1,2 m/s (for example).



SIZING OF A POSSIBLE HYDRAULIC SHOCK ABSORBER

The hydraulic shock absorber must be mounted, so as to strike the centre of gravity of the load.

$$Ec = \frac{1}{2} \cdot m \cdot V^2$$

Ec = Kinetic energy

m = Mass (P/9,81)

V = Translation speed (2 m/s)

P = Weight 50 N

9,81 = Acceleration of the centre of gravity

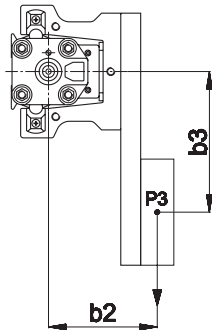
$$Ec = \frac{1}{2} \cdot \frac{50}{9,81} \cdot 2^2 = \frac{200}{19,62} = 10 \text{ Nm}$$

In this case the hydraulic shock absorber must have a capacity greater than or equal to 10 Nm.



CYLINDER WITH MISALIGNED LOAD (PICTURE B)

Let us suppose that we want to move a load of 50 N displaced at a distance B3 from the central axis, at a maximum translation speed of 1,2 m/s. Due to the misaligned load a cylinder with an external carriage is required and we must verify if a S5 cylinder with integrated slide is suitable for this application.



$$P3 = 50 \text{ N}$$

$$V = 1,2 \text{ m/s}$$

$$b2 = 150 \text{ mm}$$

$$b3 = 200 \text{ mm}$$



VERIFICATION OF THE CUSHIONING CAPACITY

The S5 series cylinder (graph on page 22), 40 mm bore, can absorb the kinetic energy developed by the 50 N load at a speed of 1,2 m/s.



VERIFICATION AND CALCULATION OF THE CARRIAGE MOMENTS

Using the equation we can calculate the percentage of the max. speed as follows.

$$\% = \frac{\text{Operational speed (m/s)}}{\text{Max. allowable speed (m/s)}} \cdot 100 = \frac{1,2 \text{ m/s}}{3 \text{ m/s}} \cdot 100 = 40\%$$

From the graph given on page 23 we can determine the KRV coefficient.

$$KRV = 0,24$$

Applying the equation 2 on page 23 we can determine the max. allowable dynamic load.

$$CD = CM \cdot KRV$$

CD = Dynamic load

CM = Static load 600 N (see table for S5 50mm cylinder series)

$$CD = 600 \cdot 0,24 = 144 \text{ N}$$

As $P3 (50 \text{ N}) < CD (144 \text{ N})$ the S5 series 40 bore cylinder is suitable for the application.



CALCULATION AND VERIFICATION OF THE CARRIAGE MOMENTS

As load P is misaligned (B3) from the central axis of the cylinder, the carriage is acted on by a significant moment M3, so that it is necessary to use a cylinder with an external carriage.



CALCULATION OF THE MOMENTS M1 - M2 - M3 AND CARRIAGE SELECTION

$$a = \frac{V^2}{2 \cdot L \cdot 0,3} = (\text{m/sec.}^2)$$

$$a = \frac{1,2^2}{2 \cdot 41,5 \cdot 10^{-3}} = 17,3 (\text{m/sec.}^2)$$

$$F = m \cdot a = \frac{P}{9,81} \cdot 17,3 = \frac{50}{9,81} \cdot 17,3 = 88 \text{ N}$$

a = Acceleration/deceleration

m = Mass (P/9,81)

F = Force

P = Weight in N

9,81 = Centre of gravity acceleration

L = Length in mm of the internal cushion (see on page 25)

V = Speed in m/s

THE EXAMPLE IS SUBJECTED TO MOMENTS M1 - M2 - M3

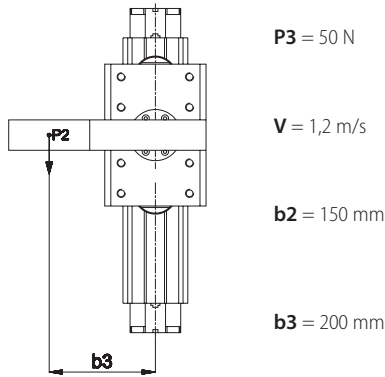
torque	Torque calculation	Maximum allowable torque
$M1 = F \times b2$	$88 \times 150 = 13200 \text{ N-mm} = 13,2 \text{ N-m}$	60 Nm
$M2 = P \times b2$	$50 \times 150 = 7500 \text{ N-mm} = 7,5 \text{ N-m}$	30 Nm
$M3 = F \times b3$	$88 \times 200 = 17600 \text{ N-mm} = 17,6 \text{ N-m}$	80 Nm

By comparing the calculated values to the max values on page 12, it can be deduced that the medium carriage is suitable for this application.



