

Pull and push-pull cables

PULL CABLES

Flexball has a wide range of wire cables that is the result of the experience of 50 years of design of pull and push-pull cables for the most different applications: from the simple pull throttle cable to the more sophisticated gear shifter cable or to the very performing cable of a power transmission pump.

Wire rope controls are only used in tension applications and can be matched with a variety of handles and levers on one side and several attachments (blades, clevis, threaded terminal) on the other side.

The pull cable is schematically composed of conduit, wire and end fittings. The mixing of these three basic elements determines a big choice of cables.



CONDUIT FOR PULL CABLES

Type of conduit	Pull load (N)	Bending radius (mm)	Conduit external diameter (mm)	Conduit internal diameter (mm)	Conduit colour	In liner tube
012	800	100	7	2.3	Black	POM
015	1000	80	6.9	2.3		Teflon
020	1200	80	6	2.3		POM
030	3500	120	10	4.3		POM
040	6000	140	13.4	7.4		POM

WIRE FOR PULL CABLES

Wire diameter (mm)	Pull load (N)	Structure	Material
2	800	7 wires	Stainless steel AISI316
	1000	19 wires	
	1200	49 wires	
	1400	133 wires	
2.5	1800	19 wires	
3	2500	19 wires	
4	3500	49 wires	
6	6000	133 wires	
6HD	20000	133 wires	R2060

PUSH-PULL CABLES

Push-pull control cables provide an efficient, highly reliable and lightweight solution of remote actuation at long distances. Push-pull cable main feature is the high flexibility and its capability to adapt to the different applications. Push-pull cables can be used in the agriculture, industrial, automotive, marine and railway sectors.

Basically the push-pull cable is made of a conduit, a wire which slides inside the conduit and two terminals, one on each side of the cable. The end fittings are the linkage between the cable and other mechanical devices.

The construction materials are plastic or metal and are chosen depending on the application and environmental conditions. Metals are usually steel, stainless steel or brass.

In addition to the cables reported in this catalogue, it is available a wide variety of special cables; our technicians are at your disposal to guide you in the selection of the right cable for your application.

Cables are basically classified according to these following main features:

- length
- force to be transmitted
- stroke
- type of end fitting

Furthermore, it must be taken into account any feature related to the specific working conditions, such as temperature, environment, flexibility, efficiency, lifetime, duty cycle, etc. In the following pages are described the different types of cables classified on the base of the features just described here above.

Type of cable	Push load (N)	Pull load (N)	Bending radius (mm)	External conduit diameter (mm)	Wire diameter (mm)		Conduit colour
E2	300	800	100	7	1.9		Black
E3	400	1000	120	8.5			
V4	500	1200	120	8	3.65		Yellow
V5	700	1500	140	10	4.7	5	
V6	900	2000	160	11.5	5.7		
V7	1200	2500	180	12.1	6		
V8	1400	2000	200	14	7.6		
O1	300	800	80	7	2.7		Black
O7	800	2000	150	9.5	3.7		
O7E	800	1800	150	9.5	3.6		
O10	1000	2000	140	9.2	3.2		
O17	1000	2000	160	9	3.2		
O18	2000	4500	200	14.5	6.4		

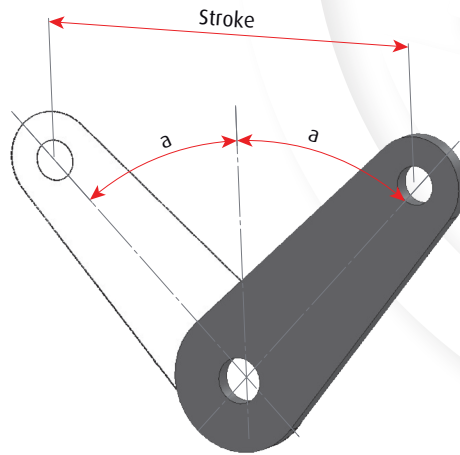


BENDING RADIUS

The table in the previous page reports the recommended minimum bending radius for each type of cable. Higher is the bending radius, better is the performance of the cable and longer is its lifetime.

