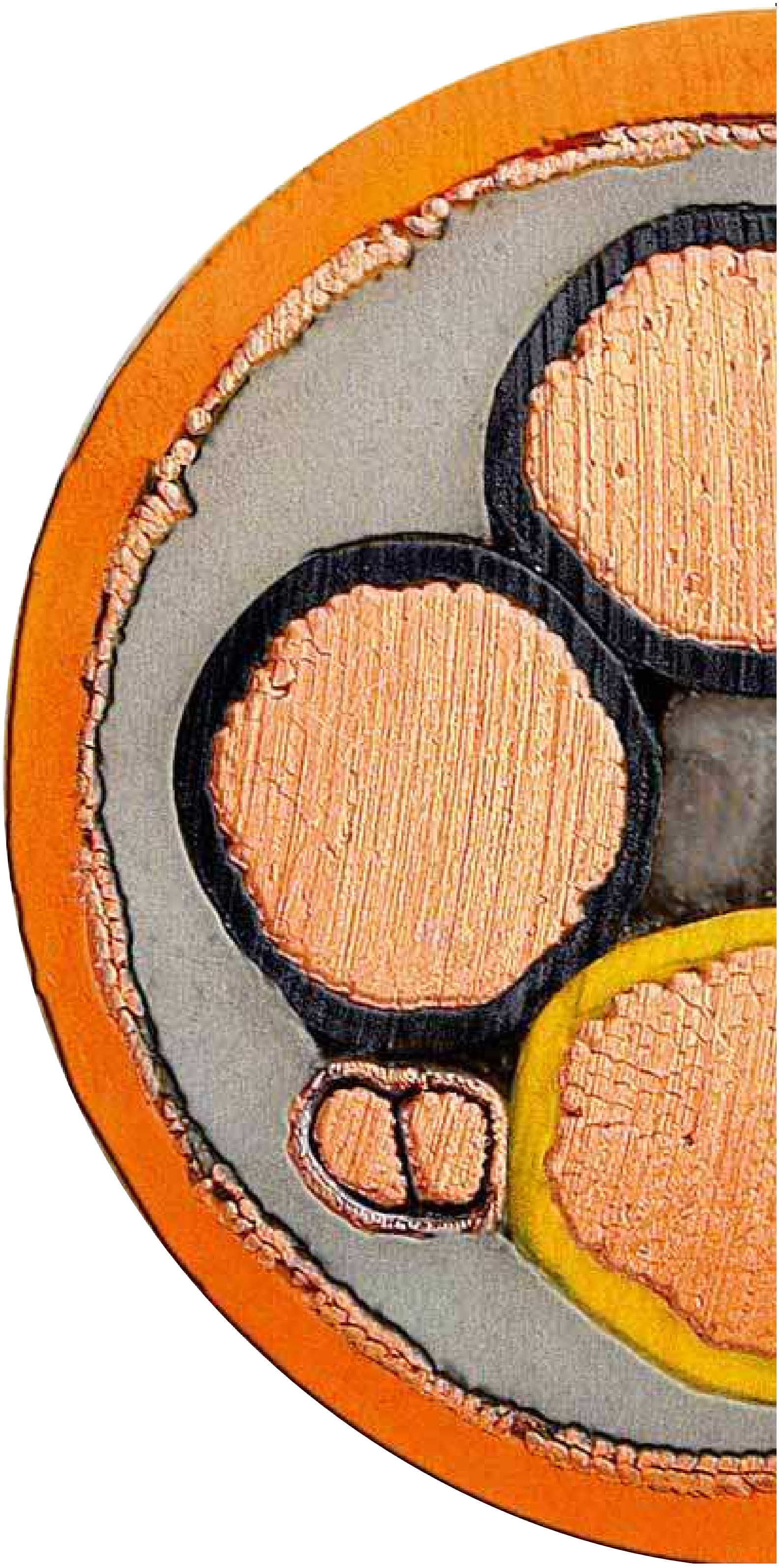
www.chainflex.de



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Definition of the icons used in the catalogue

Control Cables

Bus-/Data Cables

Servo Cables

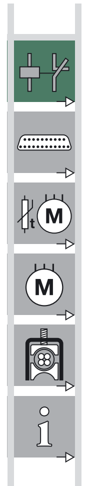
Motor Cables

Technical Information

Strain Relief Devices

Page side margin

The pictograms arranged on the side in the chapter show where you are at the moment. The arrows point toward the various Chainflex® cables and additional chapters.



Approvals:

VERBAND DEUTSCHER ELEKTROTECHNIKER

UNDERWRITERS LABORATORIES INC.

UNDERWRITERS LABORATORIES INC.

CANADIAN STANDARDS ASSOCIATION

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

CUSTOMER EQUITY

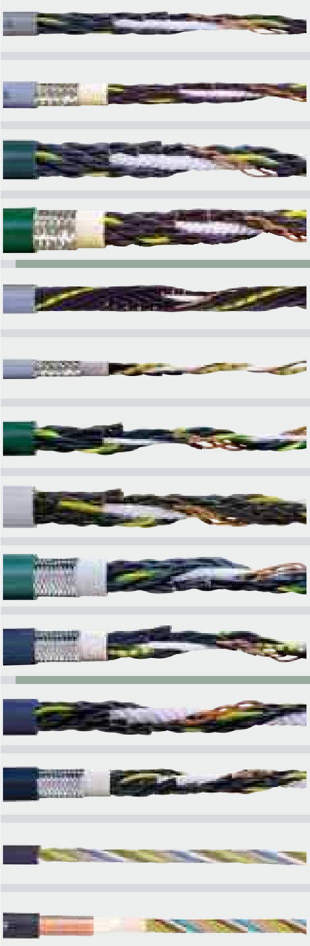
DEZENTRALE UND STANDARDISIERTE INSTALLATIONSTECHNIK

Economy Line	Energy Chain® cable for light and medium stressing capacity, preferred for unsupported applications.
High Class Line	Energy Chain® cable for high stressing capacity, for unsupported and gliding applications up to 100 m distance of travel.
Premium Line	Energy Chain® cable for maximum stressing capacity, for unsupported and gliding applications exceeding 100 m distance of travel.

