

**Railway  
products &  
systems**

**FLEXBALL  
ITALIANA**

**WR CONTROLS GROUP**

## Production sites



**WR Controls Flexball**  
Turin, Italy



**WR Controls Europe**  
Timmele, Sweden



**WR Controls Asia**  
Shanghai, China



**WR Controls Europe**  
Tallinn, Estonia



# Global Manufacturing Facilities

Since 2003 member of **WRControls Group**, with production facilities in Europe and Asia, **Flexball Italiana** is a global company with customers worldwide and an international leader in the design and manufacturing of remote control systems for the transportation sector and for several other fields.

Thanks to our technical competence with more than 50 years experience, fast reaction time and one of the widest range of controls, we can provide customized solutions to maximize the performance of your vehicles.



**FLEXBALL**  
ITALIANA  
WR CONTROLS GROUP







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# ABOUT US: BUSINESS, DEVELOPMENT, ENGINEERING AND PRODUCTION CAPABILITIES

Located in Orbassano (Turin – ITALY), **Flexball Italiana** designs, engineers and manufactures “Flexball” ball bearing controls since 1960, wire cables since 1970 and control boxes for many different kind of applications for various industries in Italy, Europe and others countries in the world.

The main business areas are:

- railways, metro, tramways and transportation in general
- agricultural machinery
- construction equipment
- professional and pleasure boat
- motor vehicle industry

We manufacture specific controls, either mechanical or electronic, for all those applications which require the transfer of a motion either linear or rotary, for any kind of movable, half movable or dragged vehicles.

All design and developments are carried out with Solidworks, 2D and 3D Mechanical CADs, in order to accomplish the following tasks:

- development of a product concept
- perform fully associative top-down and bottom-up design
- weight analysis
- animations to analyze how the product will work
- carry out of prototype design and industrialization

Flexball has the full capability to design, test and qualify all its equipments. Specific testing like endurance, friction, vibration, sand, dust or salt spray are carried on the products before their final release.

All the critical parts of our controls are produced internally. Three assembly lines and two manufacturing workshops permit a full quality control during all the production processes and a detailed know-how of each component produced. This kind of organisation is a mandatory condition to fulfil the On Time Delivery and Quality requirements requested by our customers.





Lupetto – Alstom



TAF Marocco – AnsaldoBreda



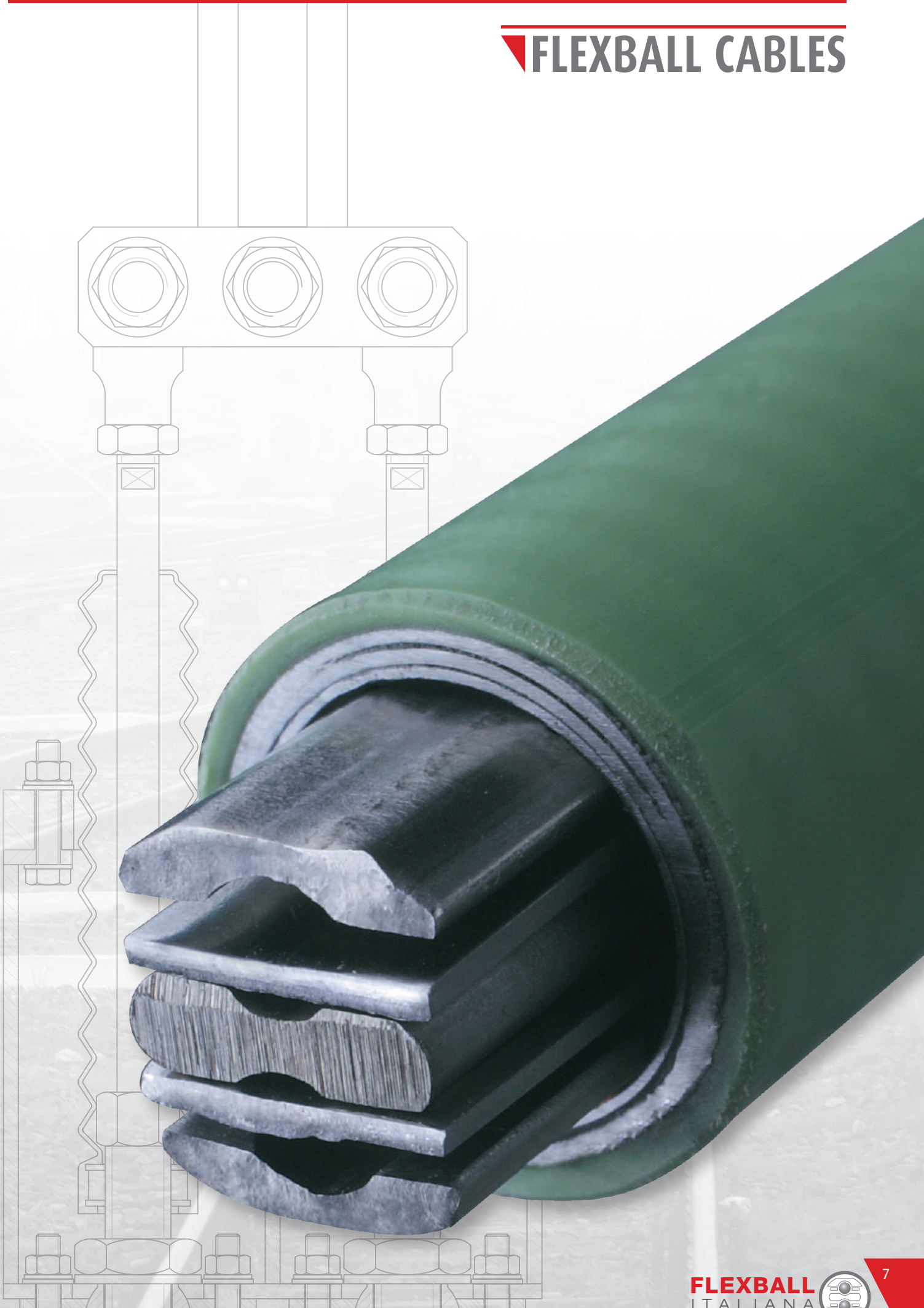
Minuetto – Alstom



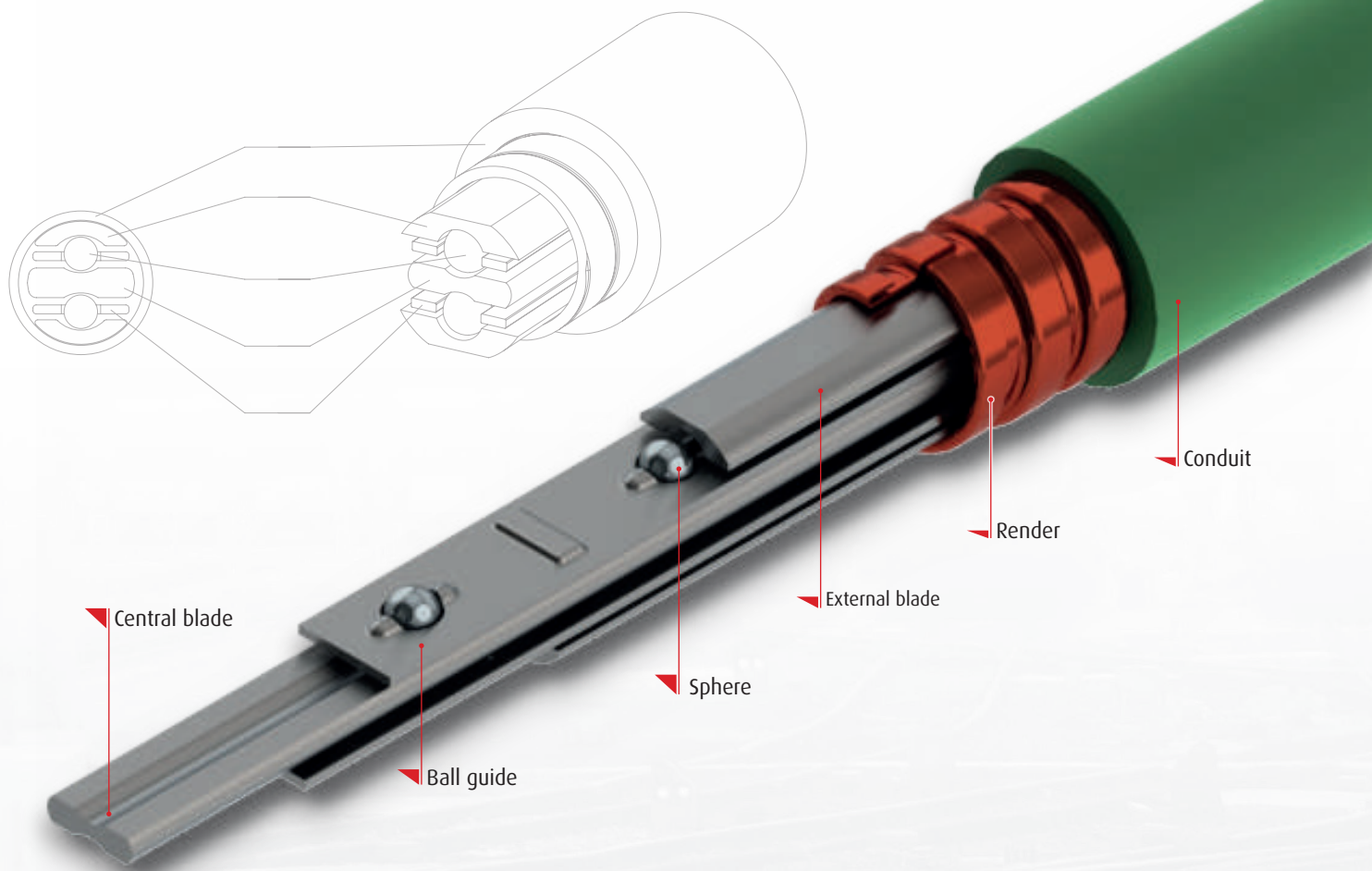
TSR – Ferrovie Nord Milano



# FLEXBALL CABLES







The **Flexball cable**, recognizable from the green colour of the plastic cover, is an extremely flexible and sliding cable. It has a very reliable and robust construction which guarantees very high performances. If mounted properly, it will last "for ever".

