TFkable

EDITION IV

Connecting
Globally

TFCrane

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Description of pictograms used in catalogue

The cable meets the requirements of the EU directive

The cable complies with the R0HS directive

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Positive result for vertical flame spread test acc. to IEC 60332-1-2

UV resistant jacket

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Application to monospiral reels

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Application Drag chain

Maxmum conductor operating temperature

Temperature of installation

Insulation temperature

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Leading manufacturer of cables and wires

TFKable Group is one of the global market leaders of wires and cable systems, with numerous trading companies and production plants located in many countries, as well as service units and research and development centers.

In August 2017, the British company JDR Cable Systems – a leading manufacturer of submarine cables and provider of offshore and onshore services for the global wind energy industry joined TFKable Group.

TFKable Group belongs to a small group of a few most specialized and technologically advanced suppliers of high and extra high voltage cable systems. The maintenance and control services provided by TFKable Group is dedicated to oil and gas and renewable energy extraction systems subsea and on land. In addition, the extensive infrastructure of research and development centers allows for qualification tests, routine tests, technological tests and fire tests. Our experience is confirmed not only by continuous supplies to electricity distribution network operators or as part of ongoing investment projects for conventional and wind farms, but also by positive results of production process audits carried out by the most renowned certification bodies.

JDR Cable Systems is a global leader in subsea production umbilicals, subsea power cables and Intervention Workover Control Systems for the offshore oil and gas industry. JDR operates in harsh, dynamic, subsea environments and is a pioneer in the development of cutting-edge inter-array power cables for offshore wind, wave and tidal energy projects. Additionally, JDR supports customers in the renewable energy sector throughout project planning, mobilisation, installation, commissioning and maintenance, providing total lifecycle support.

TFKable Group produces, among others, cables for the energy sector in the following product groups: low voltage power cables up to 1 kV, medium voltage power cables from 6/10 kV to 18/30 kV, high voltage power cables from 36 to 150 kV, extra high voltage power cables from 220 to 400 kV; telecommunication copper and fiber optic cables; rubber insulated cables, including mining and crane cables; control cables for data transmission and security, as well as Inter-array cables (33 kV & 66 kV), Subsea Power Umbilicals, Steel Tube Umbilicals, rental and oil & gas services, i.e. submarine cables (including cables connecting wind towers and export cables), which are used in the construction and operation of offshore and onshore wind farms.

UK

JDR Littleport Plant
Production of cables and wires

JDR Hartlepool Plant
Production of cables and wires

Copper Cable Company Ltd, Measham
Distribution of cables and wires

JDR Newcastle
Trade and service unit

JDR Blyth – under construction
Production of cables and wires

Poland

TFK Bydgoszcz Plant
Production of cables and wires

TFK Bukowno
Post-production waste recycling plant

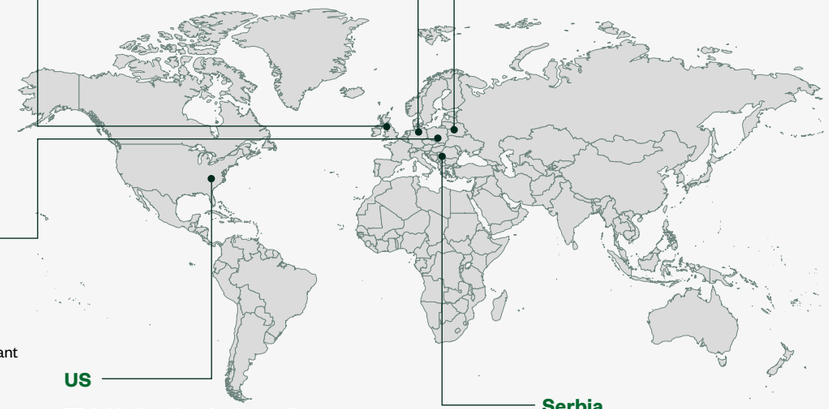
TFK Myślenice Plant
Production of cables and wires

TFK Kraków-Wielicka Plant
Production of cables and wires

TFK Kraków-Bieżanów Plant
Production of cables and wires

Germany

TFK Hilden
Distribution of cables and wires



US

TF Cable Americas, Lockport , IL
Distribution of cables and wires

JDR Houston, TX
Trade and service unit

JDR Fall River, MA
Renewables – trade unit

Lithuania

TFK Kaunas
Distribution of cables and wires

Serbia

TFK Zajecar Plant
Production of cables and wires, trade unit

Experience and competence of the TELE-FONIKA Kable Group

GLOBAL RELATIONS

Kraków – Wielicka Plant, Poland
One of the biggest cable factories in Poland. It manufactures power cables and wires, including rubber insulated cables and wires applicable in the mining industry and in the offshore and onshore wind farms. As one of the few European manufacturers, the plant is a supplier for mines located in the US, Canada, South America, and Africa. Its offer also includes specialized cables for applications in the railway and shipbuilding industry.

Bydgoszcz Plant, Poland
The oldest cable and wire factory in Poland and the biggest production center of medium, high and extra-high voltage cables in Europe. Together with the plants in Littleport and Hartlepool, it belongs to the elite group of direct suppliers of complete solutions for the offshore electricity industry.

Myślenice Plant, Poland
Production of fiber optic and telecommunication cables, computer cables and car cables.

Zajecar Plant, Serbia
Production of Al and Cu wires, low and middle voltage cables, signaling and control cables, telecommunication cables, as well as halogen-free cables and wires and car cables.

Waste Recycling Facility in Bukowno, Poland
It has the recycling capacity of approx. 10 thousand tons of cable waste per year. This allows for the recovery of fractions from individual materials with purity of over 99.5%.

Littleport Plant, UK
Design and engineering services, IWOC, Subsea Production Umbilicals and Power Cables up to 100 t production. The plant has specialized research facilities.

Hartlepool Plant, Victoria Dock, UK
The biggest JDR production plant with specialized design teams. Strategically located on the quay, next to the port on the North Sea. A plant with an area of 20,000 m², commissioned in 2009, supplying and producing Subsea Production Umbilicals, Subsea Power Cables and Inter-array Cables. Modern infrastructure of the machine park provides flexibility of the large-size cables production process.

Houston Service Center, US
Carrying out assembly, integration and testing of umbilicals, reelers and associated packages. The facility provides technical support in projects executed mainly in the Gulf of Mexico, and carries out offshore commissioning, testing and repair works at sea.

Quality connect us

At TFKable, we create a respectful, ethical, and inclusive work environment. We are convinced that to create products of the highest quality, we need to foster commitment and good relations with employees every day and ensure a friendly and safe environment to work in.

HEALTH AND SAFETY OF EMPLOYEES

We implemented an H&S (Health & Safety) system at our Bydgoszcz plant, compliant with **ISO 45001** standard.
The **THINK QUALITY** and **THINK SAFETY** programs were successfully launched at the Bydgoszcz plant, focusing on occupational safety. These programs enhance organizational improvement and foster a culture of quality, safety, and waste elimination. We employ various tools and methodologies, ensuring employees have the space and opportunities to contribute to improvements in their areas. Internships at TFKable are mutual learning experiences. Interns learn about our company, and we assess their potential. Annually, at least one intern typically joins us permanently, with many of our specialist engineers beginning their careers this way.
TFKable in 2022 proudly receiving the "Best in Safety" award from the Central Institute for Labour Protection - National Research Institute, which serves as a strong integrated indicator of TFKable occupational health and safety management processes.

PRODUCT SAFETY AND TESTS

We've implemented an **ISO 9001**-based quality management system and established comprehensive operational policies. Our commitment to product safety includes rigorous testing by external certification bodies and academic institutions, both domestic and international. We also invest in our own laboratory equipment for thorough inspections, evaluating factors like fire spread rate, smoke and gas emissions, and core integrity. This ensures we consistently produce high-quality products that meet our partners' needs and expectations.

