Fluidic Muscle DMSP/MAS

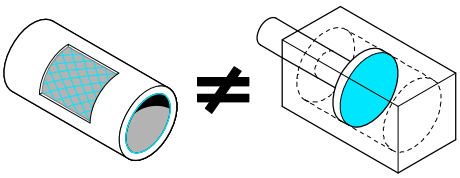
FESTO

Fluidic Muscle DMSP/MAS

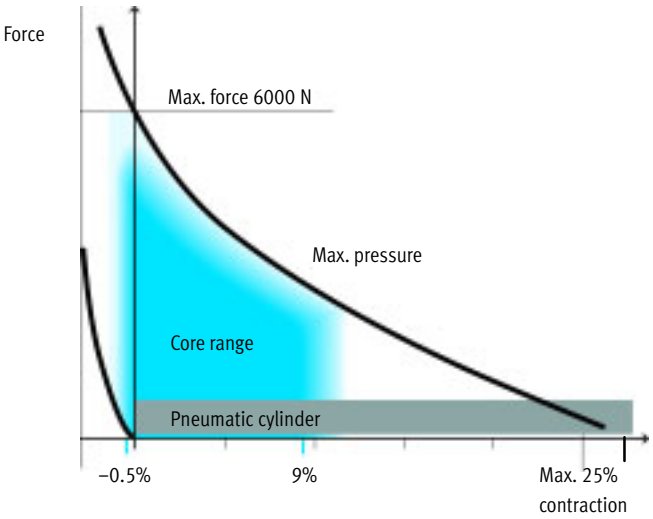
Key features

Mode of operation

Fluidic Muscle is a tensile actuator which mimics the natural movement of a muscle. It consists of contractible tubing and appropriate connectors. The contractible tubing is made up of a rubber diaphragm with a non-crimped fibre made of aramid yarns on the inside. The diaphragm provides a hermetic seal enclosing the operating medium. The yarns serve as a reinforcement and transmit power. When internal pressure is applied, diaphragm extends in the circumferential direction. This creates a tensile force and a contraction motion in the longitudinal direction. The usable tensile force is at its maximum at the start of the contraction and then decreases with the stroke.



Force profile and operating range



The muscle expands lengthways when it is pretensioned by an external force. When pressurised, on the other hand, the muscle contracts, i.e. its length decreases.

Areas of application

Clamping

- High force combined with a small diameter
- Insensitive to dirt
- Frictionless movement
- Hermetically sealed

Vibrating and shaking

- Frequency up to 150 Hz
- Amplitude/frequency can be adjusted independently of each other
- Insensitive to dirt

Pneumatic spring

- Adjustable spring force
- Frictionless movement
- Hermetically sealed
- Easy to handle

Other

- Positioning using pressure
- High acceleration of a load

Fluidic Muscle DMSP/MAS

Key features

Fluidic Muscle DMSP with press-fitted connection

➔ 11

In the DMSP, the diaphragm is crimped by means of a sleeve and the adapters are integrated.
The DMSP is further distinguished from the MAS by its compact design (25% smaller cross section, 30% lighter).

Fluidic Muscle MAS with screwed connections

➔ 20

In the MAS, the diaphragm is clamped by means of a threaded connection.
Adapter and threaded rod are available separately.
The MAS is optionally available with force limiter.

Nominal length

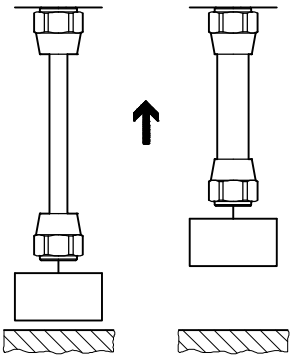
The nominal length of the Fluidic Muscle is defined in the non-pressurised, load-free state. It corresponds to the visible muscle length between the connections (➔ 16).

Single-acting actuator

Sizing examples ➔ 33

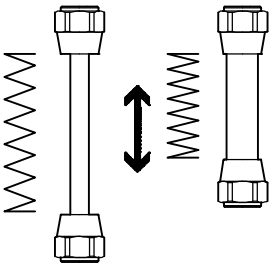
In the simplest case, the Fluidic Muscle operates as a single-acting actuator against a mechanical spring or a load. The mechanical spring pretensions the muscle out of its normal position when in the expanded, non-pressurised state. Ideal: 0.5% of nominal length. This operating state is ideal with regard to the technical properties of the Fluidic Muscle: in the unpressurised state, the diaphragm is not compressed. When pressurised, a muscle pretensioned in this way develops maximum force with optimum dynamic characteristics and minimum air consumption.
The most effective operating range is provided with contractions below 9%. The smaller the degree of contraction of the Fluidic Muscle, the more effectively it works.

Load = Constant



The muscle behaves like a spring when there is a change in external force: it follows the application of force. With the Fluidic Muscle, both the pretensioning force of this “pneumatic spring” and its spring stiffness can be varied. The Fluidic Muscle can be operated as a spring with constant pressure or constant volume. This produces different spring characteristics that enable the spring effect to be matched perfectly to the application.

Pressure/volume = Constant



- - Note

If the muscle is fed with compressed air and the volume id blocked, the pressure in the muscle can increase significantly when the external force is varied.

Fluidic Muscle DMSP/MAS

Key features

Sizing

The simplest and most reliable way to ensure correct sizing is by going through the specialist department “Membrane Technologies” at Festo. Otherwise, calculation software is available to help you size the Fluidic Muscle. You can also use the force/displacement graphs to make a rough estimate.

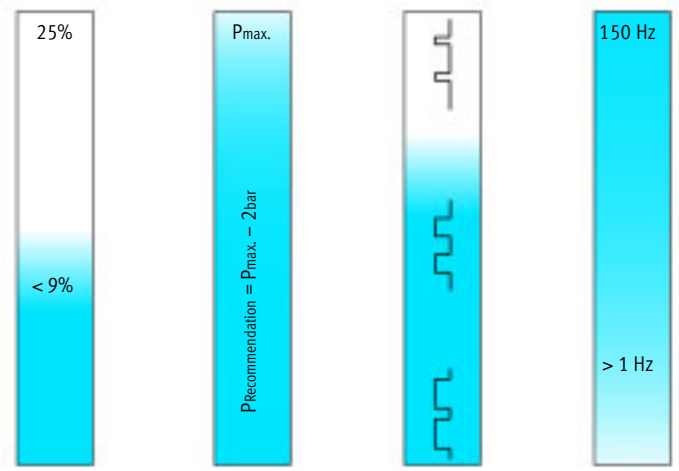
Sizing of the Fluidic Muscle is explained using examples ➔ 33.

- - Note

Do you need technical support?
We will be happy to help!

Membrane Technologies
➔membrantechnologie@festo.com

Efficient range



Contraction | Operating pressure | Motion sequence | Frequency

- - Note

- Kinking, compression or torsion are not permissible
  ➔ lead to failure of the diaphragm
- Pretensioning by up to 0.5% will prevent kinking and compression
- Avoid unpressurised state
  ➔ residual pressure up to 0.5 bar

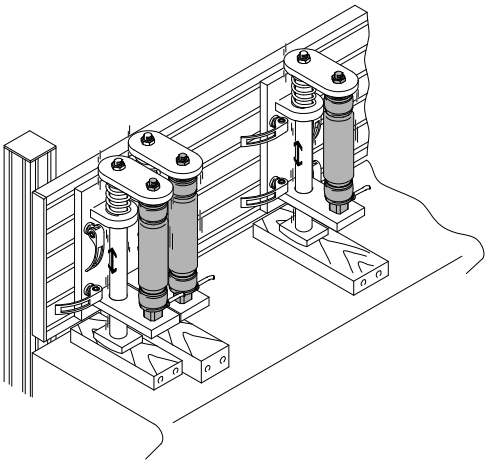
Fluidic Muscle DMSP/MAS

Application examples

Successful areas of application
Clamping

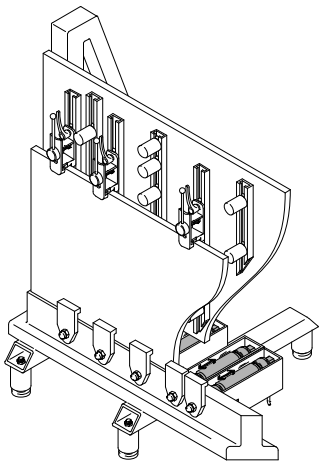
- High force combined with a small diameter
- Insensitive to dirt
- Frictionless movement
- Hermetically sealed

Clamping workpieces



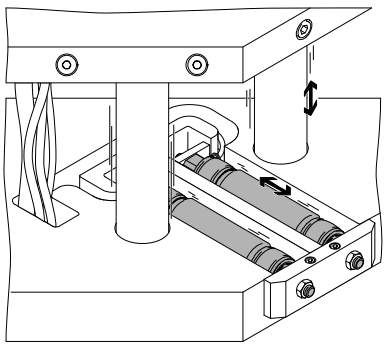
High forces combined with a small diameter? Not a problem for the Fluidic Muscle.
Thanks to its small diameter, it can be integrated and used in the smallest of spaces, e.g. when clamping workpieces. It has an initial force 10 times higher than that of a conventional pneumatic cylinder.

Clamping metal sheets



The Fluidic Muscle enables large and unwieldy workpieces, such as plates, walls and side covers, to be easily clamped so they can be machined (turning, drilling, milling). This brings out the muscle's outstanding characteristics, such as high force combined with a small diameter, frictionless and thus jerk-free movement, insensitivity to dirt (swarf, abraded particles) and hermetically sealed design.

Clamping parts to be joined



In joining processes such as those that take place in welding machines, the components to be welded are held in place by the Fluidic Muscle during the joining procedure. Here, too, the muscle can make the most of its high force combined with a small diameter.