It's efficiency is highly better than any traditional push-pull cable. The Flexball cable maintains high mechanical efficiency and very low backlash which approaches to zero, even in complex routings and difficult installations. Flexball cable can be spatially laid on all the three dimensions with low bending radii and 97% efficiency, also under heavy loads.

It works reliably and without interruption, even at lengths over 60 meters. No maintenance or lubrication is necessary. It is indifferent to changes of temperature.

It can operate in severe environmental conditions such as moisture, condensation or icing, without impact on performance. For standard cables the working temperature is 108 °C but special cable versions can work up to 200 °C degrees.

It can transfer linear movements with a stroke up to 300 mm. The ball-bearing principle enables a smooth movement, low play and delay-free transfer of loads which can reach 15000 N in push and 25000 N in pull operation mode.





## CONSTRUCTION

Ball bearing controls have an inner blade which is held between two rows of ball bearings by two outer blades, and all is contained in a high strength outer casing.

Stainless steel inner components guarantee an optimal lifetime with high fatigue resistance in any working condition.

Terminal and end fittings can be made of steel, stainless steel or brass.

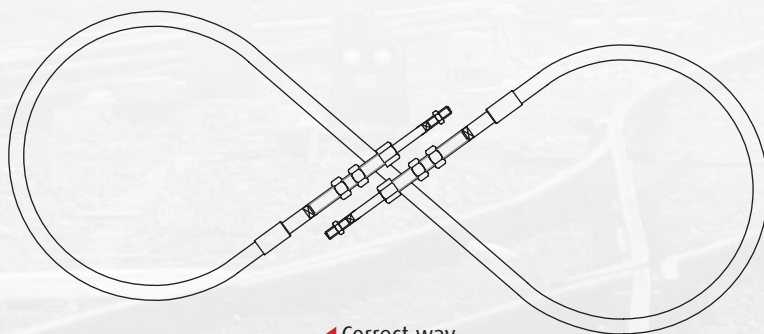
## APPLICATION

Ball bearing controls are generally used in applications with long routings and high tension and compression.

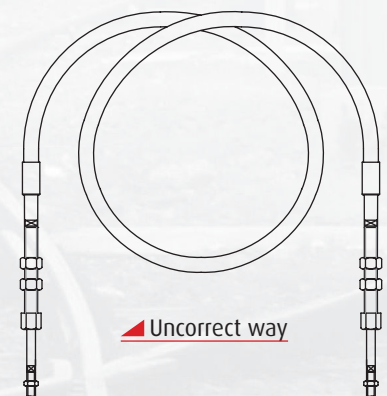
The **Flexball cable** is manufactured in lengths ready to install. It replaces complex solid rods, hydraulic, pneumatic or electric transfer devices.

## HOW TO HANDLE AND STORE

The **Flexball cable** is delivered in a proper box and bent with an "8" shape to respect its minimum bending radius. Once received, it should be opened and stored as a straight line. If not possible, just leave it in the box like you have received it. Flexball cable must not be stored in circle, otherwise it can be seriously damaged.



Correct way



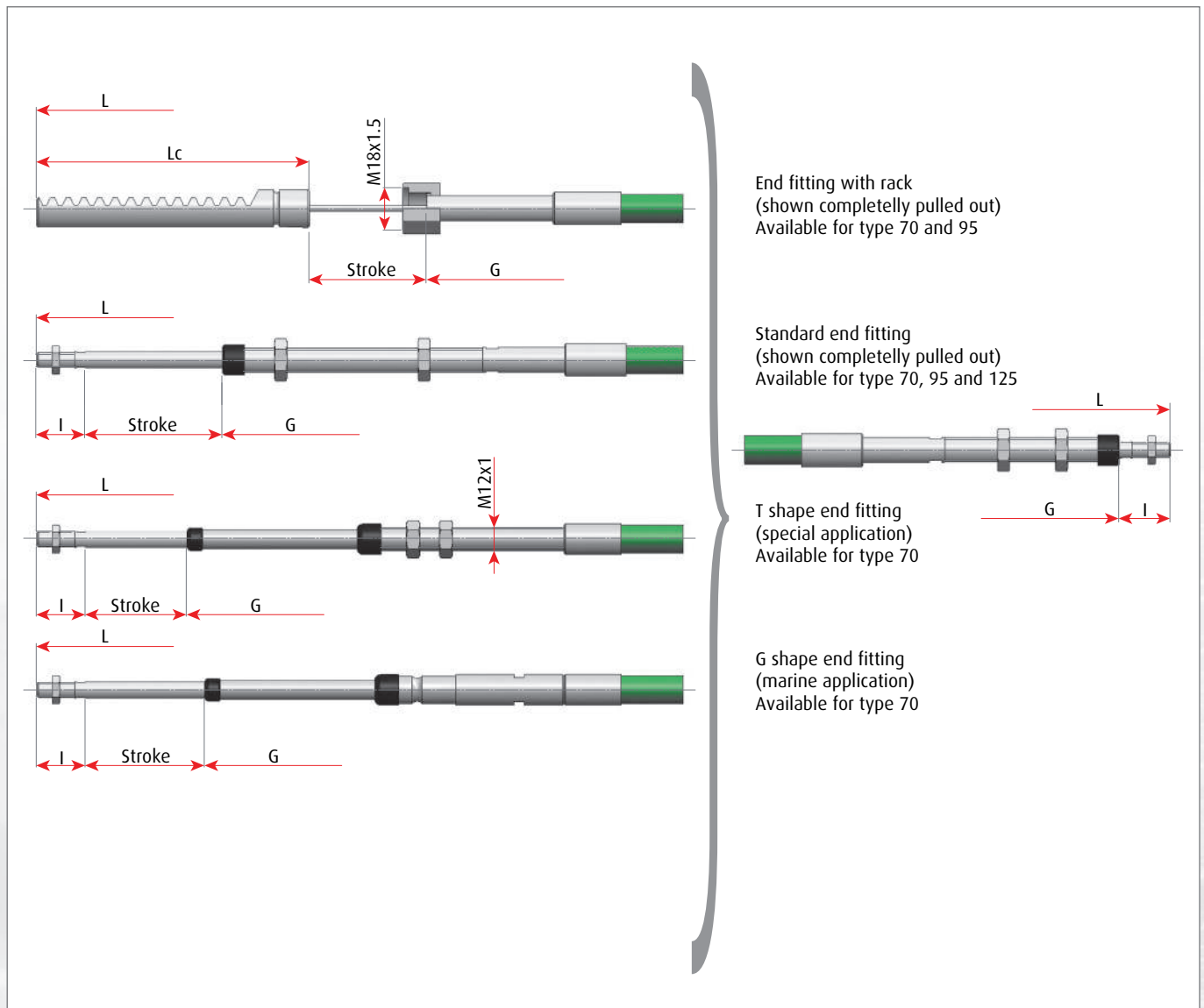
Uncorrect way



## PRODUCT RANGE

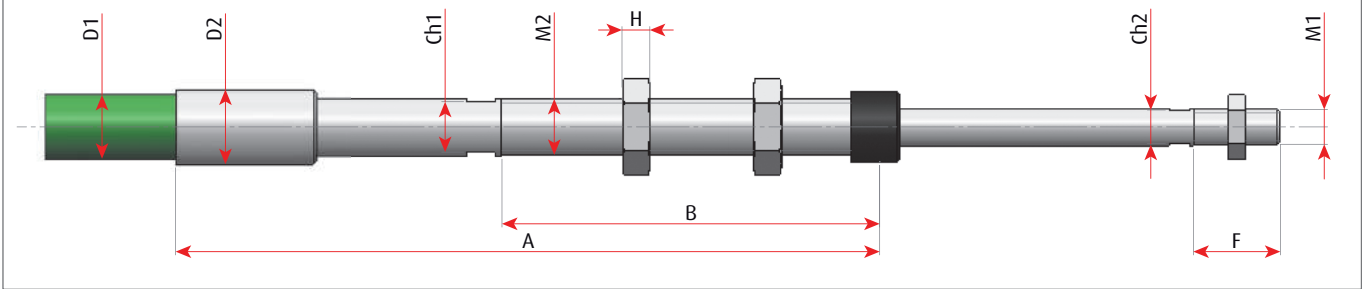
The **Flexball cable** is available in different sizes, from type 55 which has a conduit diameter of 9.5 mm, to type 160 that has a conduit diameter of 24.3 mm.