User information

Since our products are constantly being developed further in the interest of our customers, we reserve the right to make technical alterations at any time. With the issue of this catalog, all previous publications lose their validity. Subject to printing errors. The terms "igus", "ReadyChain", "Chainflex", "E-Chain Systems", "Energy Chain", "Energy Chain Systems", "E-Ketten", "E-KettenSysteme", "Flizz", "plastics for longer life", "iglidur", "DryLin" and "Polysorb" are legally protected trademarks in the Federal Republic of Germany and in case also in foreign countries.

Chainflex® types

	Chainflex® cable	Jacket	Shield	Bending radius, moved [factor x d]	Temperature, moved from/to [°C]	Bending radius, fixed [factor x d]	Temperature, fixed from/to [°C]	Price index
Control cables								
	CF130.UL	PVC		7,5-10	-5/ +70	5	-20/ +70	◐○○
	CF140.UL	PVC	✔	7,5-15	-5/ +70	7,5	-20/ +70	◐○○
	CF5	PVC		6,8-7,5	-5/ +70	4	-20/ +70	●○○
	CF6	PVC	✔	6,8-7,5	-5/ +70	4	-20/ +70	●○○
	CF170.D	PUR		7,5-10	-35/ +80	5	-40/ +80	◐○○
	CF180	PUR	✔	7,5-15	-35/ +80	5	-40/ +80	◐○○
	CF7	PUR		6,8-7,5	-20/ +80	4	-40/ +80	●◐○
	CF7.D	PUR		6,8-7,5	-20/ +80	4	-40/ +80	●◐○
	CF8	PUR	✔	6,8-7,5	-20/ +80	4	-40/ +80	●◐○
	CF2	PUR	✔	5	-20/ +80	4	-40/ +80	●●○
	CF9	TPE		5	-35/ +100	3	-40/ +100	●●◐
	CF10	TPE	✔	5	-35/ +100	3	-40/ +100	●●◐
	CF98	TPE		4	-35/ +90	3	-40/ +90	●●◐
	CF99	TPE	✔	4	-35/ +90	3	-40/ +90	●●◐

These values are based on concrete applications or tests. These values do not represent the limit of what is technically feasible.

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Chainflex® types

Approvals and standards	Flame-retardant	Oil-resistant	Halogen-free	Torsion resistant	V max. unsupported [m/s]	V max. gliding [m/s]	a max. [m/s²]	Number of conductors	Cross section Ø [mm²]	Page
										36
CE, RoHS, VDE, CEI, UL, cULus	✔			✔	3	2	20	2 - 25	0,25 - 6,0	38
CE, RoHS, VDE, CEI, UL, cULus	✔				3	2	20	3 - 36	0,25 - 2,5	42
CE, RoHS, VDE, CEI, UL, CSA	✔	✔		✔	10	5	80	2 - 42	0,25 - 6,0	46
CE, RoHS, VDE, CEI, UL, CSA	✔	✔			10	5	80	3 - 25	0,25 - 2,5	50
CE, RoHS, VDE, DESINA		✔	✔	✔	3	2	20	3 - 30	0,5 - 10,0	54
CE, RoHS, VDE		✔	✔		3	2	20	3 - 25	0,75 - 2,5	56
CE, RoHS, VDE, CEI, UL, CSA	✔	✔		✔	10	5	80	3 - 36	0,25 - 2,5	58
CE, RoHS, VDE, CEI, UL, CSA, DESINA	✔	✔		✔	10	5	80	3 - 25	0,75 - 1,5	60
CE, RoHS, VDE, CEI, UL, CSA	✔	✔			10	5	80	3 - 24	0,5 - 2,5	62
CE, RoHS, VDE, CEI, UL, CSA	✔	✔			10	5	80	3 - 48	0,14 - 1,5	64
CE, RoHS, VDE		✔	✔	✔	10	6	100	2 - 36	0,25 - 35,0	68
CE, RoHS, VDE		✔	✔		10	6	100	2 - 25	0,14 - 4,0	72
CE, RoHS, VDE		✔	✔	✔	10	6	100	2 - 7	0,14 - 0,34	76
CE, RoHS, VDE		✔	✔		10	6	100	2 - 7	0,14 - 0,34	78

Chainflex® types mentioned in the catalogue as "resistant to bio oil" have been tested by DEA according to VMDA 24568 with Plantocut 8 S-MB.

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Many Chainflex® cables possess these certificates. **UL material certification** for igumid materials with Energy Chains® and energy tubes. **CE mark** for all Chainflex® cables. Many Chainflex®-cables conform to **DESINA** specifications.