CYLINDER WITH MISALIGNED LOAD IN VERTICAL POSITION

In this instance let us suppose to verify if a 40 mm bore VL1 series cylinder, in the vertical plane, is sufficient to move a 50 N load misaligned at a distance b_3 , at a speed of 1,2 m/s.



$$P_3 = 50 \text{ N}$$

$$V = 1,2 \text{ m/s}$$

$$b_2 = 150 \text{ mm}$$

$$b_3 = 200 \text{ mm}$$

ATTENTION!

By checking the data given in the example, we note that the cylinder, in the vertical position, is not able to cushion the load and it is therefore necessary to use a 50 mm bore cylinder or an external shock absorber (see on page 26). Now we must calculate the dynamic load capacity and the developed moments. To obtain the value of the KRV coefficient follow the procedure as given in the examples, which will result in a coefficient of KRV 0,24 (SEE PICTURES A AND B).

$$CD = CM \cdot KRV = 1100 \cdot 0,24 = 264 \text{ N}$$

$$P < CD$$

The cylinder is therefore able to move the applied load.

In this application the moment M_2 is not generated, as no force is acting transversally to the moving axis; therefore we must calculate only the moments M_1 and M_3 .

$$F = m \cdot a$$

$$a = \frac{V^2}{2L \cdot 10^{-3}} = 17,3 \text{ (m/sec}^2\text{)} \text{ (esempio B)}$$

$$F = m \cdot a = 88 \text{ N (esempio B)}$$

THE EXAMPLE IS SUBJECTED TO MOMENTS M_1 - M_2 - M_3

torque	Torque calculation	Maximum allowable torque
$M_1 = F \times b_1$	$88 \times 110 = 9680 \text{ Nmm} = 9,68 \text{ Nm}$	120 Nm
$M_3 = F \times b_3$	$88 \times 200 = 17600 \text{ Nmm} = 17,6 \text{ Nm}$	120 Nm

By comparing the obtained values with the maximum values in table at page 18, we can verify that the cylinder is proper, but in order to cushion the vertical load, we must either use an external cushion, increase the cylinder bore size or use another cylinder series.

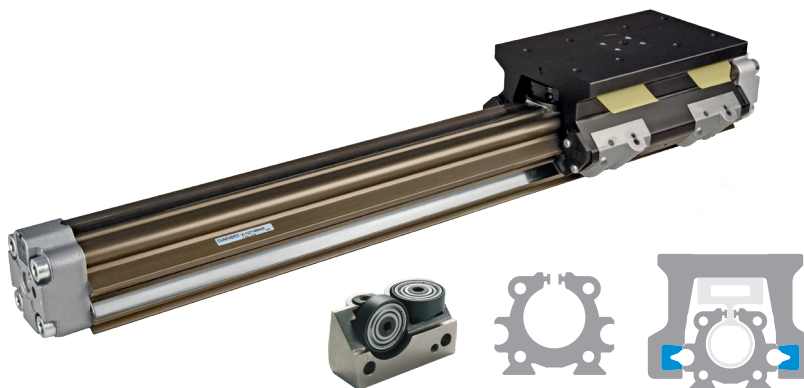
FOR A CORRECT USE SEE THE FOLLOWING INSTRUCTIONS:

- For a longer life of the cylinder it is suggested to use the cylinder at a speed of 1 m/s
- If the cushioning value is in proximity to the max. value, please apply an additional shock absorber
- If the cylinder is used vertically, the cushioning capacity is reduced by 40%.
- Maintain a correct and constant lubrication.