The **Flexball cables** are available with several types of end fittings to fit the different application requirements.





## STANDARD FLEXBALL END FITTING DIMENSIONS

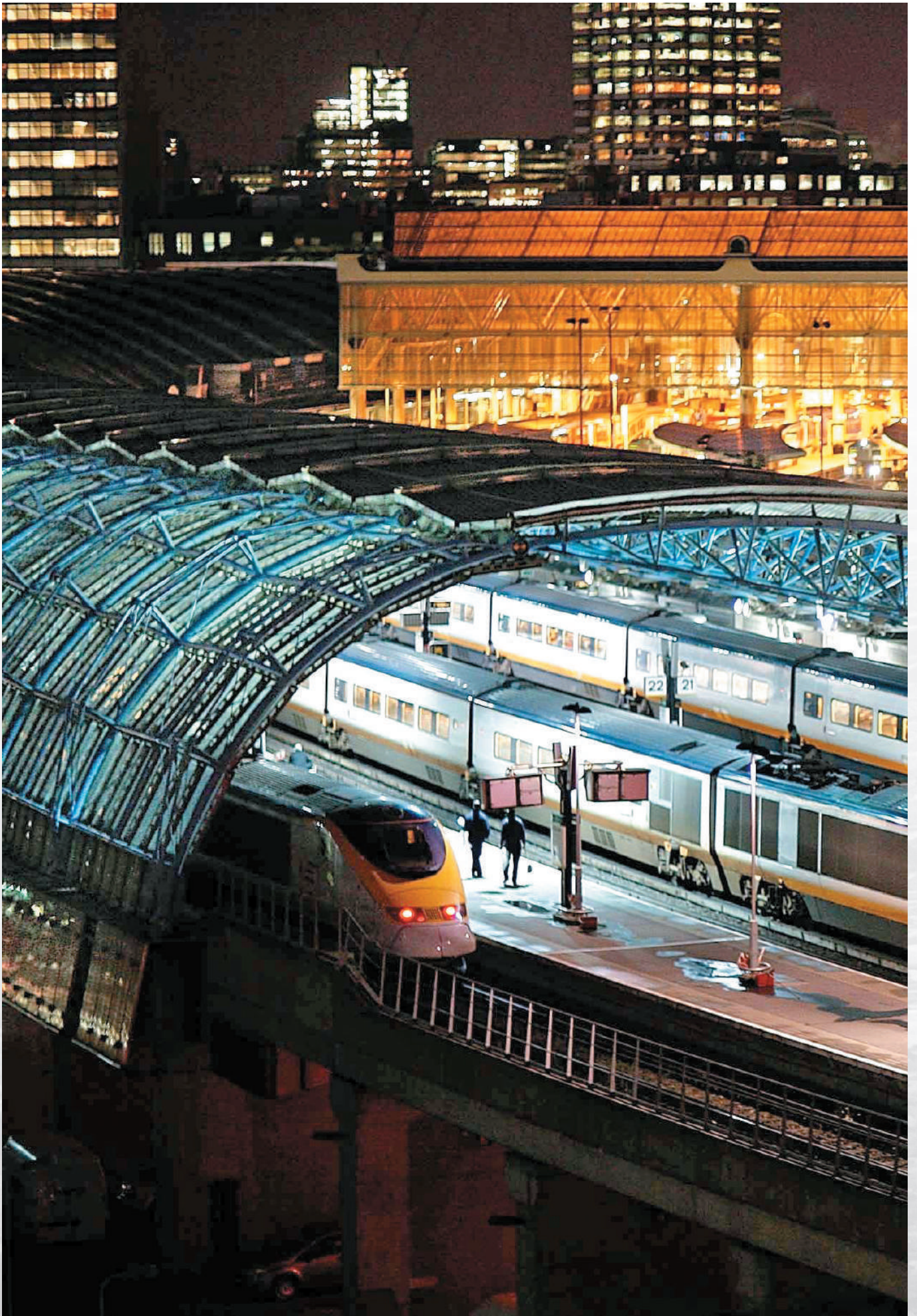


Cable type	Stroke	A	B	F	H	I	Ch1	Ch2	D1		D2		M1	M2	LC	Rack module (mm)	Push load (N)	Pull load (N)	Bending radius (mm)	Weight per meter (gr)	E <sub>c</sub>	
									AN*	ACP**	AN	ACP										
55	50	130	55	20	5	26	8	5	9.5	12	12	14	M6x1(M5x0.8)	M10x1	126	1.5	300	800	100	245	0.3	
	70	145	70																			154
	100	175	100																			178
70	50	142	55	30	8	37	11	6	11	12.8	13	15	M7x1(M6x1)	M12x1	126	1.5	1550	2800	120	320	0.18	
	70	157	70																			154
	100	187	100																			178
	150	237	150																			225
	200	292	170																			276
95	50	163	70	30	8	37	14	9	14.3	16.5	16	19	M10x1.5	M16x1.5	126	1.5	2700	5000	140	518	0.15	
	70	183	90																			154
	100	213	120																			178
	150	263	170																			225
	200	313	220																			276
125	50	195	70	35	9	45	17	11	17	21	20	24	M12x1.5	M18x1.5	-	1.5	5300	10000	200	827	0.05	
	70	215	90																			-
	100	245	120																			-
	150	295	170																			295
	200	345	210																			345
160	50	240	100	35	10	45	21	13	24.3	28	-	-	M14x1.5	M22x1.5	-	-	6500	15000	250	1280	0.03	
	70	260	120																			6000
	100	290	150																			3000
	150	340	200																			1500
	200	390	250																			1400
	250	440	300																			
300	490	350																				

### Notes:

- AN: standard cable coating
- ACP: reinforced cable coating
- Cable's elongation (mm): Cable's length (m) x Applied Load (N) x E<sub>c</sub> x 0.01







# WIRE 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.

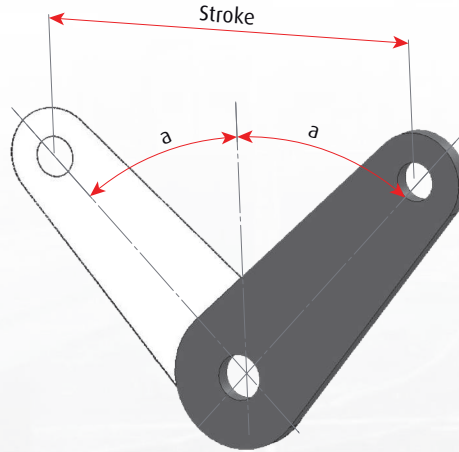
Type of cable	Push load (N)	Pull load (N)	Bending radius (mm)	External conduit diameter (mm)	Wire diameter (mm)		Conduit colour
E2	300	800	100	7	1.9		Black
E3	400	1000	120	8.5	1.9		
V4	500	1200	120	8	3.65		Yellow
V5	700	1500	140	10	4.7	5	
V6	900	2000	160	11.5	5.7		
V7	1200	2500	180	12.1	6		
V8	1400	2000	200	14	7.6		
01	300	800	80	7	2.7		Black
07	800	2000	150	9.5	3.7		
07E	800	1800	150	9.5	3.6		
010	1000	2000	140	9.2	3.2		
017	1000	2000	160	9	3.2		
018	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.