Quality is about using the best raw materials.
We source top-quality raw materials like copper, aluminum, PVC, polyethylene, and rubber from carefully selected suppliers, ensuring our cables and wires maintain their unique properties for safe use. Before reaching the market, our products undergo rigorous quality and safety tests, adhering to international and national standards.
These include:

- **IEC**, i.e. International Electrotechnical Commission standards, such as IEC 6033, IEC 60332, IEC 61034, IEC 60754;
- **EN** these are binding standards in all of the European Union. They are usually developed on the initiative of the EU by European standardisation organisations – CEN and CENELEC. CEN and CENELEC form the basis for all national standardisation organisations in Europe;
- **BS**, i.e. British standards which cables and wires introduced on the market have to fulfil;
- **DIN**, i.e. standards developed by the German Institute for Standardisation (DIN), which is responsible for publishing standards for electronic and electrotechnical equipment and systems applicable in Germany;
- **UL** i.e. North American standards introduced by UL enterprise such: UL62, UL 44, UL1650, UL1580;
- **AS/NZS** i.e. joint Australian/New Zealand Standard consisting of requirements for cables of dedicated markets;
- **SANS** i.e. South African National Standards such as SANS 1520-1 and SANS 1520-2.

ENVIRONMENTAL RESPONSIBILITY, AUDITS OF SUPPLIERS AND RAW MATERIAL SOURCES

We've implemented environmental management system based on **ISO 14001** standards.

According to our policy, we operate in mind the prevention of pollution emissions to the environment, with particular emphasis on reducing greenhouse gas emissions, and effective use of natural resources.

We audit our suppliers. To a large degree, it means an environmental audit. The basic supplier evaluation parameters that we have adopted include:

- Complying with the environmental management system **ISO 14001** we expect our suppliers to comply with regulations related to environmental protection.
- In line with the **REACH** regulation, we require its suppliers to provide information on the properties of supplied chemicals and the associated risks to human health and the environment. This information enables effective risk management and action to minimise the negative impact of these substances.
- **RoHS** we require that our suppliers deliver information regarding the concentration of these substances in the raw materials and minerals that we use in manufacturing processes.

Advancing Innovation

Our Research and Development Testing Centers ensure compliance with national and international regulations for quality and safety which is paramount for us. Our extensive R&D facilities allow us to optimize designs for harsh environments, focusing on cable effectiveness, efficiency, and longevity.

Our research and development activities include rigorous testing of cables and wires, continuous improvement of production processes through investments in specialized equipment, collaboration with universities and certifying institutions, and assessment by certifying units.

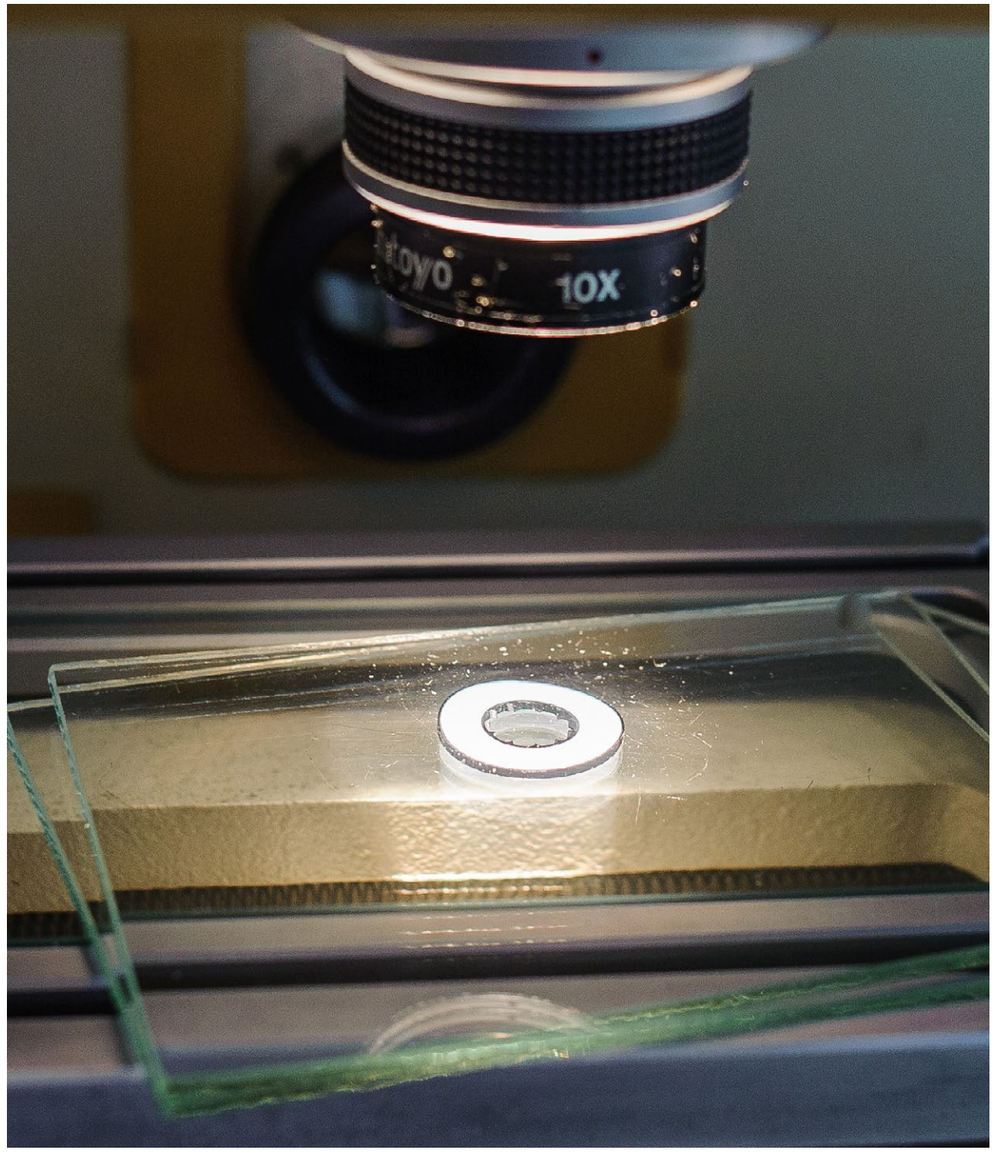
TFKable's development is driven by innovation and technological advancement, supported by our outstanding, knowledgeable specialists. Thanks to teamwork of our dedicated, experience employees and highly modern research facilities, our partners can count on high-quality services, exceptional cables, openness to specialized needs, and fruitful long-term cooperation.

- The Laboratory in Bydgoszcz and Krakow cooperates with **VDE** (VDE Testing and Certification Institute, Representative Office in Poland), **KEMA** (Keuring van Elektrotechnische Materialen te Arnhem), **DEKRA** (DEKRA Certification S.A.), **CESI** (Centro Elettrotecnico Sperimentale Italiano) and **STRI** (Swedish National Testing and Research Institute).

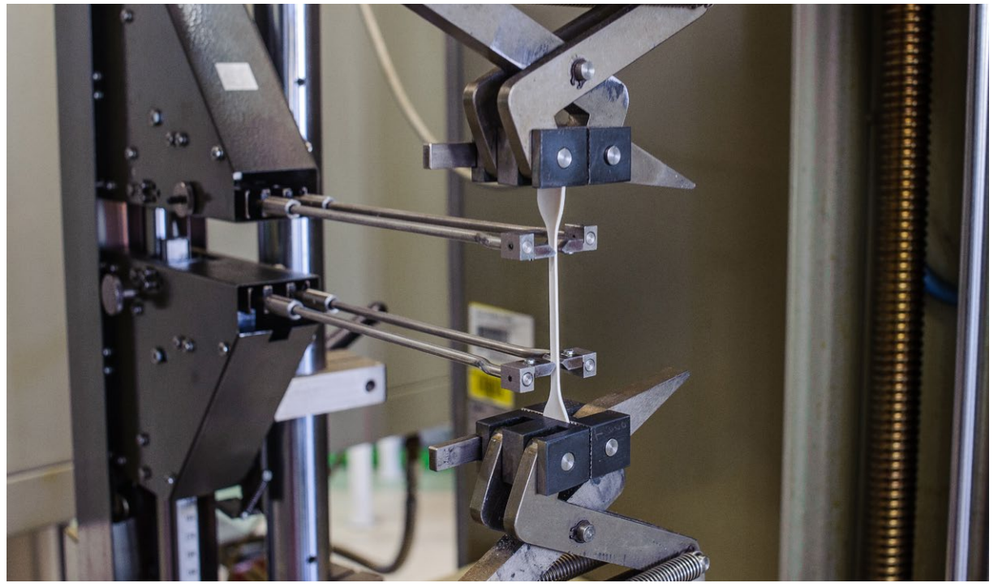
Additionally, we continuously explore new technology trends and discoveries to enhance the properties of our cables and wires, optimizing existing designs and developing new ones using our comprehensive range of production, quality, and testing equipment:

- We have enhanced the technological capabilities of our Kraków-Wielicka plant by adding a fully automated **Internal Mixer for Rubber Compounds**, to our production line. This mixer is designed for the production of rubber compounds. In this way, we have significantly reduced production waste, gained independence from rubber compound suppliers for the production of cables with rubber insulation, and specialized in this plant, allowing for efficient production planning.
- We have equipment to test **the density of emitted fumes and the level of corrosive gas emissions**. We check the continuity of cores and the lack of puncture on a special fireproof board subjected to mechanical impact with cables exposed to direct fire for a specified time. We perform several hundred flammability tests every year.
- Our **Twin Screw Extruder for Low Smoke Halogen-Free Compounds** enables continuous production processes that combine the advantages of intensive mixing and rapid extrusion. The machine is used to produce halogen-free, fire-resistant, low-smoke (LS0H) compounds based on EVA polymer, which is flame-retardant with the use of mineral flame retardants.
- Our devices for **torsion testing** of cables are used to perform torsion testing along their own axis, enabling the assessment of cables' resistance to repeated stress caused by angular displacement. This test is primarily conducted on cables used in wind turbine towers.

- Our **abrasion testing machine** is utilized to evaluate the wear resistance of cable coatings. These tests are conducted on specialized stations to assess the coating's ability to withstand abrasion. This resilience is particularly critical for cables used in moving components, as they are prone to excessive wear and tear on the coating.
- Our **climatic chamber** is used to test the temperature resistance of materials. These tests are conducted in aging chambers, subjecting materials to bending, winding, pressure, and long-term elongation.
- Our **drying and heating chamber** is utilized for accelerated aging simulation of cables, plastics, and elastomers.
- Our **Weather-Ometer chamber**, used for UV resistance testing, simulates the effects of atmospheric factors such as UV radiation, temperature, and elevated humidity. This testing is relevant for cables exposed to atmospheric conditions.
- Our **Ozone Aging Test Chamber** is used to assess the resistance of materials used in cable production to ozone exposure. This procedure evaluates the impact of ozone on the mechanical properties of materials. The test helps determine whether a specific material is resistant to ozone exposure, which is crucial for the long-term durability of cables in outdoor conditions.



- Our **water-penetration testing device** is used to assess the waterproofing capabilities of cables against longitudinal water penetration. In this testing procedure, the cable sample is subjected to water penetration under hydrostatic pressure on a dedicated research station.
- Our **tensile testing machine** is utilized for peel strength testing, aiming to assess the adhesion between coatings.
- Our **oxygen (air) bomb aging test chamber**, commonly known as an air bomb aging chamber, is used to test the aging of electrical conductors or insulation layers under required pressure and temperature conditions in an oxygen-rich or high-pressure air environment.
- Our **immersion pressure testing device**, allows for testing both water penetration resistance and pressure crushing tests to assess cable resistance, simulating conditions at the bottom of the sea.
- Our **cable bending device** is used for multiple bending tests of wires. The test involves repeatedly bending the cable sample between three rollers. The sample is energized and subjected to the appropriate current. A positive test result indicates no breakage in the wires or insulation breakdown between the wires.
- Our **Climatic Test Chambers** are utilized for conducting tests that require constant controlled temperature and humidity.



- Our **Rubber Compound Testing Laboratory** at Kraków-Wielicka specializes in testing and analyzing rubber compounds, LS0H compounds, and polymers used in TFKable products. Equipped with the latest technology, we can evaluate rheological properties (such as Mooney viscosity, vulcanization kinetics, Payne's effect, and viscoelastic properties), mechanical parameters (including tensile strength, elongation at break, hardness, abrasion resistance, and tear resistance), as well as aging properties (such as thermal aging and oil resistance).
- Our **Burn Test Laboratory** at the Kraków-Wielicka plant is equipped with instruments which allow for conducting broad tests on flame spreading on samples and cores. This means we can determine the impact of a structure and materials on the flame spreading during a fire.
- **The High and Extra-High Voltage Laboratory in Bydgoszcz** is equipped with 5 Faraday chambers for routine and type tests of cables, as well as cable systems, equipped with a high voltage generators up to 1000kV and surge generator up to 2400kV. TFKable have two of their own test field for qualification tests, equipped with a 500kV and 750kV test system and 5000 A heating transformer sets. Those state of the art laboratories, gives capabilities of performing routine tests and full qualification test for cables up to 500kV. The laboratory also researches prototypes of HVDC cables and EHVAC alternating current cables with optimised construction and technological guidelines for their production.

TFCrane

TFCrane cables are specialized power and control cables designed primarily for use in mobile applications where high operating speeds are required. They are particularly useful in material handling equipment such as cranes, hoists, and other devices that necessitate cable movement. These cables are widely used in ports, shipyards, and handling terminals.

KEY FEATURES OF TFCRANE CABLES:

- **Flexibility: The cables are flexible, allowing for freely movement in mobile applications.**
- **Weather resistance: The cables can operate in challenging weather conditions, including low and high temperatures.**
- **Mechanical strength: They have an excellent outer sheat that provides resistance to tears, deformations, impacts, and abrasion.**
- **Oil, UV, and ozone resistance: The cables are resistant to the effects of oils, UV radiation, and ozone, which is crucial in demanding industrial conditions.**
- **Designed for high-speed operation, up to 250 m/min.**
- **Can function in low temperature, with a minimum operating temperature as low as -35°C.**
- **Available in various nominal voltages to meet different application requirements: 300/500 V; 0.6/1 kV; 3.6/6 kV; 6/10 kV; 8.7/15 kV; 12/20 kV.**

TFCrane cables find broad applications in the industry. They are used for power supply in applications where frequent reeling, unreeling and bending of cables with specified operating speeds are common. The primary destinations for such cables are ports and shipyards. They operate in harbor cranes, indoor cranes, hoists, and industrial automation systems. These designs are characterized by high mechanical strength, flexibility, weather resistance, as well as resistance to contact with chemical substances.

The Laboratory of Extra High-Speed Cables has been established with the purpose of continuously improving the design of cables intended for mobile applications. The research infrastructure has been designed to simulate real operating conditions of cables in moving applications. The research program of this project focuses on conducting studies for three mobile applications. The main objective of these studies is to achieve new cable designs that can safely operate at an exceptionally high speed of up to 320 m/min.

Project co-financed by European Funds:
“Research and Development Center for electric wires for the application of extra high speed mobile devices.”

Fundusze Europejskie Inteligentny Rozwój
Rzeczpospolita Polska
Europejskie Fundusze Strukturalne i Inwestycyjne

RESEARCH INFRASTRUCTURE:

Gantry Test Rig has been specially designed for testing the fatigue strength of cables. It is an advanced device that enables precise tests to assess how cables perform under continuous load and operation.

Gantry Test Rig is equipped with three different applications, allowing the testing of cables with various diameters:

- **Monospiral wheel application:** This application allows testing of cables reeling on a monospiral wheel. This enables the examination of cable strength and durability when subjected to repeated reelingand unreeling. Weather resistance: The cables can operate in challenging weather conditions. including low and high temperatures.
- **Festoon application:** This application allows testing of cables suspended on cable trolleys. The festoon application involves hanging cables on special trolleys, enabling their free movement during device operation. Testing cables in this application helps evaluate their strength during multiple bending cycles.
- **Drag chain application:** This application facilitates the testing of cables placed in special cable chains. Testing cables in this configuration allows the examination of their strength under multiple bending and other dynamic loads.

