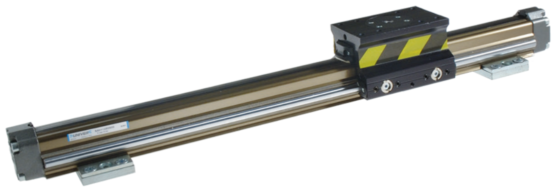
S1-S5-LV1 - RODLESS CYLINDERS

SERIES
S1

Standard version rodless cylinders

SERIES
S5

Rodless cylinders with integrated guides



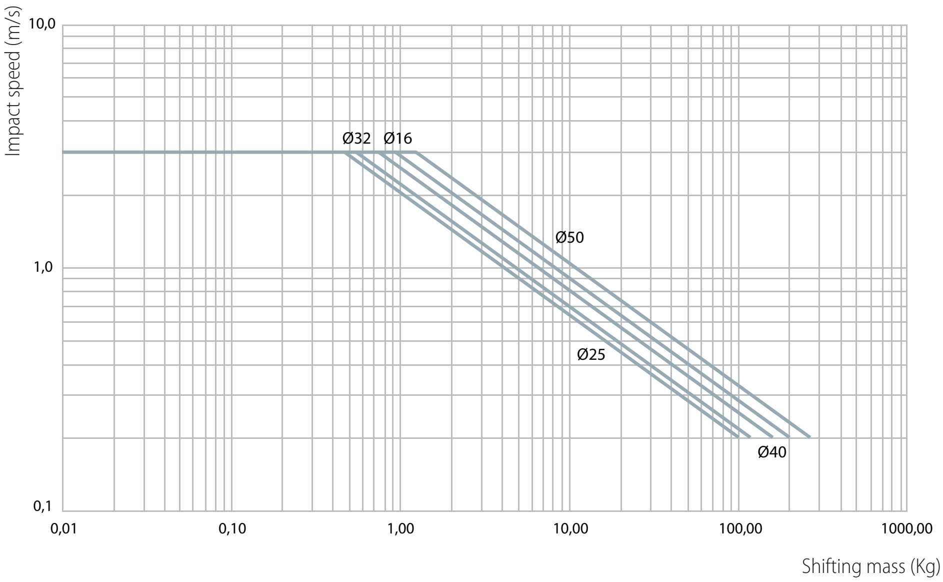
SERIES
VL1

Rodless cylinders with 90° integrated guides

EXAMINATION AND VERIFICATION OF THE CUSHIONING

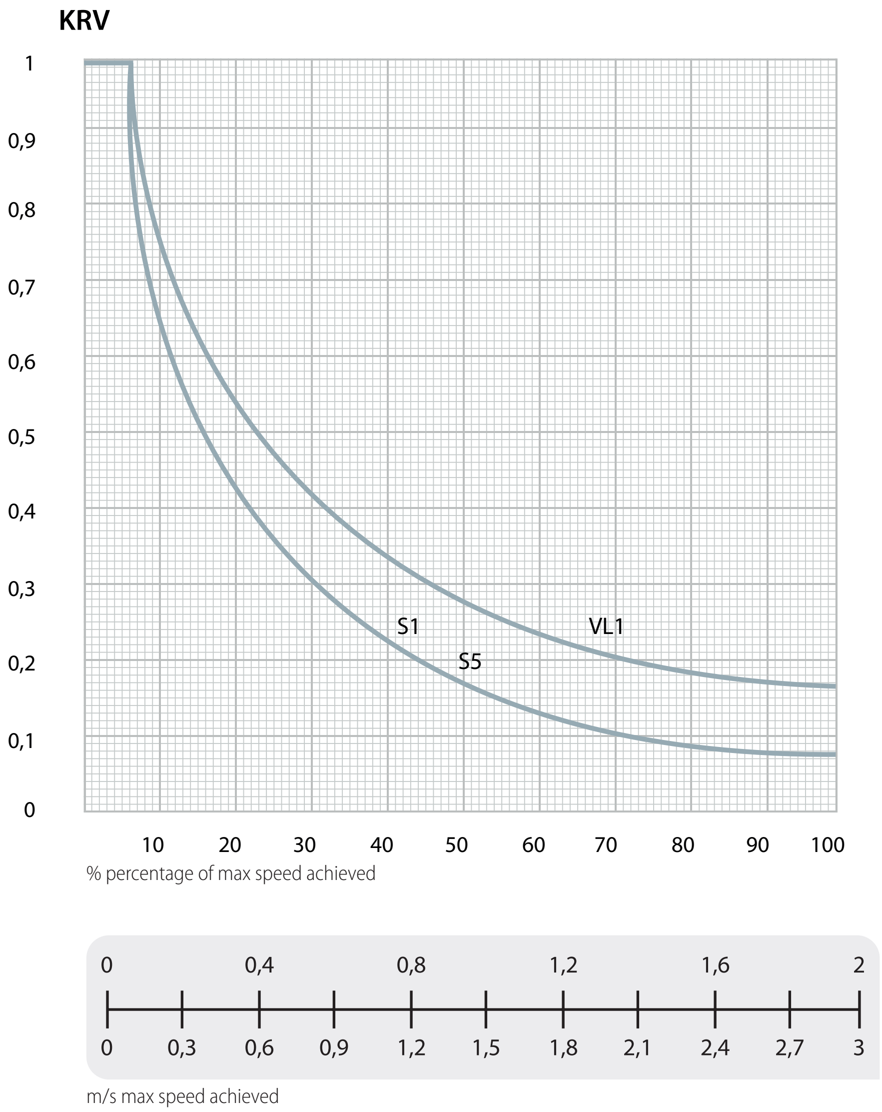
In a system with moving masses, as in the case of rodless cylinders, it is essential to control the dissipation of the system's kinetc energy as it is brought to a stop. First of all, it is necessary to establish and verify the most suitable method for cushioning the system, in order to avoid the moving 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 absorbe the kinetic energy. In that case you must:
a) decrease the load and mantain the translation speed
b) decrease the speed and mantain the load
c) 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:

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

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

CD = CM · KRV

CD = Max. dynamic load (N)
CM = Max. static load (N). See relevant load tables for the various series
KRV = System coeff icient (which acts to reduce the max. load based on the system speed)

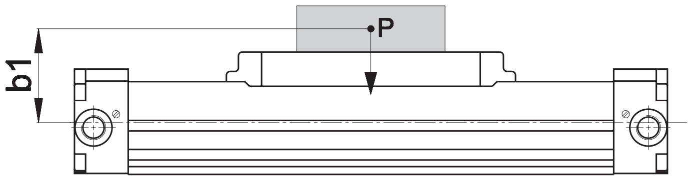
CYLINDER SELECTION

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 dinamic 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)

$$KRV = 0{,}24$$

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

$$CD = CM \cdot KRV$$

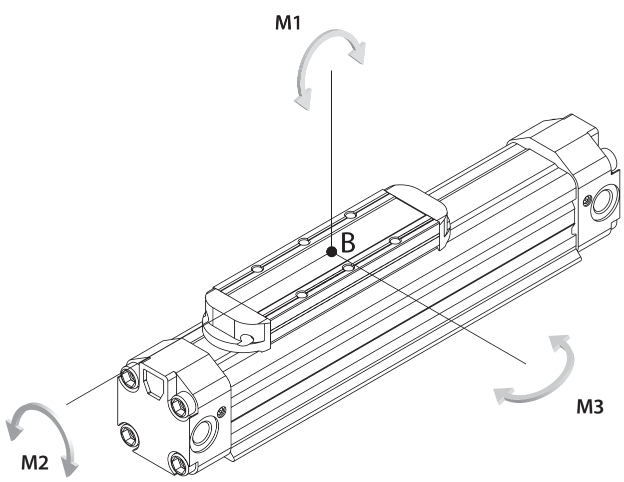
CD = Dynamic load
CM = Static load 500 N (see table for S1 50mm cylinder series - P1)

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

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 infl uence the life of the cylinder.
By selecting a cylinder that can support off-set loads, we can avoid compomising 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.

$$a = \frac{V2}{2L \cdot 10^{-3}} = (m/sec.^2)$$

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

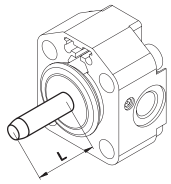
$F = m \cdot a$

$F =$ Force $m =$ Mass (P/9,81)

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

$M1 = F \cdot b1$

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.

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

The equation gives the following result:

M1 = 7,7 Nm < 19 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.

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

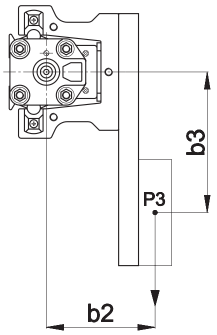
Ec = Kinetic energy
m = Mass (P/9,81)
V = Translation speed (2 m/s)
P = Weight 50 N
9,81 = Acceleration of the centre of gravity

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

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 use 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 N

V = 1,2 m/s

b2 = 150 mm

b3 = 200 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 · KRV

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

CD = 600 · 0,24 = 144 N

As P3 (50 N) < CD (144 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 signifi cant moment M3, so that it is necessary to use a cylinder with an external carrriage.

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

$$a = \frac{V2}{2\,L \cdot 0\text{-}3} = (m/sec.^2)$$

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

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

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

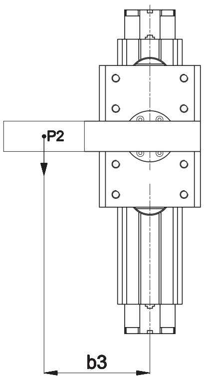
THE EXAMPLE IS SUBJECTED TO MOMENTS M1 - M2 - M3

torque	Torque calculation	Maximum allowable torque
M1 = F × b2	88 × 150 = 13200 N·mm = 13,2 N·m	60 Nm
M2 = P × b2	50 × 150 = 7500 N·mm = 7,5 N·m	30 Nm
M3 = F × b3	88 × 200 = 17600 N·mm = 17,6 N·m	80 Nm

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

CYLINDER WITH MISALIGNED LOAD IN VERTICAL POSITION

In this istance let use 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 b3, at a speed of 1,2 m/s.



P3 = 50 N

V = 1,2 m/s

b2 = 150 mm

b3 = 200 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 coeeficient follow the procedure as given in the examples, which will result in a coefficient of KRV 0,24 (**SEE PICTURES A AND B**).

