Chainflex


IGUS CHAINFLEX® CFBUS.001
IGUS CHAINFLEX® CF260.
IGUS CHAINFLEX® CF211.
IGUS CHAINFLEX® CF30.
IGUS CHAINFLEX® CF31.
IGUS CHAINFLEX® CF300.
IGUS CHAINFLEX® CF5.
IGUS CHAINFLEX® CF6.

Chainflex Cables

Chainflex

2

The tricks and ingenious features of the Chainflex® design and why we feel so confident about this design

From the customer's point of view, a flexible energy supply system only needs to function properly. However, this demand presupposes the perfect operation of all components, including the cables being used in this system. And this is exactly where problems came up in the early 1980s. Due to constantly – and frequently even tremendously – increasing loads resulting from the application of automation technology, guided cables often failed although the energy supply system itself was functioning perfectly. In extreme cases, failures caused by "corkscrews" and core ruptures brought the entire production process to a standstill and resulted in high costs.
In order to find a solution to this unsatisfactory situation for its customers, igus® decided to take the initiative. As the first company worldwide, igus® began to develop complete Energy Chain Systems®. Chainflex® cables and Energy Chains® are now being offered as a delivery from a single source and with a system guarantee depending on the application in each case. Based on the increasing know-how gained since 1989 and on the very sophisticated series of tests that have been conducted since then, design principles were and are still being created that help prevent machine downtimes in factories throughout the world today.

How can "corkscrews" be prevented?

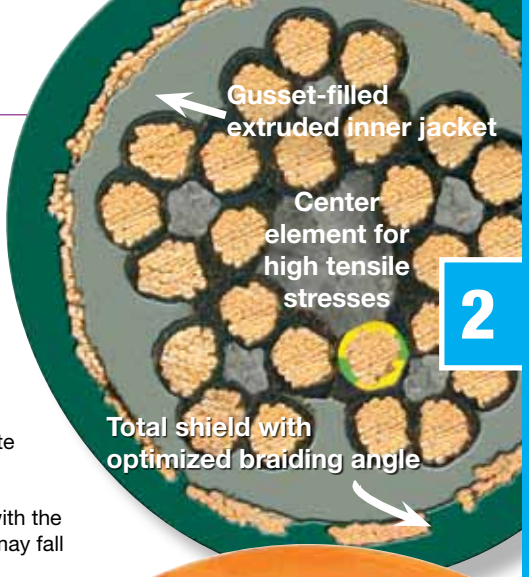
Here, the term "corkscrew" does not refer to a useful instrument for wine connoisseurs. Instead, it refers to the permanent deformation of guided, moved cables caused by excessive stressing – which, in most cases, results in core rupture almost immediately afterwards.
How does this happen? How can "corkscrews" be prevented?
An important factor here – in addition to a sensible design of the total Energy Chain System® – is the construction of the guided cables. Basically speaking, a clear distinction can be made between cables stranded in bundles and cables stranded in layers.

Properties of stranding in layers

Stranding in layers is significantly easier to produce and is therefore offered on the market in so-called "chain-suitable" cables at low cost. But what appears to be tempting at first glance can quickly turn into an expensive mistake when a "corkscrew" immobilizes the system being operated with these cables. In the case of stranding in layers, the cable cores are mostly stranded more or less firmly and relatively long in several layers around a center and are then provided with a jacket extruded to the form of a tube. In the case of shielded cables, the cores are wrapped up with fleece or foils. But what, for example, happens to a similarly structured 12-core cable during normal operation?
The bending process compresses, in the movement of the core, the inner radius of the cable and stretches the core in the outer radius. Initially, this works quite well because the elasticity of the material is still sufficient. But very soon, material fatigue causes permanent deformations and then due to excursion from the specified paths, the cores make their "own compressing and stretching zones": The corkscrew is created, then followed rather quickly by core ruptures most of the time.

Stranding in bundles tried and tested expensively and efficiently millions of times since 1989

Stranding in bundles eliminates these problems by means of its very sophisticated, multiply stranded internal structure. Here, the litz wires are stranded with a special pitch length first and then the resulting cores are stranded into single core bundles. For large cross sections, this is done around a strain relief element. The next step is the renewed stranding of this core bundle around a tension-proof center – a genuine center cord.
Due to this multiple stranding of the cores, all cores change the inner radius and the outer radius of the bent cable several times at identical spacing distances. Pulling and compressing forces balance one another around the high-tensile center cord that gives the stranded structure its necessary inner stability. Accordingly, the stranding remains stable even under maximum bending stress.



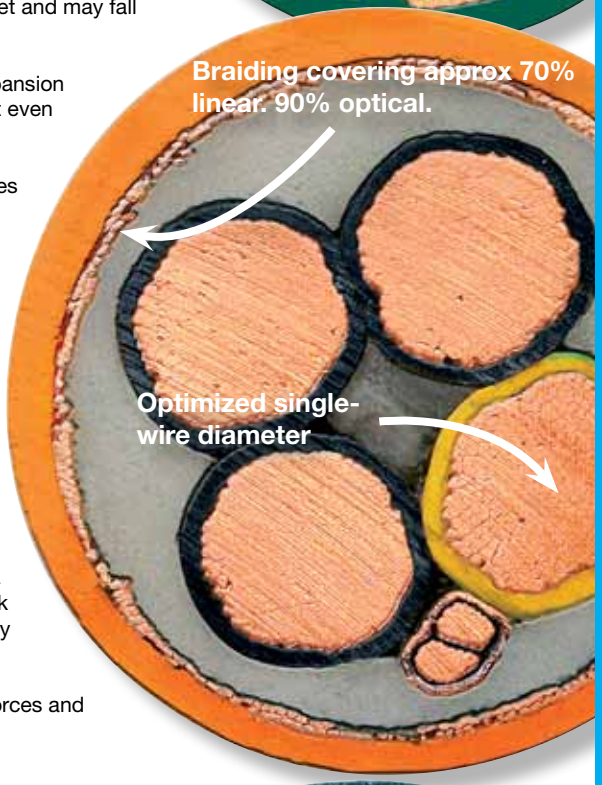
What are EMC problems and shield wire breakage?

In principle, cable shields must fulfil two tasks:
- Protecting the cables from external interferences
- Shielding any interferences before transmitting them to the outside

In the case of so-called “chain-suitable” cables, for example, the stranding bond of an intermediate layer is wrapped up with foils or fleeces. This stranding bond is supposed to guarantee the separation between the cores and the shield braid. But something that functions quite well for the fixed installation of cables is often quite insufficient in the case of moving cables. This has to do with the fact that the foils and fleeces do not create a bond between the stranding, shield and jacket and may fall apart under stress. Consequently, the metallic shield then rubs on the insulation of the cores – short circuits are then to be expected.
Open shields only possess a limited shielding effect in their moved state – motion and expansion reduce this effect even further. The type of shield is therefore an important point that is not even mentioned in some catalogues.

In its up to approx, 70% linearly and approx, 90% optically covered cables, igus® eliminates these weak points by means of an optimized internal structure. In virtually all shielded Chainflex® cables, a gusset-filled extruded inner jacket over the stranded structure is therefore used. This “second jacket” fulfils two tasks:

- It holds the stranded structure together and guides the individual cores as in a channel.
- It serves as a firm, round base for a very tight-fitting shield.



Shield wire breakage – and how this can be prevented

And even during the production of the shield, there are many things that can be done correctly – or incorrectly. Here, an important parameter is the braiding angle.
In the case of “chain-suitable” cables, a tensile load of the shield wires in the outer radius of the cable must usually be taken into account. If an unfavorable braiding angle is to be added, the tensile load increases even further and shield wire breakage is the result. The consequences range from reduced shielding effects right up to short circuits whenever the sharp wire ends penetrate through the fleeces or foils into the cores. Here, a useful tip: If, after the insulation has been stripped off the shield can be easily pushed back over the jacket, the shield is then usually unsuitable for use in moved flexible energy supply systems! This is a problem that igus® has now solved with its direct approach:

The shield braiding angle determined in long-term tests efficiently neutralizes the tensile forces and is therefore highly suitable for
- Energy Chains®.
- Due to the stable inner jacket, the shield cannot wander uncontrolled.
- The shield itself has a torsion protection effect on the stranded structure.

Jacket abrasion/ jacket breakage

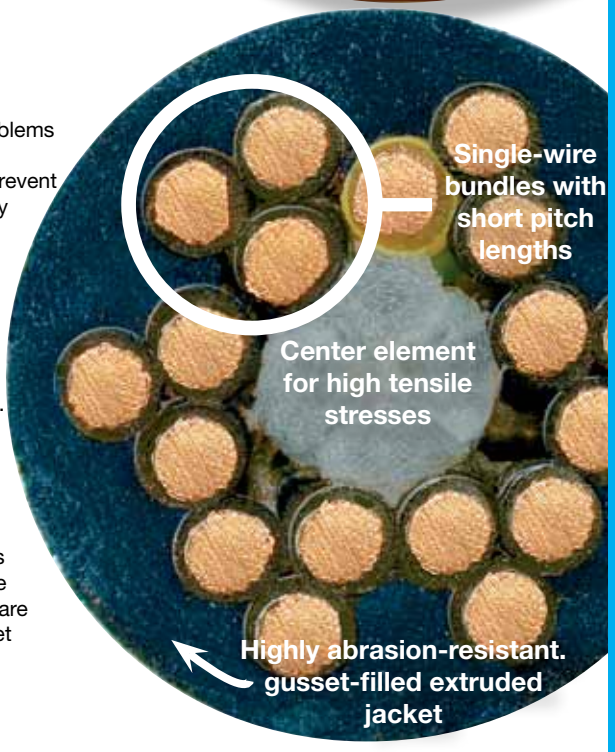
Whereas defects in the internal structure are hardly detectable on the outside, jacket problems strike the eye immediately. The jacket is the first protection for the complicated internal structure. This is why broken, worn and swollen jackets are a serious quality defect. To prevent this problem the igus® customer can select among 7 jacket materials to adapt his Energy Chain® cables to suit the conditions of the respective environment.

Gusset-filled extruded jacket

Here not only the material is an important factor but also the production process. In the case of the so-called “chain-suitable” cables the jackets are usually produced extruded to the form of a tube and therefore do not provide the stranded structure with the necessary support for constant bending processes. The stranded structure can fall apart.

Therefore, igus® is the first manufacturer of Energy Chain Systems® to offer the so-called the “gusset-filled extruded” jacket.

Here, the jacket material is injected between the core stranding powdered with talc and ensures that the stranded structure does not open up and also makes sure that the cores are guided as in a channel. The special characteristic of this type of production is that the intermediate spaces, which are created between the cores during the stranding process are completely filled with jacket material by the high extrusion pressure. As a result, the jacket material creates a channel-like guide which allows the cores to carry out a defined longitudinal movement. The jacket also provides a supporting function for the stranding.