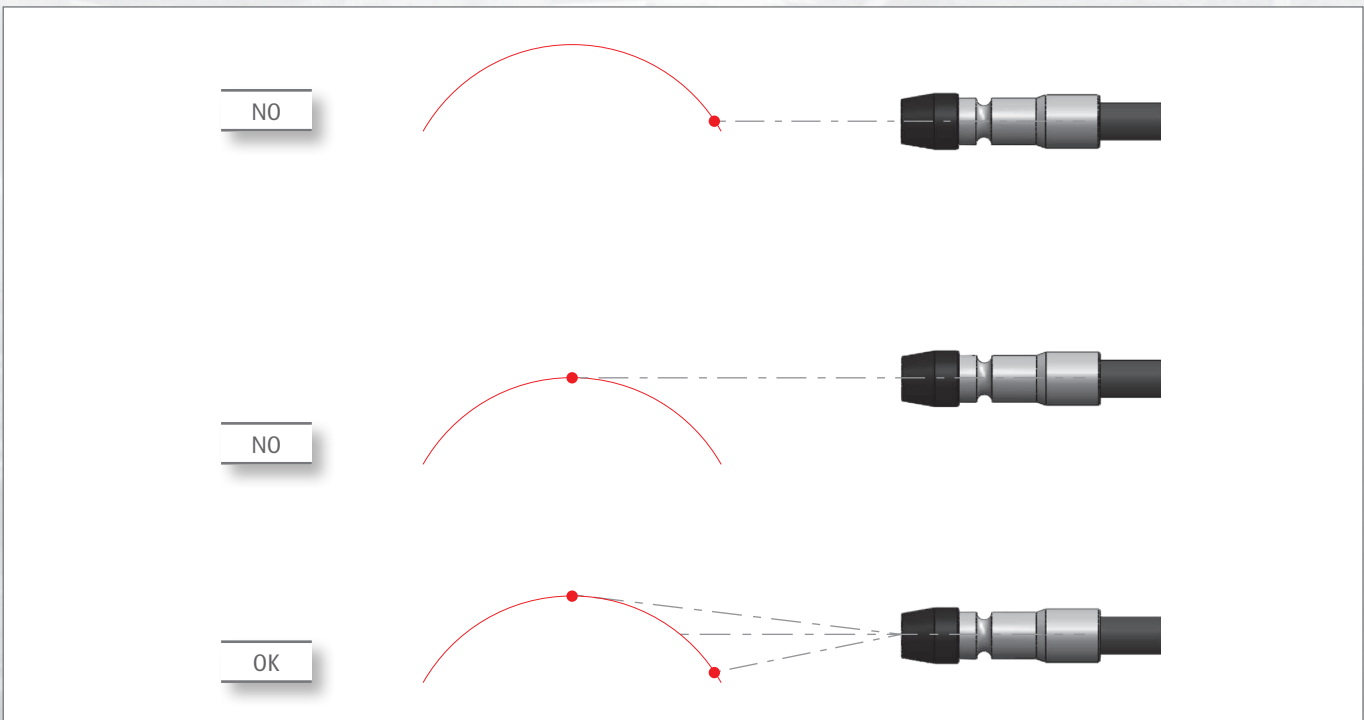
## CALCULATION OF THE STROKE

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 bulkhead 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:

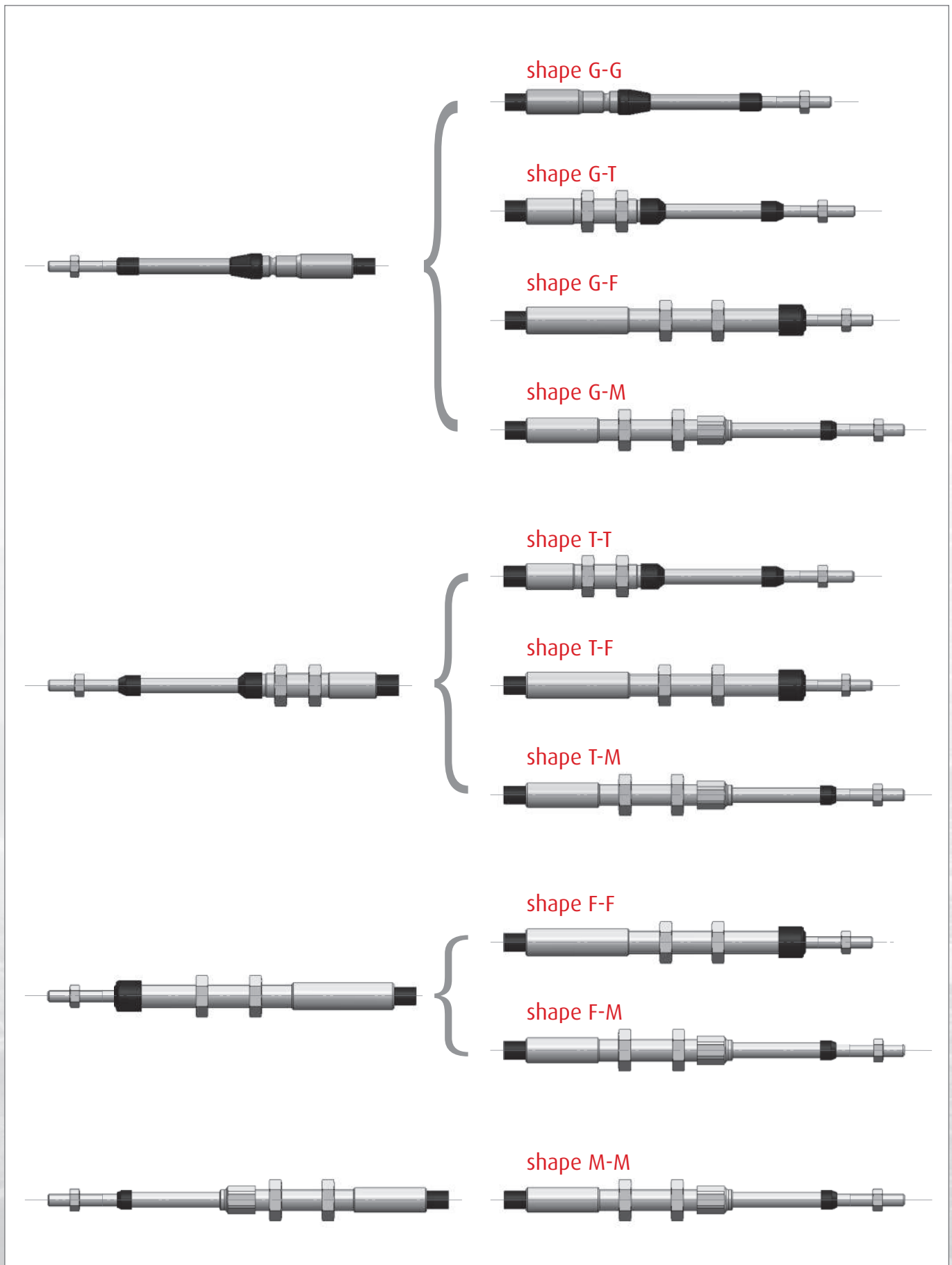
Total degrees of bending in cable installation	90°	180°	270°	360°
Bending factor	1.2	1.4	1.6	1.8

## WORKING TEMPERATURE

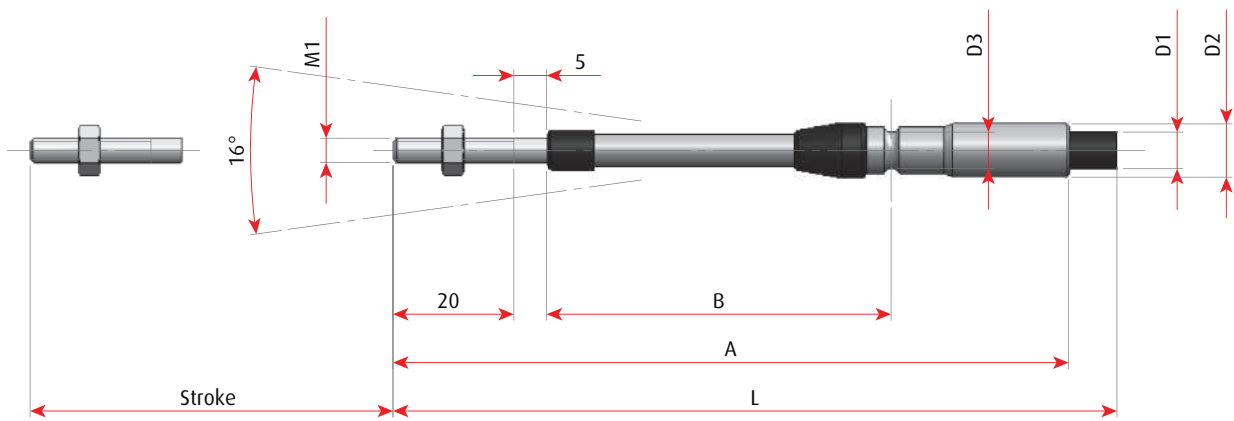
Flexball push-pull cables can operate from -20°C to +70°C with standard lubricant. In case push-pull cables are lubricated with special grease, the operating temperature field is from -40°C to 110°C. To operate at temperatures beyond standard specification, please contact Flexball technical department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





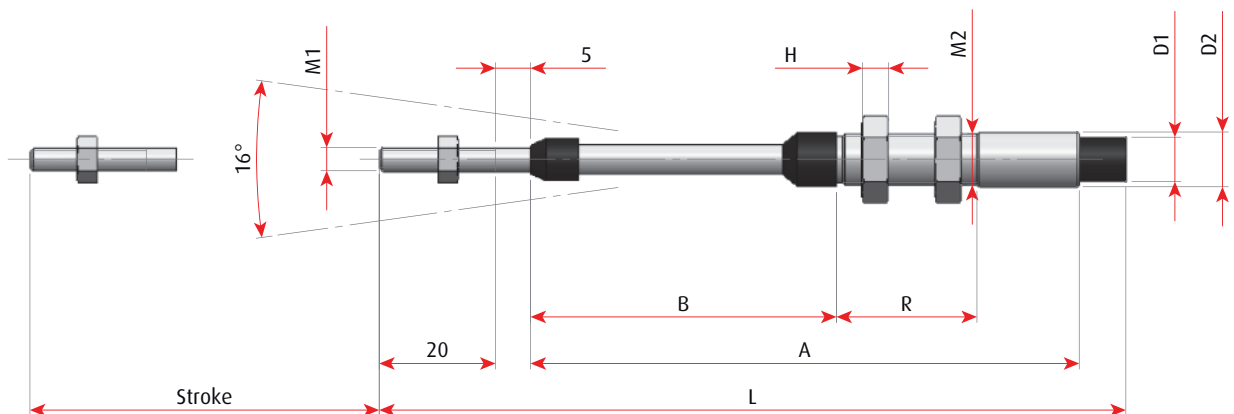


### CABLE FITTING G SHAPE

Type	Stroke	A	B	M1
E2 E3 01	50	151	84	M5x0.8 10/32
	75	176	109	
	100	201	134	
	125	229	162	
V4	50	151	80	M5x0.8
	75	176	105	
	100	201	130	
	125	226	155	
V5 07 07E V6 010	50	163	83	M6x1
	75	188	108	
	100	213	133	
	125	238	158	
	200	313	223	
V7 V8	50	167	95	M8x1.25
	75	192	120	
	100	217	145	
	125	242	170	
	200	317	245	