SERIES VL1 - RODLESS CYLINDERS WITH INTEGRATED SLIDE 90°



TECNICAL CHARACTERISTICS



Pressure

3 bar ÷ 10 bar



Temperature

- 20 °C ÷ + 80 °C



Fluid

filtered air, with or without lubrication



Bore

25 - 32 - 40 - 50 mm



Standard strokes

corse fino a 6000 mm



Operation

The carriage, running on ball bearings, ensures high rigidity, precision and speeds ranging from 0.2 to 2 m/s. Available with a parking lock.



Materials and Components

- Die-cast aluminium end caps
- Anodized aluminium barrel
- Aluminium piston
- Acetal resin guide shoe
- Double-lip piston seal in nitrile rubber (NBR)
- Nitrile rubber (NBR) bumpers on both sides
- Extruded aluminium profile

Series	Type	Number of bearing pairs in series	Left-hand side power supply	Right-hand side power supply	Bore (mm)	Stroke (mm)
V L 1	2	2	1	1	2 5	1 0 0 0
VL1 Rodless cylinders with integrated 90° guides, Ø 25-50 mm – Ball bearing guidanc	2 Medium carriage 3 Long carriage	Medium carriage 2 = Ø 25÷40 3 = Ø 50 Long carriage 3 = Ø 25÷40 4 = Ø 50	0 No supply (both chambers are supplied from the right-hand end cap) 1 Side supply 2 Top supply 3 Rear supply	1 Side supply 2 Top supply 3 Rear supply 4 Rear supply of both chambers from the right-hand end cap	25 = Ø25 32 = Ø32 40 = Ø40 50 = Ø50	Fino a 6000

STROKE TOLERANCES

Ø	mm
25	+2,5 -0
32	+3,2 -0
40	+3,2 -0
50	+3,2 -0

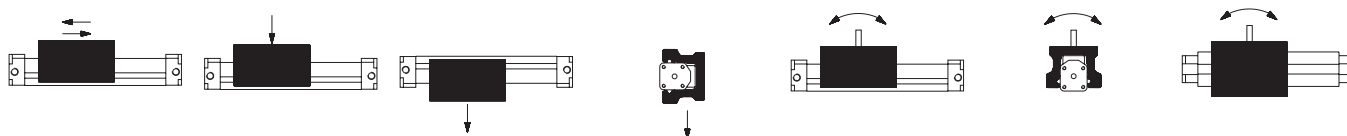
Ø	CYLINDER MASS MEDIUM CARRIAGE	CYLINDER MASS LONG CARRIAGE	Increase for 100 mm stroke g
	Cylinder - stroke 0 g	Cylinder - stroke 0 g	
25	2095	2855	300
32	3125	4410	415
40	6340	8955	670
50	10850	15365	1020


Theoretical forces (N) at different working pressure (bar) Static load value (N) and torque (Nm)

Please note that in dynamic conditions, the load must be reduced due to effects associated with the speed.

A moment is the product of the load (Newton) and the arm (meters), i.e the distance between the centre of gravity of the load and the longitudinal axis of the piston.

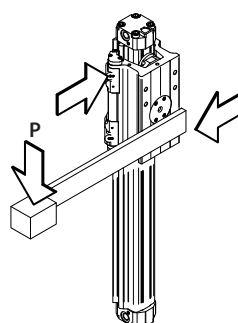
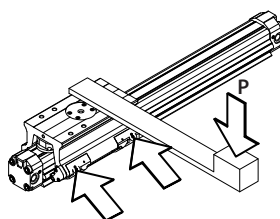
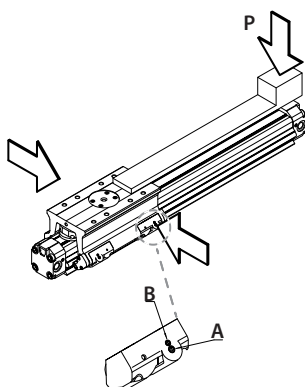
Force 6 bar	P1	Load P2	P3	Bending moment M1	Torque M2	Bending moment M3
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Ø	Force	Load			Standard carriage			Medium carriage			Long carriage		
	F (N)	P1 (N)	P2 (N)	P3 (N)	M1 (Nm)	M2 (Nm)	M3 (Nm)	M1 (Nm)	M2 (Nm)	M3 (Nm)	M1 (Nm)	M2 (Nm)	M3 (Nm)
25	250		700		34	17	34		1000		63	25	63
32	420		700		51	20	51		1000		93	30	93
40	640		1100		120	46	120		1600		230	69	230
50	1050		1500		170	85	170		2000		310	110	310