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

$$P < CD$$

The cylinder is therefore able to move the applied load.
In this application the moment M2 is not generated, as no force is acting transversally to the moving axis; therefore we must calculate only the moments M1 and M3.

$$F = m \cdot a$$

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

$$F = m \cdot a = 88\ N$$ (**esempio B**)

THE EXAMPLE IS SUBJECTED TO MOMENTS M1 - M2 - M3		
torque	**Torque calculation**	**Maximum allowable torque**
M1 = F × b1	88 × 110 = 9680 Nmm = 9,68 Nm	120 Nm
M3 = F × b3	88 × 200 = 17600 Nmm = 17,6 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:

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

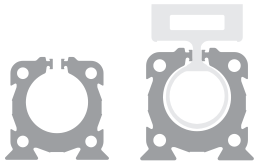
SERIES S1 - RODLESS CYLINDERS STANDARD VERSION

TECNICHAL CHARACTERISTICS

Reference standard

II 2G Ex h IIC T5 Gb

II 2D Ex h IIIC T100°C Db



Pressure

3 bar ÷ 10 bar

Temperature

- 20 °C ÷ + 80 °C

Fluid

filtered air, with or without lubrication

Recommended sensors

DH- DHF
DF only for Ø 16

Bore

16 - 25 - 32 - 40 - 50 mm

Standard strokes

Strokes up to 6000 mm

Operation

Double-acting, magnetically cushioned rodless cylinder. Aluminium profile, Ø16–50 mm, high-speed operation up to 3 m/s. Customizable configurations with carriage and integrated guide available on request.

Materials and Components

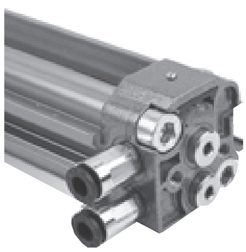
- End caps: zinc alloy (Ø16), die-cast aluminium (Ø25–50)
- Barrel: anodized aluminium
- Piston: aluminium
- Guide carriage: acetal resin
- Double-lip NBR piston seal
- NBR cushioning pads on both ends
- Neodymium magnet

Series	Type	Left-hand side power supply	Right-hand side power supply	Bore (mm)	Stroke (mm)	Magnetic variant
S 1	0	1	1	2 5	1 0 0 0	M
S1 Rodless Cylinders Standard version standard Ø 16÷50 mm	**0** Standard carriage **2** Medium carriage (except for Ø16) **3** Long carriage (except for Ø16)	**0** No supply port (both chambers are supplied from the right end-cap) **1** Side supply port (except for Ø16) **2** Bottom supply port (except for Ø16) **3** Rear supply port (except for Ø16)	**1** Side supply port (except for Ø16) **2** Bottom supply port (except for Ø16) **3** Bottom supply port (except for Ø16) **4** Rear supply ports for both chambers on the right end-cap **5** Side supply ports for both chambers on the right end-cap (only for Ø16)	**16** = Ø16 **25** = Ø25 **32** = Ø32 **40** = Ø40 **50** = Ø50	Up to **5000** (Ø 16) Up to **6000** (Ø 25÷50)	**M** Standard magnetic version

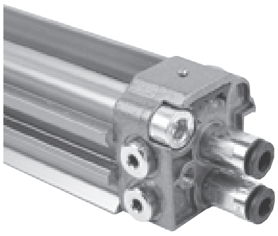
END-CAPS

End-caps in die-cast light alloy with various supply port options. The unique method of stripseal attachment permits easy assembly and disassembly, without the need for tools or the necessity for continous adjustment.

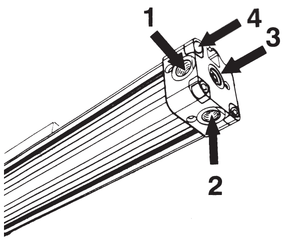
Ø 16 MM	Ø 25 ÷ 50 MM



Double side supply ports



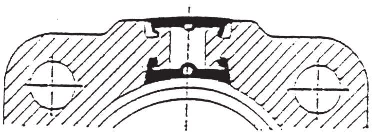
Double rear supply ports



0 = no supply port (on left end-cap only when both chambers are supplied from the right end-cap)
1= side
2= bottom
3= rear
4= both chambers supplied from one end-cap

SLIDEWAY SEALING

The pneumatic sealing is achieved through an axial elastomer stripseal reinforced with Kevlar. This system guarantees dimensional stability even with high speeds. The external protection seal consists of a thermoplastic stripseal reinforced with Kevlar.



PISTON-CARRIAGE ASSEMBLY
In extruded aluminium alloy with thermoplastic plane guide bearings. The piston is fi tted with double lip seals which automatically self-compensate against wear. Pistons with permanent magnets are available upon request (S1 series only).

BARREL
In extruded aluminium alloy with internal and external anodisation.

CUSHIONINGS
Pneumatic adjustable cushionings with two regulation screws in each end-cap allow an improved regulation of piston deceleration.

MECHANICAL SHOCK ABSORBERS
Mechanical rubber shock absorbers avoid mechanical stress and reduce machinery noise (below 50 dB).