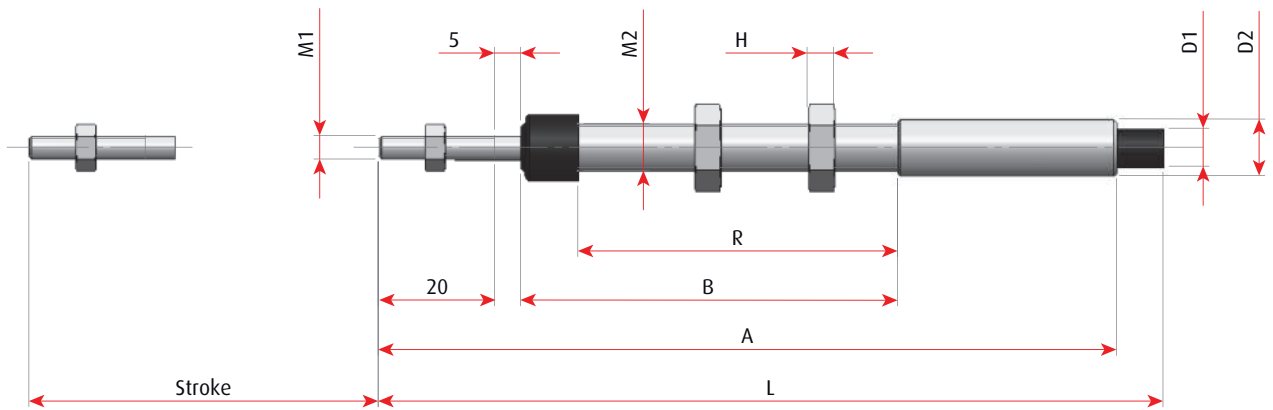
### CABLE FITTING T SHAPE

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				
	125	208	158				
V4	50	143	88	30	5	M5x0.8	M11x1
	75	168	113				
	100	193	138				
	125	218	163				
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				
	200	305	237				
V7 V8	50	196	91	47	8	M8x1.25	M16x1.5
	75	221	116				
	100	246	141				
	125	271	166				
	150	296	191				
	200	347	247				



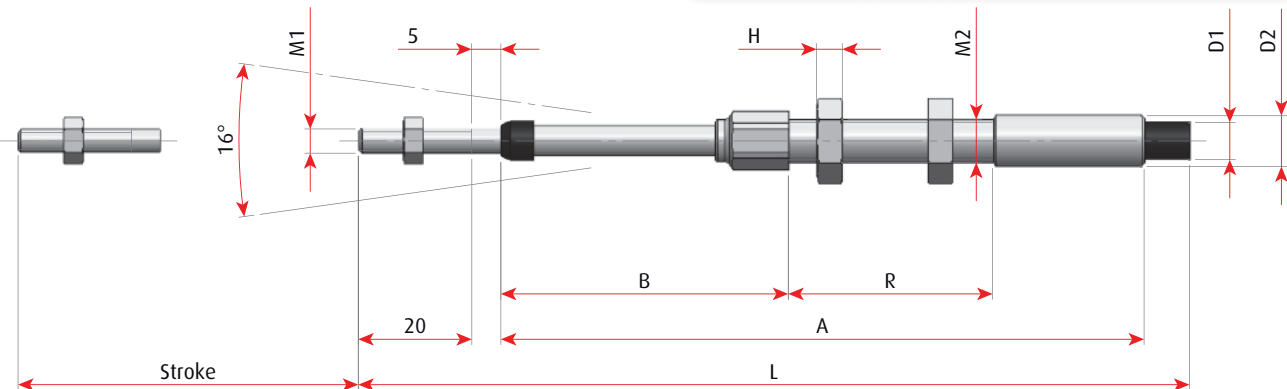
Type	Stroke	A	B	R	H	M1	M2
V4	50	112	65	52	5	M5x0.8 (M6x1)	M10x1
	75	137	90	77			
	100	162	115	102			
V5 07 07E V6 010 017	50	134	79	68	8	M6x1 (M7x1)	M12x1
	75	159	104	93			
	100	184	129	118			
	125	209	154	143			
	150	234	179	168			
V7 V8	50	132	76	59	8	M8x1.25 (M10x1.5)	M16x1.5
	75	157	101	84			
	100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

### CABLE FITTING F SHAPE



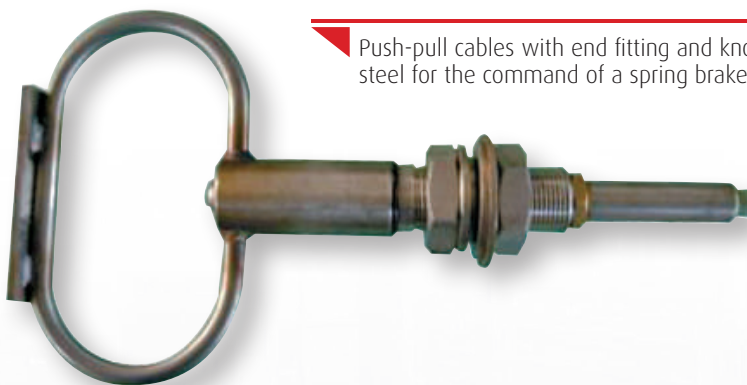
### CABLE FITTING M SHAPE

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				

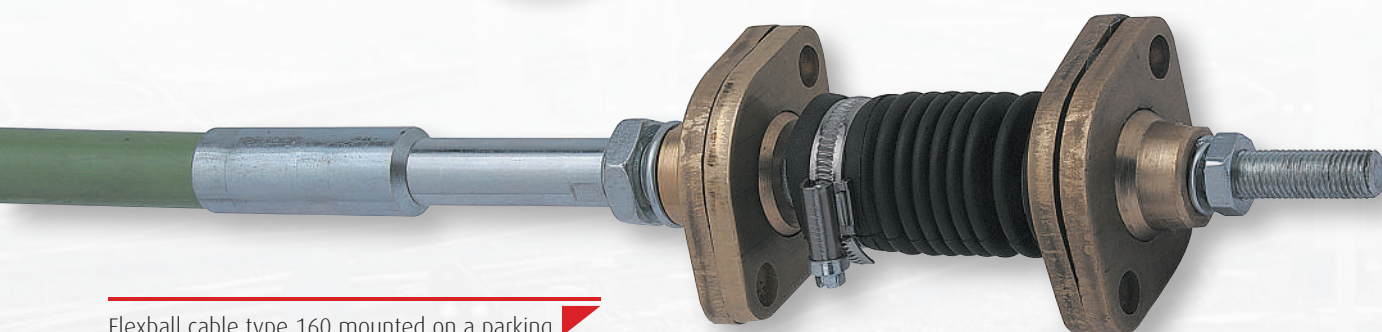




# ACCESSORIES & END FITTINGS FOR RAILWAY'S CABLES



Push-pull cables with end fitting and knob in stainless steel for the command of a spring brake system.



Flexball cable type 160 mounted on a parking brake system. End fitting is composed of bulkhead swivel, bellow and fork.



Push-pull cable with black painted aluminum knob to command a spring brake system.



Push-pull cable for un-locking the brake air distributor system.







# CONTROL LEVERS





Our control levers are designed to deliver superior motion and higher force transmission with maximum precision and reliability. It follows a brief presentation of the most common control levers for the railway sector.

All these control levers are equipped with a rack and pinion mechanism. In railways applications often it is mounted an intermediate box to command two or more cables with the same lever.

## LEVER E95



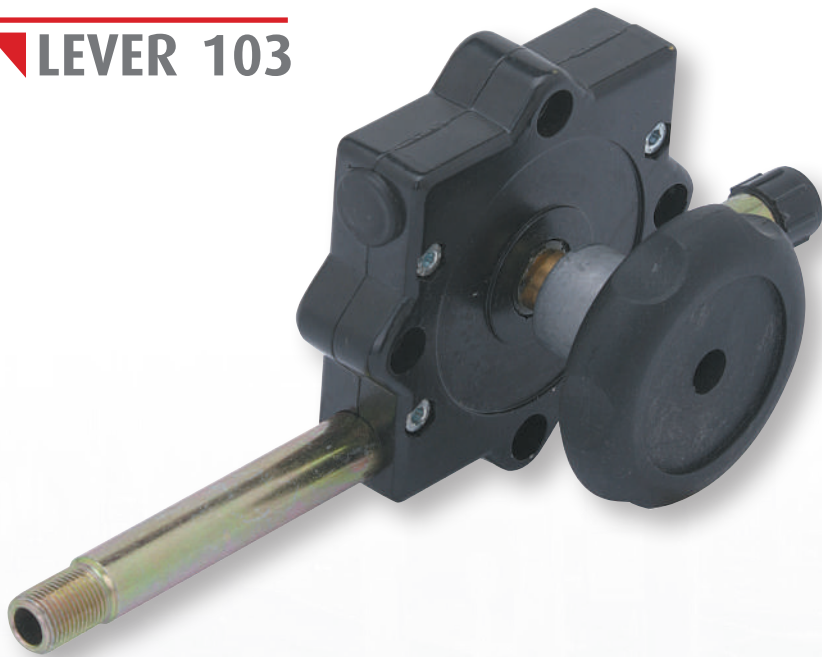
### FEATURES

Very robust control lever with or without friction and neutral central detent. It is possible to have either in floor or wall mounted versions.