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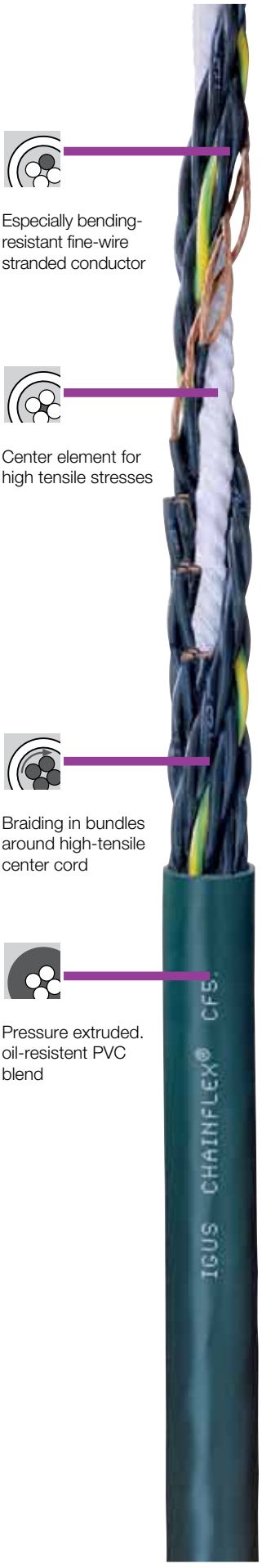
PVC Control Cable



Especially bending-resistant fine-wire stranded conductor

Center element for high tensile stresses

Braiding in bundles around high-tensile center cord

Pressure extruded. oil-resistent PVC blend

Chainflex® CF5

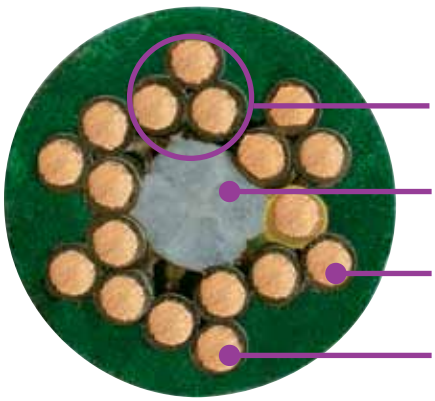
- **for high load requirements**
- **PVC outer jacket**
- **oil-resistant**
- **flame-retardant**

Bend Radius. moving	-5 °C to +70 °C. minimum bending radius 6.8 x d with < 10 m travel; minimum bending radius 7.5 x d with ≥ 10 m travel
Bend Radius. fixed	-20 °C to +70 °C. minimum bending radius 4 x d
V max.	unsupported/gliding 10 m/s. 5 m/s
a max.	80 m/s2
UV-resistant	Medium
Nominal voltage	300/500 V (following DIN VDE 0245).
Testing voltage	2000 V (following DIN VDE 0281-2).
Oil	Oil-proof (following DIN EN 60811-2-1. DIN EN 50363-4-1).
Flame-retardant	According to IEC 332-1. CEI 20-35. FT1.
Silicon-free	Free from silicon which can affect paint adhesion (in compliance with PV 3.10.7 – status 1992).
Conductor	Fine-wire stranded conductor consisting of bare copper wires (following EN 60228).
Core insulation	Mechanically high-quality PVC mixture (following DIN VDE 0207 Part 4).
Core stranding	Number of cores < 12: cores stranded in a layer with short pitch length. Number of cores ≥ 12: cores combined in bundles and stranded together around a centre for high tensile stresses with adapted. short pitch lengths and pitch directions. especially low-torsion structure.
Core identification	Cores < 0.5 mm2: color code in accordance with DIN 47100 Cores ≥ 0.5 mm2: cores black with white numerals. one core green/yellow.
Inner jacket	PVC mixture adapted to suit the requirements in Energy Chains®.
Outer jacket	Low-adhesion. oil-resistant mixture on the basis of PVC. adapted to suit the requirements in Energy Chains® (following DIN VDE 0282 Part 10). Colour: green (similar to RAL 6005)
UL/CSA	≤ **1.5 mm²:** Style 1007 and 2464. 300 V. 80 °C ≥ **2.5 mm²:** Style 1011 and 2570. 600 V. 80 °C
CEI	Following CEI 20-35
CE	Following 2006/95/EG
Lead Free	Following EU guideline (RoHS) 2002/95/EC
Clean Room	According to ISO Class 2. material/cable tested by IPA according to ISO standard 14644-1

Typical application area
- for high load requirements
- light oil influence
- preferably indoor applications. but also outdoor ones at temperatures > 5 °C
- especially for freely suspended and gliding travel distances up to 100 m
- storage and retrieval units for high-bay warehouses. machining units/packaging machines. quick handling. indoor cranes

Delivery program Part No.	Number of cores and conductor nominal cross section [mm²]	External diameter in mm approx.	Copper index [kg/km]	Weight [kg/km]
CF5.05.05	5 G 0.5	7.0	24	72
CF5.05.07	7 G 0.5	8.0	34	77
CF5.05.12	12 G 0.5	11.5	58	158
CF5.05.18	18 G 0.5	13.5	86	230
CF5.05.25	25 G 0.5	17.0	121	310
CF5.07.04	4 G 0.75	7.0	29	72
CF5.07.05	5 G 0.75	8.0	36	85
CF5.07.07	7 G 0.75	9.0	50	108
CF5.07.12	12 G 0.75	12.0	86	240
CF5.07.18	18 G 0.75	15.5	130	322
CF5.07.25	25 G 0.75	19.0	181	432
CF5.07.36	36 G 0.75	22.0	259	564
CF5.10.03	3 G 1.0	7.0	29	62
CF5.10.04	4 G 1.0	8.0	39	85
CF5.10.05	5 G 1.0	8.5	48	100
CF5.10.07	7 G 1.0	10.0	68	145
CF5.10.12	12 G 1.0	13.5	116	260
CF5.10.18	18 G 1.0	17.5	173	450
CF5.10.25	25 G 1.0	19.5	241	590
CF5.15.03	3 G 1.5	8.0	44	95
CF5.15.04	4 G 1.5	8.0	58	120
CF5.15.05	5 G 1.5	10.0	72	170
CF5.15.07	7 G 1.5	11.0	101	220
CF5.15.12	12 G 1.5	16.0	173	320
CF5.15.18	18 G 1.5	22.0	260	550
CF5.15.25	25 G 1.5	24.0	361	810
CF5.25.04	4 G 2.5	11.0	96	200
CF5.25.05	5 G 2.5	12.0	120	250
CF5.25.07	7 G 2.5	15.0	168	340
CF5.25.12	12 G 2.5	21.0	288	667
CF5.25.18	18 G 2.5	27.5	432	970

Note: The mentioned external diameters are maximum values and may tend toward lower tolerance limits.



Chainflex® control cable

Individual bundles with optimized pitch length and pitch direction

Center element for high tensile stresses

Single-wire diameter optimized for Energy Chains®

Highly abrasion-resistant. gusset-filled extruded jacket

PVC Control Cable. Shielded

2

Chainflex® CF6

- **for high load requirements**
- **PVC outer jacket**
- **shielded**
- **oil-resistant**
- **flame-retardant**

Especially bending-resistant fine-wire stranded conductor

Center element for high tensile stresses

Braiding in bundles around high-tensile center cord

Gusset-filled extruded

Highly flexible braided copper shield

Pressure extruded. oil-resistent PVC blend

Bend Radius. moving	-5 °C to +70 °C. minimum bending radius 6.8 x d with < 10 m travel; minimum bending radius 7.5 x d with ≥ 10 m travel
Bend Radius. fixed	-20 °C to +70 °C. minimum bending radius 4 x d
V max.	unsupported/gliding 10 m/s. 5 m/s
a max.	80 m/s2
UV-resistant	Medium
Nominal voltage	300/500 V (following DIN VDE 0245).
Testing voltage	2000 V (following DIN VDE 0281-2).
Oil	Oil-proof (following DIN EN 60811-2-1. DIN EN 50363-4-1).
Flame-retardant	According to IEC 332-1. CEI 20-35. FT1.
Silicon-free	Free from silicon which can affect paint adhesion (in compliance with PV 3.10.7 – status 1992).
Conductor	Fine-wire stranded conductor consisting of bare copper wires (following EN 60228).
Core insulation	Mechanically high-quality PVC mixture (following DIN VDE 0207 Part 4).
Core stranding	Number of cores < 12: cores stranded in a layer with short pitch length. Number of cores ≥ 12: cores combined in bundles and stranded together around a centre for high tensile stresses with adapted. short pitch lengths and pitch directions. especially low-torsion structure.
Core identification	Cores < 0.5 mm2: color code in accordance with DIN 47100 Cores ≥ 0.5 mm2: cores black with white numerals. one core green/yellow.
Inner jacket	PVC mixture adapted to suit the requirements in Energy Chains®.
Overall shield	Extremely bending-resistant. tinned braided copper shield. Coverage approx. 70% linear. approx. 90% optical.
Outer jacket	Low-adhesion. oil-resistant mixture on the basis of PVC. adapted to suit the requirements in Energy Chains® (following DIN VDE 0282 Part 10). Colour: green (similar to RAL 6005)

	UL/CSA	≤ 1.5 mm2: Style 1007 and 2464. 300 V. 80 °C ≥ 2.5 mm2: Style 1011 and 2570. 600 V. 80 °C
	CEI	Following CEI 20-35
	CE	Following 2006/95/EG
	Lead free	Following EU guideline (RoHS) 2002/95/EC
	Clean room	According to ISO Class 2. Outer sheath material complies with CF5.10.07. tested by IPA according to standard 14644-1

Typical application area

- for high load requirements
- light oil influence
- preferably indoor applications. but also outdoor ones at temperatures > 5 °C
- especially for freely suspended and gliding travel distances up to 100 m
- storage and retrieval units for high-bay warehouses. machining units/packaging machines. quick handling. indoor cranes

Delivery program Part No.	Number of cores and conductor nominal cross section [mm2]	External diameter in mm approx.	Copper index [kg/km]	Weight [kg/km]
CF6.05.05	(5 G 0.5)C	9.0	48	114
CF6.05.07	(7 G 0.5)C	10.5	63	142
CF6.05.09	(9 G 0.5)C	11.5	77	180
CF6.05.12	(12 G 0.5)C	13.0	93	206
CF6.05.18	(18 G 0.5)C	15.0	120	276
CF6.05.24	(24 G 0.5)C	17.0	190	406
CF6.07.03	(3 G 0.75)C	8.5	52	110
CF6.07.04	(4 G 0.75)C	9.0	54	120
CF6.07.05	(5 G 0.75)C	10.0	73	150
CF6.07.07	(7 G 0.75)C	12.0	93	190
CF6.07.12	(12 G 0.75)C	14.0	138	264
CF6.07.18	(18 G 0.75)C	17.5	204	410
CF6.07.24	(24 G 0.75)C	19.5	250	466
CF6.10.03	(3 G 1.0)C	8.5	61	103
CF6.10.04	(4 G 1.0)C	9.0	75	115
CF6.10.05	(5 G 1.0)C	11.0	87	170
CF6.10.07	(7 G 1.0)C	13.0	113	217
CF6.10.12	(12 G 1.0)C	15.0	171	313
CF6.10.18	(18 G 1.0)C	19.0	261	470
CF6.10.24	(24 G 1.0)C	21.0	307	488
CF6.15.03	(3 G 1.5)C	10.0	81	155
CF6.15.04	(4 G 1.5)C	10.0	85	170
CF6.15.05	(5 G 1.5)C	11.0	106	190
CF6.15.07	(7 G 1.5)C	14.0	153	270
CF6.15.12	(12 G 1.5)C	18.0	232	411
CF6.15.18	(18 G 1.5)C	22.0	367	637
CF6.15.25	(25 G 1.5)C	23.0	492	819
CF6.25.04	(4 G 2.5)C	12.5	135	275

Note: The mentioned external diameters are maximum values and may tend toward lower tolerance limits.