Chainflex® types

	Chainflex® Cable	Jacket	Shield	Bending radius, moved [factor x d]	Temperature, moved from/to [°C]	Bending radius, fixed [factor x d]	Temperature, fixed from/to [°C]	Price index
Data cables								
	CF240	PVC	✔	10-12	-5/ +70	5	-20/ +70	◐○○
	CF211	PVC	✔	10	-5/ +70	5	-20/ +70	◐○○
	CF11	TPE	✔	10	-35/ +100	5	-40/ +100	●●○
	CF12	TPE	✔	10	-35/ +100	5	-40/ +100	●●◐
Bus cables (with selection chart for Chainflex® bus cables)								
	CFBUS	TPE	✔	10-12,5	-35/ +70	5	-40/ +70	●●○
	CF11.LC	TPE	✔	10	-35/ +70	5	-40/ +70	●●○
	CF11.LC.D	TPE	✔	10	-35/ +70	5	-40/ +70	●●○
	CF14 CAT5	TPE	✔	12,5	-35/ +70	7,5	-40/ +70	●●○
Measuring system cables								
	CF211	PVC	✔	10	-5/ +70	5	-20/ +70	◐○○
	CF111.D	TPE	✔	12	-35/ +100	6	-40/ +100	◐○○
	CF11.D	TPE	✔	10	-35/ +100	5	-40/ +100	●●○
Fibre optic cable (FOC)								
	CFLG	PVC		10	-5/ +70	5	-15/ +70	●●○
	CFLG.2HG.MF	PUR		12,5	-20/ +60	7,5	-25/ +60	●●○
	CFLK	PUR		12,5	-20/ +70	7,5	-25/ +70	●◐○
	CFLG. G.T	TPE		15	-20/ +60	8,5	-25/ +60	●●○
Koax cables								
	CF Koax 1	TPE		10	-35/ +100	7,5	-40/ +100	●●○

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Chainflex® types

Approvals and standards	Flame-retardant	Oil-resistant	Halogen-free	Torsion resistant	V max. unsupported [m/s]	V max. gliding [m/s]	a max. [m/s²]	Number of conductors	Cross section Ø [mm²]	Page
										80
CE RoHS DESINA CEI UL CSA	✔	✔			3	2	20	3 - 24	0,14 - 0,34	82
CE RoHS DESINA CEI UL CSA	✔	✔			5	3	50	2 - 28	0,25 - 0,5	84
CE RoHS DESINA		✔	✔		10	6	100	4 - 36	0,14 - 2,5	86
CE RoHS DESINA		✔	✔		10	6	100	6 - 28	0,25 - 1,0	88
										90
CE RoHS DESINA cULus	✔	✔			10	6	100	2 - 10	0,14 - 1,0	92
CE RoHS DESINA		✔	✔		10	6	100	2 - 4	0,5	96
CE RoHS DESINA		✔	✔		10	6	100	2 - 6	0,25 - 1,5	98
CE RoHS DESINA		✔	✔		10	6	100	4 - 10	0,25	100
CE RoHS DESINA CEI cULus	✔	✔			5	3	50	6 - 16	0,14 -1,0	102
CE RoHS DESINA CEI cULus	✔	✔			2		30	12 - 16	0,14 - 0,5	106
CE RoHS DESINA		✔	✔		10	6	100	6 - 17	0,14 - 1,0	110
CE RoHS DESINA CEI	✔	✔			10	5	20	4	200/230 µm	114
CE RoHS		✔	✔		10	6	20	2	50 + 62,5/125 µm	116
CE RoHS	✔	✔			10	5	20	1	980/1000 µm	118
CE RoHS		✔	v		10	6	20	6 - 12	50 + 62,5/125 µm	120
CE RoHS DESINA		✔	✔		10	5	100	1 - 5		122

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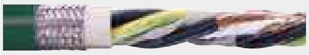
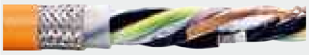
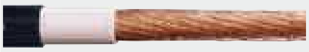
Many Chainflex® cables possess these certificates. **UL material certification** for igumid materials with Energy Chains® and energy tubes. **CE mark** for all Chainflex® cables. Many Chainflex®-cables conform to **DESINA** specifications.

Chainflex® types

	Chainflex® Cable	Jacket	Shield	Bending radius, moved [factor x d]	Temperature, moved from/to [°C]	Bending radius, fixed [factor x d]	Temperature, fixed from/to [°C]	Price index
Servo cables								
	CF21.UL	PVC	✔	7,5	-5/ +70	4	-20/ +70	●○○
	CF260	PUR	✔	10	-20/ +80	5	-40/ +80	●○○
	CF27.D	PUR	✔	7,5	-20/ +80	4	-40/ +70	●◐○
Power cables								
	CF30	PVC		7,5	-5/ +70	4	-20/ +70	●○○
	CF31	PVC	✔	7,5	-5/ +70	4	-20/ +70	●○○
	CF34	TPE		7,5	-35/ +90	4	-40/ +90	●●◐
	CF35	TPE	✔	7,5	-35/ +90	4	-40/ +90	●●◐
	CF300.UL	TPE		7,5	-35/ +90	4	-40/ +90	●●○
	CFPE	TPE		7,5	-35/ +90	4	-40/ +90	●●○
	CF310.UL	TPE	✔	7,5	-35/ +90	4	-40/ +90	●●○
	CF.BRAID	TPE	✔	7,5	-35/ +70	4	-40/ +70	●●○
	CFCRANE	iguprene	✔	10	-20/ +80	7,5	-30/ +80	●●●
Pneumatic hose								
	CF.Air	PU		10	-25/ +80	5	-40/ +85	●○○

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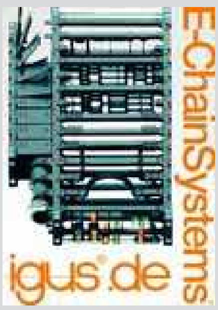

Energy Chain Systems® main catalog

On 896 pages, more than 70,000 Energy Chain® components, available ex stock.