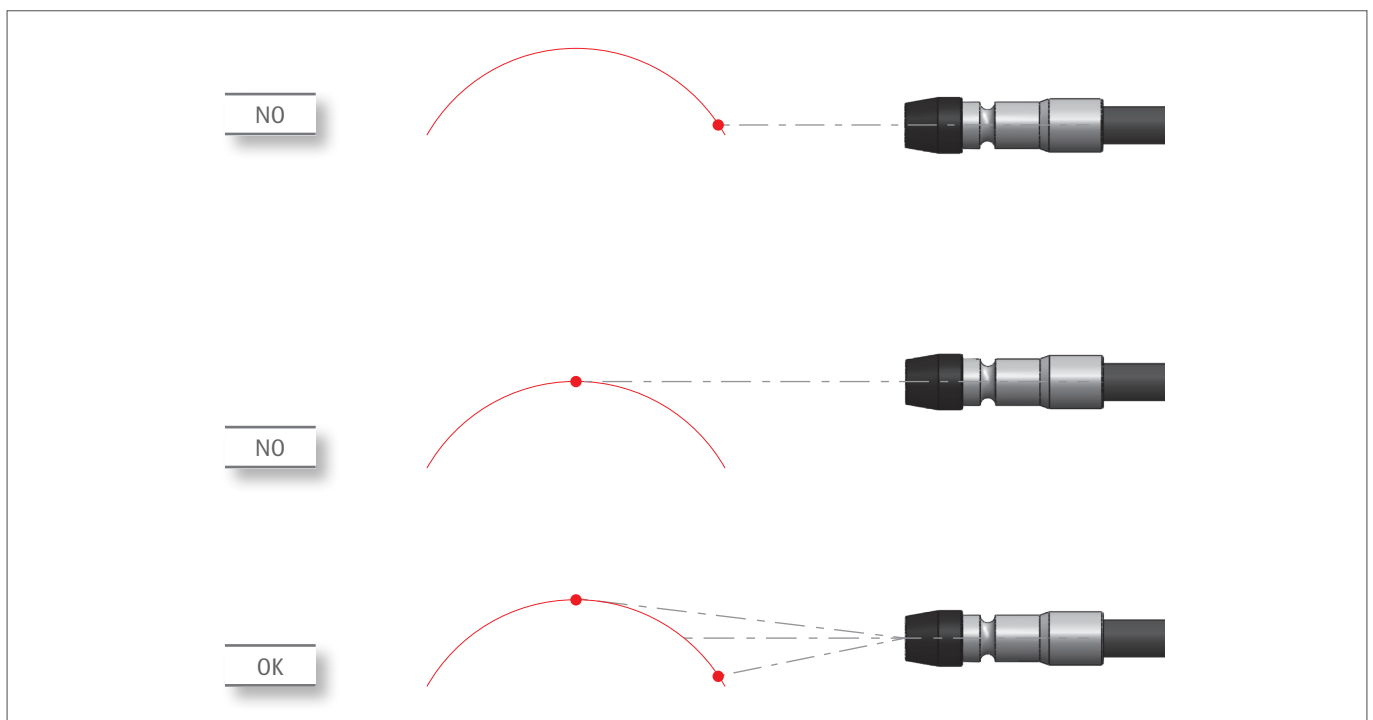
CALCULATION OF THE STROKE

In case of linear actuation, to understand the necessary stroke it is enough to measure the difference between the initial position of the actuation point and the end position after the cable has been full operated.



If the cable is connected to the lever, the connection point moves on an arc profile but the travel is its segment. Cable fitting with G and T shapes are indicated to operate in these conditions because the rods are running into a swiveling sleeve that can compensate the deflection. Also cable fitting with F shape can operate in this condition, but it is necessary to use a bulk-head swivel to compensate the deflection.

To guarantee the longest operating life and the best efficiency of the cable, the deflection has to be reduced as much as possible. One of the factors that contributes to the deflection's reduction is how the cable is mounted: the cable has to be mounted as per the side picture.



BACKLASH

The backlash is caused by the free play between the core (wire) and the conduit. It is measured as the lost motion (on the output) under light input forces applied on the cable. Backlash increases proportionally with the bending degrees and it becomes evident during cable's changes of direction.

The backlash is related to diameter differences between core and conduit, the input force and the total number of bending degrees of the cable once installed. Here below, we summarize the backlash of each type of cables, calculated considering a total bending of 360° degrees.