TPE Control Cable

2

Chainflex® CF9

- **For maximum load requirements**
- **TPE outer jacket shielded**
- **Oil-resistant and bio-oil-resistant**
- **PVC-free/halogen-free**
- **Low temperature-flexible**

Highly flexible special conductor

Center element for high tensile stresses

Braiding in bundles around high-tensile center cord

Gusset-filled extruded. halogen free TPE mixture

	Bend Radius. moving	-35 °C to +100 °C. minimum bending radius 5 x d
	Bend Radius. fixed	-40 °C to +100 °C. minimum bending radius 3 x d
	V max. Unsupported/gliding	10 m/s. 6 m/s
	a max.	100 m/s2
UV	UV-resistant	High
U	Nominal voltage	300/500 V (following DIN VDE 0245).
	Testing voltage	2000 V (following DIN VDE 0281-2).
oil	Oil	Oil-resistant (following DIN EN 60811-2-1). bio-oil-resistant (following VDMA 24568).
	Silicon-free	Free from silicon which can affect paint adhesion (in compliance with PV 3.10.7 – status 1992).
Hal	Halogen Free	Following EN 50267-2-1
	Conductor	Fine-wire stranded conductor in especially bending resistant version consisting of bare copper wires (following EN 60228).
	Core insulation	Mechanically high-quality TPE mixture.
	Core stranding	Number of cores < 12: cores stranded in a layer with short pitch length. Number of cores ≥ 12: cores combined in bundles and stranded together around a centre for high tensile stresses with adapted. short pitch lengths and pitch directions. especially low-torsion structure.
	Core identification	Cores < 0.75 mm²: color code in accordance with DIN 47100 Cores ≥ 0.75 mm²: cores black with white numerals. one core green/yellow.
	Outer jacket	Low-adhesion. oil-resistant mixture on the basis of TPE. adapted to suit the requirements in Energy Chains® Colour: Dark Blue green (similar to RAL 5011)
CE	CE	Following 2006/95/EG
RoHS	Lead Free	Following EU guideline (RoHS) 2002/95/EC.
IPA	Clean room	According to ISO Class 2. Outer sheath material complies with CF5.10.07. tested by IPA according to standard 14644-1

Typical application area

- for maximum load requirements
- almost unlimited resistance to oil. also with bio-oils
- indoor and outdoor applications. UV-resistant
- especially for freely suspended and gliding travel distances up to 400 m and more
- storage and retrieval units for high-bay warehouses. machining units/machine tools. quick handling. clean room. semiconductor insertion. ship to shore. outdoor cranes. low-temperature applications

Delivery program Part No.	Number of cores and conductor nominal cross section [mm2]	External diameter in mm approx.	Copper index [kg/km]	Weight [kg/km]
CF9.02.02	2 x 0.25	4.0	5	1812.0
CF9.02.03.INI	3 x 0.25	4.5	8	20
CF9.02.07	7 x 0.25	6.0	17	42
CF9.02.12	12 x 0.25	8.0	29	70
CF9.03.04.INI	4 x 0.34	5.0	13	31
CF9.03.05.INI	5 x 0.34	5.5	17	37
CF9.05.04	4 x 0.5	5.5	20	36
CF9.05.05	5 x 0.5	6.0	24	46
CF9.05.07	7 x 0.5	7.0	34	78
CF9.05.12	12 x 0.5	9.5	58	105
CF9.05.18	18 x 0.5	12.5	86	165
CF9.05.25	25 x 0.5	13.5	120	201
CF9.07.05	5 G 0.75	6.5	36	58
CF9.07.07	7 G 0.75	7.0	50	76
CF9.07.12	12 G 0.75	11.0	86	142
CF9.07.20	20 G 0.75	13.0	144	231
CF9.07.25	25 G 0.75	14.5	180	320
CF9.10.04	4 G 1.0	6.5	38	56
CF9.10.05	5 G 1.0	7.0	48	70
CF9.10.12	12 G 1.0	11.5	115	181
CF9.10.18	18 G 1.0	14.0	173	267
CF9.10.25	25 G 1.0	17.0	241	329
CF9.15.04	4 G 1.5	7.5	58	86
CF9.15.05	5 G 1.5	8.0	72	110
CF9.15.07	7 G 1.5	9.5	101	140
CF9.15.12	12 G 1.5	14.0	173	265
CF9.15.18	18 G 1.5	17.0	260	400
CF9.15.25	25 G 1.5	20.0	360	602
CF9.25.04	4 G 2.5	9.0	96	128
CF9.25.05	5 G 2.5	10.0	120	174
CF9.25.07	7 G 2.5	12.0	168	301
CF9.25.12	12 G 2.5	17.0	288	468
CF9.25.18*	18 G 2.5	24.0	432	827
CF9.25.25	25 G 2.5	24.5	600	990
CF9.40.04	4 G 4.0	10.0	154	195
CF9.60.04	4 G 6.0	12.5	230	310

G = with earthed conductor green-yellow
X = without earthed conductor

TPE Control Cable

2

Chainflex® CF10

- **For maximum load requirements**
- **TPE outer jacket**
- **Shielded**
- **Oil-resistant and bio-oil-resistant**
- **PVC-free/halogen-free**
- **Low temperature-flexible**

Highly flexible special conductor

Center element for high tensile stresses

Braiding in bundles around high-tensile center cord

Gusset-filling pressure extruded

Highly flexible braided copper shield

Gusset-filled extruded. halogen free TPE mixture

	Bend Radius. moving	-35 °C to +100 °C. minimum bending radius 5 x d
	Bend Radius. fixed	-40 °C to +100 °C. minimum bending radius 3 x d
	V max. Unsupported/gliding	10 m/s. 5 m/s
	a max.	100 m/s2
UV	UV-resistant	High
U	Nominal voltage	300/500 V (following DIN VDE 0245).
	Testing voltage	2000 V (following DIN VDE 0281-2).
oil	Oil	Oil-resistant (following DIN EN 60811-2-1). bio-oil-resistant (following VDMA 24568).
	Silicon-free	Free from silicon which can affect paint adhesion (in compliance with PV 3.10.7 – status 1992).
Hal	Halogen Free	Following EN 50267-2-1
	Conductor	Fine-wire stranded conductor in especially bending resistant version consisting of bare copper wires (following EN 60228).
	Core insulation	Mechanically high-quality TPE mixture.
	Core stranding	Number of cores < 12: cores stranded in a layer with short pitch length. Number of cores ≥ 12: cores combined in bundles and stranded together around a centre for high tensile stresses with adapted. short pitch lengths and pitch directions. especially low-torsion structure.
	Core identification	Cores < 0.75 mm²: color code in accordance with DIN 47100 Cores ≥ 0.75 mm²: cores black with white numerals. one core green/yellow.
	Inner Jacket	TPE mixture adapted to suit the requirements in Energy Chains®
	Overall Shield	Extremely bending resistant. tinned braided copper shield.

	Outer jacket	Low-adhesion. oil-resistant mixture on the basis of TPE. adapted to suit the requirements in Energy Chains® Colour: Dark Blue green (similar to RAL 5011)
	CE	Following 2006/95/EG
	Clean room	According to ISO Class 2. Outer sheath material complies with CF5.10.07. tested by IPA according to standard 14644-1

Typical application area

- for maximum load requirements
- almost unlimited resistance to oil. also with bio-oils
- indoor and outdoor applications. UV-resistant
- especially for freely suspended and gliding travel distances up to 400m and more
- storage and retrieval units for high-bay warehouses. machining units/machine tools. quick handling. clean room. semiconductor insertion. ship to shore. outdoor cranes. low-temperature applications.

Delivery program Part No.	Number of cores and conductor nominal cross section [mm2]	External diameter in mm approx.	Copper index [kg/km]	Weight [kg/km]
CF10.02.04	(4 x 0.25)C	6.5	25	52
CF10.02.12	(12 x 0.25)C	9.5	64	118
CF10.05.04	(4 x 0.5)C	7.0	38	68
CF10.05.05	(5 x 0.5)C	7.5	55	91
CF10.05.12	(12 x 0.5)C	11.5	102	192
CF10.05.18	(18 x 0.5)C	13.5	143	270
CF10.05.25	(25 x 0.5)C	14.5	167	280
CF10.07.04	(4 G 0.75)C	7.5	47	86
CF10.07.05	(5 G 0.75)C	7.5	57	95
CF10.07.07	(7 G 0.75)C	9.0	85	137
CF10.07.12	(12 G 0.75)C	12.5	138	244
CF10.07.20	(20 G 0.75)C	15.0	205	346
CF10.07.24	(24 G 0.75)C	16.5	239	419
CF10.10.04	(4 G 1.0)C	8.0	59	100
CF10.10.05	(5 G 1.0)C	8.5	71	101
CF10.10.07	(7 G 1.0)C	10.0	105	166
CF10.10.12	(12 G 1.0)C	13.5	169	293
CF10.10.18	(18 G 1.0)C	16.5	240	407
CF10.10.24	(24 G 1.0)C	18.0	305	506
CF10.15.04	(4 G 1.5)C	9.0	96	144
CF10.15.05	(5 G 1.5)C	9.5	108	163
CF10.15.07	(7 G 1.5)C	11.5	155	225
CF10.15.12	(12 G 1.5)C	15.5	235	387
CF10.15.18	(18 G 1.5)C	20.0	361	585
CF10.25.04	(4 G 2.5)C	11.0	126	180
CF10.25.07	(7 G 2.5)C	13.5	221	331
CF10.25.12	(12 G 2.5)C	19.0	373	624
CF10.40.04	(4 G 4.0)C	11.5	200	290
CF10.40.05	(5 G 4.0)C	13.5	246	353

G = with earthed conductor green-yellow
X = without earthed conductor

PVC Data Cable. Paired

2

Chainflex® CF211

- **for high load requirements**
- **PVC outer jacket**
- **shielded**
- **oil-resistant**
- **flame-retardant**

Bend Radius. moving	-5 °C to +70 °C. minimum bending radius 10 x d
Bend Radius. fixed	-20 °C to +70 °C. minimum bending radius 5 x d
V max.	unsupported/gliding 5 m/s. 3 m/s
a max.	50 m/s²
UV-resistant	Medium
Nominal voltage	300/300 V (following DIN VDE 0245).
Testing voltage	1500 V
Oil	Oil-resistant (following DIN EN 60811-2-1. DIN EN 50363-4-1)
Flame-retardant	According to IEC 332-1. CEI 20-35. FT1.
Silicon-free	Free from silicon which can affect paint adhesion (in compliance with PV 3.10.7 – status 1992).
Conductor	Very finely stranded special cores of particularly high-flex design made of bare copper wires.
Core insulation	Mechanically high-quality PVC mixture (following DIN VDE 0207 Part 4).
Core stranding	2 cores each stranded in pairs with short pitch lengths. core pairs also stranded with short pitch lengths.
Core identification	Color code in accordance with DIN 47100.
Intermediate sheath	Foil taping over the external layer.
Overall shield	Extremely bending-resistant. tinned braided copper shield. Coverage approx. 70% linear. approx. 90% optical.
Outer jacket	Low-adhesion. oil-resistant mixture on the basis of PVC. adapted to suit the requirements in Energy Chains® (following DIN VDE 0282 Part 10). Colour: gray (similar to RAL 7001)
UL/CSA	< 0.5 mm²: Style 10467 and 2464. 300 V. 80 °C ≥ 0.5 mm²: Style 1729 and 2464. 300 V. 80 °C
CEI	Following CEI 20-35

CE	CE	Following 2006/95/EG
RoHS	Lead free	Following EU guideline (RoHS) 2002/95/EC
IPA	Clean room	According to ISO Class 2. Outer sheath material complies with CF5.10.07. tested by IPA according to standard 14644-1