STROKE TOLERANCES

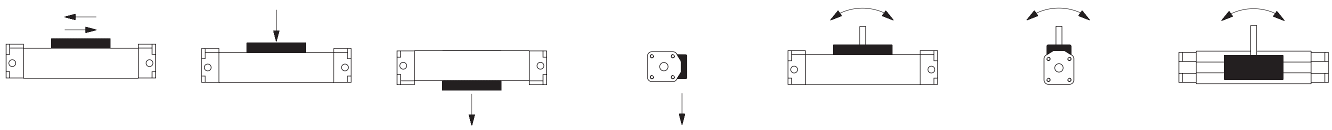
Ø	mm
16	+2,5 -0
25	+2,5 -0
32	+3,2 -0
40	+3,2 -0
50	+3,2 -0

	CYLINDER MASS STANDARD CARRIAGE	CYLINDER MASS MEDIUM CARRIAGE	CYLINDER MASS LONG CARRIAGE	
Ø	Cylinder - stroke 0 g	Cylinder - stroke 0 g	Cylinder - stroke 0 g	Increase for 100 mm stroke g
16	310	-	-	104
25	750	840	1050	210
32	1310	1480	1930	325
40	2600	2910	3800	555
50	4785	5550	7330	955

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.

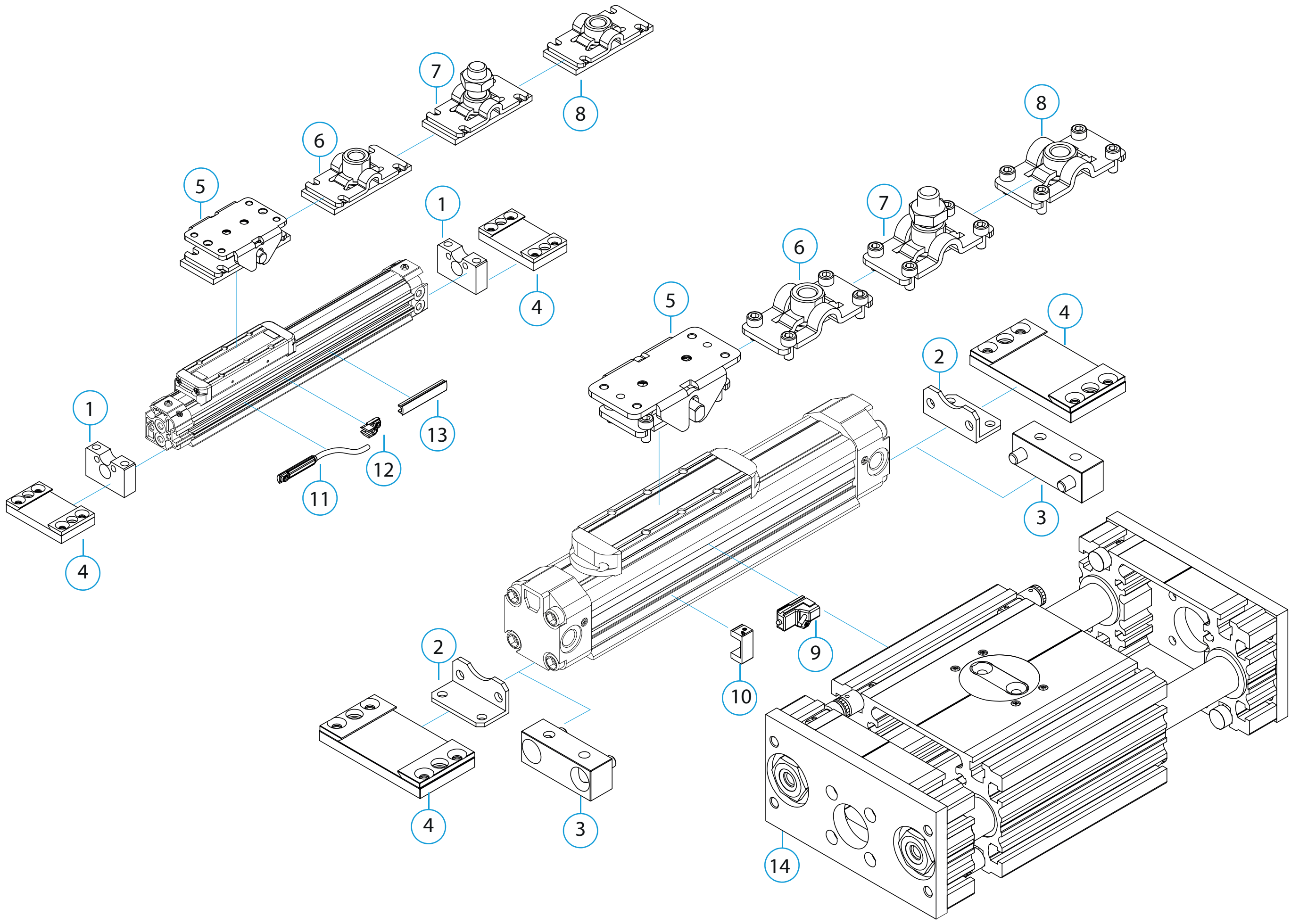
Force		Load		Bending moment	Torque	Bending moment
6 bar	P1	P2	P3	M1	M2	M3