- Maximum stroke: 85 mm
- Maximum output working load: 120 kg

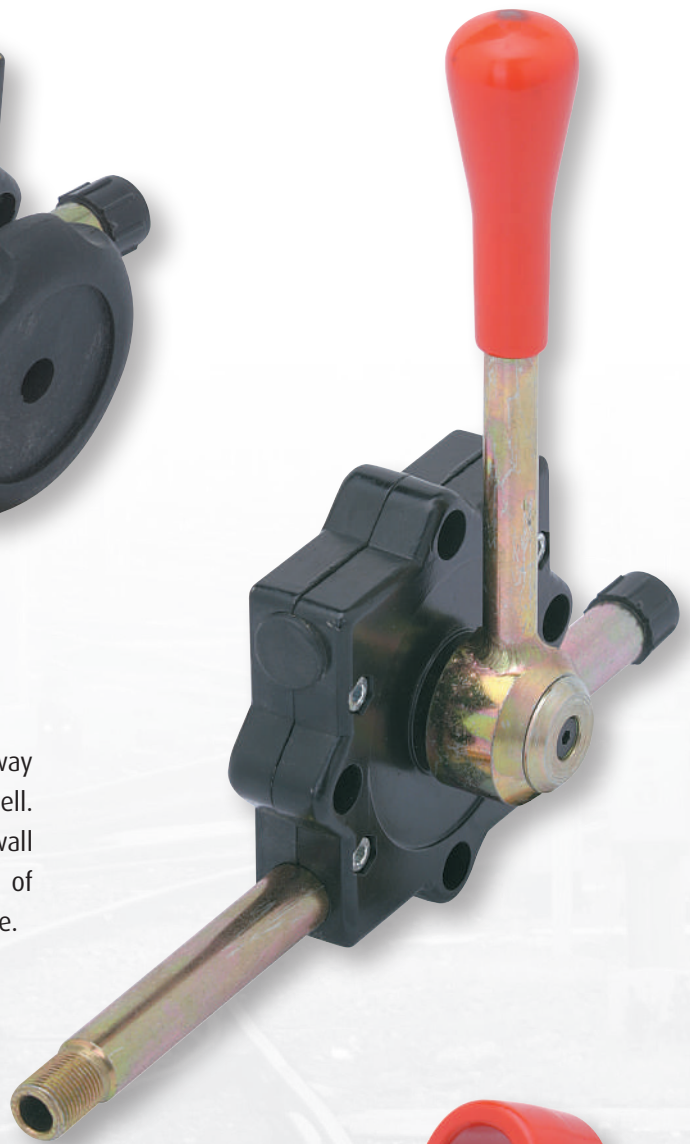


## LEVER 103



Rack and pinion control lever Series 103 is used both in the railway and industrial sectors to perform tuning and transmission as well. Quite small, aluminium made, this lever is very suitable for wall mounting applications. It can be equipped with several types of knobs and a central locking lever. Friction option is also available.

- Maximum stroke: 100 mm



## LEVER 561

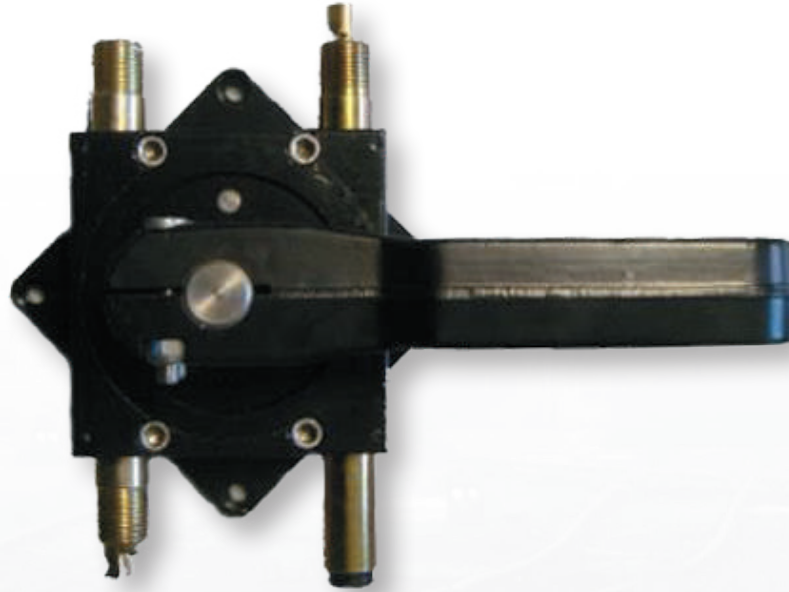
Extremely flexible control lever, it can be mounted side by side offering the possibility to create several levers in a limited amount of space.

- Maximum stroke: 150 mm



## LEVER 900

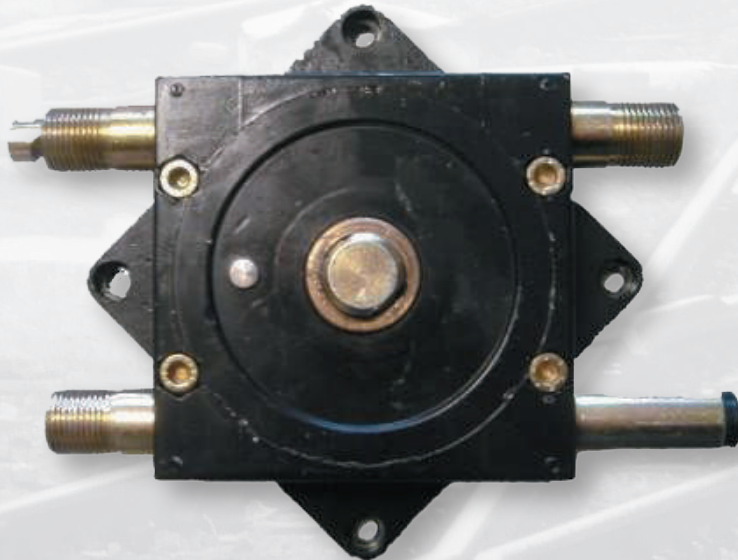
It is a rack and pinion control lever which perfectly fits in heavy duty applications. It has an essential and robust design.



Apart from the railway sector, control lever Series 900 are used to activate winches, gearboxes, cranes, power transmissions, etc.

Control lever Series 900 can be matched either with a single or with two push-pull cables. It can be configured with or without locking lever device. It is designed for side mounting applications.

- Maximum stroke: 150 mm



Lever 900 can be used as a shifting box to change the movement's direction of the force transmitted through the cable.



## ▼ ELECTRONIC CONTROLS

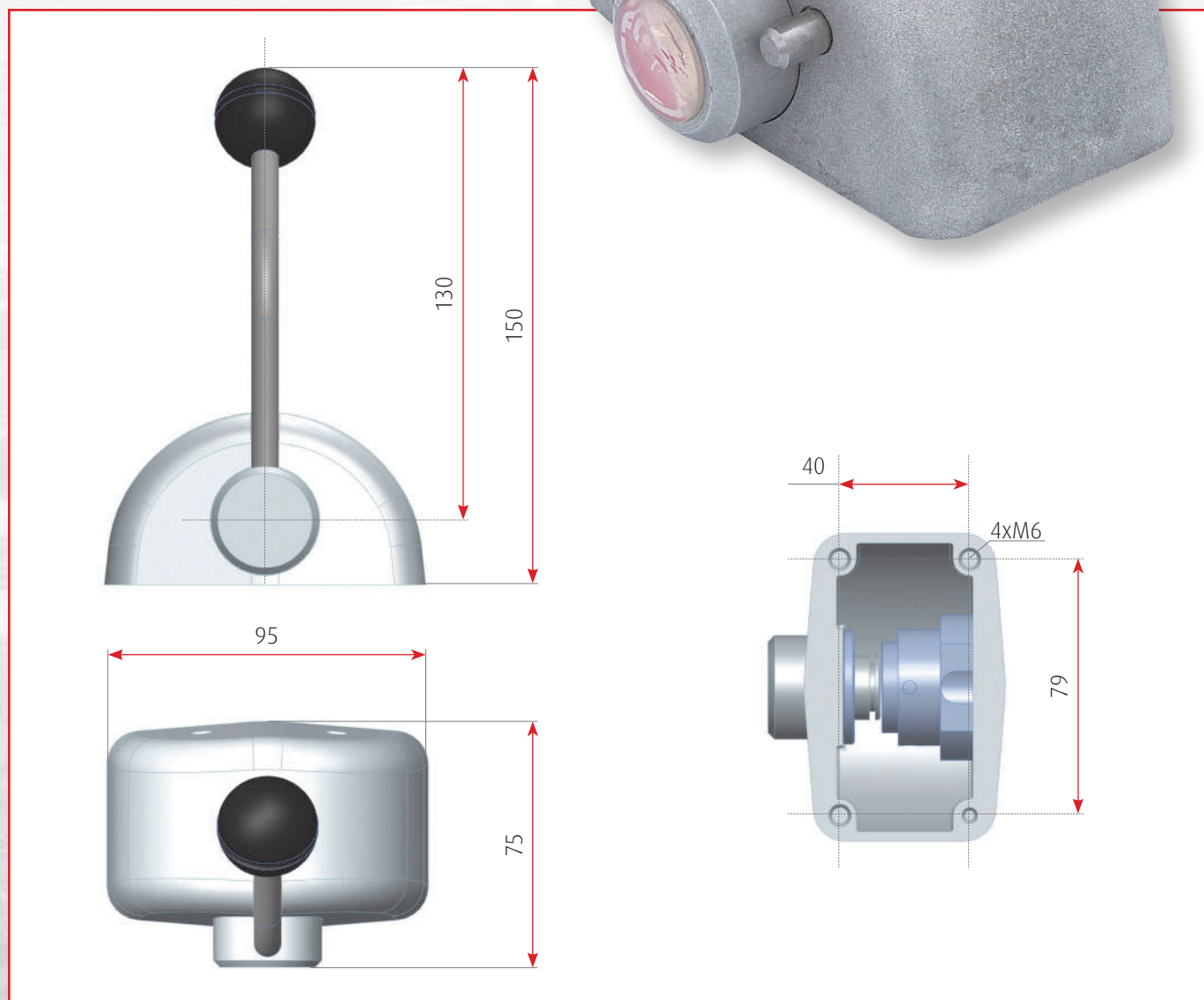
Flexball provides a full range of electronic control levers which can be used either to interface to the ECU of diesel motors or to the frequency converter for the electric motors.