Typical application area

- for high load requirements
- light oil influence
- preferably indoor applications. but also outdoor ones at temperatures > 5 °C
- especially for freely suspended and gliding travel distances up to 100 m
- storage and retrieval units for high-bay warehouses. machining units/packaging machines. handling. indoor cranes

Delivery program Part No.	Number of cores and conductor nominal cross section [mm²]	External diameter in mm approx.	Copper index [kg/km]	Weight [kg/km]
CF211.02.01.02	(1 x 2 x 0.25)C	5.	16	35
CF211.02.02.02	(2 x 2 x 0.25)C	5.5	28	60
CF211.02.03.02	(3 x 2 x 0.25)C	7.0	37	73
CF211.02.04.02	(4 x 2 x 0.25)C	8.0	44	85
CF211.02.05.02	(5 x 2 x 0.25)C	8.5	51	97
CF211.02.06.02	(6 x 2 x 0.25)C	9.5	58	110
CF211.02.08.02	(8 x 2 x 0.25)C	11.5	75	160
CF211.02.10.02	(10 x 2 x 0.25)C	13.0	93	195
CF211.02.14.02	(14 x 2 x 0.25)C	13.5	109	205
CF211.03.03.02	(3 x (2 x 0.34))C	8.0	37	79
CF211.05.01.02	(1 x 2 x 0.5)C	5.5	23	50
CF211.05.02.02*	(2 x 2 x 0.5)C	8.5	44	80
CF211.05.03.02	(3 x 2 x 0.5)C	9.0	57	100
CF211.05.04.02	(4 x 2 x 0.5)C	9.5	68	120
CF211.05.05.02	(5 x 2 x 0.5)C	11.0	80	145
CF211.05.06.02	(6 x 2 x 0.5)C	12.5	99	185
CF211.05.08.02	(8 x 2 x 0.5)C	14.0	124	230
CF211.05.10.02	(10 x 2 x 0.5)C	16.0	175	320
CF211.05.14.02	(14 x 2 x 0.5)C	17.0	187	335

Note: The mentioned external diameters are maximum values and may tend toward lower tolerance limits.

Guide Lock

Guide lock horizontal - upper run guide for long travels. Travels unsupported up to 50 m are possible. Chips cannot get stuck between upper and lower run. Enormous increase of "self supporting" length of E-Chains®.

TPE Bus cable

2

Especially bending-resistant fine-wire stranded conductor

Cores each stranded in especially short pitch

Gusset-filled extruded

Highly flexible braided copper shield

Pressure extruded. flame-retard TPE blend

Chainflex® CFBUS

- **for maximum load requirement**
- **TPE outer jacket**
- **shielded**
- **oil-resistant**
- **bio-oil-resistant**
- **flame-retardant**

Bend Radius. moving	-35 °C to +70 °C. minimum bending radius 10-12.5 x d
Bend Radius. fixed	-40 °C to +70 °C. minimum bending radius 5 x d
V max.	unsupported/gliding 10 m/s. 6 m/s
a max.	100 m/s2
UV-resistant	Medium
Nominal voltage	30 V
Testing voltage	500 V
Oil	Oil-resistant (following EN 60811-2-1). bio-oil-resistant (following VDMA 24568).
Flame-retardant	According to IEC 332-1. CEI 20-35. FT1.
Silicon-free	Free from silicon which can affect paint adhesion (in compliance with PV 3.10.7 – status 1992).
Conductor	Fine-wire stranded conductor in especially bending-resistant version consisting of bare copper wires (following EN 60228).
Core insulation	Following bus specification.
Core stranding	Following bus specification.
Core identification	Following bus specification Schedule delivery program
Inner Jacket	TPE mixture adapted to suit the requirements in Energy Chains®.
Overall shield	Extremely bending-resistant. tinned braided copper shield. Coverage approx. 70% linear. approx. 90% optical.
Outer jacket	Low-adhesion mixture on the basis of TPE. especially abrasion -resistant and highly flexible. adapted to suit the requirements in Energy Chains®. Colour: violet (similar to RAL4001)
UL/CSA	Style 1589 and 21371. 30 V. 80 °C
CEI	Following CEI 20-35

CE	CE	Following 2006/95/EG
DESINA	DESINA	According to VDW. DESINA standardisation
RoHS	Lead free	Following EU guideline (RoHS) 2002/95/EC.
IPA	Clean room	According to ISO Class 2. Outer sheath material complies with CF5.10.07. tested by IPA according to standard 14644-1

Typical application area

- for maximum load requirements
- almost unlimited resistance to oil. also with bio-oils
- indoor and outdoor applications without direct sun radiation
- especially for freely suspended and gliding travel distances up to 400 m
- bus connection cable for storage and retrieval units for high-bay warehouses. machining units/machine tools. quick handling. clean room. semiconductor insertion. indoor cranes. low-temperature applications

Delivery program Part No.	Number of cores and conductor nominal cross section [mm2]	External diameter in mm approx.	Copper index [kg/km]	Weight [kg/km]	Characteristic wave impedance in Ω approx.	Colour Code
Profibus (minimum bending radius 10 x d)						
CFBUS.001	(2x0.25)C	8.5	23	70	150	Red, Green
Interbus (minimum bending radius 10 x d)						
CFBUS.010	(3x(2x0.25))C	8.5	42	83	100	White/Brown, Green/Yellow Grey/Pink
CAN-BUS/Fieldbus (minimum bending radius 10 x d)						
CFBUS.020	(2x(2x0.25))C	8.5	33	66	120	White, Green, Brown, Yellow
CFBUS.022	(2x(2x0.5))C	8.5	45	83	120	White, Green, Brown, Yellow
DeviceNet (minimum bending radius 10 x d)						
CFBUS.030 Drop	(1x2xAWG24+1x2xAWG22)C	7.5	33	65	120	White/Blue (AWG24) Red/Black (AWG22)
CFBUS.031 Trunk	(1x2xAWG18+1x2xAWG15)C	11.5	96	110	120	White/Blue (AWG18) Red/Black (AWG15)
Ethernet/CAT5 (minimum bending radius 12.5 x d)						
CFBUS.040	(2x(2x0.25))C	7.0	33	43	100	White, Green, Brown, Yellow
CFBUS.041	(4x(2x0.25))C	10.0	46	101	100	White/Brown, Green/Yellow Grey/Pink, Blue/Red
CFBUS.044	(4x(2x0.15))C	8.0	35	79	100	White/Brown, Green/Yellow Grey/Pink, Blue/Red
Ethernet/CAT6 (minimum bending radius 12.5 x d)						
CFBUS.050	(4x(2x0.14)C)C	10.0	77	131	100	White/Blue, White/Orange, White/Green, White/Brown
FireWire (minimum bending radius 12.5 x d)						
CFBUS.055	2x(2x0.15)C+2x(0.34)C	7.5	42	118	100	Orange/Blue, Green/Red, Black, White
Other types available on request. **Note:** The mentioned external diameters are maximum values and may tend toward lower tolerance limits.						

PUR Servo Cable. Shielded

2

Chainflex® CF270.UL.D

- **for medium load requirements**
- **PUR outer jacket**
- **shielded**
- **oil-resistant**
- **PVC-free/halogen-free**

Bending-resistant conductor

Extremely highly flexible braided-pair copper shield

Energy conductor with signal pair elements stranded around high-tensile center cord

Bending-resistant braided copper shield

Pressure extruded PUR blend

Bend Radius. moving	-20 °C to +80 °C. minimum bending radius 10 x d
Bend Radius. fixed	-40 °C to +80 °C. minimum bending radius 5 x d
V max.	unsupported/gliding 10 m/s
a max.	50 m/s2
UV-resistant	Medium
Nominal voltage	600/1000 V (following DIN VDE 0250).
Testing voltage	4000 V (following DIN VDE 0281-2).
Oil	Oil-resistant (following DIN EN 60811-2-1. DIN EN 50363-10-2)
Offshore	MUD-resistant following NEK 606
Silicon-free	Free from silicon which can affect paint adhesion (in compliance with PV 3.10.7 – status 1992).
Halogen-Free	Following EN 50267-2-1.
Conductor	Fine-wire stranded conductor in especially bending-resistant version consisting of bare copper wires (following EN 60228).
Core insulation	Mechanically high-quality. especially low-capacitance PE mixture.
Core stranding	Energy conductor with signal pair elements stranded around high tensile center cord.
Core identification	**Energy conductor:** cores black with white numerals. one core green/yellow. **1 control pair:** cores black with white numerals. **2 control pairs:** cores black with white numerals.
Element shield	Bending-resistant. tinned braided copper shield.Coverage approx. 55% linear. approx. 80% optical.
Intermediate sheath	Foil taping over the external layer.
Overall shield	Bending-resistant. tinned braided copper shield. Coverage approx. 55% linear. approx. 80% optical.
Outer jacket	Low-adhesion mixture on the basis of PUR. adapted to suit the requirements in Energy Chains® (following DIN VDE 0282 Part 10). Colour: orange (similar to RAL 2003)
CE	Following 2006/95/EG

2

DESINA — According to VDW. DESINA standardisation

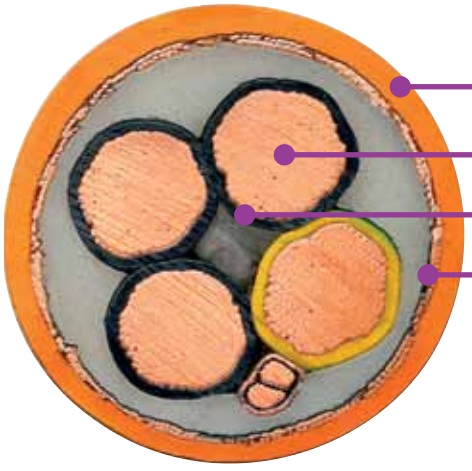
Lead free — Following EU guideline (RoHS) 2002/95/EC.

Typical application area

- for medium load requirements
- almost unlimited resistance to oil
- indoor and outdoor applications without direct sun radiation
- especially for freely suspended travel distances
- machining units/machine tools. low temperature applications

Delivery program Part No.	Number of cores and conductor nominal cross section [mm2]	External diameter in mm approx.	Copper index [kg/km]	Weight [kg/km]
1 control pair shielded				
CF270.UL.15.15.02.01.D	(4 G 1.5+(2x1.5)C)C	11.0	12.0	149
CF270.UL.25.15.02.01.D(1)	(4 G 2.5+(2x1.5)C)C	13.5	203	317
CF270.UL.40.15.02.01.D(1)	(4 G 4.0+(2x1.5)C)C	15.0	272	408
CF270.UL.60.15.02.01.D(1)	(4 G 6.0+(2x1.5)C)C	16.5	364	521
CF270.UL.100.15.02.01.D(1)	(4 G 10.0+(2x1.5)C)C	20.5	582	841
CF270.UL.160.15.02.01.D(1)	(4 G 16.0+(2x1.5)C)C	24.0	855	1225
2 control pair shielded				
CF270.UL.10.07.02.02.D(1)	(4 G 1.0+2x(2x0.75)C)C	13.0	143	251
CF270.UL.15.07.02.02.D(1)	(4 G 1.5+2x(2x0.75)C)C	13.5	169	290
CF270.UL.25.15.02.02.D(1)	(4 G 2.5+2x(2x1.5)C)C	15.5	260	408
CF270.UL.40.15.02.02.D(1)	(4 G 4.0+2x(2x1.5)C)C	17.0	330	506
CF270.UL.60.15.02.02.D(1)	(4 G 6.0+2x(2x1.5)C)C	18.5	425	633
CF270.UL.100.15.02.02.D(1)	(4 G 10.0+2x(2x1.5)C)C	22.0	632	940
CF270.UL.160.15.02.02.D(1)	(4 G 16.0+2x(2x1.5)C)C	26.0	901	1315
CF270.UL.250.15.02.02.D(1)	(4 G 25.0+2x(2x1.5)C)C	28.0	1365	1847
CF270.UL.350.15.02.02.D(1)	(4 G 35.0+2x(2x1.5)C)C	35.0	1804	2516
Without signal pair				
CF270.UL.15.04.D(1)	(4 G 1.5)C	9.0	82	147
CF270.UL.25.04.D(1)	(4 G 2.5)C	11.0	141	224
CF270.UL.40.04.D(1)	(4 G 4.0)C	12.5	211	309
CF270.UL.60.04.D(1)	(4 G 6.0)C	14.5	306	434
CF270.UL.100.04.D(1)	(4 G 10.0)C	18.0	496	698
CF270.UL.160.04.D(1)	(4 G 16.0)c	21.5	782	1052
CF270.UL.250.04.D(1)	(4 G 25.0)C	25.5	1197	1572
CF270.UL.350.04.D(1)	(4 G 35.0)C	33.0	1695	2312

Note: The mentioned external diameters are maximum values and may tend toward lower tolerance limits.