Ø	Forc e	Load			Standard carriage			Medium carriage			Long carriage		
	F (N)	P1 (N)	P2 (N)	P3 (N)	M1 (Nm)	M2(a) (Nm)	M3 (Nm)	M1 (Nm)	M2(a) (Nm)	M3 (Nm)	M1 (Nm)	M2 (Nm)	M3 (Nm)
16	125	100	100	25	5	0,2	0,8	-	-	-	-	-	-
25	250	200	200	50	8	2	3	14	3	5	15	6	9
32	420	250	250	65	9	3	4	15	4	7	28	8	12
40	640	350	350	90	11	9	14	16	14	20	31	27	39
50	1050	500	500	125	19	13	19	29	20	30	52	36	53

(a) = Using the cylinder with heavy stress is not recommended

FIXING ELEMENTS AND ACCESSORIES

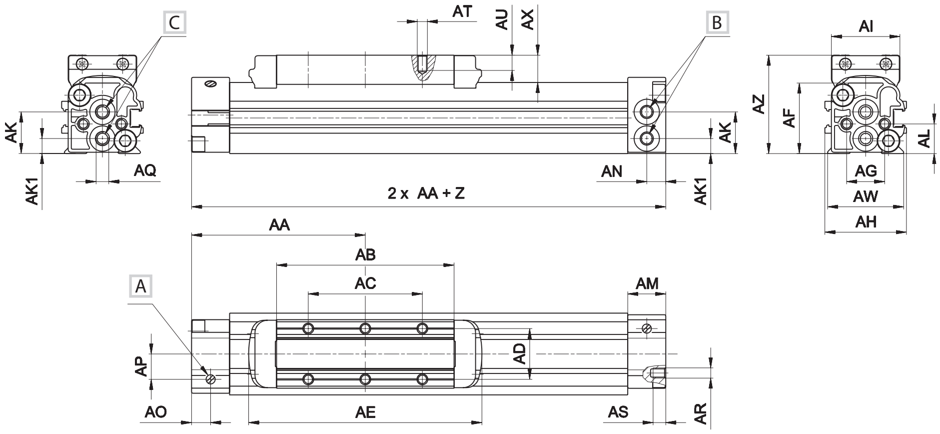


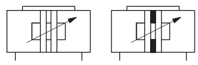
1	Bracket Ø16 **SF-13**
2	Angle bracket Ø25-32 **SF-13**
3	Bracket Ø40-50 **SF-13**
4	Fixing plate **SF-12**
5	Oscillating bracket **SF-24**
6	Female threaded connection **SF-26**
7	Male threaded pin **SF-27**
8	Female connection without thread **SF-28**
9	sensor **DH**
10	sensor fixing plate **DH-S**
11	**DF** sensor (Ø16 only)
12	Cable clamping for DF sensor (Ø16 only) **DF-001**
13	DHF covering strip (Ø16 only) **DHF-0020100**
14	Slide unit **J30A**

S1

RODLESS CYLINDER WITH STANDARD CARRIAGE - 6 FIXING HOLES

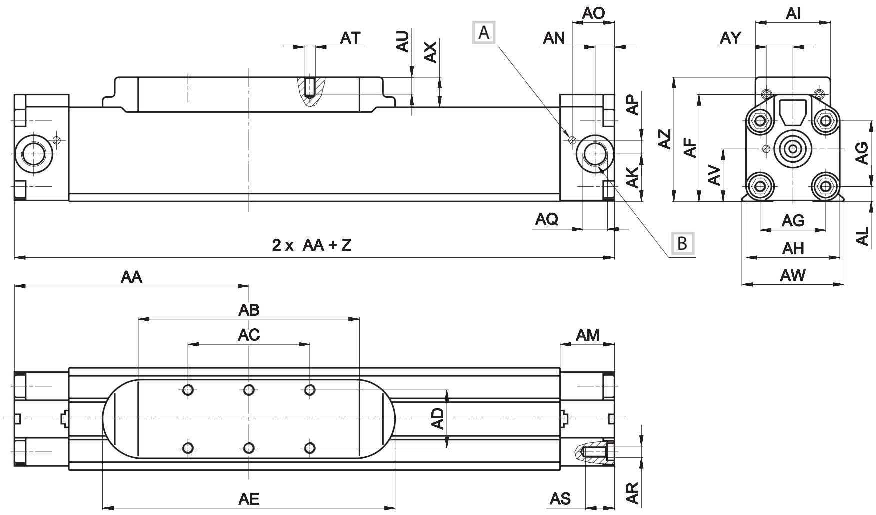
Ø 16 MM

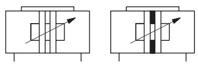




A Pneumatic cushioning adjusting screw
B Side supply port
C Rear supply port
Z = Stroke

Ø 25÷50 MM





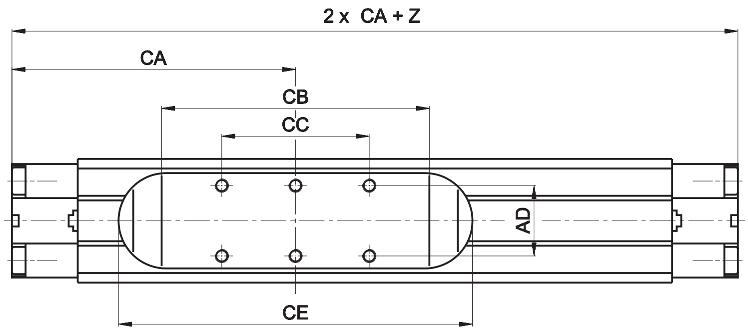
A Pneumatic cushioning adjusting screw
B Side supply port
Z = Stroke