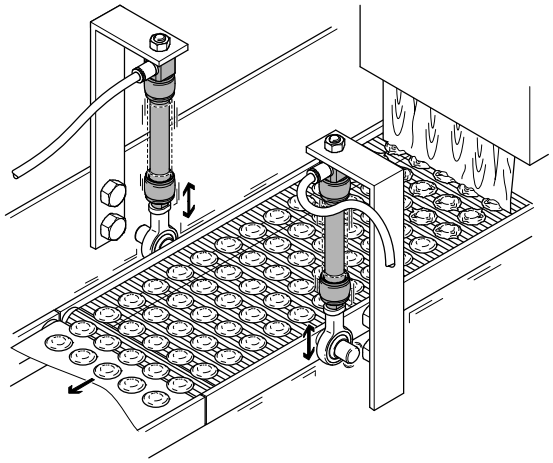
Fluidic Muscle DMSP/MAS

Application examples

Successful areas of application
Vibrating and shaking

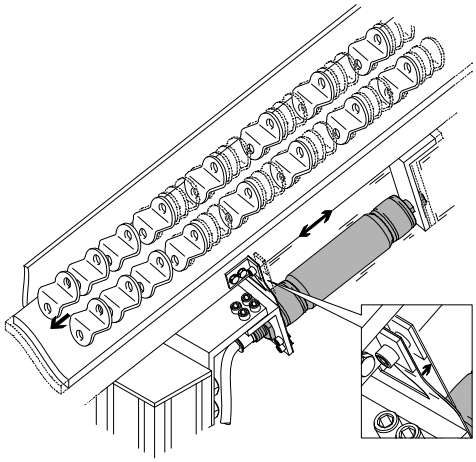
- Frequency up to 150 Hz
- Amplitude/frequency can be adjusted independently of each other
- Insensitive to dirt

Distributing



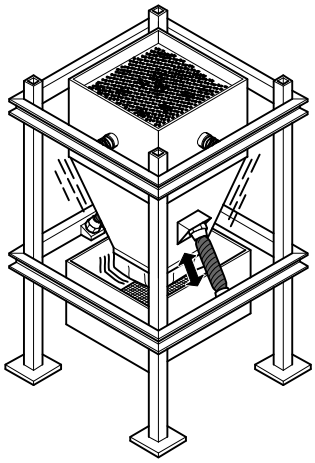
When a viscous coating agent is applied to a fixed substance carrier, a vibrating support is required to ensure even distribution over the surface. In the case of strokes of less than 1 mm, the Fluidic Muscle can achieve cycle rates of up to 150 Hz.

Conveying



The Fluidic Muscle is exceptionally well suited to transporting or aligning parts. Amplitude and cycle rate can be adjusted simply and independently of each other. The muscle's flexibility makes it possible to set the optimum conveying speed for any conveying process.

Releasing



Hoppers and silos are often susceptible to problems, such as a “jamming arch” forming during feeding. In practice, discharge aids such as vibrators or knockers are used to prevent such a jam from forming. This function can be implemented with the help of the Fluidic Muscle. The frequency can be set in an infinitely adjustable manner up to 150 Hz, independently of the amplitude. This guarantees a continuous conveying process.

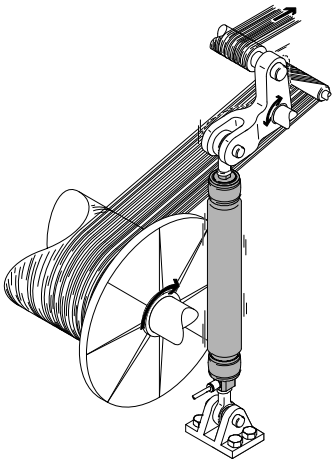
Fluidic Muscle DMSP/MAS

Application examples

Successful areas of application
Pneumatic spring

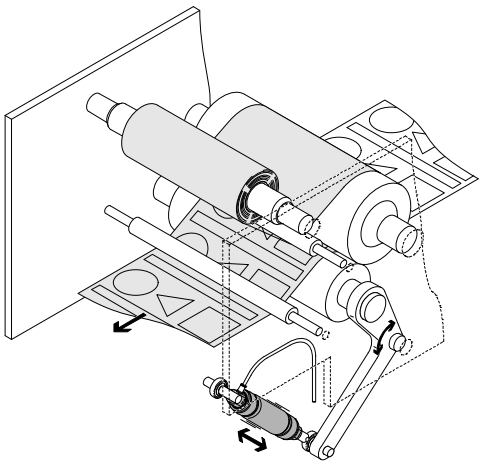
- Adjustable spring force
- Frictionless movement
- Hermetically sealed
- Easy to handle

Stress equalisation



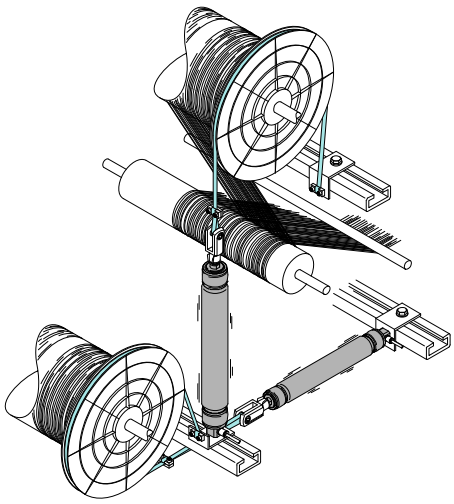
In all applications in which threads, films, papers or tapes are transported or wound and unwound using rollers, high stresses develop (peak stresses) and the continuous material being transported can tear. With its adjustable spring force and frictionless movement, the Fluidic Muscle can absorb these stresses. The muscle stands out because of the simple adjustment of the spring strength by means of the pressure and hence by its ease of use. Changes to the process require a change of the mechanical spring and weights. The Fluidic Muscle is an excellent replacement for existing solutions using loads and mechanical springs.

Adjustable contact pressure



The Fluidic Muscle is exceptionally well suited to pressing on rollers. The contact pressure can be varied using the operating pressure. The design means that components do not become stuck and there are thus no peak forces. The Fluidic Muscle is hermetically sealed and can be disconnected from the compressed air supply. It will nevertheless continue to perform its function.

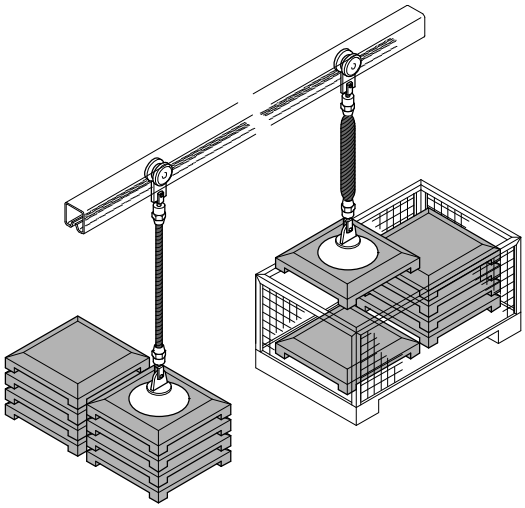
Brakes for tension regulation



The spring properties of the Fluidic Muscle make it exceptionally well suited to regulating the thread tension when winding threads. The tension in the threads is always as high as it needs to be for the process in question. This means that the optimum thread tension is always available, leading to better protection of the threads and counteracting wear on all components.

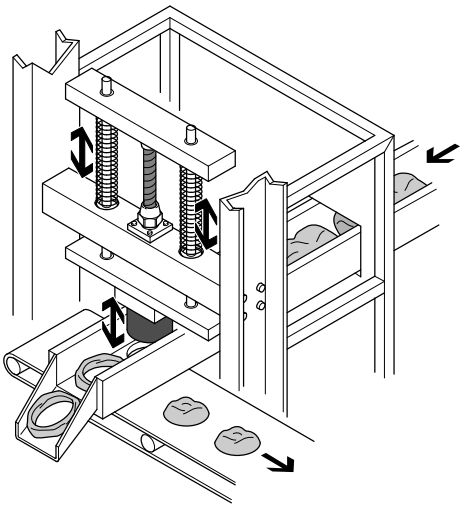
Other possible applications

Lifting aid



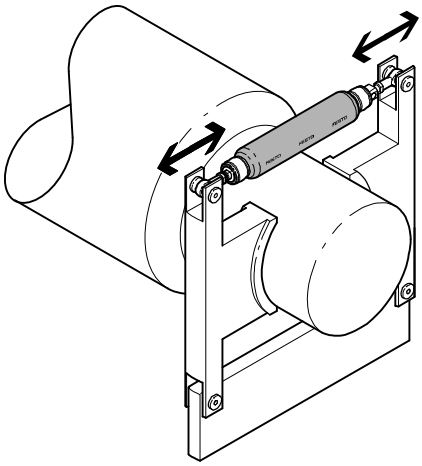
Achieving intermediate positions? Very simple, using pressure regulation: the workpieces can be raised or lowered as required by pressurising or exhausting the muscle via a hand lever valve. Muscle lengths up to 9 m facilitate various types of application.

Punching



Very high cycle rates can be achieved with the muscle, on the one hand because of its low weight and on the other because it has no moving parts (e.g. a piston). The simple design – one muscle pretensioned using two springs – replaces a complicated toggle lever clamping system using cylinders.

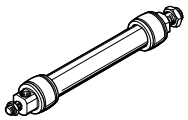
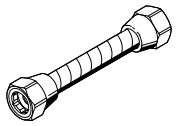
Emergency stop device



The Fluidic Muscle is setting benchmarks in applications that require fast response times. The emergency stop for rollers demands both speed and a high initial force. This can prevent risks to the operator in the event of malfunctions.