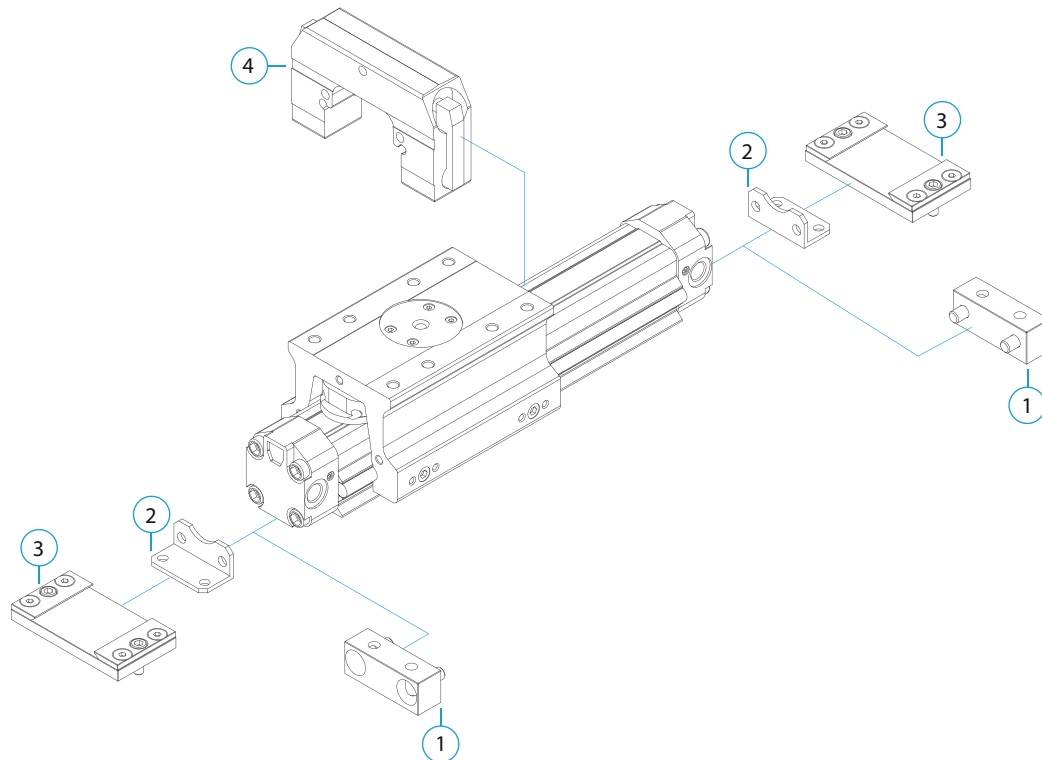

CARRIAGE ADJUSTMENT

In case of off-set loads it is necessary to adjust the screws (A) as indicated below:

LONGITUDINAL
HORIZONTAL LATERAL
VERTICAL LATERAL


- Identify the lateral grub screws indicated by the arrows and adjust them according to the position of the load P.
- Tighten the screws (A) indicated by the arrows by 1 turn or more, depending on the applied load. Apply a drop of Loctite 242 to the grub screws (B). Tighten the screws (B) until they reach the stop, then loosen all of them by 90°.