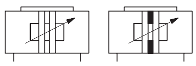
Ø	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ
16	7,5	7,5	10	M5	M4	5	M4	6	-	30	11	-	39
25	7,4	18,2	5,7	G1/8	M5	12	M5	9	22,8	42,8	16	12,2	57,6
32	10,3	22,5	7,3	G1/4	M6	15,5	M6	9	28	54,5	16	14,2	66,2
40	12,5	26,5	8,7	G3/8	M8	20	M6	11	37	67	19,5	16,5	85,8
50	14,2	25,7	11,8	G3/8	M10	20	M8	12	47,7	86	20,5	19,1	103

Ø	AA	AB	AC	AD	AE	AF	AG	AH	AI	AK	AK	AL	AM
16	68,5	70	45	20	92	30	18	32	27	16,5	6	11,5	15
25	100	95	50	24	130	48,3	28	40,5	33	20,2	-	7	24
32	125	118	65	31	156	57	35	50	40	25,3	-	8	29
40	150	134	65	31	177	74	44	64	44	33,8	-	11,8	33
50	175	164	105	39	211	90,7	55	80	54	41,4	-	14,7	33

S1

RODLESS CYLINDER WITH MEDIUM CARRIAGE - 6 FIXING HOLES Ø 25 ÷ 50 MM

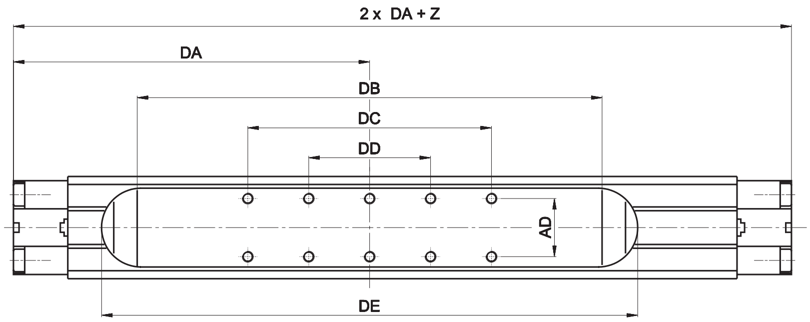


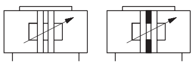


Z = Stroke

S1

RODLESS CYLINDER WITH LONG CARRIAGE - 10 FIXING HOLES Ø 25 ÷ 50 MM



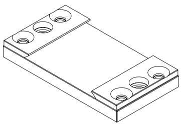


Z = Stroke

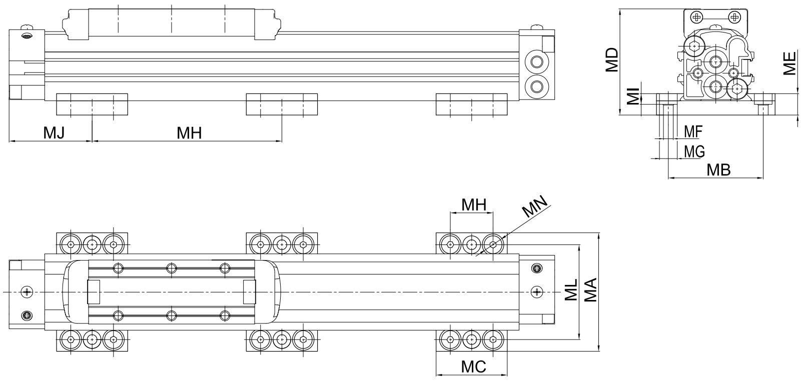
Ø	AD	CA	CB	CC	CE	DA	DB	DC	DD	DE
25	24	114,5	125	50	160	147,5	190	100	50	225
32	31	142,5	153	65	191	190	248	130	65	286
40	31	169	172	65	215	225	284	130	65	327
50	39	205	224	105	271	277	364	315	105	411