TYPE OF CABLES	BACKLASH
E2/E3	3 mm
V4	3 mm
V5	3.2 mm
V6	3.5 mm
V7	3 mm
V8	3.5 mm
01	1.3 mm
07	1.2 mm
07E	1.9 mm
010	1.3 mm
017	1.3 mm
018	2.6 mm

EFFICIENCY

Efficiency is the relation between the input force necessary to move the load applied on the other end of the cable and the output load. The relations between input force and output load are the following:

- input force = output load x bending factor
- output load = input force / bending factor

The bending factor is related to the total bending degrees of the cable installation, as shown in the following table:

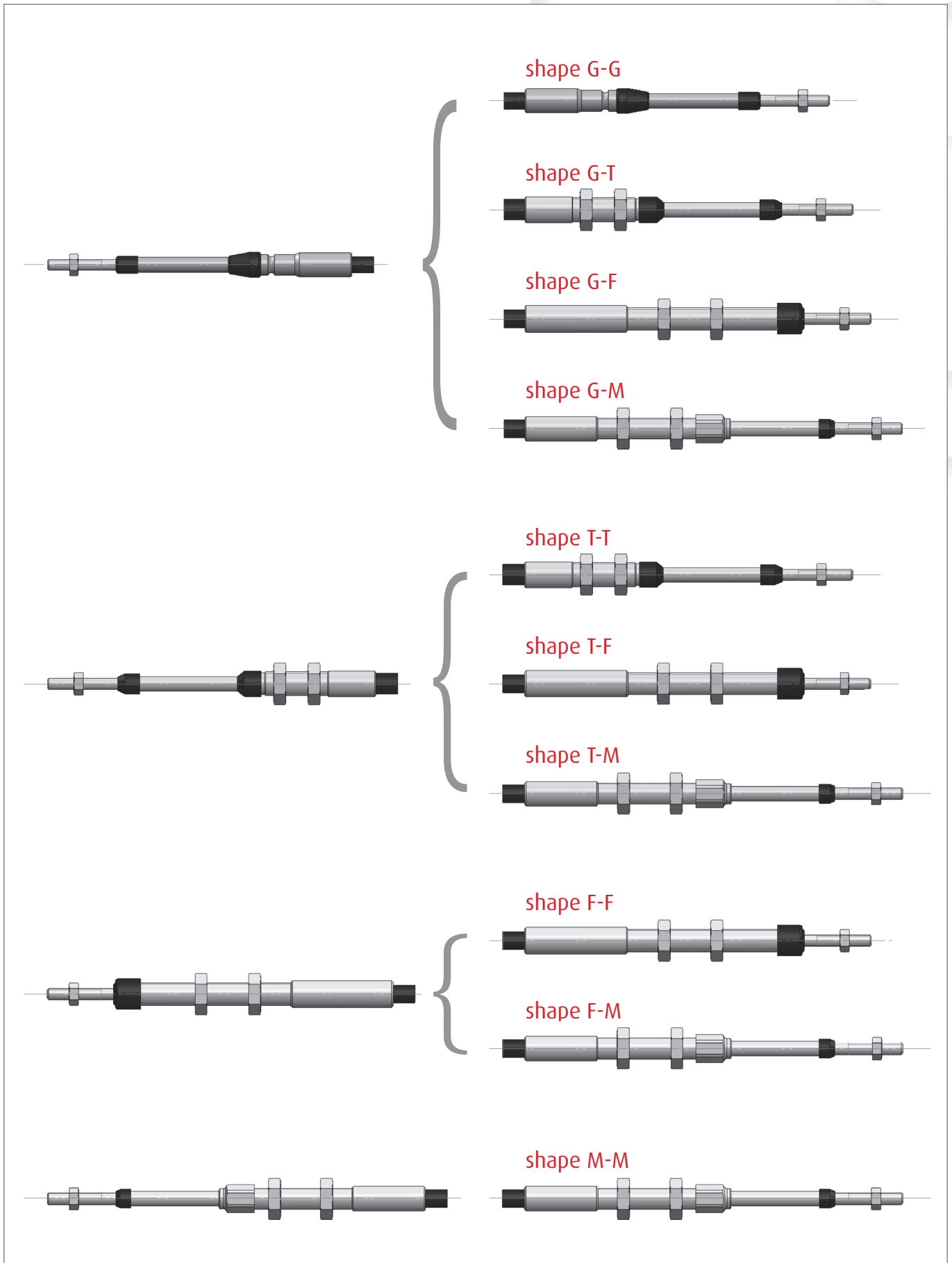
Total degrees of bending in cable installation	90°	180°	270°	360°
Bending factor	1.2	1.4	1.6	1.8