Fluidic Muscle DMSP/MAS

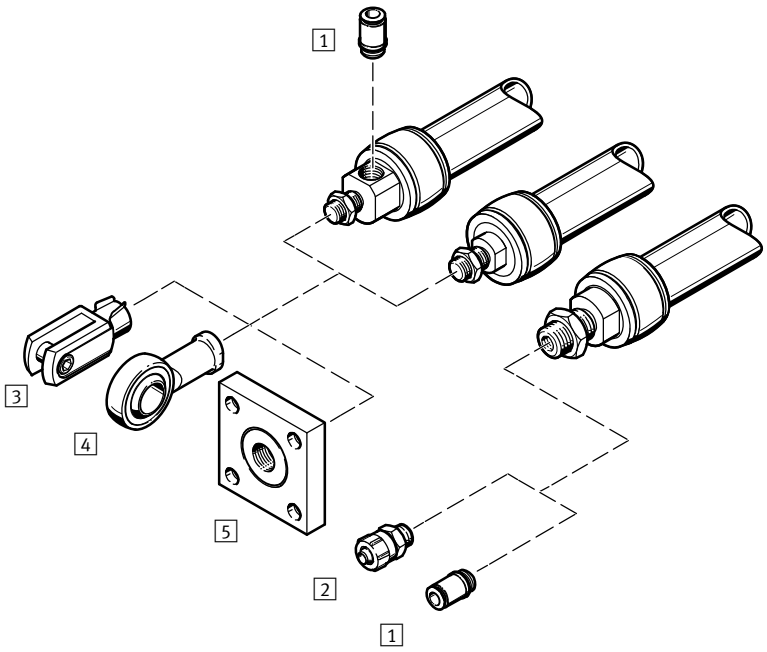
Product range overview

Function	Version	Type	I.D. [mm]	Nominal length [mm]	Lifting force [N]
Single-acting, pulling	**Fluidic Muscle with press-fitted connection**				
		DMSP	5	30 ... 1000	0 ... 140
			10	40 ... 9000	0 ... 630
			20	60 ... 9000	0 ... 1500
			40	120 ... 9000	0 ... 6000
	Fluidic Muscle with screwed connection				
		MAS	10	40 ... 9000	0 ... 630
			20	60 ... 9000	0 ... 1500
			40	120 ... 9000	0 ... 6000

Type	I.D. [mm]	Max. permissible pretensioning	Max. permissible contraction	Operating pressure [bar]	→ Page/Internet
Fluidic Muscle with press-fitted connections					
DMSP	5	1% of nominal length	20% of nominal length	0 ... 6	11
	10	3% of nominal length	25% of nominal length	0 ... 8	
	20	4% of nominal length	25% of nominal length	0 ... 6	
	40	5% of nominal length	25% of nominal length	0 ... 6	
Fluidic Muscle with screwed connection					
MAS	10	3% of nominal length	25% of nominal length	0 ... 8	20
	20	4% of nominal length	25% of nominal length	0 ... 6	
	40	5% of nominal length	25% of nominal length	0 ... 6	

Fluidic Muscle DMSP with press-fitted connection

Peripherals overview



Accessories

		Description	Size				→ Page/Internet
			5	10	20	40	
1	Push-in fittings QSM/QS	For connecting compressed air tubing with standard outside diameters	■	■	■	■	qs
2	Quick connectors CK	For connecting compressed air tubing with standard internal diameters	–	■	■	■	ck
3	Rod clevis SG	Permits swivel motion of the Fluidic Muscle in one plane	■	■	■	■	19
4	Rod eye SGS	With spherical bearing	■	■	■	■	19
5	Coupling pieces KSZ	To compensate for radial deviations	■	■	■	■	19
	Coupling pieces KSG	To compensate for radial deviations	–	■	■	■	19

Fluidic Muscle DMSP with press-fitted connection

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Type codes

DMSP	–	5	–	500N	–	RM	–	CM	–	

Drive function	
Single-acting, pulling	
DMSP	Fluidic Muscle

I.D. [mm]

Nominal length [mm]	
...N	30 ... 9000

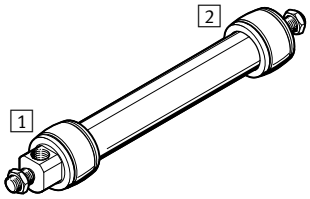
First connection	
RM	Pneumatic connection, radial
AM	Pneumatic connection, axial

Second connection	
RM	Pneumatic connection, radial
AM	Pneumatic connection, axial
CM	No pneumatic connection, with male thread
CF	No pneumatic connection, with female thread

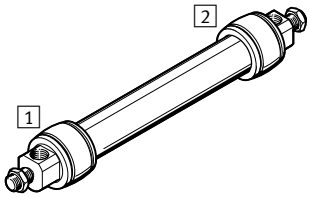
Operating instructions	
–	Standard
DN	Express waiver – no operating instructions to be included (already available)

Variants

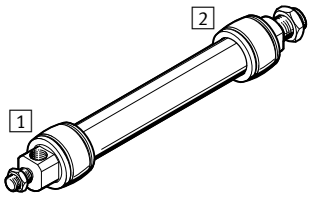
DMSP-...-RM-CM
1 Radial connection
2 No connection, with male thread



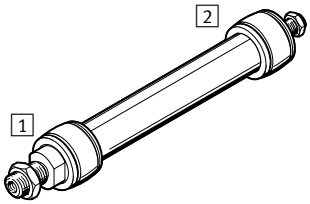
DMSP-...-RM-RM
1 Radial connection
2 Radial connection



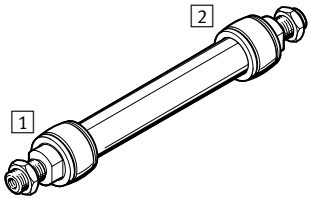
DMSP-...-RM-AM
1 Radial connection
2 Axial connection



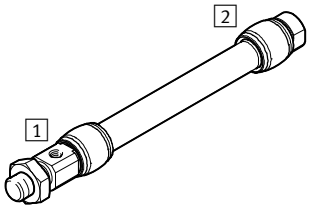
DMSP-...-AM-CM
1 Axial connection
2 No connection, with male thread



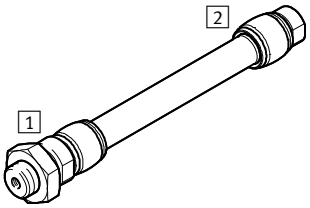
DMSP-...-AM-AM
1 Axial connection
2 Axial connection



DMSP-...-RM-CF (DMSP-5)
1 Radial connection
2 No connection, with female thread



DMSP-...-AM-CF (DMSP-5)
1 Axial connection
2 No connection, with female thread



New
DMSP-5

Fluidic Muscle DMSP with press-fitted connection

Technical data

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Size
5 … 40

Nominal length
30 … 9000 mm

Lifting force
0 … 6000 N

General technical data					
Size		5	10	20	40
Pneumatic connection		M3	G1⁄8	G1⁄4	G3⁄8
Design		Contracting diaphragm			
Mode of operation		Single-acting, pulling			
I.D.	[mm]	5	10	20	40
Nominal length	[mm]	30 … 1000	40 … 9000	60 … 9000	120 … 9000
Stroke	[mm]	0 … 200	0 … 2250	0 … 2250	0 … 2250
Max. additional load, freely suspended	[kg]	5	30	80	250
Max. permissible pretensioning[1]		1% of nominal length	3% of nominal length	4% of nominal length	5% of nominal length
Max. permissible contraction		20% of nominal length	25% of nominal length		
Max. perm. offset of connections		Angle tolerance: ≤ 1.0°			
		Parallelism tolerance: ± 0.5 % (up to 400 mm nominal length), ≤ 2 mm (from 400 mm nominal length)			
Type of mounting		Via accessories			
Mounting position		Any (an external guide is required if lateral forces occur)			

1) The max. pretensioning is achieved when the max. permissible freely suspended payload is attached.

Operating and environmental conditions					
Size		5	10	20	40
Operating pressure	[bar]	0 … 6	0 … 8	0 … 6	0 … 6
Operating medium		Compressed air according to ISO 8573-1:2010 [7:–:–]			
Note on operating/pilot medium		Lubricated operation possible (in which case lubricated operation will always be required)			
Ambient temperature	[°C]	–5 … +60			
Corrosion resistance class CRC[1]		2			
Certification		TÜV			

1) Corrosion resistance class CRC 2 to Festo standard FN 940070
Moderate corrosion stress. Indoor applications in which condensation may occur. External visible parts with primarily decorative requirements for the surface and which are in direct contact with the ambient atmosphere typical for industrial applications.

Forces [N] at max. permissible operating pressure				
Size	5	10	20	40
Theoretical force[1]	140	630	1500	6000

1) For minimum nominal length, the force is reduced by approx. 10%.

Fluidic Muscle DMSP with press-fitted connection

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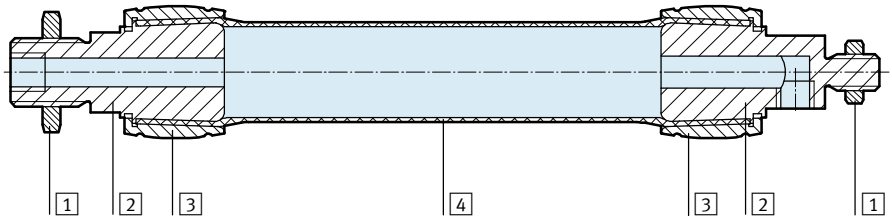
Technical data

Weight [g]				
Size	5	10	20	40
Product weight for 0 m length				
DMSP-...-RM-CM	10	58	169	675
DMSP-...-RM-RM	11	66	182	707
DMSP-...-RM-AM	12	75	202	767
DMSP-...-AM-CM	12	66	189	735
DMSP-...-AM-AM	14	83	222	827
DMSP-...-RM-CF	7	–	–	–
DMSP-...-AM-CF	9	–	–	–
Additional weight per 1 m length	27	94	178	340

Materials

Sectional view



Fluidic Muscle		
1	Nut	Galvanised steel
2	Flange	Clear anodised wrought aluminium alloy
3	Sleeve	Clear anodised wrought aluminium alloy
4	Diaphragm	AR, CR
	Note on materials	RoHS-compliant
		Free of copper and PTFE
		Contains paint-wetting impairment substances

Fluidic Muscle DMSP with press-fitted connection

Technical data

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Permissible force F [N] as a function of the contraction h [%] of the nominal length

Force/displacement diagrams and sizing ranges

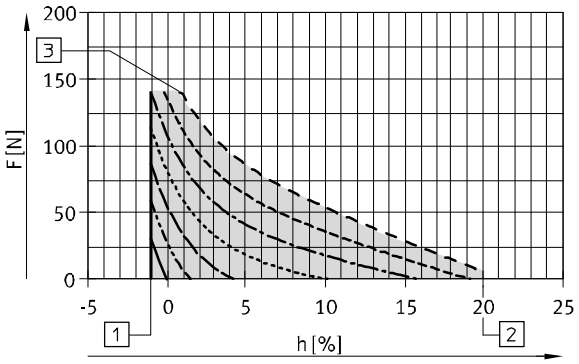
The limits specified in the technical data must be complied with when using the Fluidic Muscle. The graphs below illustrate the operating range of the Fluidic Muscle as a function of the diameter, within the limits shown below.

Using the graphs

1. The upper limit of the grey area indicates the maximum permissible force.
2. The right limiting curve of the grey area indicates the maximum permissible operating pressure.
3. The right vertical limit of the grey area indicates the maximum permissible contraction.
4. The left limit of the grey area indicates the load limit of the muscle in terms of the maximum permissible pretensioning.