Chainflex® types

Approvals and standards	Flame-retardant	Oil-resistant	Halogen-free	Torsion resistant	V max. unsupported [m/s]	V max. gliding [m/s]	a max. [m/s²]	Number of conductors	Cross section Ø [mm²]	Page
										124
CE, RoHS, VDE, CEI, cULus	✔	✔			10	5	80	6 - 8	0,75 - 35 / Pairs 0,34 - 1,5	126
CE, RoHS, VDE, DESINA		✔	✔		10		50	4 - 6	1,5 - 16 / Pairs 0,5 - 1,0	130
CE, RoHS, VDE, CEI, cULus, DESINA	✔	✔	✔		10	5	80	4 - 8	0,75 - 50 / Pairs 0,5 - 1,5	132
										136
CE, RoHS, VDE, CEI, cULus, DESINA	✔	✔		✔	10	5	80	4 - 5	1,5 - 50	138
CE, RoHS, VDE, CEI, cULus	✔	✔			10	5	80	4 - 5	1,5 - 70	140
CE, RoHS, VDE, CEI, cULus, DESINA	✔	✔		✔	10	6	80	3 - 5	1,5 - 50	142
CE, RoHS, VDE, CEI, cULus	✔	✔			10	6	80	4	1,5 - 25	144
CE, RoHS, VDE, CEI, cULus		✔	✔		10	6	100	1	6 - 185	146
CE, RoHS, VDE, CEI, cULus	✔	✔			10	6	100	1	4 - 25	148
CE, RoHS, VDE, CEI, cULus	✔	✔			10	6	100	1	4 - 185	150
CE, RoHS, VDE, CEI, cULus	✔	✔			10	6	80	4 - 8	2,5	152
CE, RoHS, VDE	✔	✔			10	6	50	1	25 - 95	154
		✔			10	5	50			156

Chainflex® types mentioned in the catalogue as "resistant to bio oil" have been tested by DEA according to VMDA 24568 with Plantocut 8 S-MB.

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Many Chainflex® cables possess these certificates. **UL material certification** for igumid materials with Energy Chains® and energy tubes. **CE mark** for all Chainflex® cables. Many Chainflex®-cables conform to **DESINA** specifications.