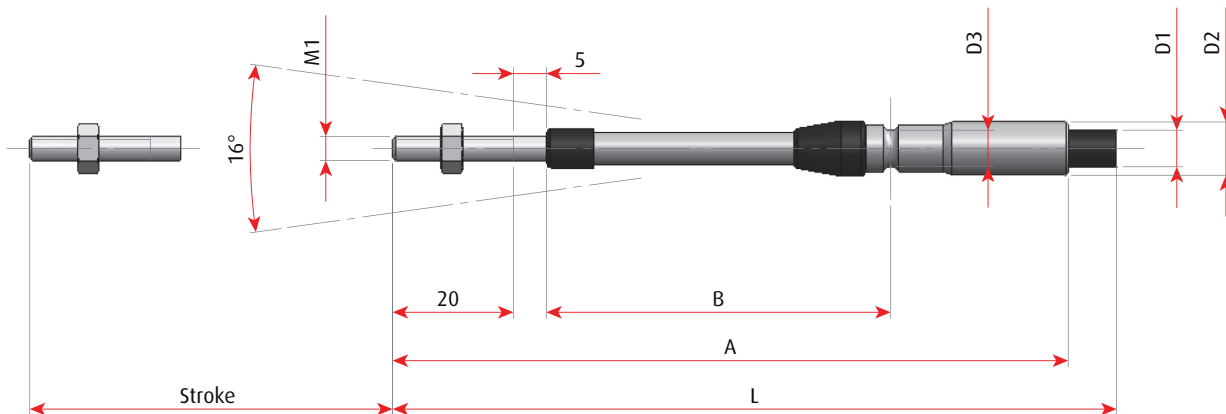
WORKING TEMPERATURE

Flexball push-pull cables can operate from -20°C to +70°C with standard lubricant. In case push-pull cables are lubricated with special grease, the operating temperature field is from -40°C to 110°C. To operate at temperatures beyond standard specification, please contact Flexball technical department as a high temperature conduit proof is available.

END FITTINGS FOR PUSH-PULL CABLES

Several kind of end fittings are available as reported here below.



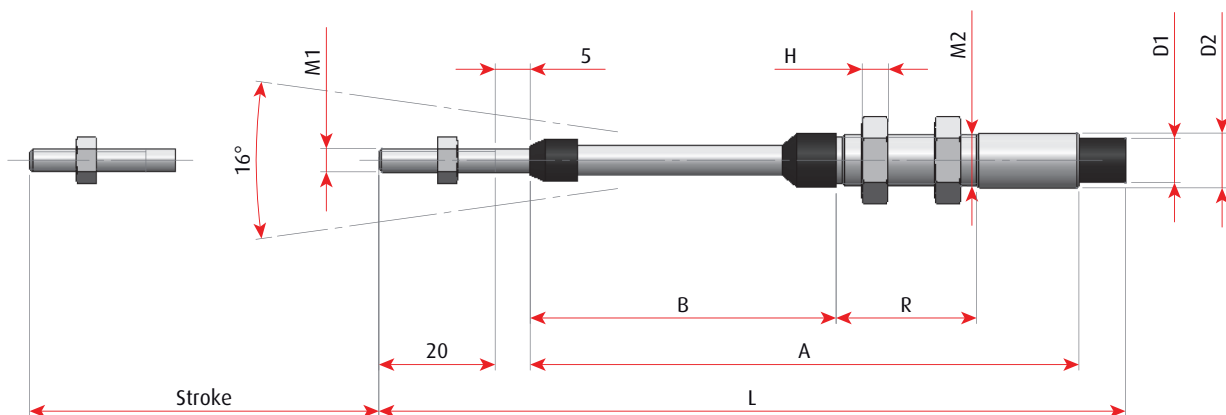


CABLE FITTING G SHAPE

Type	Stroke	A	B	M1
E2 E3 01	50	151	84	M5x0.8 10/32
	75	176	109	
	100	201	134	
V4	50	151	80	M5x0.8
	75	176	105	
	100	201	130	
V5 07 07E V6 010	50	163	83	M6x1
	75	188	108	
	100	213	133	
	125	238	158	
	150	263	183	
V7 V8	50	167	95	M8x1.25
	75	192	120	
	100	217	145	
	125	242	170	
	150	267	195	
200	317	245		