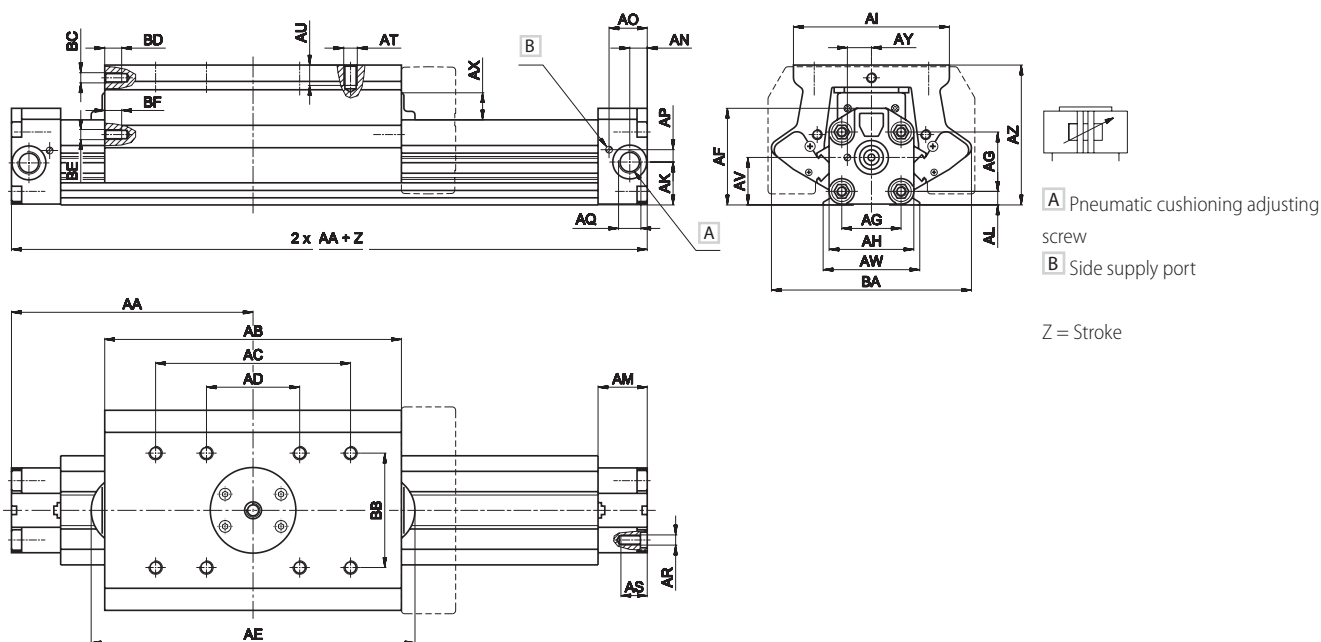
FIXING ELEMENTS AND ACCESSORIES



1	Angle bracket Ø25-32 SF-13
2	Bracket Ø40-50 SF-13
3	Fixing plate SF-12
4	L6 locking unit L6-S5

VL1

RODLESS CYLINDERS WITH 90° INTEGRATED GUIDES WITH MEDIUM CARRIAGE - 8 FIXING HOLES

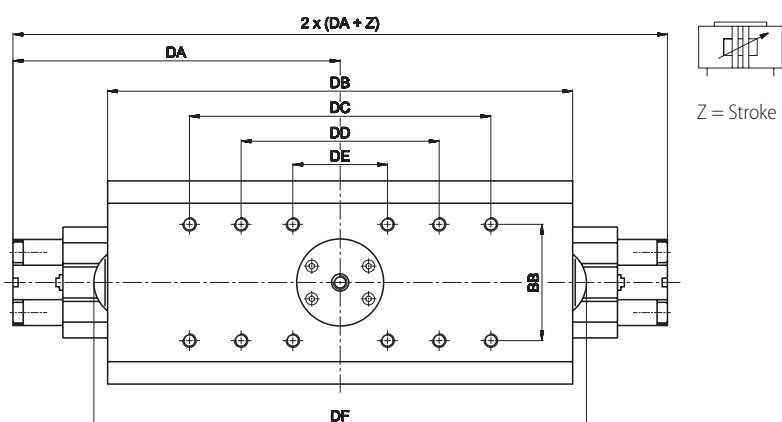


Ø	AA	AB	AC	AD	AE	AF	AG	AH	AI	AK	AL	AM	AN	AO	AP	AQ
25	114,5	136	90	50	160	48,3	28	40,5	83,5	20,2	7	24	7,4	18,2	5,7	G1/8
32	142,5	175	115	55	191	57	35	50	92	25,3	8	29	10,3	22,5	7,3	G1/4
40	169	205	180	75	215	74	44	64	125	33,8	11,8	33	12,5	26,5	8,7	G3/8
50	207	258	190	80	271	90,7	55	80	140	41,4	14,7	33	14,2	25,7	11,8	G3/8