Operating range DMSP-5-100N-...

Sizing examples ➔ 33



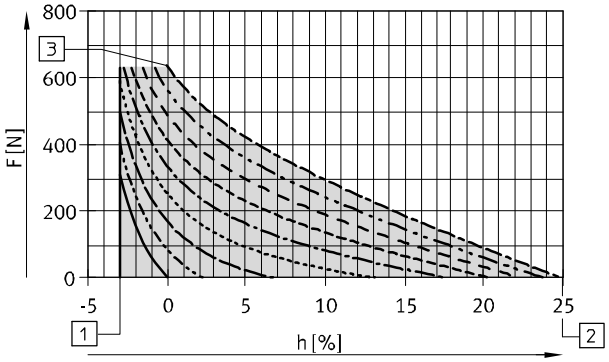
0 bar
1 bar
2 bar
3 bar
4 bar
5 bar
6 bar

1 Max. permissible pretensioning
2 Max. permissible contraction
3 Theoretical force (140 N) at max. operating pressure

Permissible operating range

Operating range DMSP-10-100N-...

Sizing examples ➔ 33



0 bar
1 bar
2 bar
3 bar
4 bar
5 bar
6 bar
7 bar
8 bar

1 Max. permissible pretensioning
2 Max. permissible contraction
3 Theoretical force (630 N) at max. operating pressure

Permissible operating range

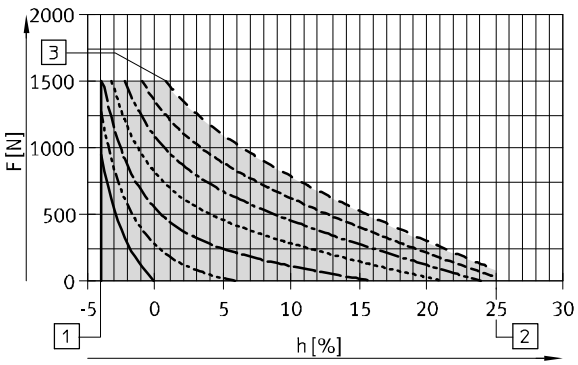
Fluidic Muscle DMSP with press-fitted connection

Technical data

Permissible force F [N] as a function of the contraction h [%] of the nominal length

Operating range DMSP-20-200N-...

Sizing examples ➔ 33



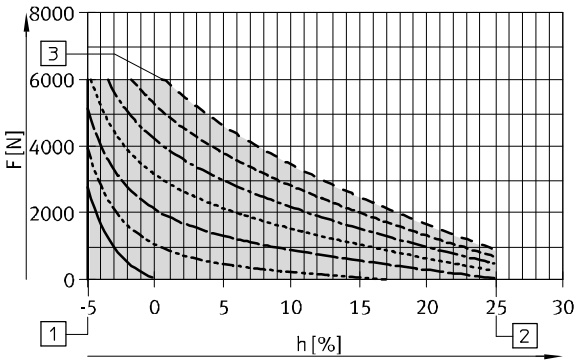
0 bar
1 bar
2 bar
3 bar
4 bar
5 bar
6 bar

1 Max. permissible pretensioning
2 Max. permissible contraction
3 Theoretical force (1500 N) at max. operating pressure

Permissible operating range

Operating range DMSP-40-400N-...

Sizing examples ➔ 33



0 bar
1 bar
2 bar
3 bar
4 bar
5 bar
6 bar

1 Max. permissible pretensioning
2 Max. permissible contraction
3 Theoretical force (6000 N) at max. operating pressure

Permissible operating range

Note

The actual value of the force as a factor of the contraction can vary according to the product characteristics and the ambient conditions present.
The deviation can be compensated if the pressure is adapted up to the maximum permissible operating pressure.

The simplest and most reliable way to ensure correct sizing is by going through the specialist department “Membrane Technologies” at Festo.
We can take all the crucial parameters for your application into consideration.

We will be happy to help!

Membrane Technologies
➔membrantechnologie@festo.com

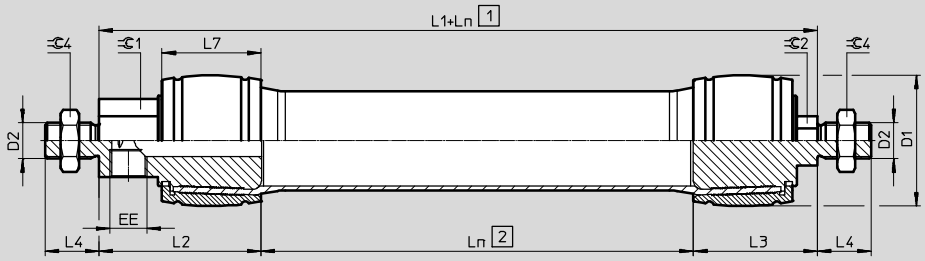
Fluidic Muscle DMSP with press-fitted connection

Technical data

FESTO

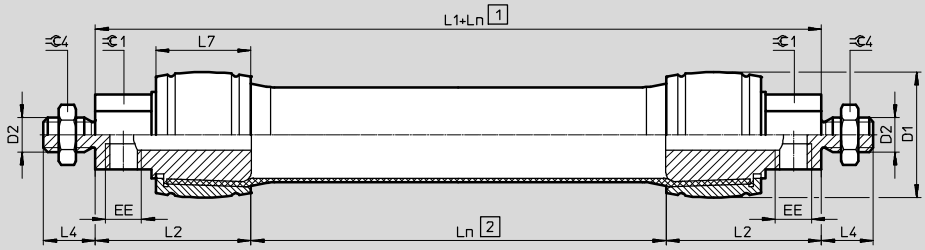
Dimensions Download CAD data ➔ **www.festo.com**

DMSP-...-RM-CM – pneumatic connection, radial – no connection, with male thread



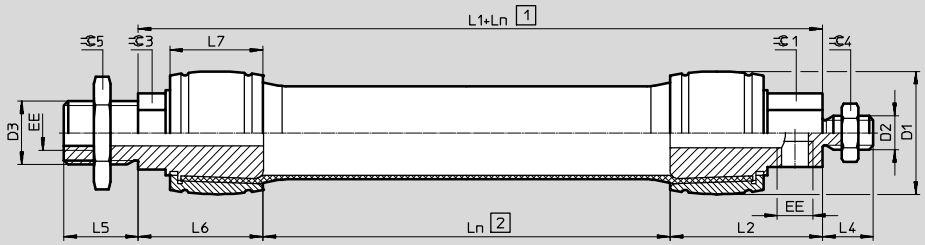
1 Installed length
2 Nominal length

DMSP-...-RM-RM – pneumatic connection, radial – pneumatic connection, radial



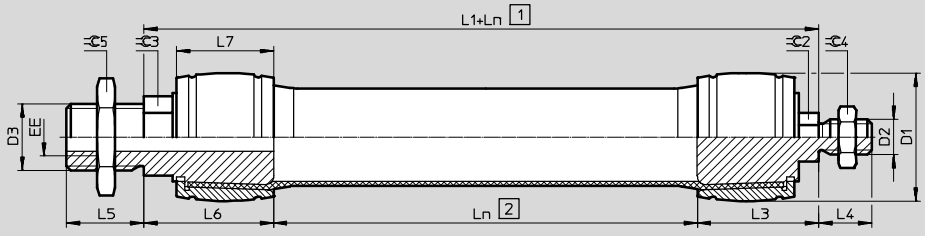
1 Installed length
2 Nominal length

DMSP-...-AM-RM – pneumatic connection, axial – pneumatic connection, radial



1 Installed length
2 Nominal length

DMSP-...-AM-CM – pneumatic connection, axial – no connection, with male thread



1 Installed length
2 Nominal length

Size	D1	D2	D3	EE[2]	Ln[1]		L1				L2
	max.				min.	max.	RM-CM	RM-RM	AM-RM	AM-CM	
5	11	M6	M8	M3	30	1000	33	37	33	29	18.5
10	22	M8	M16x1.5	G1⁄8	40	9000	62	72	63	53	36
20	35	M10x1.25	M20x1.5	G1⁄4	60		95	113	97	79	56.5
40	57	M16x1.5	M30x1.5	G3⁄8	120		127	144	131	114	72

Size	L3	L4	L5	L6	L7	=C1[2]	=C2[2]	=C3[2]	=C4	=C5
5	14.5	10	10	14.5	10	8	8	10	13	13
10	26	15	16	27	19	17	10	17	13	24
20	38.5	20	18	40.5	30	19	12	20	17	30
40	55	24	35	59	44	30	19	30	24	46

1) Tolerance < 100 mm ±1 mm, 100 ... 400 mm ±1%, > 400 mm ±4 mm.
2) Parallel orientation of the spanner flats on the left and right connection side can lead to deviations (for production reasons).