Chainflex® harnessed

Chainflex® accessory

Chainflex® harnessed

Chainflex® accessory

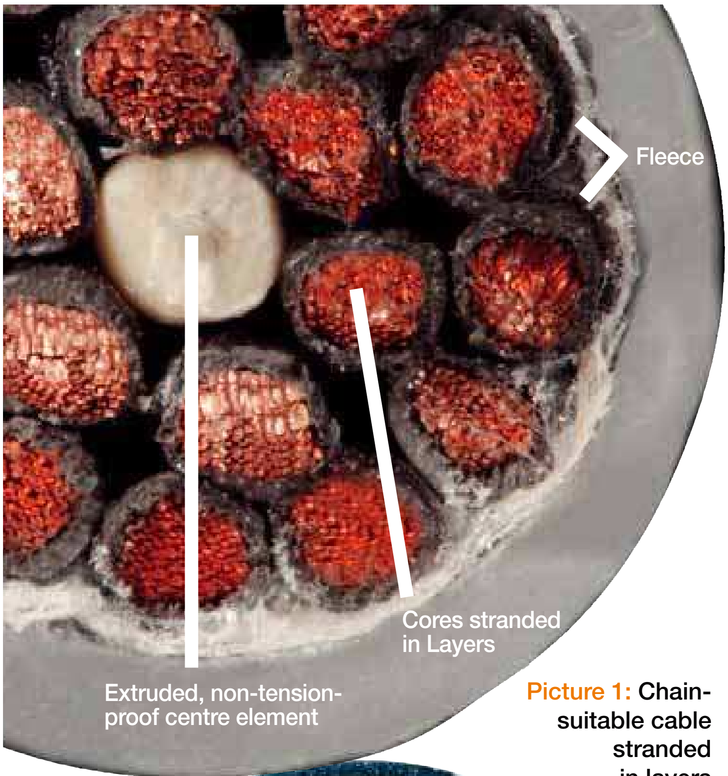
Page

Chainflex® Quick Selection

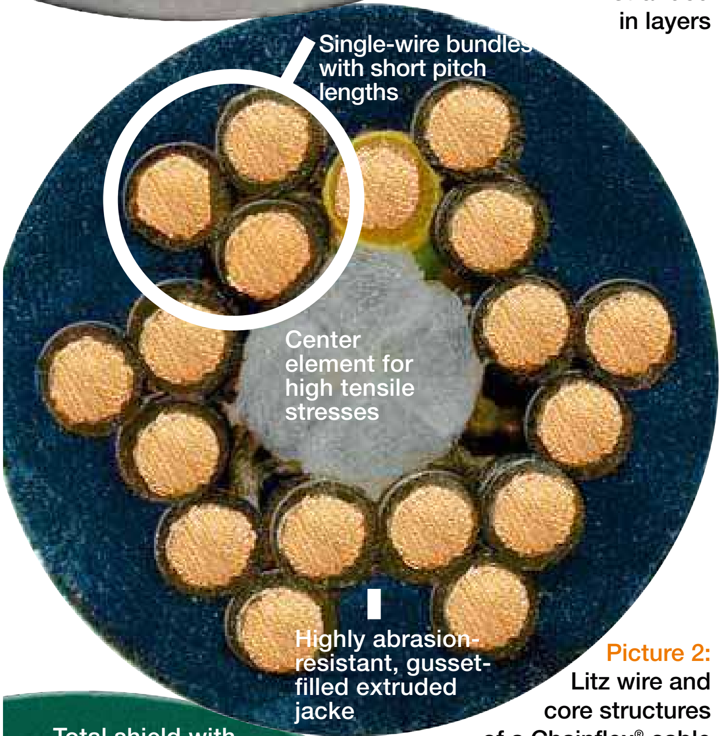
	Control cables														Data				Bus			
	CF130.UL	CF140.UL	CF5	CF6	CF170.D	CF180	CF7	CF7.D	CF8	CF2	CF9	CF10	CF98	CF99	CF240	CF211	CF11	CF12	CFBUS	CF11.LC	CF11.LC.D	CF14 CAT5
Page No.	36	40	44	48	52	54	56	58	60	64	66	70	74	76	80	82	84	86	90	94	96	98
Machine Tools/ Processing Machines			●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●
Packaging Handling Automation	●	●	●	●				●			●	●	●	●	●	●	●	●	●	●	●	●
Cranes Materials-Handling Technology Storage and Retrieval Units for High-Bay Warehouses Indoor			●	●							●	●	●	●	●	●	●	●	●	●	●	●
Cranes Harbor Equipment Systems Materials-Handling Technology Outdoor											●	●	●	●			●	●	●	●		
Low-Temperature Applications					●	●	●	●	●		●	●	●	●			●	●	●	●		●
Timber Processing Machines	●	●	●	●	●	●									●	●	●	●	●	●	●	●
Cutting and Welding Systems	●	●	●	●	●	●									●	●	●	●	●	●	●	●
PVC-free and halogen-free					●	●					●	●	●	●			●	●		●	●	●
UL and/or CSA approval	●	●	●	●			●	●	●	●					●	●			●			
DESINA-conforming					●			●											●		●	●

Chainflex® according to Branches

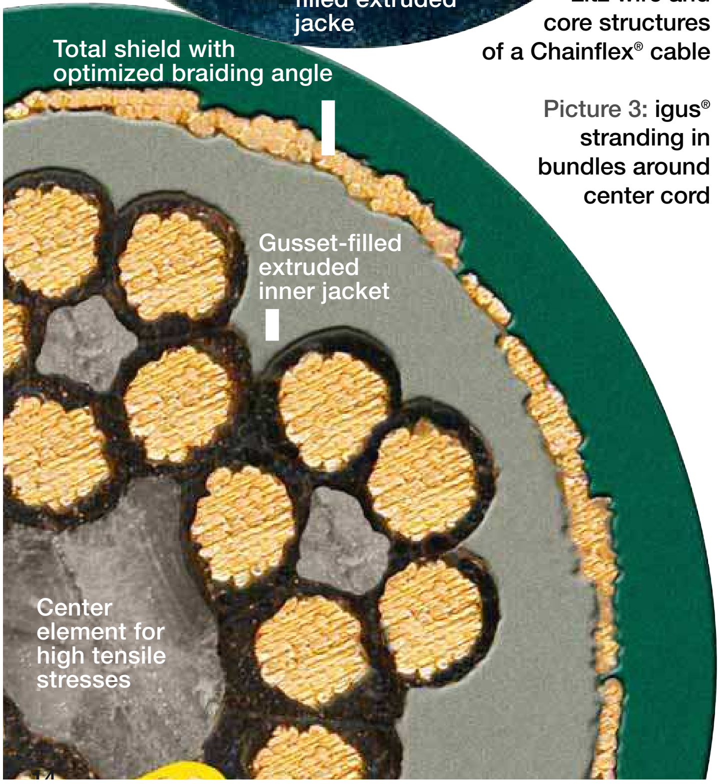
Measuring System			FOC/Koax					Servo cables		Power cables										Pneumatics	Chainflex® Quick Selection
CF211	CF111.D	CF11.D	CFLG	CFLG.2HG.MF	CFLK	CFLG. G.T	CF Koax 1	CF21.UL	CF260	CF27	CF30	CF31	CF34	CF35	CF300.UL	CFPE	CF310.UL	CF.BRAID	CFCRANE	Pneumatik-schlauch	
100	104	108	112	114	116	118	120	124	128	130	136	138	140	142	144	146	148	152	154	156	Page No.



Picture 1: Chain-suitable cable stranded in layers



Picture 2: Litz wire and core structures of a Chainflex® cable



Picture 3: igus® stranding in bundles around center cord

Chainflex®...

The tricks and ingenious features of...

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 form 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 **(see picture 4).**

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. How do these problems arise? A look at the cable structure can be quite helpful (see picture 1).
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.

lasts or your money back!

...the Chainflex® design and why we feel so confident about this design

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. (see picture 2)

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 (see picture 3).

Picture 4: **Shielded "chain-suitable" control cable after only 400,000 to-and-fro cycles with a bending factor of 10 x d**

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

Both tasks are equally important because faulty signals can cause considerable consequential damage in the system itself as well as in any external systems. Furthermore, this is an especially problematic point due to the fact that incorrect shielding usually cannot be detected from outside, and this is something that makes the trouble-shooting procedure extremely difficult. How can these kinds of problems arise in the first place?

Once again, the answer is to be found in the internal structure of the cable itself: Is the shielding designed for the movements of the cable? Although it may be very easy to shield a fixed cable, it is much more difficult to guarantee the permanent shielding of a moving cable.

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

Dictionary of defects

Core rupture

Failure of electric conductivity due to broken copper wires as a result of subjecting the individual cores to mechanical overload/ tensile load under constant bending stress. In most cases, the causes are incorrect litz wires and/or incorrect stranding pitch directions and lengths.

Insulation damage

Short circuits due to damage to the insulation above the conductor. The cause can be material fatigue under constant bending stress or material abrasion within the stranded structure. Single-wire breakage of the conductor or the shield braid result in perforation of the insulation.