Ø	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF
25	M5	12	M6	10	22,8	42,8	16	12,2	74,3	111	50	M6	10	15	M6
32	M6	15,5	M6	12	28	57	16	14,2	82,5	118	67,5	M6	10	15	M6
40	M8	20	M8	14	37	67	19,5	16,5	106	158	65	M6	15	15	M6
50	M10	20	M8	15	47,7	86	20,5	19,1	126,2	173	100	-	-	12	M6

VL1

RODLESS CYLINDERS WITH 90° INTEGRATED GUIDES WITH LONG CARRIAGE - 12 FIXING HOLES



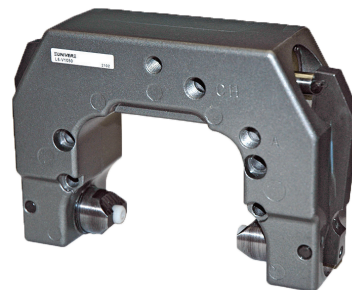
Ø	BB	DA	DB	DC	DD	DE	DF
25	50	147,5	201	130	90	50	225
32	67,5	190	270	175	115	55	286
40	65	225	317	280	185	75	327
50	100	277	398	320	200	80	411

LOCKING UNITS FOR RODLESS CYLINDERS



TECNICAL CHARACTERISTICS

UNIVER Locking Units for rodless cylinders perform the function of keeping the carriage in any intended point of its stroke and allow high locking accuracy. They can be mounted on both sides of the carriage and the mechanical braking force can be further increased by means of an additional pneumatic override.



Pressure

4,5 bar ÷ 10 bar



Temperature

- 20 °C ÷ + 80 °C



Fluid

filtered air, with or without lubrication



Bore

25 - 32 - 40 - 50 mm



Materials and Components

- Body in die-cast aluminium
- Seals in NBR
- Internal parts in brass/aluminium

Series

L 1 - V 1

L1-V1 Locking Units for VL1 series rodless cylinder

Bore (mm)

0 2 5

25 = Ø25
32 = Ø32
40 = Ø40
50 = Ø50

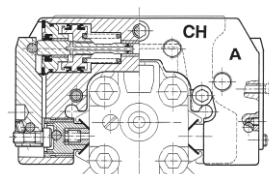


Characteristics

- Min release pressure 4,5 bar
- Able to keep the carriage in position in both directions
- Easy installation, possible by both the carriage sides indifferently.
- Permanent manual release by tightening two M5 screws.
- Locking by means of mechanic springs acting over the carriage in event of lack of air pressure (A).
- To increase the locking force, this unit is ready for an additional pneumatic override (CH).

SERIE VL1 CON BLOCCO DI STAZIONAMENTO L6

MANUAL RELEASE M5X12



STATIC LOCKING FORCE

Ø	Force N	A = CH
25	810	M5
32	1185	G1/8
40	825	G1/8
50	1235	G1/8

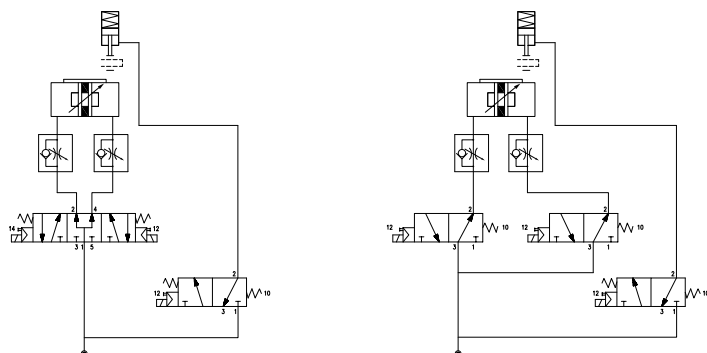
MASS

Code	Ø	Locking unit g
L6-V1025	25	350
L6-V1032	32	460
L6-V1040	40	820
L6-V1050	50	1450