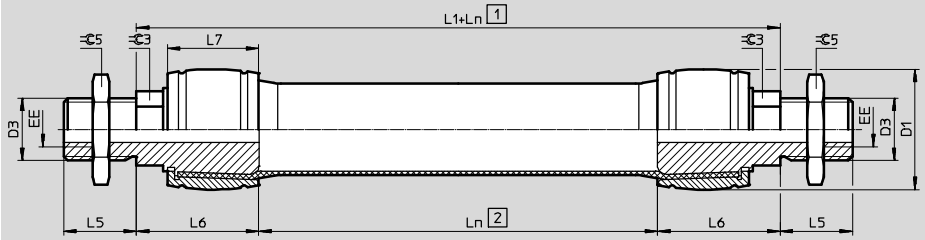
Fluidic Muscle DMSP with press-fitted connection

Technical data

FESTO

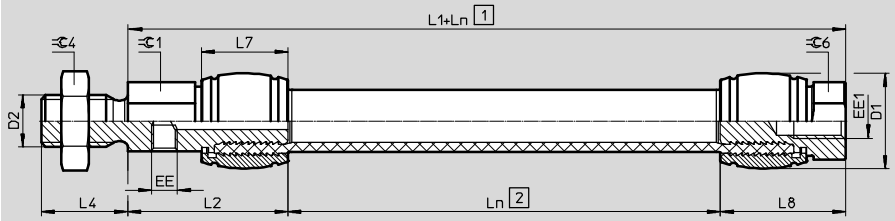
Dimensions Download CAD data ➔ **www.festo.com**

DMSP-...-AM-AM – pneumatic connection, axial – pneumatic connection, axial



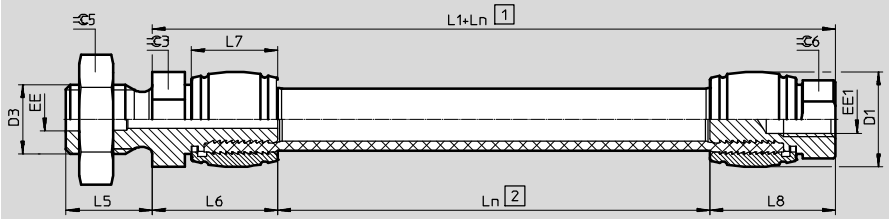
1 Installed length
2 Nominal length

DMSP-...-RM-CF – pneumatic connection, radial – no connection, with female thread



1 Installed length
2 Nominal length

DMSP-...-AM-CF – pneumatic connection, axial – no connection, with female thread



1 Installed length
2 Nominal length

Size	D1	D2	D3	EE	EE1	Ln[1]		L1			L2
	max.					min.	max.	AM-AM	RM-CF	AM-CF	
5	11	M6	M8	M3	M4	30	1000	29	33	29	18.5
10	22	M8	M16x1.5	G1⁄8	–	40	9000	54	–	–	36
20	35	M10x1.25	M20x1.5	G1⁄4	–	60		81	–	–	56.5
40	57	M16x1.5	M30x1.5	G3⁄8	–	120		118	–	–	72

Size	L4	L5	L6	L7	L8	⌀1[2]	⌀3[2]	⌀4	⌀5	⌀6
5	10	10	14.5	10	14.5	8	10	13	13	8
10	15	16	27	19	–	17	17	13	24	–
20	20	18	40.5	30	–	19	20	17	30	–
40	24	35	59	44	–	30	30	24	46	–

1) Tolerance < 100 mm ±1 mm, 100 ... 400 mm ±1%, > 400 mm ±4 mm.
2) Parallel orientation of the spanner flats on the left and right connection side can lead to deviations (for production reasons).

Diameter expansion at maximum contraction				
Size	5	10	20	40
[mm]	12	24	40	80

Fluidic Muscle DMSP with press-fitted connection

FESTO

Ordering data – Modular products

Ordering table

Size		5	10	20	40	Condi-tions	Code		Entry code
M	Module no.	**3733012**	**541403**	**541404**	**541405**				
	Function	Fluidic Muscle with press-fitted connection					**DMSP**		DMSP
	Size [mm]	5	10	20	40		**-...**		
	Nominal length [mm]	30 ... 1000	40 ... 9000	60 ... 9000	120 ... 9000		**-... N**		-... N
	First connection	Radial, male thread Mounting thread/supply port M6 / M3	M8 / G1/8	M10x1.25 / G1/4	M16x1.5 / G3/8		**-RM**		
		Axial, male thread Mounting thread/supply port M8 / M3	M16x1.5 / G1/8	M20x1.5 / G1/4	M30x1.5 / G3/8		**-AM**		
	Second connection	Closed, male thread Mounting thread M6	M8	M10x1.25	M16x1.5		**-CM**		
		Closed, female thread Mounting thread M4	–				**-CF**		
		Radial, male thread Mounting thread/supply port M6 / M3	M8 / G1/8	M10x1.25 / G1/4	M16x1.5 / G3/8		**-RM**		
		Axial, male thread Mounting thread/supply port M8 / M3	M16x1.5 / G1/8	M20x1.5 / G1/4	M30x1.5 / G3/8		**-AM**		
	Operating instructions	Standard							
		Express waiver – no operating instructions to be included (already available)					**-DN**		

M Mandatory data

Transfer order code

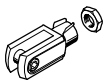
	DMSP	–		–	... N	–		–		–	

Fluidic Muscle DMSP with press-fitted connection

Accessories

FESTO

Ordering data Technical data ➔ Internet: piston-rod attachment

Description	For size	Part No.	Type
Rod eye SGS			
	5	**9254**	**SGS-M6**
	10	**9255**	**SGS-M8**
	20	**9261**	**SGS-M10x1,25**
	40	**9263**	**SGS-M16x1,5**[1)]
Rod clevis SG			
	5	**3110**	**SG-M6**
	10	**3111**	**SG-M8**
	20	**6144**	**SG-M10x1,25**
	40	**6146**	**SG-M16x1,5**[1)]

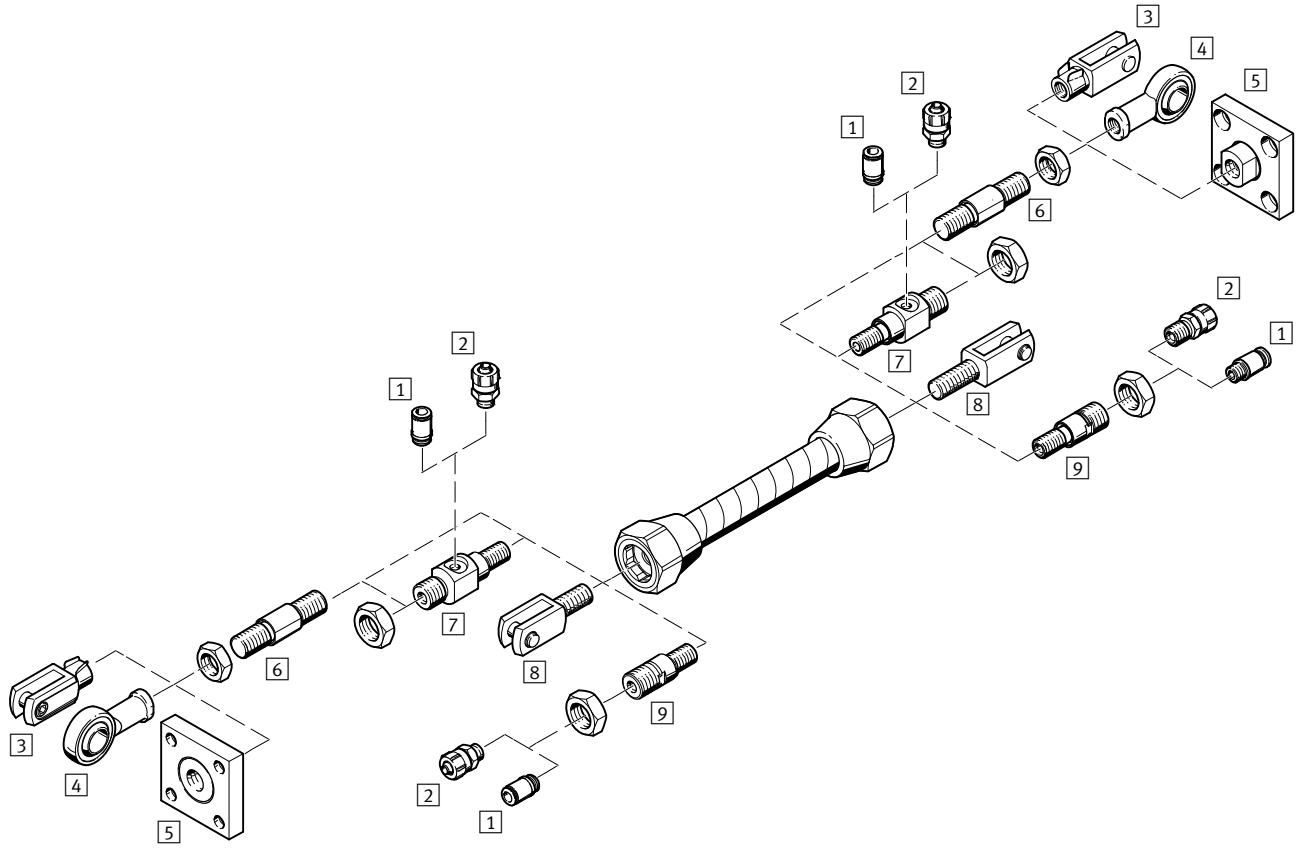
Description	For size	Part No.	Type
Coupling piece KSG			
	5	–	
	10	–	
	20	**32963**	**KSG-M10x1,25**
	40	**32965**	**KSG-M16x1,5**
Coupling piece KSZ			
	5	**36123**	**KSZ-M6**
	10	**36124**	**KSZ-M8**
	20	**36125**	**KSZ-M10x1,25**
	40	**36127**	**KSZ-M16x1,5**

Note

1) If there is a dynamic load on the DMSP40, the technical data will be subject to restrictions because of the accessories.
Fundamentals: rated load, friction torque where μ = 0.2:
– Endurance limit at 6000 N: 1 million load cycles (higher values on request)
– Endurance limit at 4000 N: 10 million load cycles

Fluidic Muscle MAS with screwed connections

Peripherals overview



Accessories			
		Description	**➔ Page/Internet**
1	Push-in fittings QS	For connecting compressed air tubing with standard outside diameters	qs
2	Quick connectors CK	For connecting compressed air tubing with standard internal diameters	ck
3	Rod clevis SG	Permits a swivelling movement of the Fluidic Muscle in one plane	32
4	Rod eye SGS	With spherical bearing	32
5	Coupling pieces KSG/KSZ	To compensate for radial deviations	32
6	Threaded rod MXAD-T	For connecting drive accessories	32
7	Radial adapter MXAD-R	For connecting drive accessories and the compressed air supply in a radial direction	31
8	Rod clevis SGA	With male thread for direct mounting on the Fluidic Muscle	32
9	Axial adapter MXAD-A	For connecting drive accessories and the compressed air supply in an axial direction	31

Fluidic Muscle MAS with screwed connections

Type codes

MAS	–	10	–	500N	–	AA	–	MC	–	K	–	ER	–	EG	–	

Drive function	
Single-acting, pulling	
MAS	Fluidic Muscle

I.D. [mm]

Nominal length [mm]	
...N	40 ... 9000

Material	
AA	Standard material (chloroprene, aramid)

Connection type	
MC	Open at one end
MO	Open at both ends

Connector type	
K	With force limiter
O	Without force limiter

Accessories enclosed separately	
Adapters	
ER	1 adapter for radial air supply, at one end
EA	1 adapter for axial air supply, at one end
BR	2 adapters for radial air supply, at both ends
BA	2 adapters for axial air supply, at both ends
RA	1 adapter for radial and 1 adapter for axial air supply
Mounting	
EG	1 threaded rod for mounting, at one end
Module	2 threaded rods for mounting, at both ends