Chainflex® servo cable. shielded

Total shield with optimized braiding angle (covering approx. 70% linear. approx. 90% optical)

Optimized single-wire diameter

Center element for high tensile stresses

Gusset-filled extruded inner jacket

Stranding with optimized pitch length and pitch direction

Pair braid shield over optimized stranded core pair

Highly abrasion-resistant pressure extruded jacket

PVC Power Cable

2

Chainflex® CF30

- **for high load requirement**
- **PVC outer jacket**
- **oil-resistant**
- **flame-retardant**

Bend Radius. moving	-5 °C to +70 °C. minimum bending radius 7.5 x d
Bend Radius. fixed	-20 °C to +70 °C. minimum bending radius 4 x d
V max.	unsupported/gliding 10 m/s. 5 m/s
a max.	80 m/s2
UV-resistant	Medium
Nominal voltage	600/1000 V (following DIN VDE 0250).
Testing voltage	4000 V (following DIN VDE 0281-2).
Oil	Oil-resistant (following DIN EN 60811-2-1. DIN EN 50363-10-2)
Flame Retardant	According to IEC 332-1. CEI 20-35. FT1.
Silicon-free	Free from silicon which can affect paint adhesion (in compliance with PV 3.10.7 – status 1992).
Halogen-Free	Following EN 50267-2-1.
Conductor	< 10 mm2: Fine-wire stranded conductor in especially ben ding-resistant version consisting of bare copper wires (follow ing EN 60228). ≥ 10 mm2: conductor cable consisting of pre-leads (following EN 60228).
Core insulation	Mechanically high-quality. especially low-capacitance TPE mixture.
Core stranding	Cores stranded in short pitch lengths over a centre for high tensile stresses.
Core identification	Energy conductor: cores black with white numerals. one core green/yellow.1. core: U / L1 / C / L+ 2. core: V / L2 3. core W/ L3 / D / L-4. core: 4 / N
Outer Jacket	Low-adhesion. oil-resistant mixture on the basis of PVC. adapted to suit the requirements in Energy Chains® (following DIN VDE 0282 Part 10). Colour: black (similar to RAL 9005)
UL/CSA	Style 10492 and 2570. 1000 V. 80 °C
CEI	Following CEI 20-35

CE	CE	Following 2006/95/EG
DESINA	DESINA	According to VDW. DESINA standardisation
RoHS	Lead free	Following EU guideline (RoHS) 2002/95/EC.

Typical application area

- for high load requirements
- light oil influence
- preferably indoor applications. but also outdoor ones at temperatures > 5 °C
- especially for freely suspended and gliding travel distances up to 100 m
- Storage and retrieval units for high-bay warehouses. machining units/packaging machines. quick handling. indoor cranes

Delivery program Part No.	Number of cores and conductor nominal cross section [mm²]	External diameter in mm approx.	Copper index [kg/km]	Weight [kg/km]
CF30.15.04	4 G 1.5	8.5	55	101
CF30.25.04	4 G 2.5	10.5	95	164
CF30.25.05*	5 G 2.5	11.5	119	196
CF30.40.04	4 G 4.0	12.0	152	237
CF30.40.05	5 G 4.0	13.0	191	286
CF30.60.04	4 G 6.0	14.0	235	344
CF30.60.05	5 G 6.0	15.0	293	417
CF30.100.04	4 G 10.0	17.5	391	555
CF30.100.05	5 G 10.0	19.5	489	698
CF30.160.04	4 G 16.0	20.5	610	834
CF30.160.05	5 G 16.0	23.5	763	1062
CF30.250.04	4 G 25.0	25.5	944	1345
CF30.350.04	4 G 35.0	28.5	1339	1731
CF30.500.04	4 G 50.0	34.0	1898	2596

Note: The mentioned external diameters are maximum values and may tend toward lower tolerance limits.

Other Types of Energy Chains: Systems E3 & E6 Extremly Low Noise

- Extremely Low Noise operation - 37dB (A)
- For high Speed and high accelerations
- Minimum vibrations
- Easy lengthening and shortening
- Various interior separations available

PVC Power Cable. Shielded

2

Chainflex® CF31

- **for high load requirement**
- **PVC outer jacket**
- **shielded**
- **oil-resistant**
- **flame-retardant**

Highly flexible special conductor

Energy conductor stranded around high-tensile center cord

Gusset-filled

Highly flexible braided copper shield

Pressure extruded. oil-proof PVC sheath blend

Bend Radius. moving	-5 °C to +70 °C. minimum bending radius 7.5 x d
Bend Radius. fixed	-20 °C to +70 °C. minimum bending radius 4 x d
V max.	unsupported/gliding 10 m/s. 5 m/s
a max.	80 m/s2
UV-resistant	Medium
Nominal voltage	600/1000 V (following DIN VDE 0250).
Testing voltage	4000 V (following DIN VDE 0281-2).
Oil	Oil-resistant (following DIN EN 60811-2-1. DIN EN 50363-10-2)
Flame Retardant	According to IEC 332-1. CEI 20-35. FT1.
Silicon-free	Free from silicon which can affect paint adhesion (in compliance with PV 3.10.7 – status 1992).
Conductor	< 10 mm2: Fine-wire stranded conductor in especially ben ding-resistant version consisting of bare copper wires (follow ing EN 60228). ≥ 10 mm2: conductor cable consisting of pre-leads (following EN 60228).
Core insulation	Mechanically high-quality. especially low-capacitance TPE mixture.
Core stranding	Cores stranded in short pitch lengths over a centre for high tensile stresses.
Core identification	Energy conductor: cores black with white numerals. one core green/yellow. 1. core: U / L1 / C / L+ 2. core: V / L2 3. core: W / L3 / D / L- 4. core: 4 / N
Inner Jacket	PVC mixture adapted to suit the requirements in Energy Chains®.
Overall shield	Extremely bending-resistant. tinned braided copper shield. Coverage approx. 70% linear. approx. 90% optical.
Outer Jacket	Low-adhesion. oil-resistant mixture on the basis of PVC. adapted to suit the requirements in Energy Chains® (following DIN VDE 0282 Part 10). Colour: black (similar to RAL 9005)
CEI	Following CEI 20-35

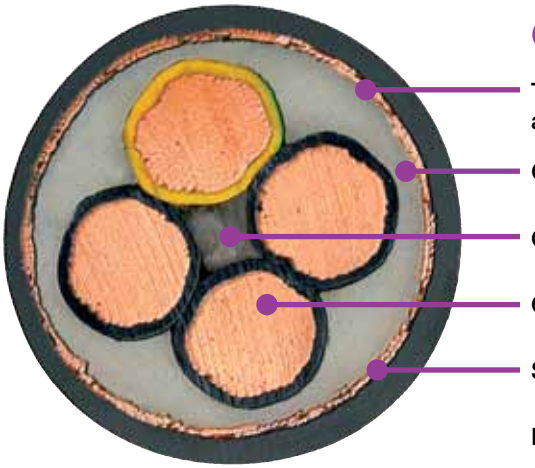
	UL/CSA	Style 10492 and 2570. 1000 V. 80 °C
	CEI	Following CEI 20-35
	CE	Following 2006/95/EG
	DESINA	According to VDW. DESINA standardisation
	Lead free	Following EU guideline (RoHS) 2002/95/EC.
	Clean room	According to ISO Class 2. Outer sheath material complies with CF5.10.07. tested by IPA according to standard 14644-1

Typical application area

- for high load requirements
- light oil influence
- preferably indoor applications. but also outdoor ones at temperatures > 5 °C
- especially for freely suspended and gliding travel distances up to 100 m
- storage and retrieval units for high-bay warehouses. machining units/packaging machines. quick handling. indoor cranes

Delivery program Part No.	Number of cores and conductor nominal cross section [mm²]	External diameter in mm approx.	Copper index [kg/km]	Weight [kg/km]
CF31.15.04	(4 G 1.5)C	10.5	82	168
CF31.25.04	(4 G 2.5)C	12.5	128	236
CF31.25.05	(5 G 2.5)C	13.5	156	277
CF31.40.04	(4 G 4.0)C	14.0	192	320
CF31.40.05	(5 G 4.0)C	15.0	246	390
CF31.60.04	(4 G 6.0)C	16.0	297	470
CF31.60.05	(5 G 6.0)C	18.5	358	565
CF31.100.04	(4 G 10.0)C	20.5	484	754
CF31.100.05	(5 G 10.0)C	22.0	598	903
CF31.160.04	(4 G 16.0)C	23.0	737	1046
CF31.250.04	(4 G 25.0)C	28.5	1081	1605
CF31.350.04	(4 G 35.0)C	32.0	1493	2088
CF31.500.04	(4 G 50.0)C	37.5	2081	3011
CF31.700.04*	(4 G 70.0)C	47.0	2961	4650

Note: The mentioned external diameters are maximum values and may tend toward lower tolerance limits.