Most of the time, control levers are designed according to customer specifications.

Position is measured with Hall effect sensors.

There are available interfaces to any kind of Electronic Control Unit (ECU):

- voltage
- PWM
- current
- frequency
- CANBus



# APPLICATIONS IN THE RAILWAY BUSINESS

During the years Flexball has developed numerous applications for the transport business, focusing particularly on train applica-

tions. In strong co-operation with our clients, our technical office has developed customized solutions for specific applications.

## FIELD OF APPLICATION

- passenger and goods railways coaches
- tram and underground coaches
- lorries, trailers and buses vehicles
- cabin lifts

## PROJECTS

- direct stationing brakes
- brakes with spring release
- remote closing & opening of valves (air, water, tanks, safety devices)
- door opening & closing actuation systems
- remote control systems to actuate train pantograph
- mechanical control to actuate the train front cowling
- various other commands

Here after there are some examples of braking system solutions.





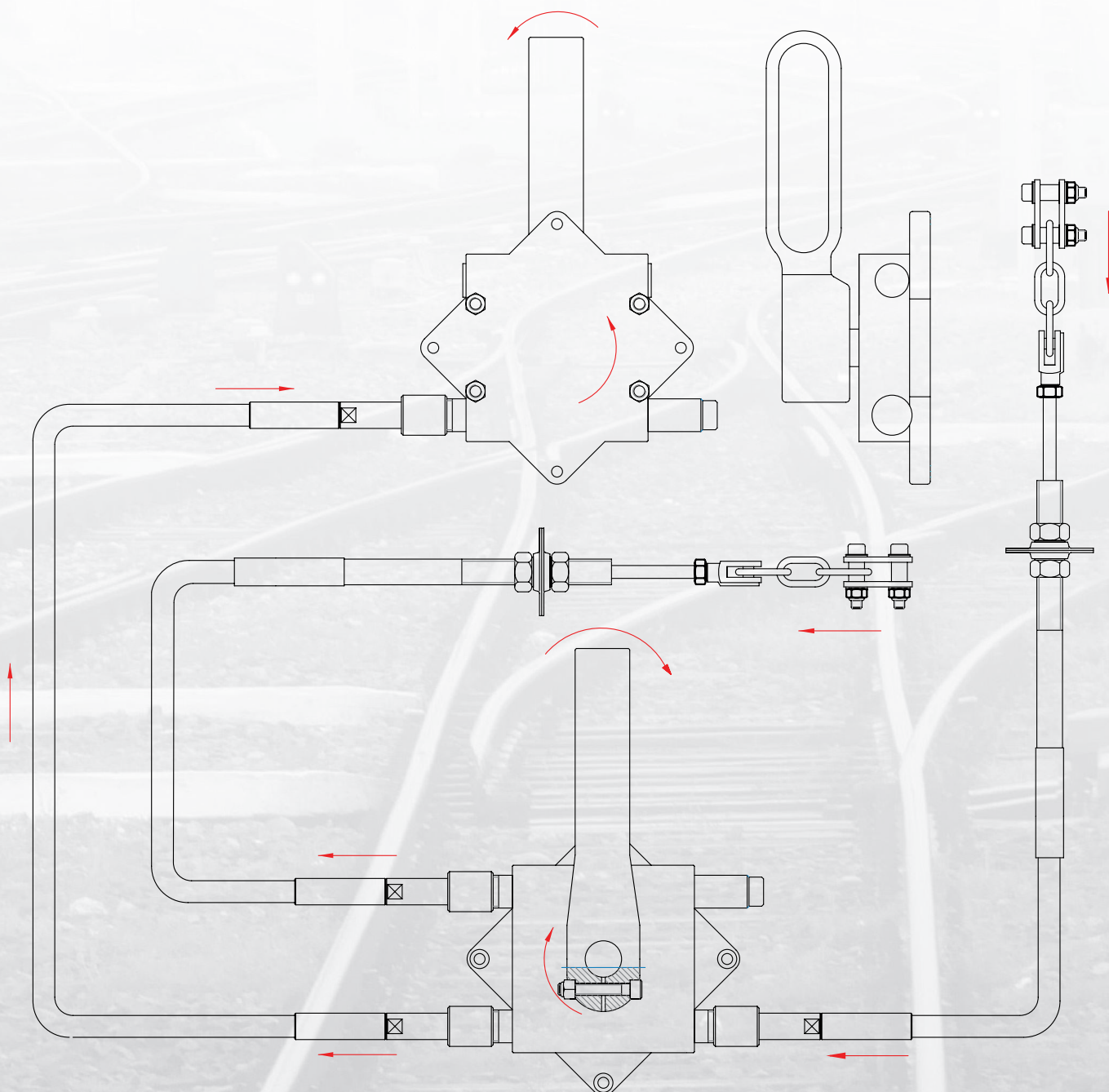
# ▼ PNEUMATIC BRAKE SYSTEMS

## APPLICATION CASE N. 1

This control system is composed of Flexball cables and command levers. The system is located under the bogie, on the main frame, near the wheel. A control lever is mounted on each side of the bogie. Moving one control lever, both pneumatic brakes are activated and also the control lever on the opposite side of the bogie moves. Releasing the control lever, the complete system comes back to zero position under the effect of the springs mounted into each control lever.

### System components

- n. 1 command lever type 900.1 with aluminium handle
- n. 3 Flexball cable type 70
- n. 1 shifting box type 900



## APPLICATION CASE N. 2

Part of the control system is located into the bogie and part under the bogie. One control lever (in this case a control lever Series 103) is mounted inside the bogie and one control lever is mounted under the bogie, connected with a rigid bar to the valve of the pneumatic brake. The valve has to be moved from "close" to "open" position with a rotation of 90°. The control levers are linked together with a Flexball cable type 70. Moving of 90° the control lever inside the bogie, moves also the lever under the bogie. The system hasn't an internal spring, so the operator must move manually the command lever to come back to the position "close".