Corkscrew

An externally detectable screw-like deformation of the entire cable due to broken copper wires as the result of subjecting the individual cores to mechanical overload/ tensile load during the bending process. In most cases, the causes are unfavorable superstructure properties (stranding in layers, missing center, loose jackets extruded to the form of a "tube") and subjecting the cables to high bending stress.

Jacket abrasion

The jacket is rubbed off down to the stranding or down to the total shield. In most cases, the causes are incorrect selection of materials and/or unfavorable extrusion processes resulting in detrimental surface properties so that abrasion is an unavoidable effect.

Jacket swelling/ jacket breakage

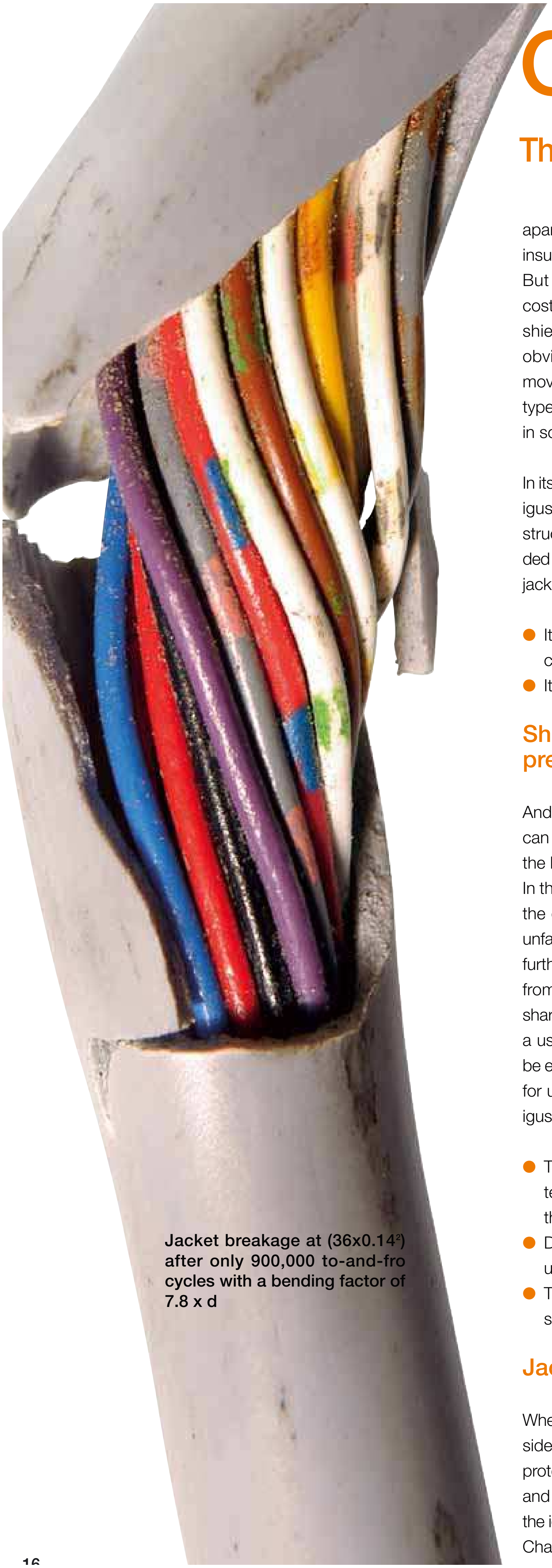
Jacket becomes soft and deformed or breaks until the stranding/shield can be seen. The cause can be the incorrect selection of materials with respect to the oils or other chemical substances being used.

Shielding losses/ EMC problems

Electromagnetic interferences inside or outside an electric cable. In most cases, the cause is shield wire breakage due to mechanical overload with incorrect shield braid angles. Other causes include loose braids over foils without supporting effects or very open coverings.

Chainflex®...

The tricks and ingenious features of...



Jacket breakage at (36x0.14^2) after only 900,000 to-and-fro cycles with a bending factor of 7.8 x d

apart under stress. Consequently, the metallic shield then rubs on the insulation of the cores – short circuits are then to be expected.
But the production of the shield itself is very time-consuming and cost-intensive and may have been the reason for the use of open braid shields or even simple wire wrappings. The disadvantages are quite obvious: 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 acket materials to adapt his Energy Chain® cables to suit the conditions of the respective environment.

lasts or your money back!

...the Chainflex® design and why we feel so confident about this design

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.

The quality bundles of igus® Chainflex® cables

- Strain-relieving center
- Stranding in bundles
- Gusset-filled extruded inner jacket in shielded cables
- Enclosed shield braid
- Optimized shield braiding angle
- Gusset-filled extruded jacket

7 basic rules for a good cable

1. Strain-relieving center

Clear space is created in the center of a cable according to the number of cores and the cross section of each cable. This center should be filled, as far as possible, with a genuine center cord (and not, as frequently the case, with fillers or dummy cores consisting of waste materials). These measures will then efficiently protect the stranded structure situated above and prevent the stranding from wandering into the middle of the cable.

2. Litz wire structure

With respect to the selection of litz wires, the maximum flexibility has proved to be the best solution. Although very flexible conductors can be made using very thin individual wires, these conductors tend toward extreme formation of kinks. Long-term series of tests provided the result of a shielded combination of single-wire diameter, pitch length and pitch direction as the best bending-resistant solution.

3. Core insulation

The insulation materials must be made so that they do not stick to one another within the cable. Furthermore, the insulation is also required to support the stranded individual wires of the conductor. Accordingly, only the highest-quality, high-pressure-extruded PVC or TPE materials that have proved their tested reliability in millions of core kilometers are then used in Energy Chain® applications.