Chainflex® power cable. shielded

Total shield with optimized braiding angle (covering approx. 70% linear. approx. 90% optical)

Gusset-filled extruded inner jacket

Center element for high tensile stresses

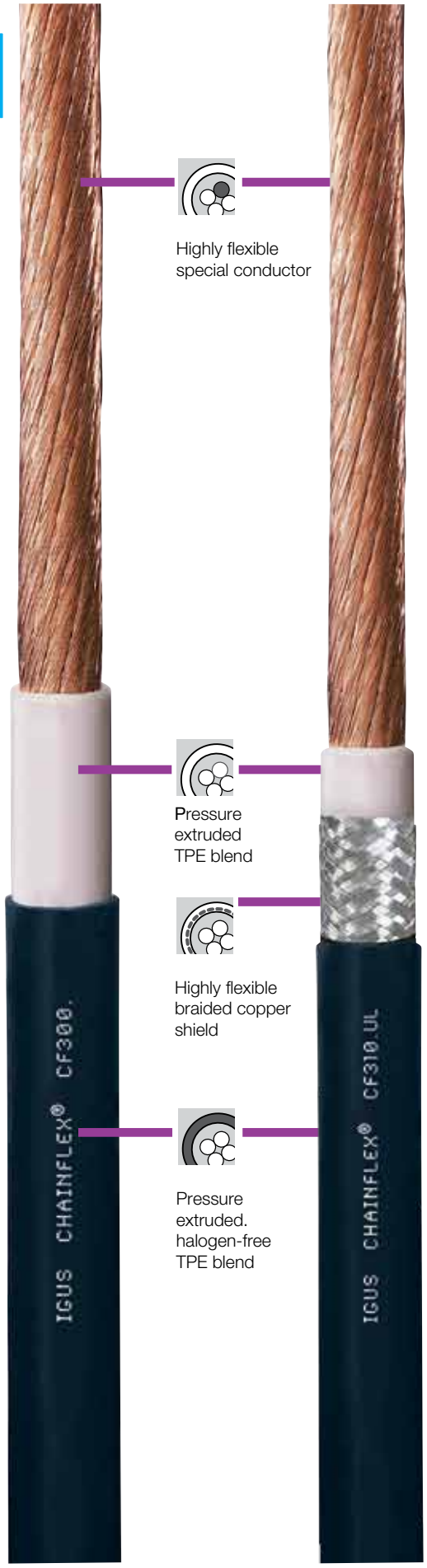
Optimized single-wire diameter

Stranding with optimized pitch length and pitch direction

Highly abrasion-resistant pressure extruded jacket

2

TPE Power Cable/TPE Shielded Power Cable



Chainflex®
CF300.UL.D/CF 310.UL.D

- **for maximum load requirement**
- **TPE outer jacket**
- **oil-resistant**
- **bio-oil-resistant**
- **flame-retardent**
- **UV-resistant**

Bend Radius. moving	-35 °C to +70 °C. minimum bending radius 7.5 x d
Bend Radius. fixed	-40 °C to +100 °C. minimum bending radius 4 x d
V max.	unsupported/gliding 10 m/s. 6 m/s
a max.	100 m/s2
UV-resistant	High
Nominal voltage	600/1000 V (following DIN VDE 0250).
Testing voltage	4000 V (following DIN VDE 0281-2).
Oil	Oil-resistant (following EN 60811-2-1). bio-oil-resistant (following VDMA 24568).
Flame Retardant	According to IEC 332-1. CEI 20-35. FT1.
Silicon-free	Free from silicon which can affect paint adhesion (in compliance with PV 3.10.7 – status 1992).
Conductor	Conductor cable consisting of pre-leads (following EN 60228).
Core insulation	Mechanically high-quality TPE mixture.
Outer Jacket	Low-adhesion mixture on the basis of TPE. especially abrasion-resistant and highly flexible. adapted to suit the requirements in Energy Chains®. Colour: black (similar to RAL 9005)
DESINA	According to VDW. DESINA standardisation
CE	Following 2006/95/EG
UL/CSA	Style 10492 and 21218. 1000 V. 80 °C
CEI	Following CEI 20-35
Lead free	Following EU guideline (RoHS) 2002/95/EC.
Clean room	According to ISO Class 1. Outer sheath material complies with CF34.25.04. tested by IPA according to standard 14644-1

Typical application area

- for maximum load requirements
- almost unlimited resistance to oil. also with bio-oils
- indoor and outdoor applications. UV-resistant
- especially for freely suspended and gliding travel distances up to 400 m and more
- storage and retrieval units for high-bay warehouses. machining units/machine tools. quick handling. clean room. semiconductor insertion. ship to shore. outdoor cranes. low-temperature applications

CF300 TPE Power Cable

Delivery program Part No.	Number of cores and conductor nominal cross section [mm²]	External diameter in mm approx.	Copper index [kg/km]	Weight [kg/km]
CF300.UL.60.01.D	1x6.0	7.0	56	77
CF300.UL.100.01.D	1x10.0	8.0	96	119
CF300.UL.160.01.D	1x16.0	9.5	151	183
CF300.UL.250.01.D	1x25.0	11.5	239	281
CF300.UL.350.01.D	1x35.0	12.5	333	377
CF300.UL.500.01.D	1x50.0	14.5	479	525
CF300.UL.700.01.D	1x70.0	16.0	623	676
CF300.UL.950.01.D	1x95.0	19.0	848	927
CF300.UL.1200.01.D	1x120.0	21.5	1059	1145
CF300.UL.1500.01.D	1x150.0	23.0	1318	1411
CF300.UL.1850.01.D	1x185.0	27.0	1890	2014

Note: The mentioned external diameters are maximum values and may tend toward lower tolerance limits.

CF310 TPE Shielded Power Cable

Delivery program Part No.	Number of cores and conductor nominal cross section [mm²]	External diameter in mm approx.	Copper index [kg/km]	Weight [kg/km]
CF310.UL.40.01	(1x4.0)C	6.5	55	74
CF310.UL.60.01	(1x6.0)C	7.5	75	97
CF310.UL.100.01	(1x10.0)C	8.5	120	144
CF310.UL.160.01	(1x16.0)C	10.0	178	210
CF310.UL.250.01	(1x25.0)C	11.5	272	314
CF310.UL.350.01	(1x35.0)C	13.5	380	423
CF310.UL.500.01	(1x50.0)C	15.0	524	568
CF310.UL.700.01	(1x70.0)C	17.5	689	746
CF310.UL.950.01	(1x95.0)C	20.5	920	997
CF310.UL.1200.01	(1x120.0)C	22.0	1140	1233
CF310.UL.1500.01	(1x150.0)C	24.0	1436	1549
CF310.UL.1850.01	(1x185.0)C	28.0	2020	2147

Note: The mentioned external diameters are maximum values and may tend toward lower tolerance limits.

2

Chainflex® cables for robots

Ever more complex sequences of movements in industrial applications demand twistable and/or three-dimensional flexible cables with a long service life similar to the classic Chainflex® cables for use in linear E-ChainSystems®.

Wires, stranded, shields and sheathing materials must compensate both major changes in bending load and changes in diameter due to torsional movements.
For this purpose, different "soft" structural elements e.g. rayon fibres, PTFE elements or filling elements that absorb torsion forces are used in Chainflex® ROBOT cables.

Special demands are made on the braided shielding in torsion cables. Torsion-optimised shield structures are chosen that can carry out the necessary compensatory movements thanks to special PTFE gliding films.

With twistable bus cables in particular, the transmission characteristics such as attenuation, cable capacity and signal quality must remain within very tight tolerance ranges over the whole service life.

This is achieved through the use of particularly torsion-optimised insulating materials and mechanical attenuation elements with matching capacity values.

The highly abrasion-resistant, halogen-free and flame-resistant PUR sheathing mixture in motor, hybrid/control cables and bus cables protects the torsion-optimised stranded elements from possible damage.

The highly abrasion-resistant, halogen-free TPE-sheath mixture matches the special requirements of the twistable FOC and individual wires, and also protects the stranded elements.
Unlike cables for linear E-ChainSystems®, the "mechanical stress" for these cables is in the combination of bending, torsion and centrifugal forces that cannot usually be determined by design in advance or during use by means of measurement.
For this reason, and unlike the situation with linear E-Chain® applications, a clear "yes/no" statement cannot be made about the possibility of using a certain cable in torsion applications.

To enable evaluation to take place nevertheless, based on sensible and comparable test results, the igus® "torsion test standard" was developed.

According to this standard, all Chainflex® ROBOT cables are twisted with a fixed-point distance of one metre and a torsion

of +/- 180° at least 3 million times. In addition, a test is carried out on a test bench with a chain length of approx. 2500 mm with 270° torsion with an extreme load through centrifugal forces and heavy blows such as those that can occur with an industrial robot.

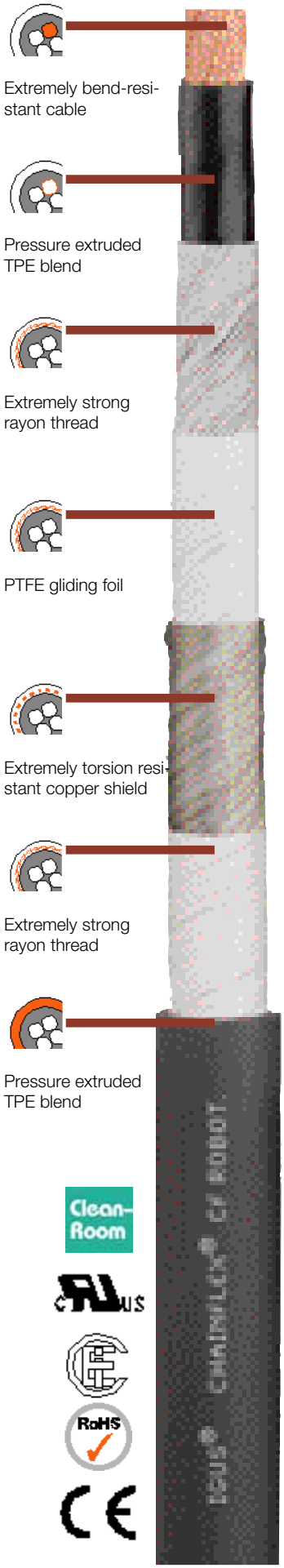
All the non-shielded, gusset-filled extruded standard Chainflex® control cables of the series CF5, CF77.UL.D and CF 9 correspond to the above-mentioned igus® standard and have been approved for use in torsion applications.
The following twistable CF ROBOT cable types are currently available:

- Hybrid/control cables
- Motor/servo cables
- Bus/data cables
- FOC cables

We can also offer you Chainflex® ROBOT cables pre-fitted with the plug-in connectors of your choice as ReadyCable®, or as a ready-to-install ReadyChain® cable assembly.

2

TPE-Robot cable



Chainflex® CF ROBOT

- **for twistable loads**
- **TPE outer jacket, shielded**
- **oil-resistant**
- **bio-oil-resistant**
- **PVC-free**
- **UV-resistant**
- **flame-retardant**
- **hydrolysis-resistant and microbe-resistant**

Temperature Range moved	-35 °C to +100 °C, minimum bending radius twisted 10 x d
Temperature Range fixed	-40 °C to +100 °C, minimum bending radius 4 x d
V Max. twisted	10 m/s
A Max	10 m/s
Travel distance	Robots and movements in the 3D range, Class 1
Torsion	± 180 °, with 1 m cable length
UV-resistant	High
Nominal voltage	600/1000 V (following DIN VDE 0250).
Testing voltage	4000 V (following DIN VDE 0281-2).
	Oil-resistant (following DIN EN 60811-2-1), bio-oil-resistant (following VDMA 24568 with Plantocut 8 S-MB), Class 4.
Flame-retardant	According to IEC 60332-1-2, CEI 20-34, FT1, VW-1.
Silicon-free	Free from silicon which can affect paint adhesion (following PV 3.10.7 – status 192).
Conductor	Extremely bend-resistant cable
Core insulation	Mechanically high-quality TPE mixture.
Overall shield	Extremely torsion resistant tinned braided
Outer jacket	Low-adhesion mixture on the basis of TPE, especially abrasion-resistant and highly flexible, adapted to suit the requirements in Energy Chains®. Colour: Jet black (similar to RAL 9005)
UL/CSA	Style 10258 and 21387, 1000 V, 90 °C
CEI	Following CEI 20-35

Typical application area

- for maximum load requirements with torsion movements
- almost unlimited resistance to oil, also with bio-oils
- indoor and outdoor applications, UV-resistant
- especially for robots and movements in the 3D range
- Robots, handling, spindle drives

Class 6.1.4

Delivery program Part No.	Number of cores and conductor nominal cross section [mm2]	External diameter in mm approx.	Copper index [kg/km]	Weight [kg/km]
CFROBOT.035(1)	(1x10.0)C	10.5	121	197
CFROBOT.036	(1x16.0)C	12.0	183	274
CFROBOT.037	(1x25.0)C	14.5	289	425
CFROBOT.038(1)	(1x35.0)C	15.5	391	534
CFROBOT.039	(1x50.0)C	17.5	546	726

Note: The mentioned external diameters are maximum values and may tend toward lower tolerance limits.
G = with green-yellow earth core x = without earth core

igus® Chainflex® cables in application of a multi-dimensional moving energy chain Triflex® R for production robots.