Operating instructions	
–	Standard
DN	Express waiver – no operating instructions to be included (already available)

Fluidic Muscle MAS with screwed connection

Technical data

Size
10 … 40

Nominal length
40 … 9000 mm

Lifting force
0 … 6000 N

General technical data				
Size		10	20	40
Pneumatic connection		➔ Adapter MXAD-... from page 31		
Design		Contracting diaphragm		
Mode of operation		Single-acting, pulling		
I.D.	[mm]	10	20	40
Nominal length	[mm]	40 … 9000	60 … 9000	120 … 9000
Stroke	[mm]	0 … 2250	0 … 2250	0 … 2250
Max. additional load, freely suspended	[kg]	30	80	250
Max. permissible pretensioning[1]				
Without force limiter		3% of nominal length	4% of nominal length	5% of nominal length
With force limiter		3% of nominal length	3% of nominal length	3% of nominal length
Max. permissible contraction		25% of nominal length		
Max. perm. offset of connections		Angle tolerance: ≤ 1.0°		
		Parallelism tolerance: ± 0.5% (up to 400 mm nominal length), ≤ 2 mm (from 400 mm nominal length)		
Type of mounting		Via accessories		
Mounting position		Any (an external guide is required if lateral forces occur)		

1) The max. pretensioning is achieved when the max. permissible freely suspended payload is attached.
2) Measured at room temperature in accordance with ISO 23529

Operating and environmental conditions				
Size		10	20	40
Operating pressure	[bar]	0 … 8	0 … 6	
Operating medium		Compressed air according to ISO 8573-1:2010 [7:–:–]		
Note on operating/pilot medium		Lubricated operation possible (in which case lubricated operation will always be required)		
Ambient temperature	[°C]	–5 … +60		
Corrosion resistance class CRC[3]		2		
Certification		TÜV		

3) Corrosion resistance class 2 according to Festo standard 940 070
Components subject to moderate corrosion stress. Externally visible parts with primarily decorative surface requirements which are in direct contact with a normal industrial environment or media such as coolants or lubricating agents.

Forces [N] at max. permissible operating pressure			
Size	10	20	40
Theoretical force[1]	630	1500	6000
Force limiter	400	1200	4000

1) For minimum nominal length, the force is reduced by approx. 10%.

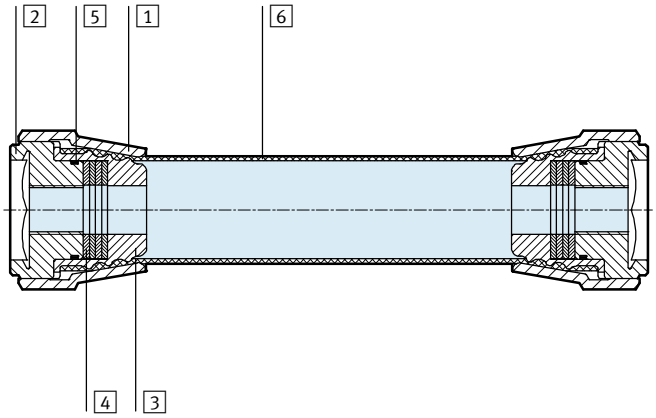
Fluidic Muscle MAS with screwed connection

Technical data

Weight [g]			
Size	10	20	40
Product weight for 0 m length			
Without force limiter			
MAS-...-MO-O	83	239	687
MAS-...-MC-O	83	249	698
With force limiter			
MAS-...-MO-K	92	277	877
MAS-...-MC-K	92	287	888
Additional weight per 1 m length	94	178	340

Materials

Sectional view



Fluidic Muscle		
1	Union nut	Clear anodised wrought aluminium alloy
2	Flange	Wrought aluminium alloy, blue anodised
3	Internal cone	Clear anodised wrought aluminium alloy
4	Disc springs	Steel
5	Sealing ring	NBR
6	Diaphragm	AR, CR
–	Adhesive	Loctite 243 (thread locking agent)
–	Lubricant	Klüberplex BE 31-102
	Note on materials	RoHS-compliant
		Free of copper and PTFE
		Contains paint-wetting impairment substances

Fluidic Muscle MAS with screwed connection

Technical data

Permissible force F [N] as a function of the contraction h [%] in the nominal length

Force/displacement diagrams and sizing ranges

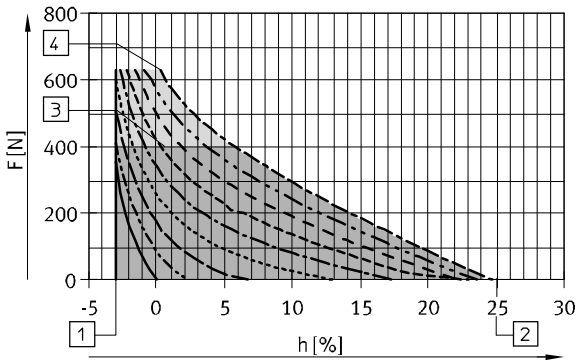
The limits specified in the technical data must be complied with when using the Fluidic Muscle. The graphs below illustrate the operating range of the Fluidic Muscle as a function of the diameter, within the limits shown below.

Using the graphs

1. The upper limit of the grey area indicates the maximum permissible force.
2. The right limiting curve of the permissible operating ranges indicates the maximum permissible operating pressure.
3. The right vertical limit of the permissible operating ranges indicates the maximum permissible contraction.
4. The left limit of the permissible operating ranges indicates the load limit of the muscle in terms of the maximum permissible pretensioning.

Operating range MAS-10-100N-...

Sizing examples ➔ 33

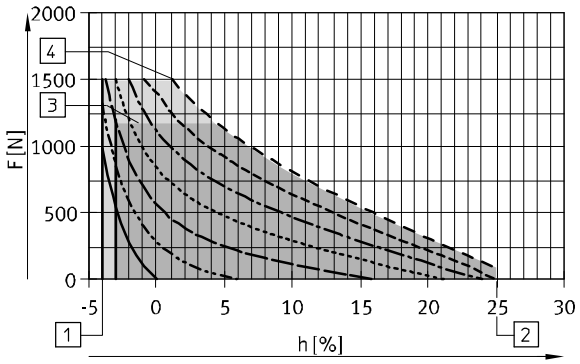


0 bar
1 bar
2 bar
3 bar
4 bar
5 bar
6 bar
7 bar
8 bar

1 Max. permissible pretensioning
2 Max. permissible contraction
3 With force limiter at 400 N
4 Theoretical force (630 N) at max. operating pressure
Permissible operating range
Operating range with force limiter

Operating range MAS-20-200N-...

Sizing examples ➔ 33



0 bar
1 bar
2 bar
3 bar
4 bar
5 bar
6 bar

1 Max. permissible pretensioning
2 Max. permissible contraction
3 With force limiter at 1200 N
4 Theoretical force (1500 N) at max. operating pressure
Permissible operating range
Operating range with force limiter

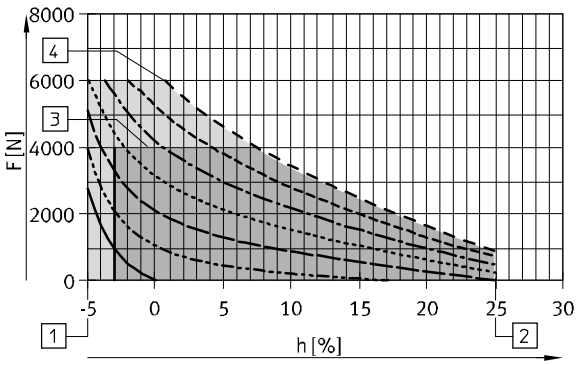
Fluidic Muscle MAS with screwed connection

Technical data

Permissible force F [N] as a function of the contraction h [%] in the nominal length

Operating range MAS-40-400N-...

Sizing examples ➔ 33



0 bar
1 bar
2 bar
3 bar
4 bar
5 bar
6 bar

1 Max. permissible pretensioning
2 Max. permissible contraction
3 With force limiter at 4000 N
4 Theoretical force (6000 N) at max. operating pressure
Permissible operating range
Operating range with force limiter

Note

The actual value of the force as a factor of the contraction can vary according to the product characteristics and the ambient conditions present.
The deviation can be compensated if the pressure is adapted up to the maximum permissible operating pressure.

The simplest and most reliable way to ensure correct sizing is by going through the specialist department “Membrane Technologies” at Festo.
We can take all the crucial parameters for your application into consideration.

We will be happy to help!

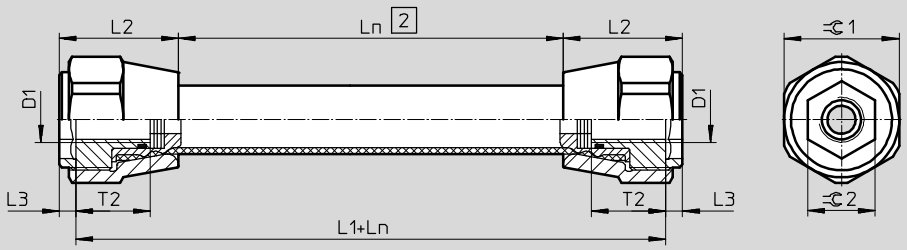
Membrane Technologies
➔membrantechnologie@festo.com

Fluidic Muscle MAS with screwed connection

Technical data

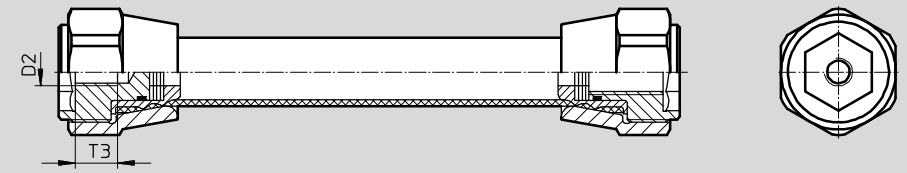
Dimensions – Without force limiter Download CAD data ➔ **www.festo.com**

MAS-...-MO-O – open at both ends



2 Nominal length

MAS-...-MC-O – open at one end



Size	D1	D2	Ln		L1
			min.	max.	
10	M10x1.25	M10x1.25	40	9000[1]	60.2
20	M16x1.5	M10x1.25	60		73
40	M20x1.5	M16x1.5	120		95

Size	L2	L3	T2	T3	⊂1	⊂2
10	34.1	4	10	10	27	17
20	42.5	6	26.5	15	41	24
40	55.5	8	21.8	20	60	41

1) Tolerance ≤ 100 mm ±1 mm, 100 ... 400 mm ±1%, > 400 mm ±4 mm.