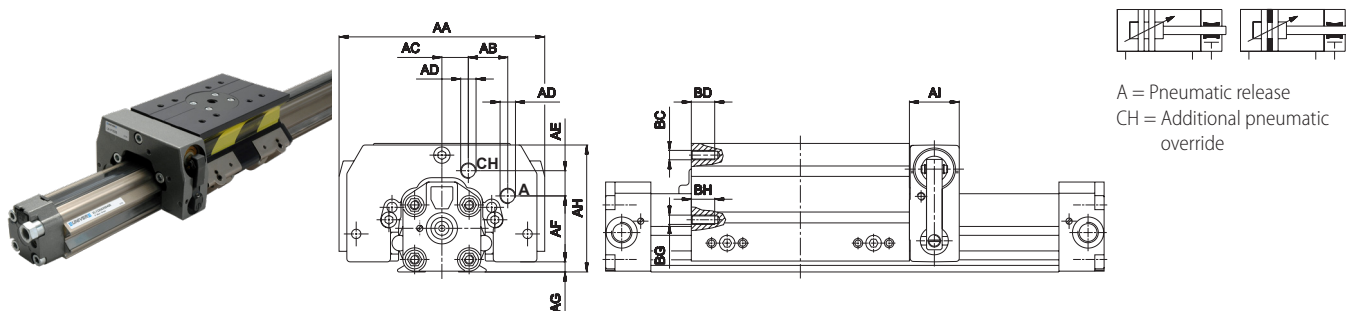
A = Pneumatic release

CH = Additional pneumatic override

SCHEME OF WORKING PRINCIPLE

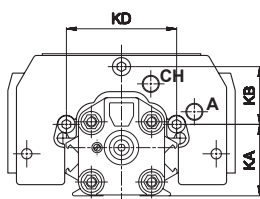


VL1

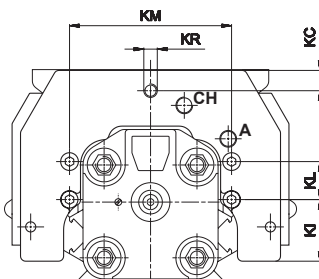


FIXING Ø 25 - 32 - 40

FIXING Ø 50



A = Pneumatic release
CH = Additional pneumatic override



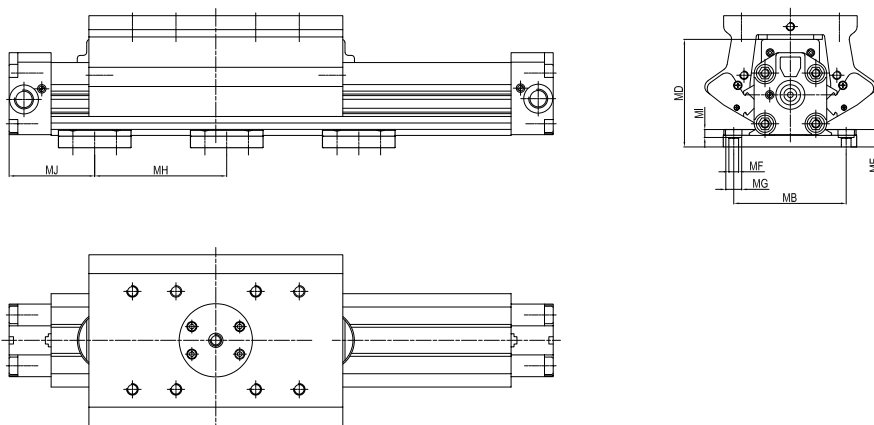
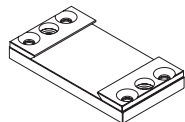
A = Pneumatic release
CH = Additional pneumatic override

Ø	AA	AB	AC	AD	AE	AF	AG	AH	AI	BC	BD	BE	BF	KA	KB	KC	KD	KI	KL	KM	KR
25	120	24,5	12,5	M5	16,5	34,5	7,1	73,6	32	M6	10	M6	10	31,5	28	-	52	-	-	-	-
32	132	25,3	17	G1/8	16,2	42,3	6,5	81,5	32	M6	10	M6	10	35	33,5	-	64	-	-	-	-
40	150	26	17	G1/8	18,2	58,3	9	105	40	M6	15	M6	15	45,3	43,8	-	81,5	-	-	-	-
50	164	26	20	G1/8	19,8	72,5	12,7	125,7	51	-	-	M6	12	-	-	12	-	36,5	22,5	96	M8x14