Gantry Test Rig allows for the testing of cables across their full range of diameters. With the capability to interchange individual application components, the gantry is flexible and can adapt to various cable sizes. This is crucial because cables used in different industrial applications come in diverse dimensions, and the testing must take these differences into account.

In addition, **The Laboratory of Extra High-Speed Cables** also houses other specialized research devices that test cables for mobile applications:

- **Low-temperature cable bending device:** This equipment enables conducting strength tests by bending cables in extremely low temperatures, reaching as low as -50°C. Testing at low temperatures allows for assessing how cables perform in extreme weather conditions that may occur in certain mobile applications.
- **Torsion device:** This specialized equipment is used to test the cable’s resistance totorsion. Testing cables in this configuration evaluate how they handle dynamic loads associated with torsion.
- **Device for testing cable strength through alternate passage over rollers:** This specialized device simulates various loading scenarios that cables may encounter in mobile applications. These tests allow for assessing the cable’s durability under cyclic loads related to the movement of devices.

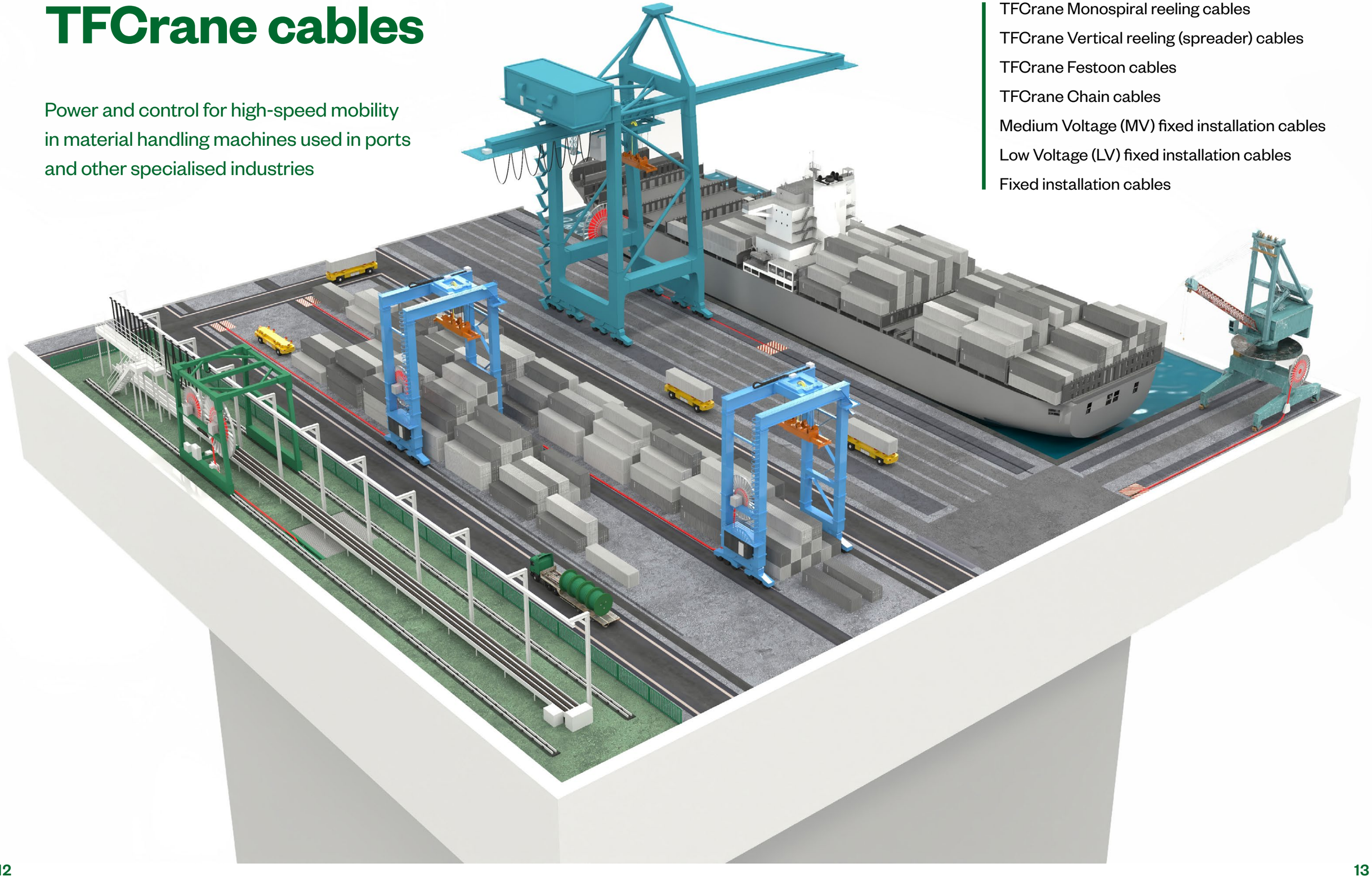
TFCrane cables. thanks to the establishment of The Laboratory of Extra High-Speed Cables. are continuously improved to enhance their properties and operating parameters, including working speed and the range of their usability in low temperatures.

“TFCrane cables are constantly being developed at high speed.”

TFCrane cables

Power and control for high-speed mobility in material handling machines used in ports and other specialised industries

- TFCrane Monospiral reeling cables
- TFCrane Vertical reeling (spreader) cables
- TFCrane Festoon cables
- TFCrane Chain cables
- Medium Voltage (MV) fixed installation cables
- Low Voltage (LV) fixed installation cables
- Fixed installation cables



APPLICATION

	Max speed m/min	Rated Voltage	Monospiral Drum	Vertical Drum	Festoon	Drag chain
TFCrane NSHTÖU-J/O	250*	0.6/ 1kV				
TFCrane (N)SHTÖU-J + FO	250	0.6/ 1kV				
TFCrane R-(N)TSCGEWÖU	180	3.6/6 kV - 12/20 kV				
TFCrane R-(N)TSCGEWÖU + FO	180	3.6/6 kV - 12/20 kV				
TFCrane R-(N)TSKCGEWÖU	180	3.6/6 kV - 12/20 kV				
TFCrane R-(N)TSKCGEWÖU + FO	180	3.6/6 kV - 12/20 kV				
TFCrane (N)SHTÖU-J/O VR	250*	0.6/1 kV				
TFCrane (N)SHTÖU-J/O VR S	100	0.6/1 kV				
TFCrane (N)GRDGÖU-J/O Festoon	250*	0.6/1 kV				
TFCrane (N)GRDGCGÖU-J/O Festoon	250*	0.6/1 kV				
TFCrane FOMFLEX Festoon	250*	0.6/1 kV				
TFCrane NGFLCGÖU-J/O	250*	300/500 V				
TFCrane (N)GFLGÖU-J/O	250*	300/500 V				
TFCrane (N)GRDGÖU-J/O Chain	250	0.6/1 kV				
TFCrane (N)GRDGCGÖU-J/O Chain	250	0.6/1 kV				
TFCrane FOMFLEX	250	-				

This parameter depends on the product scope.