### System components

- n. 1 command lever type 103
- n. 1 push-pull cable type 007
- n. 1 command lever type 103 with special lever
- n. 1 rigid link



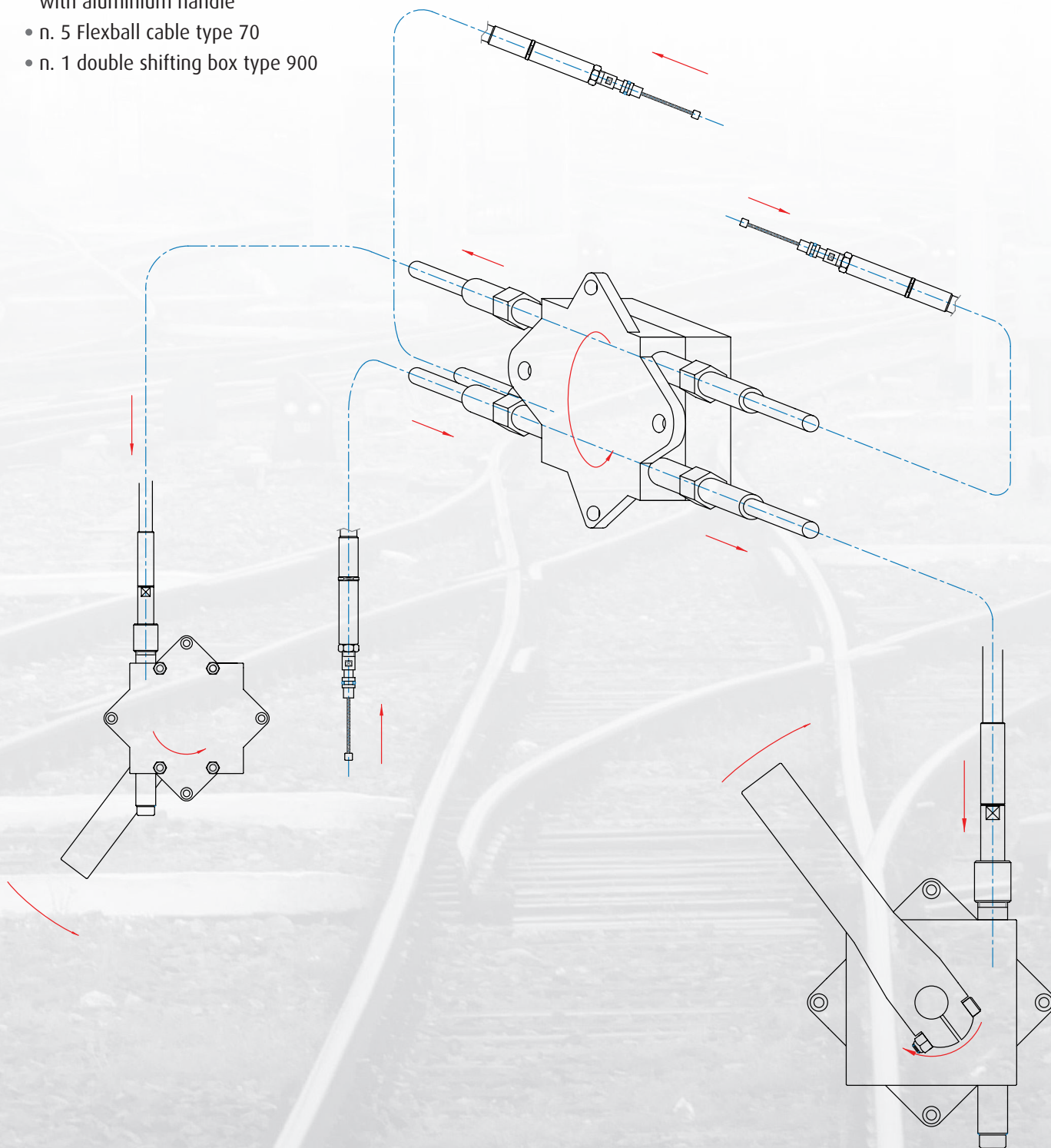


### APPLICATION CASE N. 3

This control system is located under the bogie, on the main frame, near the wheel. A control lever is mounted on each side of the bogie. Moving one control lever, the three pneumatic brakes are activated and synchronously moves also the control lever on the opposite side of the bogie. Releasing the control lever, the complete system comes back to zero position, under the effect of the springs mounted into each control lever.

#### System components

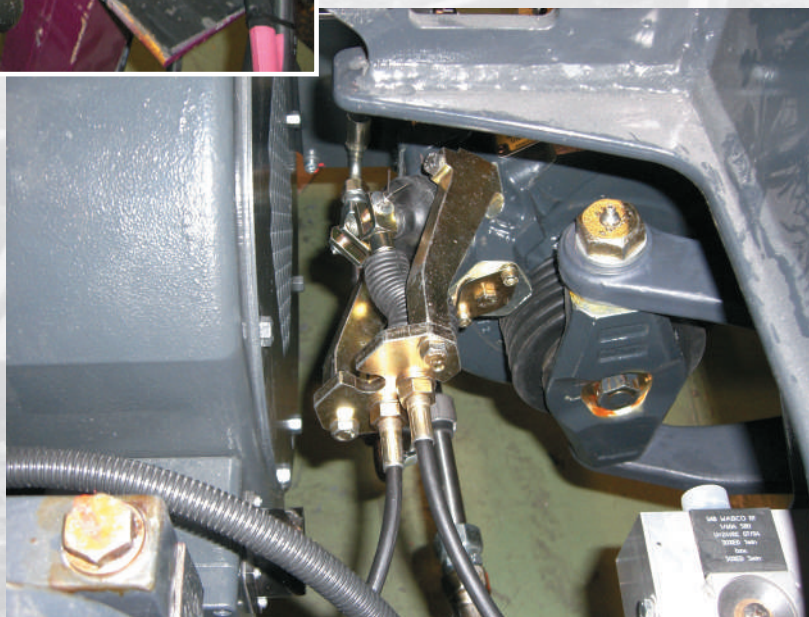
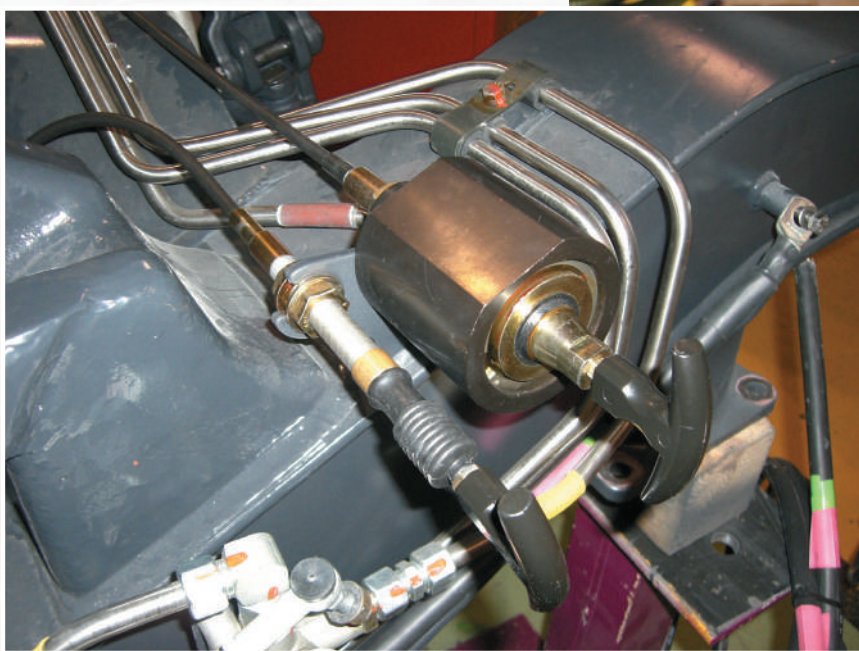
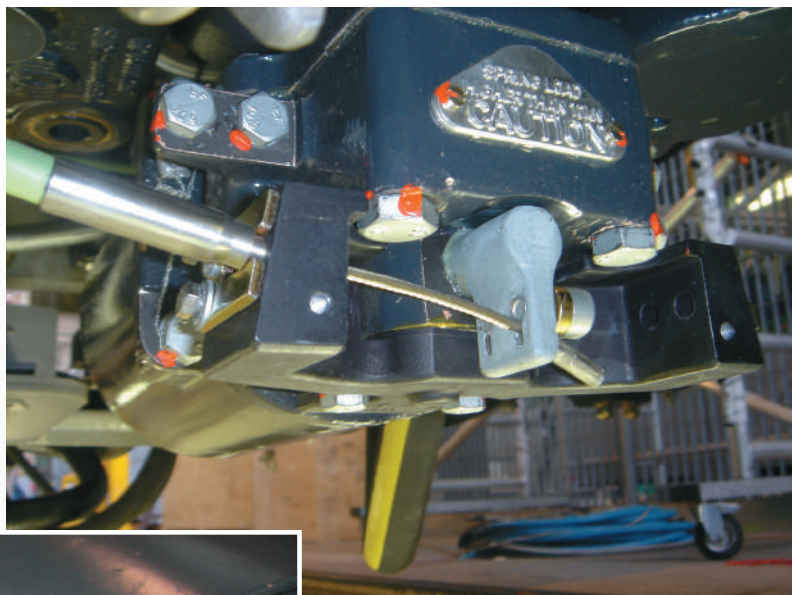
- n. 3 command lever type 900.1 with aluminium handle
- n. 5 Flexball cable type 70
- n. 1 double shifting box type 900





Several versions of our push/pull cables are used to command the pneumatic brake cylinders mounted on train, metro and tram. Our cables today are working on the Metro of Brussels, Madrid, Barcelona, Roma, San Paolo, Argelia, Mexico City, Santiago de Chile and several others. All these systems have been studied in cooperation with CAF.

The pull (green) cable activates the Knorr - Bremse brake. The cable has a special plastic cover which performs a better resistance to heat and a better flame protection with respect to standard push-pull cables.





## PARKING BRAKE SYSTEMS

In its biggest dimension, the Flexball cable is used to command the parking brake of a wide range of wagons. The two cables mounted in parallel as described in the picture here below, can push or pull load up to 2000 kg.



The cable may be enclosed in a metallic cover as a further protection against stones or any element with sharp edge which might damage it. In other cases the Flexball cable is covered with a rubber stocking to seal it against water or oil.

The picture on left shows the connection of a Flexball cable type 125 to a parking brake. This solution has been studied in cooperation with AnsaldoBreda.





# Notes



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