PUR Measuring system cable, twistable

2

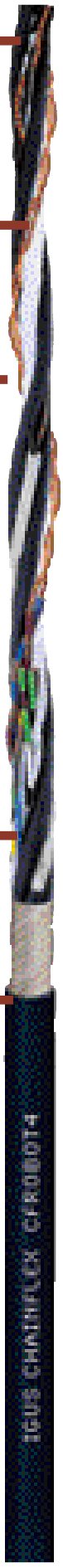


Image exemplary.

Chainflex® CF ROBOT4

- **for twistable loads**
- **PUR outer jacket**
- **shielded**
- **oil-resistant and coolant-resistant**
- **notch-resistant**
- **flame-retardant**
- **hydrolysis-resistant and microbe-resistant**

Temperature Range moved	-25 °C to +80 °C, minimum bending radius twisted 10 x d
Temperature Range fixed	-40 °C to +80 °C, minimum bending radius 4 x d
V Max. twisted	10 m/s
A Max	10 m/s²
Travel distance	Robots and movements in the 3D range, Class 1
Torsion	±180°, with 1 m cable length
UV-resistant	High
Nominal voltage	30 V
Testing voltage	500 V
Oil-resistant (following DIN EN 60811-2-1, DIN EN 50363 -10-2), Class 3.	
Flame-retardant	According to IEC 60332-1-2, CEI 20-34, FT1, VW-1.
Silicon-free	Free from silicon which can affect paint adhesion (following PV 3.10.7 – status 1992).
Conductor	Extremely bend-resistant cable
Core insulation	Mechanically high-quality TPE mixture.
Element shield	Extremely torsion resistant tinned braided copper shield. Coverage approx. 85% optical.
Outer jacket	Low-adhesion, halogen-free, highly abrasion-resistant mixture on the basis of PUR, adapted to suit the requirements in Energy Chains® (following DIN VDE 0282 Part 10). Colour: Steel blue (similar to RAL 5011)

	CEI	Following CEI 20-35
	CE	Following 2006/95/EG
	Lead free	Following EC (RoHS) 2002/95/EC
	Clean Room	According to ISO Class 1. Outer jacket material complies with CF27.07.05.02.01.D, tested by IPA according to standard 14644-1

Typical application area

- for maximum load requirements with torsion movements
- almost unlimited resistance to oil
- indoor and outdoor applications, UV-resistant
- especially for robots and movements in the 3D range
- Robots, handling, spindle drives

Class 6.1.3

Delivery program Part No.	Number of cores and conductor nominal cross section [mm2]	External diameter in mm approx.	Copper index [kg/km]	Weight [kg/km]
CFROBOT4.001	(3x(2x0,14)C+(4x0,14) + (2x0,5))C	11,0	65	166
CFROBOT4.002(1)	(3x(2x0,14)C + 2x(0,5)C)C	10,5	67	128
CFROBOT4.009(1)	(4x(2x0,25) + (2x0,5))C	9,0	53	102
CFROBOT4.015(1)	(4x(2x0,14) + 4x0,5)C	9,0	54	106
CFROBOT4.028(1)	(2x(2x0,15) + (2x0,38))C	7,5	42	72

Note: The mentioned external diameters are maximum values and may tend toward lower tolerance limits.
G = with green-yellow earth core x = without earth core

Delivery program Part No.	Number of cores and conductor nominal cross section [mm2]	Core Group	Colour Code
CFROBOT4.001	(3x(2x0,14)C + (4x0,14) + (2x0,5))C	3x(2x0,14)C4x0,142x0,5	yellow/green, black/brown, red/orange gray, blue, white-yellow, white-black brown-red, brown-blue
CFROBOT4.002	(3x(2x0,14)C + 2x(0,5)C)C	3x(2x0,14)C2x(0,5)C	green/yellow, black/brown, red/orange black, red
CFROBOT4.009	(4x(2x0,25) + (2x0,5))C	4x(2x0,25)2x0,5	brown/green, blue/violet, gray/pink, red/black, white, brown
CFROBOT4.015	(4x(2x0,14) + 4x0,5)C	4x(2x0,14)4x0,5	brown/green, violet/yellow, gray/pink, red/black, blue, white, brown-green, white-green
CFROBOT4.028	(2x(2x0,15) + (2x0,38))C	2x(2x0,15)(2x0,38)	green/yellow, pink/blue, red, black

Note: The mentioned external diameters are maximum values and may tend toward lower tolerance limits.
G = with green-yellow earth core x = without earth core

2

TPE-Fibre optic cable, twistable

FOC cores with high-tensile aramide fibres

GRP core element

FOC wires stranded with dampers around the GRP core

Pressure extruded, halogen-free TPE blend

Image exemplary.

Chainflex® CF ROBOT5

- **for twistable loads**
- **TPE outer jacket**
- **oil-resistant**
- **bio-oil-resistant**
- **UV-resistant**
- **low-temperature-flexible**
- **hydrolysis-resistant and microbe-resistant**

Temperature Range moved	-20 °C to +60 °C, minimum bending radius twisted 12,5 x d
Temperature Range fixed	-25 °C to +60 °C, minimum bending radius 7,5 x d
V Max. twisted	10 m/s
A Max	10 m/s²
Travel distance	Robots and movements in the 3D range, Class 1
Torsion	±180°, with 1 m cable length
UV-resistant	High
	Oil-resistant (following DIN EN 60811-2-1), bio-oil-resistant (following VDMA 24568 with Plantocut 8 S-MB), Class 4.
Silicon-free	Free from silicon which can affect paint adhesion (following PV 3.10.7 – status 192).
Fibre Optic Cable	50/125 µm, 62.5/125 µm special fixed wire elements with aramide strain relief.
Core Stranding	FOC wires stranded with high-tensile aramide dampers around the GRP central element.
Outer Jacket	Low-adhesion mixture on the basis of TPE, especially abrasion-resistant and highly flexible, adapted to suit the requirements in Energy Chains®. Colour: Steel blue (similar to RAL 5011)
CE	Following 2006/95/EG
Lead Free	Following EC (RoHS) 2002/95/EC.
Clean Room	According to ISO Class 1. Outer jacket material complies with CF9.15.07, tested by IPA according to standard 14644-1

Typical application area

- for maximum load requirements with torsion movements
- almost unlimited resistance to oil, also with bio-oils
- indoor and outdoor applications, UV-resistant
- especially for robots and movements in the 3D range
- Robots, handling

Class 7.1.4

Delivery program Part No.	Number of fibres	Fibre diameter approx. [µm]	External Diameter Approx [mm]	Weight [kg/km]
CFROBOT5.500	2	62.5/125	8.5	87
CFROBOT5.501	2	50/125	8.5	87
Note: **Note:** The mentioned external diameters are maximum values and may tend toward lower tolerance limits.				

Delivery program Part No.	Bandwidth with 850nm [MHz x km]	Attenuation with 850 nm [dB/km]	Bandwidth with 1300 nm [MHz x km]	Attenuation with 1300 nm [dB/km]	Colour Code
CFROBOT5.500	160 - 200	3.2	200 - 500	0.9	blue with white numbers
CFROBOT5.501	200 - 600	2.5 - 3.5	600 - 1200	0.7 - 1.5	blue with white numbers

Metallfreie Lichtenwellenleiter für schnelle Handlinganwendungen. E-Kette®: System E2/000

2

PUR Motor cable, twistable

Chainflex® CF ROBOT6/7

- **for twistable loads**
- **PUR outer jacket**
- **unshielded/shielded**
- **oil-resistant and coolant-resistant**
- **notch-resistant**
- **flame-retardant**
- **hydrolysis-resistant and microbe-resistant**

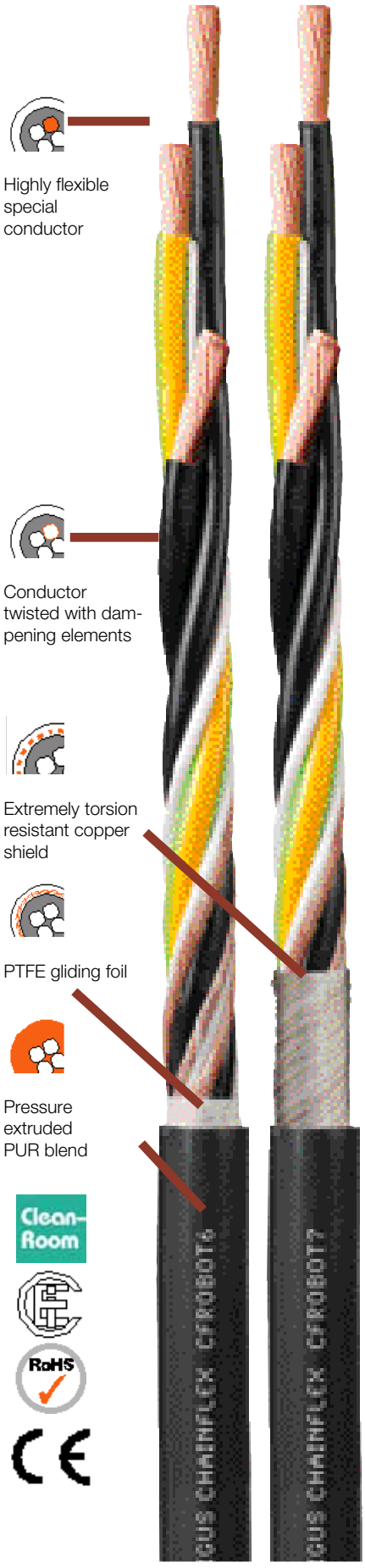


Image exemplary.