SF-12

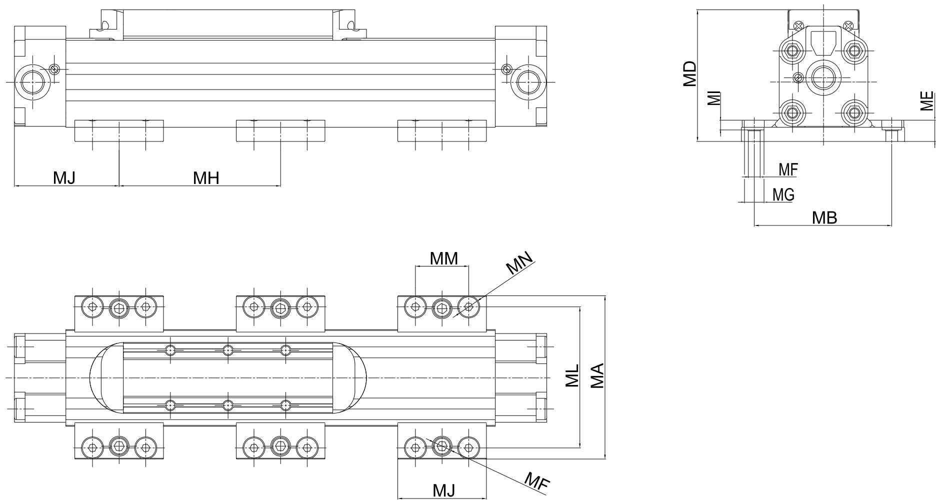
FIXING PLATE



Ø 16 mm



Ø 25÷50 mm



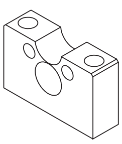
	Ø	MA	MB	MC	MD	ME	MF	MG	MH (a)	MI	MJ	ML	MM	MN	Mass g
SF-12016	16	50	40	30	44,8	9	M5	8	400	4,5	35	40	-	M6	83
SF-12025	25	78,5	63,5	50	65,6	12	M8	11	500	6,5	55	65,5	30	M6	310
SF-12032	32	92	77,5	50	74,2	12	M8	11	600	8,5	60	79,5	30	M6	340
SF-12040	40	117	96	60	95,8	15	M10	14	700	8	70	96	37,5	M8	660
SF-12050	50	136	115	60	113	15	M10	14	800	8	70	115	37,5	M8	700

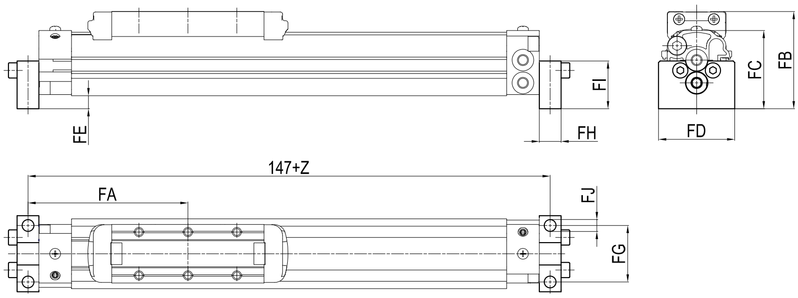
(a) = Max allowable dimension to limit the bending of the cylinder according to the stroke and to provide a correct fixing

Material: zinc-plated steel

SF-13

BRACKET



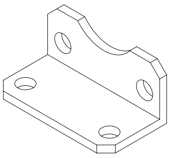


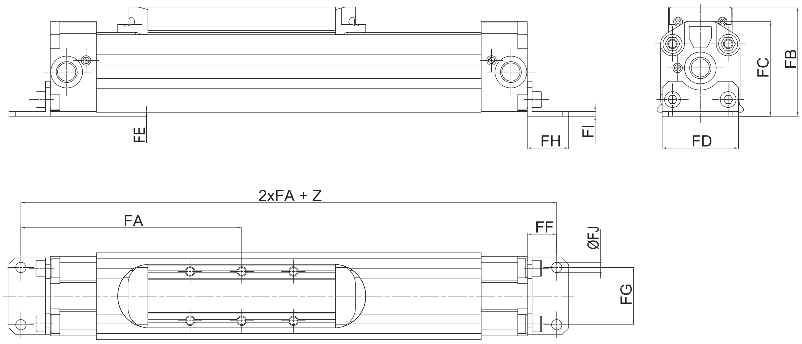
	Ø	FA	FB	FC	FD	FE	FG	FH	FI	FJ Ø	Mass g
SF-13016	16	73,5	45	36	35	6	26	10	22	5,5	15

Material: Anodized aluminium

SF-13

ANGLE BRACKET



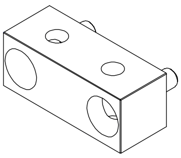


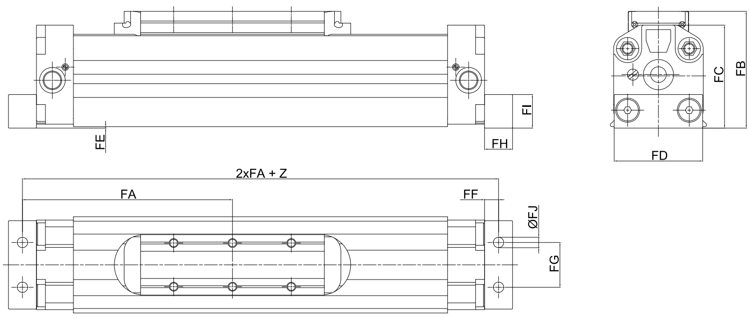
	Ø	FA	FB	FC	FD	FE	FF	FG	FH	FI	FJ Ø	Mass g
SF-13025	25	116	58,1	48,8	40	0,5	16	27	22	2,5	5,5	34
SF-13032	32	143,5	68,7	59,2	48	2,5	18,5	36	26	3	6,5	53