Diameter expansion at maximum contraction

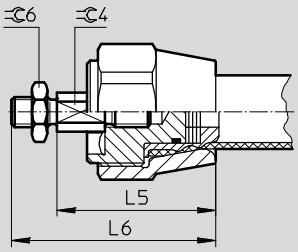
Size	10	20	40
[mm]	24	40	80

Fluidic Muscle MAS with screwed connection

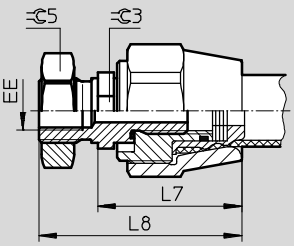
Technical data

Dimensions – Without force limiter Download CAD data ➔ **www.festo.com**

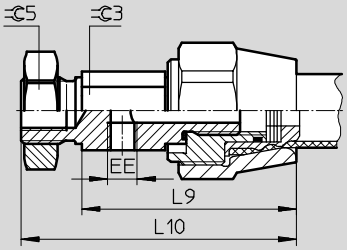
MAS-...-EG – open at one end, with threaded rod



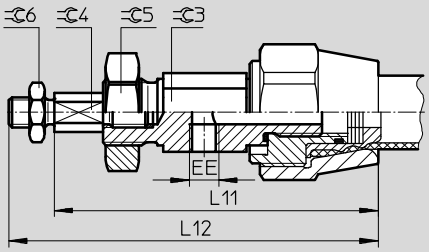
MAS-...-EA/BA – pneumatic connection, axial, one end/both ends



MAS-...-ER/BR – pneumatic connection, radial, one end/both ends



MAS-...-ER/BR-EG/BG – pneumatic connection, radial, with threaded rod, one end/both ends



Size	EE		L5	L6	L7	L8	L9
	Axial	Radial					
10	G1⁄8	M5	46.1	61.1	42.6	60	58.2
20	G1⁄4	G1⁄8	52.5	67.5	49	69	71
40	G3⁄8	G1⁄4	67.5	91.5	63	101	93

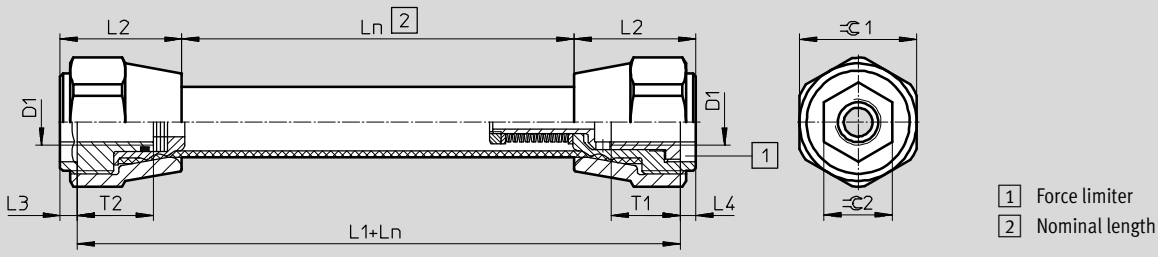
Size	L10	L11	L12	⌀3	⌀4	⌀5	⌀6
10	75.6	96.6	111.6	17	11	24	17
20	91	107	122	24	11	32	17
40	131	151	175	36	17	46	24

Fluidic Muscle MAS with screwed connection

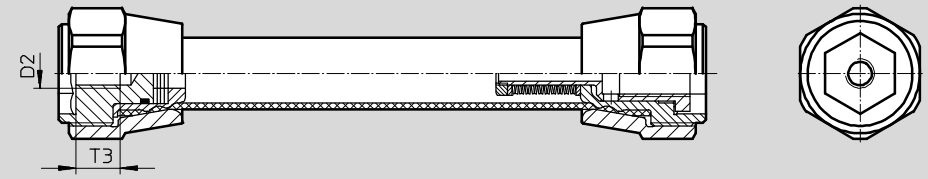
Technical data

Dimensions – With force limiter Download CAD data ➔ **www.festo.com**

MAS-...-MO-K – open at both ends



MAS-...-MC-K – open at one end



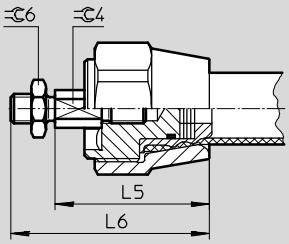
Size	D1	D2	Ln		L1	L2
			min.	max.		
10	M10x1.25	M10x1.25	40	9000[1]	61.7	34.1
20	M16x1.5	M10x1.25	60		73.5	42.5
40	M20x1.5	M16x1.5	120		96.5	55.5

Size	L3	L4	T1	T2	T3	⊂1	⊂2
10	4	2.5	15	10	10	27	17
20	6	5.5	24	26.5	15	41	24
40	8	6.5	30	21.8	20	60	41

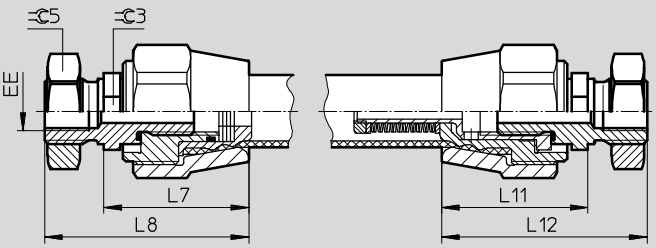
1) Tolerance ≤ 100 mm ±1 mm, 100 ... 400 mm ±1%, > 400 mm ±4 mm.

Dimensions – With force limiter Download CAD data ➔ **www.festo.com**

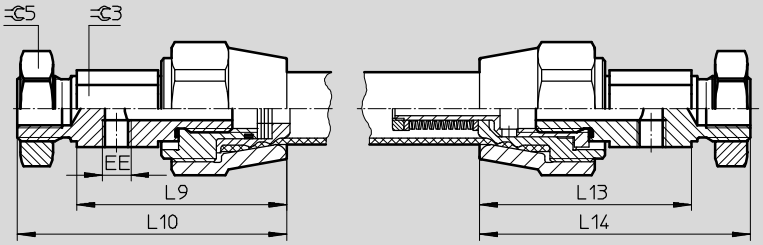
MAS-...-EG – open at one end, with threaded rod



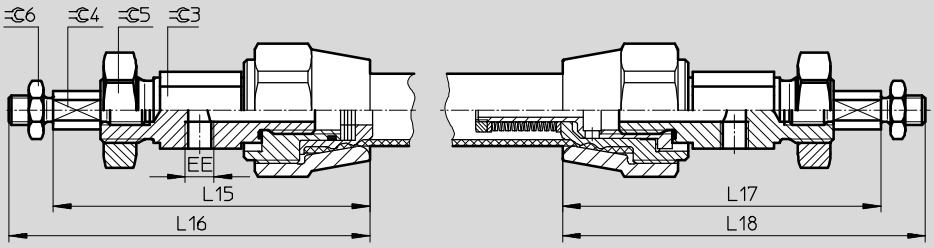
MAS-...-EA/BA – pneumatic connection, axial, one end/both ends



MAS-...-ER/BR – pneumatic connection, radial, one end/both ends



MAS-...-EA/BA-EG/BG – pneumatic connection, radial, with threaded rod, one end/both ends



Size	EE		L5	L6	L7	L8	L9	L10	L11	L12
	Axial	Radial								
10	G1⁄8	M5	46.1	61.1	42.6	60	58.2	75.6	44.1	61.5
20	G1⁄4	G1⁄8	52.5	67.5	49	69	71	91	49.5	69.5
40	G3⁄8	G1⁄4	67.5	91.5	63	101	93	131	64.5	102.5

Size	L13	L14	L15	L16	L17	L18	⊂3	⊂4	⊂5	⊂6
10	59.7	77.1	96.6	111.6	98.1	113.1	17	11	24	17
20	71.5	91.5	107	122	107.5	122.5	24	11	32	17
40	94.5	132.5	151	175	152.5	176.6	36	17	46	24

Fluidic Muscle MAS with screwed connection

Ordering data – Modular products

FESTO

Ordering table

	Size		10	20	40	Condi-tions	Code		Entry code
M	Module no.		**534201**	**534202**	**534203**				
	Function		Fluidic Muscle with screwed connection				**MAS**		MAS
	I.D.	[mm]	10	20	40		**-...**		
	Nominal length	[mm]	40 ... 9000	60 ... 9000	120 ... 9000		**-...N**		
	Material		Standard material (chloroprene)				**-AA**		-AA
	Connection type		Fluidic Muscle open at one end				**-MC**		
			Fluidic Muscle open at both ends				**-MO**		
	Connector type		Threaded connection with force limiter				**-K**		
			Threaded connection without force limiter				**-O**		
O	Adapters, enclosed separately		1 adapter for radial air supply, at one end			1	**-ER**		
			1 adapter for axial air supply, at one end			1	**-EA**		
			2 adapters for radial air supply, at both ends			2	**-BR**		
			2 adapters for axial air supply, at both ends			2	**-BA**		
			1 adapter for radial and 1 adapter for axial air supply			2	**-RA**		
	Mountings, enclosed separately		1 threaded rod for mounting, at one end			3	**-EG**		
			2 threaded rods for mounting, at both ends			4	**-BG**		
	Operating instructions		Standard						
			Express waiver – no operating instructions to be included (already available)				**-DN**		

1 **ER, EA** Not in combination with connection type MO.

2 **BR, BA, RA** Not in combination with connection type MC.

3 **EG** In combination with connection type MO only permissible in combination with adapter BR, RA.

4 **Module** In combination with connection type MC only permissible in combination with adapter ER.
In combination with connection type MO only permissible in combination with adapter BR.