Temperature Range moved	-25 °C to +80 °C, minimum bending radius twisted 10 x d
Temperature Range fixed	-40 °C to +80 °C, minimum bending radius 4 x d
V Max. twisted	10 m/s
A Max	10 m/s²
Travel distance	Robots and movements in the 3D range, Class 1
Torsion	±180 °, with 1 m cable length
UV-resistant	High
Nominal voltage	600/1000 V (following DIN VDE 0250).
Testing voltage	4000 V (following DIN VDE 0281-2).
Oil	Oil-resistant (following DIN EN 60811-2-1, DIN EN 50363 -10-2), Class 3.
Flame-retardant	According to IEC 60332-1-2, CEI 20-34, FT1, VW-1
Silicon-free	Free from silicon which can affect paint adhesion (following PV 3.10.7 – status 192).
Conductor	50/125 µm, 62.5/125 µm special fixed wire elements with aramide strain relief.
Core Insulation	Mechanically high-quality TPE mixture.
Core identification	**Energy conductor:** cores black with white numerals, one core green/yellow **2 control pairs:** cores black with white numerals. 1. control core: 5 2. control core: 6 3. control core: 7 4. control core: 8 **4 control pairs:** colour code in accordance with DIN 47100
Overall shield	Extremely torsion resistant, tinned braided copper shield. Coverage approx. 85% optical.
Outer Jacket	Low-adhesion mixture on the basis of TPE, especially abrasion-resistant and highly flexible, adapted to suit the requirements in Energy Chains®. Colour: Steel blue (similar to RAL 5011)

	CEI	Following CEI 20-35
	CE	Following 2006/95/EG
	Lead free	Following EC (RoHS) 2002/95/EC
	Clean Room	According to ISO Class 1. Outer jacket material complies with CF27.07.05.02.01.D, tested by IPA according to standard 14644-1

Typical application area

- for maximum load requirements with torsion movements
- almost unlimited resistance to oil
- indoor and outdoor applications, UV-resistant
- especially for robots and movements in the 3D range
- Robots, handling, spindle drives

Class 6.1.3

Delivery program Part No.	Number of cores and conductor nominal cross section [mm2]	External diameter in mm approx.	Copper index [kg/km]	Weight [kg/km]
CF ROBOT6 Unshielded				
CFROBOT6.100.03(12)	3 G 10	16.5	287	404
CFROBOT6.160.03(12)	3 G 16	19.0	459	601
CFROBOT6.250.03(12)	3 G 25	23.5	722	926
CFROBOT6.350.03(12)	3 G 25	26.0	1020	1233
CF ROBOT7 Shielded				
CFROBOT7.15.03(12)	(3 G 1.5)C	8.0	58	95
CFROBOT7.25.03(12)	(3 G 2.5)C	9.5	89	137
CFROBOT7.15.04(12)	(4 G 1.5)C	8.5	74	121
CFROBOT7.25.04(12)	(4 G 2.5)C	10.5	115	171
2 control pairs shielded				
CFROBOT7.15.15.02.02.C(14)	(4 G 1,5 + 2x(2x1,5)C)C	16.5	190	380
CFROBOT7.25.15.02.02.C(1/14)	(4 G 2,5 + 2x(2x1,5)C)C	18.5	230	450
4 control pairs shielded				
CFROBOT7.40.02.02.04.C(14)	(4 G 4 + 4x(2x0,25)C)C	16.5	240	340

(1) Delivery time upon inquiry

(12) Core identification energy conductor: 1. Core: 1 2. Core: 2

(13) Core identification energy conductor: 1. Core: 1 2. Core: 2 3. Core: 3

(14) Core identification energy conductor: 1. Core: U / L1 / C / L+ 2. Core: V / L2 3. Core: W / L3 / D / L-

Note: The mentioned external diameters are maximum values and may tend toward lower tolerance limits.

G = with green-yellow earth core **x =** without earth core

PUR Bus cable, twistable

2

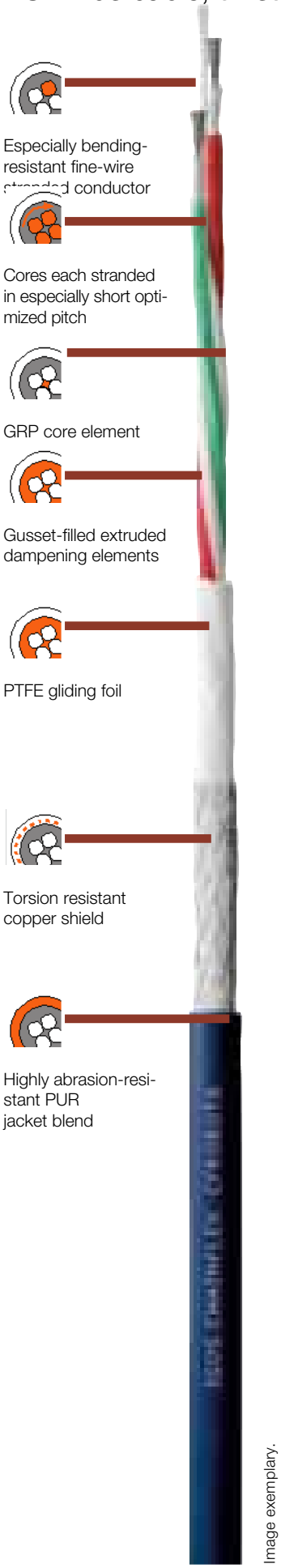


Image exemplary.

Chainflex® CF ROBOT8

- **for twistable loads**
- **PUR outer jacket**
- **shielded**
- **oil-resistant**
- **notch-resistant**
- **flame-retardant**
- **hydrolysis-resistant and microbe-resistant**

Temperature Range moved	-20 °C to +70 °C, minimum bending radius twisted 10 x d
Temperature Range fixed	-25 °C to +70 °C, minimum bending radius 7,5 x d
V Max. twisted	10 m/s
A Max	10 m/s²
Travel distance	Robots and movements in the 3D range, Class 1
Torsion	±180 °, with 1 m cable length
UV-resistant	High
Nominal voltage	30 V
Testing voltage	500 V
	Oil-resistant (following DIN EN 60811-2-1, DIN EN 50363 -10-2), Class 3.
Flame-retardant	According to IEC 60332-1-2, CEI 20-34, FT1, VW-1.
Silicon-free	Free from silicon which can affect paint adhesion (following PV 3.10.7 – status 192).
Conductor	Fine-wire stranded conductor in especially bending-resistant version consisting of bare copper wires (following EN 60228).
Core insulation	According to bus specification
Core stranding	According to bus specification
Core identification	According to bus specification
Intermediate jacket	Foil taping over the external layer.
Overall shield	Extremely torsion resistant tinned braided
Outer jacket	Low-adhesion, highly abrasion-resistant mixture on the basis of PUR, adapted to suit the requirements in Energy Chains®. Colour: Steel blue (similar to RAL 5011)

	UL/CSA	Style 10258 and 21387, 1000 V, 90 °C
	CEI	Following CEI 20-35
	CE	Following 2006/95/EG
	Lead free	Following EC (RoHS) 2002/95/EC.
	Clean room	According to ISO Class 1. material/cable tested by IPA according to ISO standard 14644-1

Typical application area

- for maximum load requirements with torsion movements
- almost unlimited resistance to oil, also with bio-oils
- indoor and outdoor applications, UV-resistant
- especially for robots and movements in the 3D range
- Robots, handling, spindle drives

Class 6.1.3

Delivery program Part No.	Number of cores and conductor nominal cross section [mm2]	External diameter in mm approx.	Copper index [kg/km]	Weight [kg/km]
CFROBOT8.001 (Profibus)	(2x0,35)C	8.0	22	57
CFROBOT8.022 (Can-Bus)	(4x0,5)C	7,0	39	65
CFROBOT8.045 (GigE)	(4x(2x0,14)C)	8,5	35	65

Note: The mentioned external diameters are maximum values and may tend toward lower tolerance limits.
G = with green-yellow earth core x = without earth core

Delivery program Part No.	Characteristic wave impedance approx. [Ω]	Number of cores and conductor nominal cross section [mm²]	Colour Code
CFROBOT8.001	150	(2x0,35)C	red, green
CFROBOT8.022	120	(4x0,5)C	white, green, brown, yellow (star-quad stranding)
CFROBOT8.045	100	(4x(2x0,14)C)	white-blue/blue, white-orange/orange, white-green/green, white-brown/brown

Note: The mentioned external diameters are maximum values and may tend toward lower tolerance limits.
G = with green-yellow earth core x = without earth core

2

PUR Hybrid cable, twistable

Chainflex® CF ROBOT9

- **for twistable loads**
- **PUR outer jacket**
- **Unsheilded/Sheilded**
- **oil-resistant and coolant resistant**
- **notch-resistant**
- **flame-retardant**
- **hydrolysis-resistant and microbe-resistant**

Image exemplary.

Temperature Range moved	-35 °C to +80 °C, minimum bending radius twisted 10 x d
Temperature Range fixed	-40 °C to +80 °C, minimum bending radius 4 x d
V Max. twisted	10 m/s
A Max	10 m/s²
Travel distance	Robots and movements in the 3D range, Class 1
Torsion	±180 °, with 1 m cable length
UV-resistant	High
Nominal voltage	300/500 V (following DIN VDE 0245).
Testing voltage	2000 V (following DIN VDE 0281-2).
Oil	Oil-resistant (following DIN EN 60811-2-1, DIN EN 50363 -10-2), Class 3.
Flame-retardant	According to IEC 60332-1-2, CEI 20-34, FT1, VW-1
Silicon-free	Free from silicon which can affect paint adhesion (following PV 3.10.7 – status 192).
Conductor	Extremely bend-resistant cable.
Core Insulation	Mechanically high-quality TPE mixture.
Element shield	Extremely torsion resistant, tinned braided copper shield. Coverage approx. 85% optical.
Outer Jacket	Low-adhesion, halogen-free, highly abrasion-resistant mixture on the basis of PUR, adapted to suit the requirements in Energy Chains® (following DIN VDE 0282 Part 10). Colour: Steel blue (similar to RAL 5011)

	CEI	Following CEI 20-35
	CE	Following 2006/95/EG
	Lead free	Following EC (RoHS) 2002/95/EC.
	Clean Room	According to ISO Class 1. Outer jacket material complies with CF34.25.04, tested by IPA according to standard 14644-1

Typical application area

- for maximum load requirements with torsion movements
- almost unlimited resistance to oil, also with bio-oils
- indoor and outdoor applications, UV-resistant
- especially for robots and movements in the 3D range
- Robots, handling, spindle drives

Class 6.1.3

Delivery program Part No.	Number of cores and conductor nominal cross section [mm2]	External diameter in mm approx.	Copper index [kg/km]	Weight [kg/km]
CFROBOT9.001	5 G 1,0 + (2x1,0)C	9.5	75	129
CFROBOT9.002	6 G 0,75 + (3x0,75)C	12.0	76	143
CFROBOT9.003	2 G 0,5 + (2 x 0,5)C	10.0	27	75
CFROBOT9.004	16 G 1,0 + (2x1,0)C	18.5	177	326
CFROBOT9.005	23 G 1,0 + (2x1,0)C	19.5	241	478
CFROBOT9.006	24 G 1,0 + (2x1,0)C	20.0	251	484
CFROBOT9.007	(15x(2x0,25)C + (4x0,25)C)C	18.0	217	330

(1) Delivery time upon inquiry
Note: The mentioned external diameters are maximum values and may tend toward lower tolerance limits.
G = with green-yellow earth core **x =** without earth core

Delivery program Part No.	Number of cores and conductor nominal cross section [mm2]	Core Group	Colour Code
CFROBOT9.001	5 G 1,0 + (2x1,0)C	5G1,0 (2x1,0)C	Cores black with white numerals 1-4, one core green-yellow Cores black with white numerals 5-6
CFROBOT9.002	6 G 0,75 + (3x0,75)C	6G0,75 (3x0,75)C	Cores black with white numerals 1-5, one core green-yellow Cores black with white numerals 6-8
CFROBOT9.003	2 G 0,5 + (2 x 0,5)C	2x0,5 (2x0,5)C	Cores black with white numerals 1-2 Cores black with white numerals 3-4
CFROBOT9.004	16 G 1,0 + (2x1,0)C	16G1,0 (2x1,0)C	Cores black with white numerals 1-4, 7-17, one core green-yellow,Cores black with white numerals 5-6
CFROBOT9.005	23 G 1,0 + (2x1,0)C	23G1,0 (2x1,0)C	Cores black with white numerals 1-4, 7-24, one core green-yellow, Cores black with white numerals 5-6
CFROBOT9.006	24 G 1,0 + (2x1,0)C	24G1,0 (2x1,0)C	Cores black with white numerals 1-4, 7-25, one core green-yellow, Cores black with white numerals 5-6
CFROBOT9.007	(15x(2x0,25)C + (4x0,25)C)C	15x(2x0,25)C (4x0,25)C	Colour code in accordance with DIN 47100 white, green, brown, yellow (CAN-Bus)

Note: The mentioned external diameters are maximum values and may tend toward lower tolerance limits.
G = with green-yellow earth core x = without earth core