main application
suitable
no application

ADDITIONAL PARAMETS

	Rated Voltage	Test Voltage (kV)	Max. working temperature On The Conductor (°C)	Short Circuit Temperature (°C)	Oil Resistance	Ozone Resistance	UV Resistanc	Flame resistance
TFCrane NSHTÖU-J/O	0.6/1 kV	AC/5min: 3 kV	90	250	V	V	V	PN - EN 60332-1-2:2010 IEC 60332-1-2:2010
TFCrane (N)SHTÖU-J + FO	0.6/1 kV	AC/5min: 3 kV	90	250	V	V	V	PN - EN 60332-1-2:2010 IEC 60332-1-2:2010
TFCrane R-(N)TSCGEWÖU	3.6/6 kV 6/10 kV 8.7/15 kV 12/20 kV	AC/5min: 3 kV	90	250	V	V	V	PN - EN 60332-1-2:2010 IEC 60332-1-2:2010
TFCrane R-(N)TSCGEWÖU + FO	3.6/6 kV 6/10 kV 8.7/15 kV 12/20 kV	AC/5 min: 3.6/6 kV - 11 kV 6/10 kV - 17 kV 8.7/15 kV - 24 kV 12/20 kV- 29 kV	90	250	V	V	V	PN - EN 60332-1-2:2010 IEC 60332-1-2:2010
TFCrane R-(N)TSKCGEWÖU	3.6/6 kV 6/10 kV 8.7/15 kV 12/20 kV	AC/5 min: 3.6/6 kV - 11 kV 6/10 kV - 17 kV 8.7/15 kV - 24 kV 12/20 kV - 29 kV	90	250	V	V	V	PN - EN 60332-1-2:2010 IEC 60332-1-2:2010
TFCrane R-(N)TSKCGEWÖU + FO	3.6/6 kV 6/10 kV 8.7/15 kV 12/20 kV	AC/5 min: 3.6/6 kV - 11 kV 6/10 kV - 17 kV 8.7/15 kV - 24 kV 12/20 kV- 29 kV	90	250	V	V	V	PN - EN 60332-1-2:2010 IEC 60332-1-2:2010
TFCrane (N)SHTÖU-J/O VR	0.6/1 kV	AC/5 min: 3 kV	90	250	V	V	V	PN - EN 60332-1-2:2010 IEC 60332-1-2:2010
TFCrane (N)SHTÖU-J/O VR S	0.6/1 kV	AC/5 min: 3 kV	90	250	V	V	V	PN - EN 60332-1-2:2010 IEC 60332-1-2:2010
TFCrane (N)GRDGÖU-J/O	0.6/1 kV	AC/5 min: 3 kV	90	250	V	V	V	PN - EN 60332-1-2:2010 IEC 60332-1-2:2010
TFCrane (N)GRDGCGÖU-J/O	0.6/1 kV	AC/5 min: 3 kV	90	250	V	V	V	PN - EN 60332-1-2:2010 IEC 60332-1-2:2010
TFCrane NGFLGÖU-J/O	300/500 V	AC/5 min: 2.5 kV	90	250	V	V	V	PN - EN 60332-1-2:2010 IEC 60332-1-2:2010
TFCrane (N)GFLCGÖU-J/O	300/500 V	AC/5 min: 2.5 kV	90	250	V	V	V	PN - EN 60332-1-2:2010 IEC 60332-1-2:2010
TFCrane FOMFLEX	N/A	N/A	N/A	N/A	V	V	V	PN - EN 60332-1-2:2010 IEC 60332-1-2:2010

Reeling Cable - 0.6/1 kV

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TFCrane NSHTÖU-J/O

DIN VDE 0250-814 VDE MARKS APPROVAL

— Low Voltage Rubber Flexible Cable for Reeling Applications
— Upon request, weights and diameters may be individually adjusted based on end-use applications or customer requirements.

Applications: Flexible cable designed for high mechanical stresses. especially for applications with frequent winding and unwinding with co-occurrent tensile and torsion stress. The cable is used for conveyors, container cranes, harbour cranes, building machinery, handling machines in mining and tunnelling equipment. For use in wet or dry conditions, in industrial units, in underground and open-cast mining. in explosion-risk areas.

Construction

Conductors	Flexible stranded annealed tin coated copper conductor class 5 to IEC 60228
Separator	If needed a suitable tape separator between the conductor and insulation
Insulation	EPDM rubber, halogen-free, lead-free compound, type 3GI3 acc. to DIN VDE 0207/20, developed by TFKable
Circuit identification	Colour coding of power conductors compliant to HD 308. DIN VDE 0293- 308 **-J version:** 3 - core: Green-yellow, blue, brown 4 - core: Green-yellow, brown, black, grey or green-yellow, blue, brown, black 5 - core: Green-yellow, blue, brown black, grey Above 5 cores: Green-yellow, other cores black with white numbering **-O version:** 3 - core: Brown, black, grey or blue, brown, black 4 - core: Blue, brown, black, grey 5 - core: Blue, brown, black, grey, black Above 5 cores: Black with white numbering
Inner sheath	A synthetic thermosetting compound type Gm1b acc. to DIN VDE 0207/21
Color of inner sheath	Black
Anti-torsion braid	Braid of polyamide threads between inner and outer sheath
Outer sheath	Designed by TFKable, synthetic thermosetting compound, type 5GM3 acc. to DIN VDE 0207/21
Colour of outer jacket	Black

** This parameter depends on the product scope.*

Characteristics

Rated Voltage U_0/U	0.6/1 kV
Max. operating voltage Um	1.2 kV
AC test voltage	3 kV
Current carrying capacity	DIN VDE 0298-4
Max. conductor operating temperature	+90°C
Max. conductor temperature during short circuit	+250°C
Minimum ambient temperature for fixed installation	-40°C
Minimum ambient temperature for mobile installation	-35°C

Minimum bending radius acc. to DIN VDE 0298-3:

OD of cable[mm]	>8 ≤ 12	>12≤ 20	>20
Fixed installation	3D	4D	4D
On drums	5D	5D	5D
On deflection pulleys	7.5D	7.5D	7.5D
Moving freely	4D	5D	5D
Twist limits	25°/m		
Travel speed up to	180m/min		
Tensile load	20N/mm²		
Flame propagation	PN-EN 60332-1-2, IEC 60332-1-2		
Oil resistant	PN-EN 60811-404, IEC 60811-404		
UV resistant	UL 2556, ISO 4892-2		
Ozone resistant	PN-ISO 1431-1		

Example of standard sheath marking: <VDE> TFKABLE 3 CE NSHTÖU-J 3x10 0.6/1 kV year + meter TFCrane

Parameters

Number of cores x cross-section	Conductor diameter	Approx. overall diameter	Approx. weight	Max. tensile load
mm²	**mm**	**mm**	**kg/km**	**N**
3x1.5	1.5	11.9	201	90
3x2.5	2.1	13.5	268	150
3x4	2.7	16.9	412	240
3x6	3.2	18.0	500	360
3x10	4.2	21.8	758	600
3x16	5.3	24.3	1022	960
3x25	6.6	28.8	1477	1500
3x35	7.8	32.9	1976	2100
3x50	9.6	38.9	2802	3000
3x70	11.4	42.7	3625	4200
3x95	13.0	48.8	4744	5700
3x120	14.7	52.5	5718	7200
3x150	16.5	57.2	6954	9000
3x185	18.3	63.8	8571	11100
3x240	20.9	72.0	11104	14400
4x1.5	1.5	12.7	234	120
4x2.5	2.1	15.7	359	200
4x4	2.7	18.1	489	320
4x6	3.2	19.4	599	480
4x10	4.2	23.5	918	800
4x16	5.3	27.3	1320	1280
4x25	6.6	32.7	1926	2000
4x35	7.8	35.7	2439	2800
4x50	9.6	42.2	3468	4000
4x70	11.4	46.5	4524	5600
4x95	13.0	53.1	5922	7600
4x120	14.7	59.0	7413	9600
4x150	16.5	64.4	9019	12000
4x185	18.3	71.5	11073	14800
5x1.5	1.5	13.6	272	150
5x2.5	2.1	16.8	417	250
5x4	2.7	19.5	575	400