4. Stranding

The stranded structure must be stranded around a stable, tension-proof center with an optimized short pitch length. However, due to the insulating materials being used, this stranded structure should still be defined in mobile form within the stranding. Starting from a quantity of 12 cores, however, the method of stranding in bundles should be applied.

5. Inner jacket

A gusset-filled extruded inner jacket must be used instead of inexpensive fleeces, fillers or accessory fillers. This measure ensures that the stranded structure is efficiently guided in longitudinal direction. Moreover, the stranded structure cannot fall apart or wander off.

6. Shielding

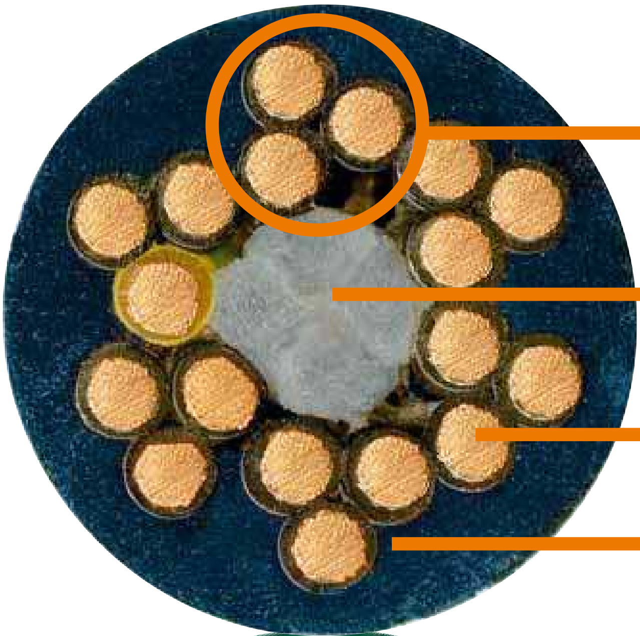
The total shield should be made tight using an optimized shield braiding angle over an extruded inner jacket. Loose open braids or wrapped stranding reduce the EMC protection considerably and can fail very quickly due to shield wire breakage. A tight total braid shield also has a torsion protection effect on the stranded structure.

7. Outer jacket

The material-optimized outer jacket can fulfil many different requirements: From UV-resistant to low-temperature-flexible, and from oil-resistant to cost-optimized. But these outer jackets must have one thing in common: A jacket material must be highly abrasion-resistant but not be allowed to stick to anything. It must be flexible but also provide a supporting function. In any case, the jacket should also be extruded under pressure (gusset-filled).

Sectional views through

Detailed structure of igus® control, data, servo and motor



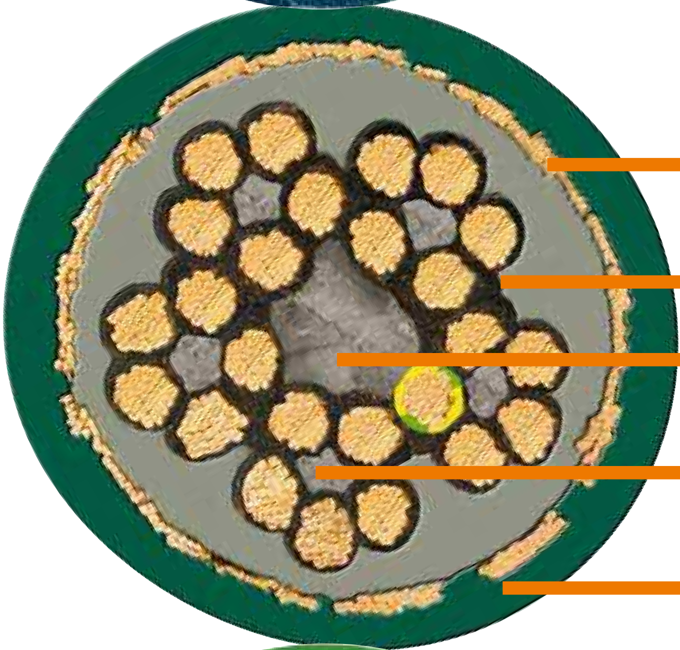
Chainflex® control cable, unshielded

Individual bundles with optimized pitch length and pitch direction

Single-wire diameter optimized for Energy Chains®

Center element for high tensile stresses

Highly abrasion-resistant, gusset-filled extruded jacket



Chainflex® control cable, shielded

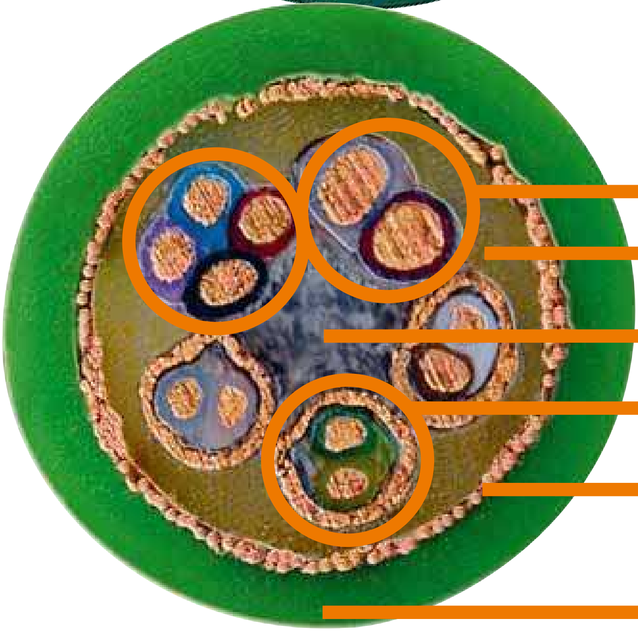
Total shield with optimized braiding angle (covering approx. 70% linear, approx. 90% optical)