M Mandatory data

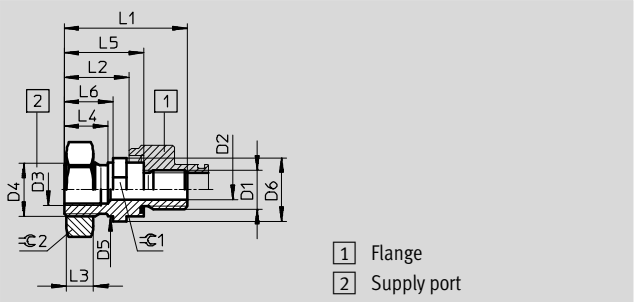
O Options

Transfer order code

	MAS	–		–		–	**AA**	–		–		–		–		–		–	

Axial adapter MXAD-A
(order code EA/BA/RA)

Materials:
Adapter: Clear anodised wrought aluminium alloy
Nut: Galvanised steel
Seal: NBR



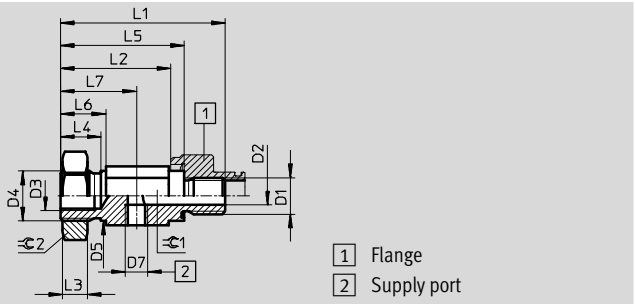
Dimensions and ordering data

For size	D1	D2 ∅	D3	D4	D5 ∅ H11	D6 ∅	L1	L2	L3
10	M10x1.25	5	G1/8	M16x1.5	16	20	39.9	25.9	8
20	M16x1.5	8	G1/4	M22x1.5	22	26	50.5	26.5	11
40	M20x1.5	10	G3/8	M30x1.5	30	40	73.5	45.5	8

For size	L4	L5	L6	⌀1	⌀2	Weight [g]	Part No.	Type
10	15.4	29.9	17.4	17	24	33	**534400**	**MXAD-A10**
20	18	32.5	20	24	32	69	**534402**	**MXAD-A16**
40	35	53.5	38	36	46	184	**534404**	**MXAD-A20**

Radial adapter MXAD-R
(order code ER/BR/RA)

Materials:
Adapter: Clear anodised wrought aluminium alloy
Nut: Galvanised steel
Seal: NBR



Dimensions and ordering data

For size	D1	D2 ∅	D3	D4	D5 ∅ H11	D7	L1	L2	L3
10	M10x1.25	5	M10x1.25	M16x1.5	16	M5	55.5	41.5	8
20	M16x1.5	8	M10x1.25	M22x1.5	22	G1/8	72.5	48.5	11
40	M20x1.5	10	M16x1.5	M30x1.5	30	G1/4	103.5	75.5	8

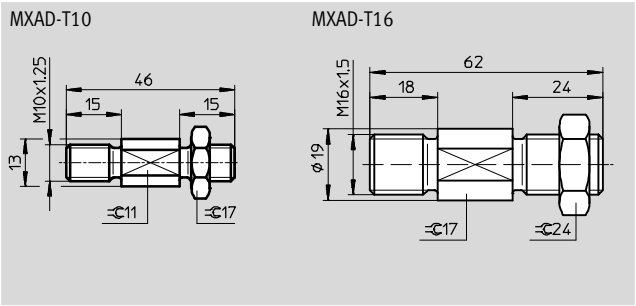
For size	L4	L5	L6	L7	⌀1	⌀2	Weight [g]	Part No.	Type
10	15.4	45.5	17.4	26.7	17	24	44	**534401**	**MXAD-R10**
20	18	54.5	20	33.5	24	32	109	**534403**	**MXAD-R16**
40	35	83.5	38	56	36	46	263	**534405**	**MXAD-R20**

Fluidic Muscle MAS with screwed connection

Accessories

Threaded rod MXAD-T
(order code EG/BG)

Materials:
Galvanised steel

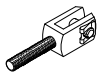
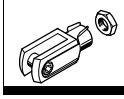


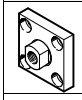
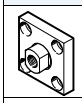
Dimensions and ordering data

For size	Suitable for threaded connection	Weight [g]	Part No.	Type
10/20	M10x1.25	40	**187597**	**MXAD-T10**
40	M16x1.5	140	**187609**	**MXAD-T16**

Ordering data

Technical data ➔ Internet: piston-rod attachment

Description	For size	Part No.	Type
Rod eye SGS[1]			
	10	**9261**	**SGS-M10x1,25**
	20	**9261**	**SGS-M10x1,25**
	40	**9263**	**SGS-M16x1,5**
Rod clevis SGA			
	10	**32954**	**SGA-M10x1,25**
	20	**32954**	**SGA-M10x1,25**
	40	**10768**	**SGA-M16x1,5**
Rod clevis SG[1]			
	10	**6144**	**SG-M10x1,25**
	20	**6144**	**SG-M10x1,25**
	40	**6146**	**SG-M16x1,5**

Description	For size	Part No.	Type
Coupling piece KSG[1]			
	10	**32963**	**KSG-M10x1,25**
	20	**32963**	**KSG-M10x1,25**
	40	**32965**	**KSG-M16x1,5**
Coupling piece KSZ[1]			
	10	**36125**	**KSZ-M10x1,25**
	20	**36125**	**KSZ-M10x1,25**
	40	**36127**	**KSZ-M16x1,5**

1) Threaded rod MXAD-T... is required.

Example 1

Lifting a constant load

The muscle is to be used to lift a constant load of 60 kg, free of forces, from a supporting surface, and raise it a distance of 10 mm. The compressed air supply provides a maximum of 6 bar.

The size (diameter and nominal length) of the Fluidic Muscle needs to be determined.

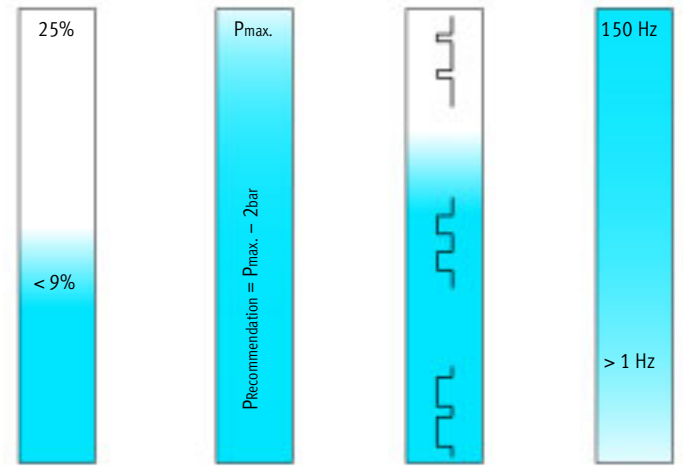
- Note

The simplest and most reliable way to ensure correct sizing is by going through the specialist department "Membrane Technologies" at Festo.
We can take all the crucial parameters for your application into consideration.
We will be happy to help!
Membrane Technologies
➔membrantechnologie@festo.com

General conditions		Values
Required force at rest	[N]	0
Required stroke	[mm]	10
Required force in contracted state	[N]	Approx. 600
Max. possible operating pressure	[bar]	6

Choice of parameters

Efficient range



Contraction | Operating pressure | Motion sequence | Frequency

Solution

Steps	Selection	Input parameters	Result
Step 1:			
Calculation of nominal length (stroke 10 mm/contraction 5%)	200 mm		
Choice of operating pressure ($p_{max.}$ – 2 bar)	4 bar		
Step 2:			
Input of values into engineering tool	Nominal length:	200 mm	
	Stroke:	10 mm	
	Operating pressure:	4 bar	
Intermediate result for force	Size:	20 mm	
			674 N
Step 3:			
Adjustment of input values	Operating pressure:	3.7 bar	
Result:			609 N

Example 2

Use as a tension spring

In this example, the muscle is to be used as a tension spring.

The size (diameter and nominal length) of the Fluidic Muscle needs to be determined.

Note

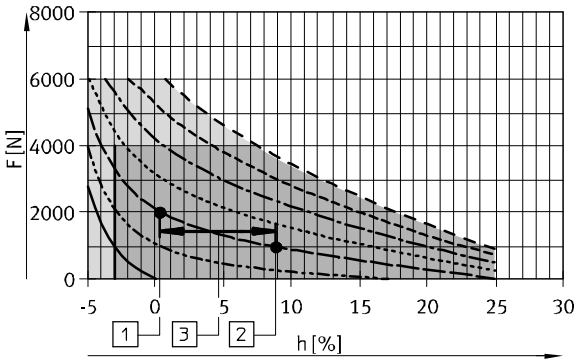
The simplest and most reliable way to ensure correct sizing is by going through the specialist department “Membrane Technologies” at Festo.
We can take all the crucial parameters for your application into consideration.
We will be happy to help!
Membrane Technologies
➔ membrantechnologie@de.festo.com

If you are determining the size yourself, you must follow this recommendation: contraction < 9%, operating pressure $p_{Recommendation} = p_{max.} - 2$ bar, see choice of parameters

General conditions		Values
Required force in extended state	[N]	2000
Required force in contracted state	[N]	1000
Required stroke (spring length)	[mm]	50
Operating pressure	[bar]	2

Solution

Step 1 **Determine the required muscle size**	Determine the most suitable muscle diameter on the basis of the required force.	The required force is 2000 N, therefore a DMSP-40-... is selected.
Step 2 **Enter load point 1**	Load point 1 is entered into the force/displacement diagram for the DMSP-40-....	Force F = 2000 N Pressure p = 2 bar
Step 3 **Enter load point 2**	Load point 2 is entered into the force/displacement diagram.	Force F = 1000 N Pressure p = 2 bar
Step 4 **Read the length change**	The change in the length of the muscle is read off between the load points on the X-axis (contraction in %).	Result: 8.7% contraction.
Step 5 **Calculate the nominal length**	The required nominal muscle length for a stroke of 50 mm is obtained by dividing by the contraction in %.	Result: 50 mm / 8.7% ~ 575 mm.
Step 6 **Result**	The nominal length of the muscle to be ordered is 575 mm.	For use as a tension spring with a force of 2000 N and a spring travel of 50 mm, a DMSP-40-575N-... is required.



0 bar
1 bar
2 bar
3 bar
4 bar
5 bar
6 bar

1 Load point 1
2 Load point 2
3 Change in length = 8.7%