Parameters

Number of cores x cross-section	Conductor diameter	Approx. overall diameter	Approx. weight	Max. tensile load
mm²	**mm**	**mm**	**kg/km**	**N**
5x6	3.2	21.8	750	600
5x10	4.2	25.5	1098	1000
5x16	5.3	29.6	1579	1600
5x25	6.6	35.5	2310	2500
5x35	7.8	40.2	3073	3500
5x50	9.6	45.9	4196	5000
5x70	11.4	52.5	5720	7000
7x1.5	1.5	16.9	406	210
7x2.5	2.1	19.4	553	350
7x4	2.7	23.5	817	560
12x1.5	1.5	22.6	710	360
12x2.5	2.1	26.2	989	600
12x4	2.7	32.1	1484	960
18x1.5	1.5	24.9	855	540
18x2.5	2.1	30.1	1274	900
18x4	2.7	37.1	1932	1440
24x1.5	1.5	25.9	1011	720
24x2.5	2.1	31.3	1521	1200
30x1.5	1.5	29.8	1309	900
30x2.5	2.1	36.3	1988	1500
36x1.5	1.5	32.4	1470	1080
36x2.5	2.1	39.4	2230	1800
42x1.5	1.5	34.8	1747	1260
42x2.5	2.1	42.0	2632	2100
44x1.5	1.5	34.8	1781	1320
44x2.5	2.1	42.0	2712	2200
50x1.5	1.5	36.7	2035	1500
50x2.5	2.1	44.4	3070	2500
56x2.5	2.1	47.1	3384	2800

Standard length cable packing: 500 m on drums. Other forms of packing and delivery are available on request

TFCrane NSHTÖU-J 3xCS + 3xCS/3 CS-abbreviation of cross-section

DIN VDE 0250-814 VDE MARKS APPROVAL

— Low Voltage Rubber Flexible Cable for Reeling Applications
— Upon request, weights and diameters may be individually adjusted based on end-use applications or customer requirements.

Applications: Special designed flexible cable for power mobile connections, for extremely high mechanical stresses. The cable is used in cable winding reels winding and unwinding with co-occurrent tensile and torsion stress. The cable is used for conveyors, container cranes, harbour cranes, building machinery, handling machines. Usable in wet or dry conditions, in industrial units, in underground and opencast mining, in explosion-risk areas.

Construction

Conductors	Flexible stranded annealed tin coated copper conductor class 5 to IEC 60228
Separator	If needed a suitable tape separator between the conductor and insulation.
Insulation	EPDM rubber, halogen-free, lead-free compound. type 3GI3 acc. to DIN VDE 0207/20, developed by TFKable
Color of insulation*	Colour coding of power conductors compliant to HD 308. DIN VDE 0293- 308 Power cores: 3-core circuit identification: Brown, black, grey Earth cores: Green-yellow
Earth conductor	Rubber insulated, tin coated copper conductor
Core arrangement	Three power cores. earth conductor splitted into 3 parts and placed into the interstices
Inner sheath	A synthetic thermosetting compound type Gm1b acc. to DIN VDE 0207/21
Color of inner sheath	Black
Anti-torsion braid	Braid of polyamide threads between inner and outer sheath
Outer sheath	Designed by TFKable, synthetic thermosetting compound, type 5GM3 acc. to DIN VDE 0207/21
Colour of outer jacket	Black

Characteristics

Rated Voltage U_0/U	0.6/1 kV
Max. operating voltage Um	1.2 kV
AC test voltage	3 kV

Characteristics

Current carrying capacity	DIN VDE 0298-4
Max. conductor operating temperature +90°C	+90°C
Max. conductor temperature during short circuit +250°C	+250°C
Minimum ambient temperature for fixed installation -40°C	-40°C
Minimum ambient temperature for mobile installation	-25°C

Minimum bending radius acc. to DIN VDE 0298-3:

OD of cable[mm]	>8 ≤ 12	>12≤ 20	7.5D
Fixed installation	3D	4D	4D
On drums	5D	5D	5D
On deflection pulleys	7.5D	7.5D	7.5D
Moving freely	4D	5D	5D
Twist limits	25°/m		
Travel speed up to	250m/min		
Tensile load	20N/mm^2		
Flame propagation	PN-EN 60332-1-2, IEC 60332-1-2		
Oil resistant	PN-EN 60811-404, IEC 60811-404		
UV resistant	UL 2556, ISO 4892-2		
Ozone resistant	PN-ISO 1431-1		

Example of standard sheath marking: <VDE> TFKABLE 3 CE NSHTÖU-J 3x70+3x35/3 0.6/1 kV year + meter

Parameters

Number of cores x cross-section	Conductor diameter	Approx. overall diameter	Approx. weight	Max. tensile load
mm²	**mm**	**mm**	**kg/km**	**N**
3x35+3x16/3	7.8	32.9	2164	2100
3x50+3x25/3	9.6	38.9	3084	3000
3x70+3x35/3	11.4	42.7	4007	4200
3x95+3x50/3	13.0	48.8	5275	5700
3x120+3x70/3	14.7	52.5	6437	7200
3x150+3x70/3	16.5	57.2	7718	9000
3x185+3x95/3	18.3	63.8	9578	11100
3x240+3x120/3	20.9	72.0	12379	14400
3x300+3x150/3	23.5	78.5	13993	18000

Standard length cable packing: 500 m on drums. Other forms of packing and delivery are available on request

TFCrane (N)SHTÖU-J

3xCS + 2xCS/2 + FO CS-abbreviation of cross-section

Based on: DIN VDE 0250-814

— Low Voltage Rubber Flexible Cable with Integrated Fiber-Optics for Reeling
— Upon request, weights and diameters may be individually adjusted based on end-use applications or customer requirements.

Applications: Flexible cable designed for high mechanical stresses, especially for applications with frequent winding and unwinding with co-occurrent tensile and torsion stress. The cable is used for conveyors, container cranes, harbour cranes, building machinery, handling machines in mining and tunnelling equipment. For use in wet or dry conditions, in industrial units, in underground and open-cast mining, in explosion-risk areas. Tear, impact and abrasion resistant jacket.

Construction

Conductors	Flexible stranded annealed tin coated or bare copper conductor class 5 to IEC 60228
Separator	If needed a suitable tape separator between the conductor and insulation
Insulation	EPDM rubber, halogen-free, lead-free compound, type 3GI3 acc. to DIN VDE 0207/20, developed by TFKable
Color of insulation*	Colour coding of power conductors compliant to HD 308. DIN VDE 0293- 308 Power cores: 3-core circuit identification: Brown, black, grey Earth cores: Green-yellow
Earth conductor	Rubber insulated, tin coated or bare copper conductor
Fiber Optic Modulus Identification of the fibers Fiber covering	A-D(ZN)13Y 6, 12, 18 or 24 fibers G50/125, G62,5/125 or E9/125 Color coding of the fibers and buffering tubes Buffering tube with filling compound
Core arrangement	Three power cores twisted togethe, earth conductor split into 2 parts and FO placed into the interstices
Inner sheath	A special synthetic thermosetting compound type 5GM3 acc. to DIN VDE 0207/21
Color of inner sheath	Yellow
Anti-torsion braid	Braid of polyamide threads between internal and outer layer of sheath
Outer layer of sheath	Special designed by TFKable, synthetic thermosetting compound, 5GM5 quality acc. to DIN VDE 0207/21
Colour of outer jacket	Yellow

**other identification available on request*

Characteristics

Rated Voltage U_0/U	0.6/1 kV
Max. operating voltage Um	1.2 kV
AC test voltage	3 kV
Current carrying capacity	DIN VDE 0298-4
Max. conductor operating temperature	+90°C
Max. conductor temperature during short circuit	+250°C
Minimum ambient temperature for fixed installation	-40°C
Minimum ambient temperature for mobile installation	-25°C

Minimum bending radius acc. to DIN VDE 0298-3:

OD of cable[mm]	>8 ≤ 12	>12≤ 20	>20
Fixed installation	3D	4D	4D
On drums	5D	5D	5D
On deflection pulleys	7.5D	7.5D	7.5D
Moving freely	4D	5D	5D
Twist limits	50 °/m		
Travel speed up to	250m/min		
Tensile load	20N/mm²		
Flame propagation	PN-EN 60332-1-2, IEC 60332-1-2		
Oil resistant	PN-EN 60811-404, IEC 60811-404		
UV resistant	UL 2556, ISO 4892-2		
Ozone resistant	PN-ISO 1431-1		

Example of standard sheath marking: TFKABLE 3 TFCrane CE (N)SHTÖU-J 3x35+2x16/2+FO 0.6/1 kV year + meter