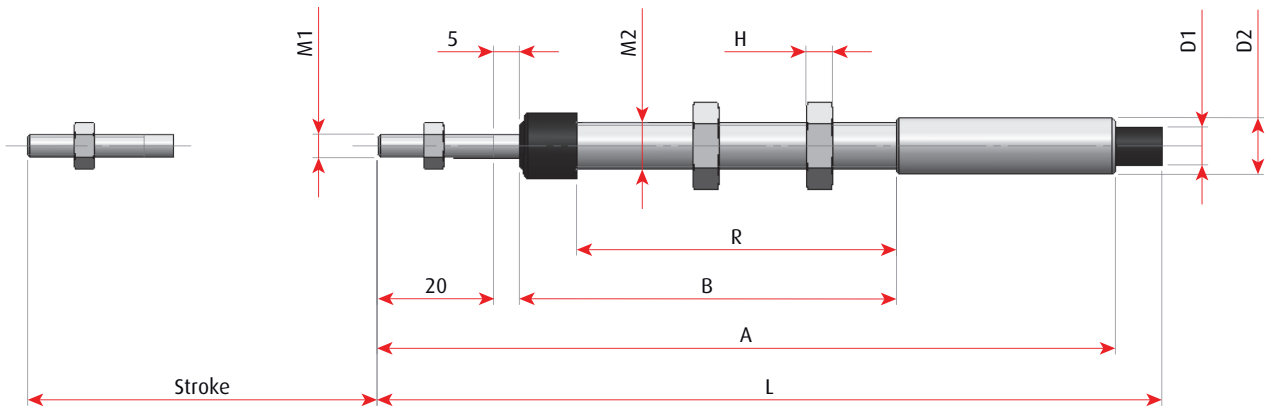
CABLE FITTING T SHAPE

Type	Stroke	A	B	R	H	M1	M2
E3	50	120	80	30	5	M5x0.8 (10/32 UNF)	M11x1 (M12x1.75)
	75	155	105				
	100	180	130				
V4	50	143	88	30	5	M5x0.8	M11x1
	75	168	113				
	100	193	138				
V5 07 07E V6 010 017	50	160	85	37	8	M6x1	M14x1 (M16x1.5)
	75	185	110				
	100	205	135				
	125	235	160				
	150	260	185				
V7 V8	200	305	237	47	8	M8x1.25	M16x1.5
	50	196	91				
	75	221	116				
	100	246	141				
	125	271	166				
	150	296	191				
200	247	247					



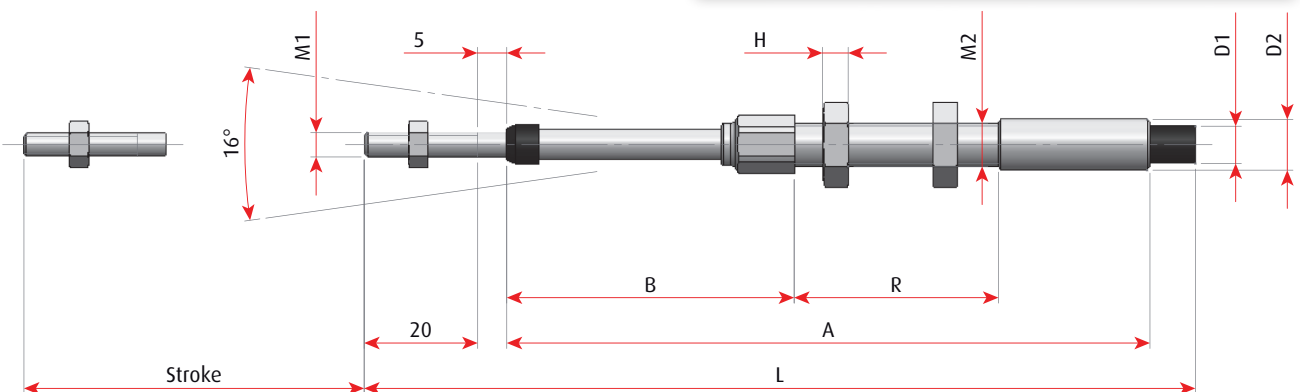
Type	Stroke	A	B	R	H	M1	M2
V4	50	112	65	52	5	M5x0.8 (M6x1)	M10x1
	75	137	90	77			
	100	162	115	102			
V5 07 07E V6 010 017	50	134	79	68	8	M6x1 (M7x1)	M12x1
	75	159	104	93			
	100	184	129	118			
	125	209	154	143			
	150	234	179	168			
V7 V8	50	132	76	59	8	M8x1.25 (M10x1.5)	M16x1.5
	75	157	101	84			
	100	182	126	109			
	125	207	151	134			
	150	232	159	159			