Material: Zinc-plated steel

SF-13

BRACKET



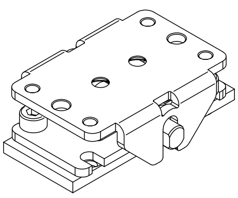


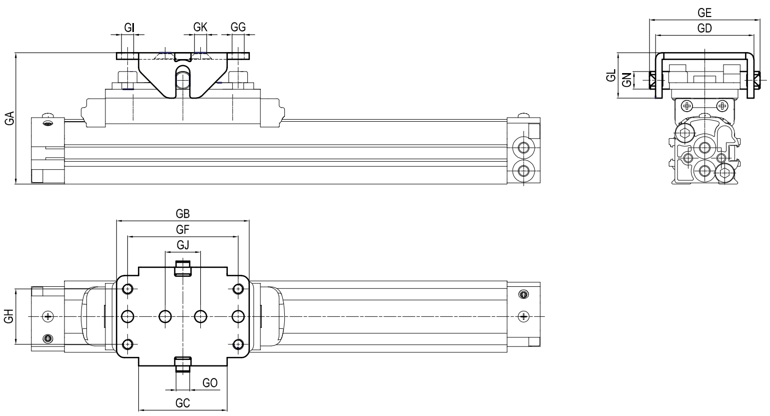
	Ø	FA	FB	FC	FD	FE	FF	FG	FH	FI	FJ Ø	Mass g
SF-13040	40	162,5	86,5	74,9	63	0,7	12,5	30	25	25	9	116
SF-13050	50	187,5	104,3	92,4	79	1,3	12,5	40	25	30	9,3	170

Material: Anodized aluminium

SF-24

OSCILLATING BRACKET





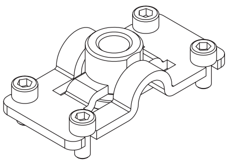
	Ø	GA	GB	GC	GD	GE	GF	GG Ø	GH	GI	GJ	GK Ø	GL	GM	GN Ø	GO	Mass g
SF-24016	16	58	60	40	44,5 ± 0,25	50	50	5,5	25	M5	16	5,5	20,5	3	8	6	195
SF-24025	25	73,5 ± 2,5	60	40	44,5 ± 2,5	50	50	5,5	25	M5	16	5,5	20,5	3	8	6,15	142
SF-24032	32	89 ± 4	100	60	56 ± 4	64	80	5,5	30	M6	40	6,5	30	4	12	8,2	362
SF-24032	40	108,5 ± 4	100	60	56 ± 4	64	80	5,5	30	M6	40	6,5	30	4	12	8,2	362

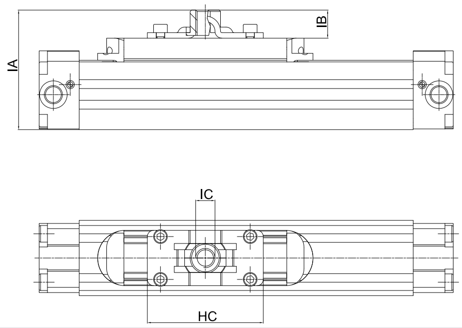
Use in case of external guide

Material: Zinc-plated steel

SF-26

FEMALE THREADED CONNECTION



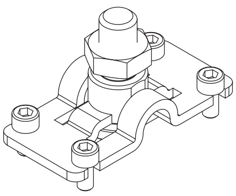


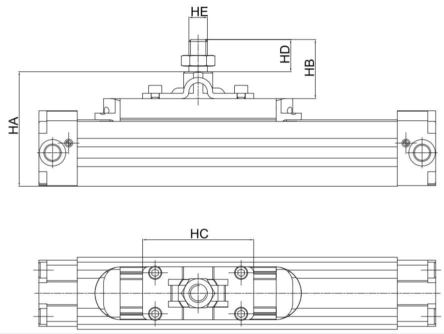
	Ø	IA	IB	IC	HC	Mass g
SF-26016	**16**	61	22	M12	64	132
SF-26025	**25**	75,6	18	M12	64	76
SF-26032	**32**	87,2	21	M14	84	157
SF-26032	**40**	106,8	21	M14	84	157

Material: Zinc-plated steel

SF-27

MALE THREADED PIN



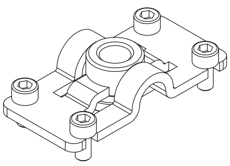


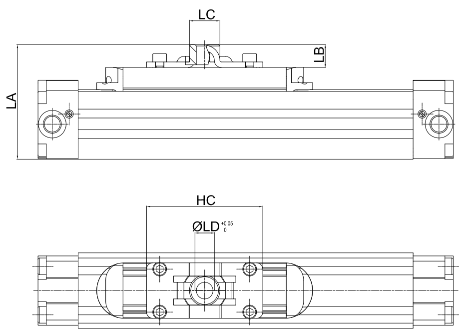
	Ø	HA	HB	HC	HD	HE	Mass g
SF-27016	**16**	76,5	37,5	64	22	M12	160
SF-27025	**25**	91,1	33,5	64	22	M12	105
SF-27032	**32**	107,7	41,5	84	24,3	M14	260
SF-27032	**40**	127,3	41,5	84	24,3	M14	260

Material: Zinc-plated steel

SF-28

FEMALE CONNECTION WITHOUT THREAD





	Ø	LA	LB	LC	LD	LH	Mass g
SF-28016	**16**	56	17	18	10	64	129
SF-28025	**25**	70,6	13	18	10	64	73
SF-28032	**32**	83,4	17,2	22	12	84	152
SF-28032	**40**	103	17,2	22	12	84	152

Material: Zinc-plated steel