Parameters

Number of cores x cross-section	Conductor diameter	Approx. overall diameter	Approx. weight	Max. tensile load
mm²	**mm**	**mm**	**kg/km**	**N**
3x35+2x16/2+FO	7.8	42.0	2918	2100
3x50+2x25/2+FO	9.6	42.3	3322	3000
3x70+2x35/2+FO	11.4	46.2	4275	4200
3x95+2x50/2+FO	13.0	49.6	5255	5700
3x120+2x70/2+FO	14.7	57.7	6986	7200
3x150+2x70/2+FO	16.5	58.1	7702	9000
3x185+2x95/2+FO	18.3	66.8	9856	11100
3x240+2x120/2+FO	20.9	73.2	12380	14400

Standard length cable packing: 500 m on drums. Other forms of packing and delivery are available on request

Fiber data

Parameter	G50/125 multimode	G62.5/125 multimode	E9/125 singlemode
Attenuation at 850 nm	≤3.0 dB/km	≤3.5 dB/km	–
Attenuation at 1300 nm	≤1.0 dB/km	≤1.0 dB/km	–
Attenuation at 1310 nm	–	–	≤0.4 dB/km
Attenuation at 1550 nm	–	–	≤0.25 dB/km
Bandwidth at 850 nm	≥500 MHz*km	≥200 MHz*km	–
Bandwidth at 1300 nm	≥500 MHz*km	≥500 MHz*km	–
Numerical Aperture at 850 nm	0.200 ±0.015	0.275 ±0.015	–
Group refractive index at 850 nm	1.482	1.496	–
Group refractive index at 1300 nm	1.477	1.491	–
Group refractive index at 1310 nm	–	–	1.466
Group refractive index at 1550 nm	–	–	1.467

Reeling Cable -

3.6/6 kV, 6/10 kV, 8.7/15 kV, 12/20 kV

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UV

I

180 m/min

MIN −25°C

MAX+90°C

O3

Insulation Pb Free

TFCrane R-(N)TSCGEWÖU

Based on: DIN VDE 0250-813

— Medium Voltage Flexible Cable for Reeling Applications
— Upon request, weights and diameters may be individually adjusted based on end-use applications or customer requirements.

Applications: Specially designed flexible reeling cable with optimised dimensions for extremely high mechanical stresses occur in applications with monospiral reels and cylindrical reels, very high reeling speed, torsional stress. Also for connection of large material handling machines such as excavators, dumpers, crushers in open-cast mines. For use in wet or dry conditions, in industrial units, in underground and open-cast mining, in explosion-risk areas. Excellent tear, impact and abrasion resistant.

Construction

Conductors	Flexible stranded annealed tin coated or bare copper conductor class 5 to IEC 60228
Separator	Wrap of semi-conductive tape between the power conductor and insulation and between earth conductor and semi-conductive layer
Conductor screen	Semi-conductive layer of special rubber, developed by TFKable
Color of insulation	White
Insulation screen	Semi-conductive. special strippable layer over insulation of power cores. Maximum resistivity of semi-conductive layers -200 [Ω x m]
Earth conductor	Tin coated or bare copper conductor class 5 to IEC 60228 with extruded special semi-conductive rubber compound
Core arrangement	Power cores and earth conductor split into 3 parts laid up around conductive filler in the centre. Antiadhesion graphite over assembled cores
Inner sheath	A special synthetic thermosetting compound type 5GM3 acc. to DIN VDE 0207/21
Color of inner sheath	Red
Anti-torsion braid	Braid of polyamide threads between internal and outer layer of sheath
Outer sheath	Special designed by TFKable, synthetic thermosetting compound, 5GM5 quality acc. to DIN VDE 0207/21
Colour of outer jacket	Red

Characteristics

Rated Voltage U_0/U	3.6/6 kV	6/10 kV	8.7/15 kV	12/20 kV
Max. operating voltage Um	7.2 kV	12 kV	18 kV	24 kV
AC test voltage	11 kV	17 kV	24 kV	29 kV
Partial discharge	$1.25U_0$/max 20 pC			

Characteristics

Current carrying capacity	DIN VDE 0298-4
Max. conductor operating temperature	+90°C
Max. conductor temperature during short circuit	+250°C
Minimum ambient temperature for fixed installation	-40°C
Minimum ambient temperature for mobile installation	-25°C

Minimum bending radius acc. to DIN VDE 0298-3:

Fixed installation	6xD
On drums	12xD
On deflection pulleys	15xD
Moving freely	10xD
Twist limits	100°/m
Travel speed up to	180m/min
Tensile load	20N/mm²
Flame propagation	PN-EN 60332-1-2, IEC 60332-1-2
Oil resistant	PN-EN 60811-404, IEC 60811-404
UV resistant	UL 2556, ISO 4892-2
Ozone resistant	PN-ISO 1431-1

Example of standard sheath marking: TFKABLE 3 TFCrane R-(N)TSCGEWÖU 3x50+3x25/3 6/10 kV year + meter

Parameters

Number of cores x cross-section	Conductor diameter	Overall diameter	Approx. weight	Max. tensile load
mm²	**mm**	**mm**	**kg/km**	**N**
3.6/6 kV				
3x25+3x25/3	6.6	39.9	2438	1500
3x35+3x25/3	7.8	42.5	2881	2100
3x50+3x25/3	9.4	46.0	3527	3000
3x70+3x35/3	11.2	51.7	4726	4200
3x95+3x50/3	12.9	55.4	5704	5700
3x120+3x70/3	14.7	59.3	6917	7200
3x150+3x70/3	16.4	64.7	8286	9000
3x185+3x95/3	18.0	68.2	9662	11100
6/10 kV				
3x25+3x25/3	6.6	41.6	2589	1500
3x35+3x25/3	7.8	44.2	3041	2100
3x50+3x25/3	9.4	47.7	3703	3000
3x70+3x35/3	11.2	53.4	4922	4200
3x95+3x50/3	12.9	57.1	5911	5700
3x120+3x70/3	14.7	61.0	7138	7200
3x150+3x70/3	16.4	66.4	8528	9000
3x185+3x95/3	18.0	69.9	9916	11100
8.7/15 kV				
3x25+3x25/3	6.6	45.1	2912	1500
3x35+3x25/3	7.8	47.7	3378	2100
3x50+3x25/3	9.4	52.9	4288	3000
3x70+3x35/3	11.2	56.9	5332	4200
3x95+3x50/3	12.9	60.6	6348	5700
3x120+3x70/3	14.7	66.2	7877	7200
3x150+3x70/3	16.4	69.9	9029	9000
3x185+3x95/3	18.0	75.1	10759	11100
12/20 kV				
3x25+3x25/3	6.6	48.1	3209	1500
3x35+3x25/3	7.8	52.5	3912	2100
3x50+3x25/3	9.4	55.9	4636	3000
3x70+3x35/3	11.2	59.9	5646	4200
3x95+3x50/3	12.9	65.4	7020	5700
3x120+3x70/3	14.7	69.3	8316	7200
3x150+3x70/3	16.4	72.9	9486	9000

Standard length cable packing: 500 m on drums. Other forms of packing and delivery are available on request

TFCrane R-(N)TSCGEWÖU + FO

Based on: DIN VDE 0250-813

— Medium Voltage Flexible Reeling Cable with Integrated Fiber-Optics
— Upon request, weights and diameters may be individually adjusted based on end-use applications or customer requirements.

Applications: Specially designed flexible reeling cable with reduced dimensions for extremely high mechanical stresses occur in applications with mono spiral reels and cylindrical reels, very high reeling speed, torsional stress. Also for connection of large material handling machines such as excavators, dumpers, crushers in opencast mines. Usable in wet or dry conditions, in industrial units, in underground and opencast mining, in explosion-risk areas.