CABLE FITTING F SHAPE

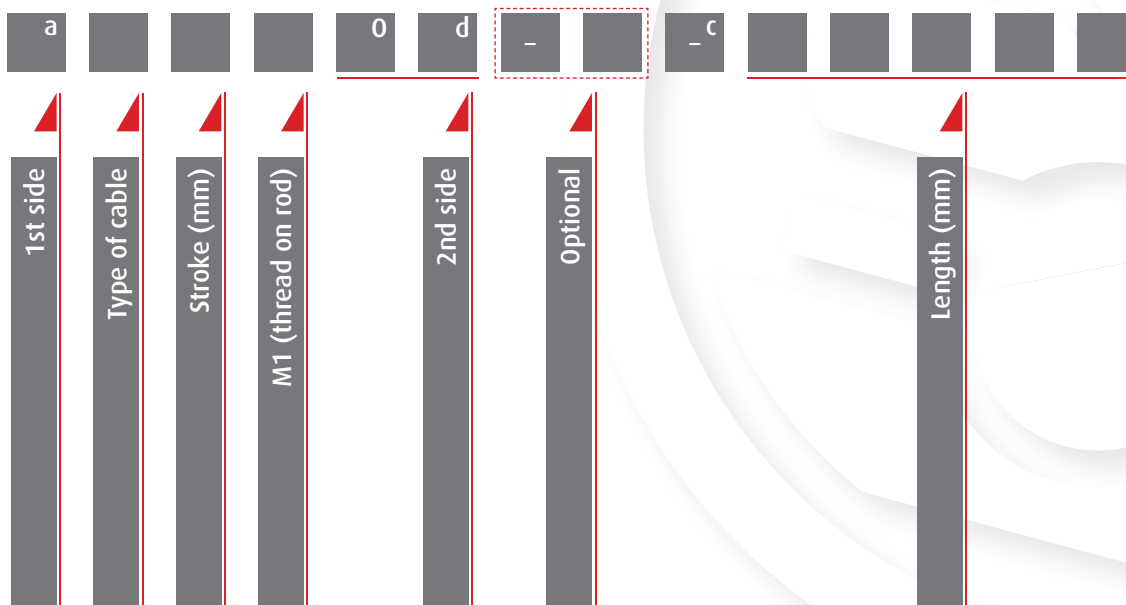


CABLE FITTING M SHAPE

Type	Stroke	A	B	R	H	M1	M2
V4	75	192	118	36	8	M6x1	M12x1
V5 07 07E V6	50	166	94	38	8	M6x1	M12x1
	75	191	119				
	100	216	144				
	125	241	169				
	150	266	194				



CODES



Cable shape	Reference
G	1
T	2
F	3
M	4

Type of cable	Reference
010/017	0
E2	2
E3	3
07/07E	7
V4	4
V5	5
V6	6
V7	12
V8	8

Stroke	Reference
30/35	1
50	2
75	3
100	4
125	5
150	6
200	8

Thread on rod	Reference
10/32 UNF	1
M12x1.5	2
1/4 UNF	3
M5x0.8	5
M6x1	6
M7x1	7
M8x1.25	8

Notes:

- If the cable has different shapes on the two ends:
 - the one which has the lower reference takes the first position (a)
 - the other end takes position (b)
- Position c: if the cable is type 07E (economical), please replace the "-" with "E"

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