FIXING ELEMENTS AND ACCESSORIES

SF-12

FIXING PLATE



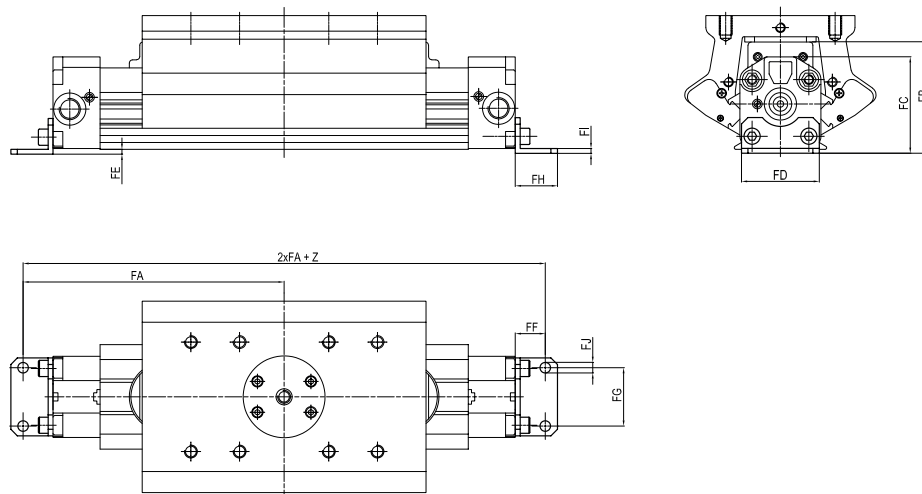
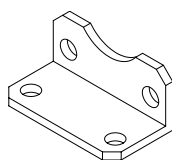
	Ø	MA	MB	MC	MD	ME	MF	MG	MH (a)	MI	MJ	ML	MM	MN	Mass g
SF-12025	25	78,5	63,5	50	79,8	12	M8	11	500	6,5	55	65,5	30	M6	310
SF-12032	32	92	77,5	50	90,5	12	M8	11	600	8,5	60	79,5	30	M6	340
SF-12040	40	117	96	60	116,6	15	M10	14	700	8	70	96	37,5	M8	660
SF-12050	50	136	115	60	133,7	15	M10	14	800	8	70	115	37,5	M8	700

(a) = Max allowable dimension to limit the bending of the cylinder according to the stroke and to provide a correct fixing

Material: Zinc-plated steel

SF-13

ANGLE BRACKET

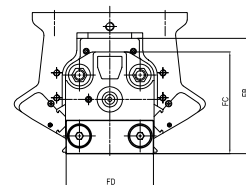
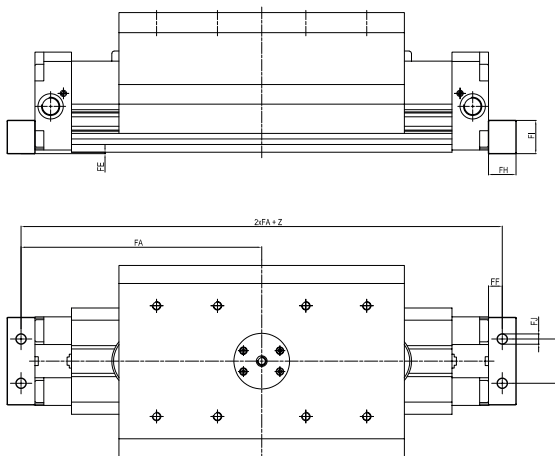
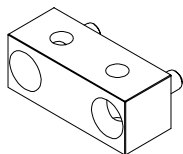


	Ø	FA	FB	FC	FD	FE	FF	FG	FH	FI	FJ Ø	Mass g
SF-13025	25	116	58,1	48,8	40	0,5	16	27	22	2,5	5,5	34
SF-13032	32	143,5	68,7	59,2	48	2,5	18,5	36	26	3	6,5	53

Material: Zinc-plated steel

SF-13

BRACKET



	Ø	FA	FB	FC	FD	FE	FF	FG	FH	FI	FJ Ø	Mass g
SF-13040	40	162,5	86,5	74,9	63	0,7	12,5	30	25	25	9	116
SF-13050	50	187,5	104,3	92,4	79	1,3	12,5	40	25	30	9,3	170

Material: Anodized aluminium