Gusset-filled extruded inner jacket supports stranding

Center element for high tensile stresses

Tension-proof center element in individual bundles

Pressure extruded jacket



Chainflex® data/ sensor cable, shielded

Stranded elements with optimized pitch length and pitch direction

Gusset-filled extruded inner jacket supports stranding

Center element for high tensile stresses

Pair braid shield

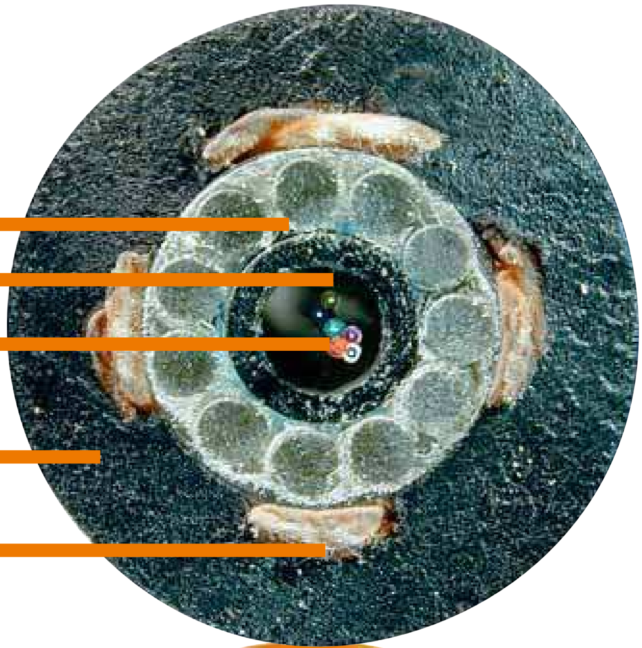
Total shield with optimized braiding angle (covering approx. 70% linear, approx. 90% optical)

Pressure extruded jacket

the igus® cable types

cables starting from the high-class category

Chainflex® FOC gradient fiber cable



Supporting braid made of glass-yarn-stranded FRP rods

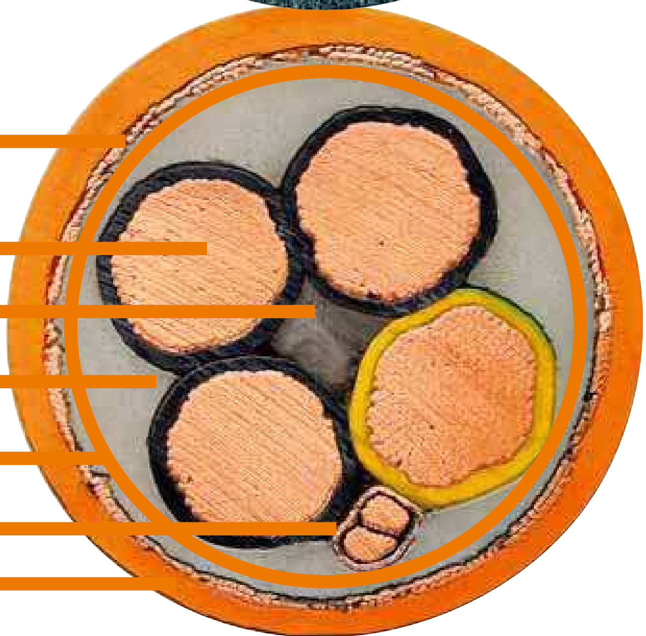
Gel-filled fiber sheath

FOC fibers

Highly abrasion-resistant TPE jacket

Integrated torsion protection

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

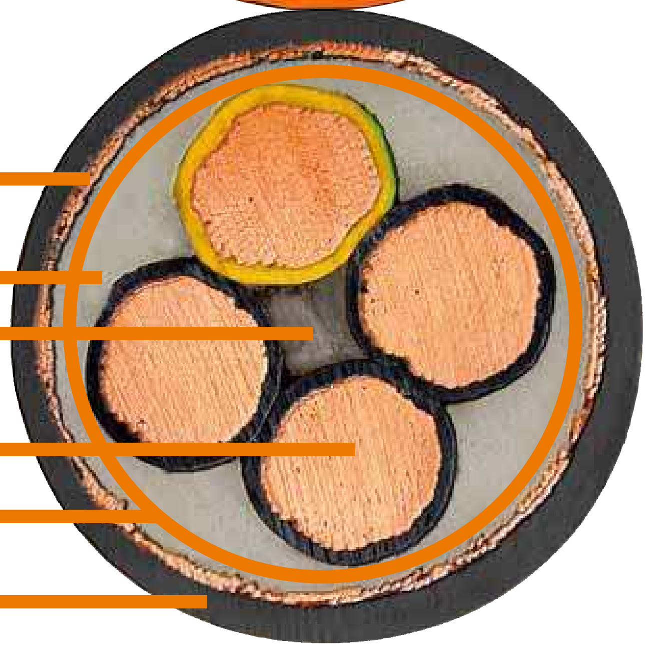
Gusset-filled extruded inner jacket

Stranding with optimized pitch length and pitch direction

Pair braid shield over optimized stranded core pair

Highly abrasion-resistant pressure extruded jacket

Chainflex® motor 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

Chainflex® are the special cables for Energy Chain Systems® – tested, tested, tested and tested.

Partial view of igus® experimental laboratory – testing, testing, testing of Chainflex® cables