Construction

Conductors	Flexible stranded annealed tin coated or bare copper conductor class 5 to IEC 60228
Separator	Wrap of semi-conductive tape between the power conductor and insulation and between earth conductor and semi-conductive layer
Conductor screen	Semi-conductive layer of special rubber, developed by TFKable
Color of insulation	White
Insulation screen	Semi-conductive. special strippable layer over insulation of power cores. Maximum resistivity of semi-conductive layers -200 [Ω x m]
Earth conductor	Tin coated or bare copper conductor class 5 to IEC 60228 with extruded special semiconducting rubber compound
Fiber Optic Modulus	A-D(ZN)13Y 6, 12, 18 or 24 fibers G50/125, G62,5/125 or E9/125
Identification of the fibers	color coded fibres and tubes
Fiber covering	Buffering tube with filling compound
Core arrangement	Power cores, earth conductor split into 2 parts and FO laid up around conductive filler in the centre. Anty-adhesion graphite over assembled cores
Inner sheath	A special synthetic thermosetting compound type 5GM3 acc. to DIN VDE 0207/21
Color of inner sheath	Red
Anti-torsion braid	Braid of polyamide threads between internal and outer layer of sheath
Outer sheath	Special synthetic thermosetting compound, 5GM5 quality acc. to DIN VDE 0207/21 developed by TFKable
Colour of outer jacket	Red

Characteristics

Rated Voltage U_0/U	3.6/6 kV	6/10 kV	8.7/15 kV	12/20 kV
Max. operating voltage Um	7.2 kV	12 kV	18 kV	24 kV
AC test voltage	11 kV	17 kV	24 kV	29 kV
Partial discharge	$1.25U_0$/max 20 pC			

Characteristics

Current carrying capacity	DIN VDE 0298-4
Max. conductor operating temperature	+90°C
Max. conductor temperature during short circuit	+250°C
Minimum ambient temperature for fixed installation	-40°C
Minimum ambient temperature for mobile installation	-25°C

Minimum bending radius acc. to DIN VDE 0298-3:

Fixed installation	6xD
On drums	12xD
On deflection pulleys	15xD
Moving freely	10xD
Twist limits	100°/m
Travel speed up to	180m/min
Tensile load	20N/mm²
Flame propagation	PN-EN 60332-1-2, IEC 60332-1-2
Oil resistant	PN-EN 60811-404, IEC 60811-404
UV resistant	UL 2556, ISO 4892-2
Ozone resistant	PN-ISO 1431-1

Example of standard sheath marking: TFKABLE 3 TFCrane R-(N)TSCGEWÖU 3x35+2x25/2+12FO 6/10 kV year + meter

Parameters

Number of cores x cross-section	Conductor diameter	Overall diameter	Approx. weight	Max. tensile load
mm²	**mm**	**mm**	**kg/km**	**N**
3.6/6 kV				
3x25+2x25/2+FO	6.6	39.9	2447	1500
3x35+2x25/2+FO	7.8	42.5	2891	2100
3x50+2x25/2+FO	9.4	46.0	3546	3000
3x70+2x35/2+FO	11.2	51.7	4701	4200
3x95+2x50/2+FO	12.9	55.4	5731	5700
3x120+2x70/2+FO	14.7	59.3	6963	7200
3x150+2x70/2+FO	16.4	64.7	8341	9000
3x185+2x95/2+FO	18.0	68.2	9713	11100
3x240+2x120/2+FO	20.7	75.8	12392	14400
6/10 kV				
3x25+2x25/2+FO	6.6	41.6	2600	1500
3x35+2x25/2+FO	7.8	44.2	3054	2100
3x50+2x25/2+FO	9.4	47.7	3721	3000
3x70+2x35/2+FO	11.2	53.4	4899	4200
3x95+2x50/2+FO	12.9	57.1	5942	5700
3x120+2x70/2+FO	14.7	61.0	7188	7200
3x150+2x70/2+FO	16.4	66.4	8586	9000
3x185+2x95/2+FO	18.0	69.9	9972	11100
8.7/15 kV				
3x25+2x25/2+FO	6.6	45.1	2925	1500
3x35+2x25/2+FO	7.8	47.7	3398	2100
3x50+2x25/2+FO	9.4	52.9	4316	3000
3x70+2x35/2+FO	11.2	56.9	5315	4200
3x95+2x50/2+FO	12.9	60.6	6382	5700
3x120+2x70/2+FO	14.7	66.2	7936	7200
3x150+2x70/2+FO	16.4	69.9	9096	9000
3x185+2x95/2+FO	18.0	75.1	10825	11100
12/20 kV				
3x25+2x25/2+FO	6.6	48.1	3232	1500
3x35+2x25/2+FO	7.8	52.5	3941	2100
3x50+2x25/2+FO	9.4	55.9	4672	3000
3x70+2x35/2+FO	11.2	59.9	5696	4200

Parameters

Number of cores x cross-section	Conductor diameter	Overall diameter	Approx. weight	Max. tensile load
mm²	**mm**	**mm**	**kg/km**	**N**
3x95+2x50/2+FO	12.9	65.4	7065	5700
3x120+2x70/2+FO	14.7	69.3	8381	7200
3x150+2x70/2+FO	16.4	72.9	9566	9000
3x185+2x95/2+FO	18.0	78.2	11329	11100

Standard length cable packing: 500 m on drums. Other forms of packing and delivery are available on request

Fiber data

Parameter	G50/125 multimode	G62.5/125 multimode	E9/125 singlemode
Attenuation at 850 nm	≤3.0 dB/km	≤3.5 dB/km	–
Attenuation at 1300 nm	≤1.0 dB/km	≤1.0 dB/km	–
Attenuation at 1310 nm	–	–	≤0.4 dB/km
Attenuation at 1550 nm	–	–-	≤0.25 dB/km
Bandwidth at 850 nm	≥500 MHz*km	≥200 MHz*km	–
Bandwidth at 1300 nm	≥500 MHz*km	≥500 MHz*km	–
Numerical Aperture at 850 nm	0.200 ±0.015	0.275 ±0.015	–
Group refractive index at 850 nm	1.482	1.496	–
Group refractive index at 1300 nm	1.477	1.491	–
Group refractive index at 1310 nm	–	–	1.466
Group refractive index at 1550 nm	–	–	1.467

TFCrane R-(N)TSKCGEWÖU

Based on: DIN VDE 0250-813

— Medium Voltage Flexible Reeling Cable with Cradle Separator
— Upon request, weights and diameters may be individually adjusted based on end-use applications or customer requirements.

Applications: Specially designed flexible reeling cable with reduced dimensions for high mechanical stresses occur in applications with mono spiral reels and cylindrical reels, extreme high reeling speed, torsional stress. Also for connection of large material handling machines such as excavators, dumpers, crushers in opencast mines. Usable in wet or dry conditions, in industrial units, in underground and opencast mining, in explosion-risk areas. Excellent tear, impact and abrasion resistant.

Construction

Conductors	Flexible stranded annealed tin coated or bare copper conductor class 5 to IEC 60228
Separator	Wrap of semi-conductive tape between the power conductor and insulation and between earth conductor and semi-conductive layer
Conductor screen	Semi-conductive layer of special rubber, developed by TFKable
Insulation	Special EPDM rubber, halogen-free, lead-free compound, exceeding type 3GI3, developed by TFKable
Color of insulation	White
Insulation screen	Semi-conductive, special strippable layer over insulation of power cores. Maximum resistivity of semi-conductive layers -200 [Ω x m]
Earth conductor	Tin coated or bare copper conductor class 5 to IEC 60228 with extruded special semi-conductive rubber compound
Core arrangement	Power cores, earth conductor split into 2 parts and FO laid up around conductive filler in the centre. Anty-adhesion graphite over assembled cores
Inner sheath	A special synthetic thermosetting compound type 5GM3 acc. to DIN VDE 0207/21
Color of inner sheath	Red
Anti-torsion braid	Braid of polyamide threads between internal and outer layer of sheath
Outer sheath	Special synthetic thermosetting compound, 5GM5 quality acc. to DIN VDE 0207/21 developed by TFKable
Colour of outer jacket	Red

Characteristics

Rated Voltage U_0/U	3.6/6 kV	6/10 kV	8.7/15 kV	12/20 kV	14/25 kV
Max. operating voltage Um	7.2 kV	12 kV	18 kV	24 kV	30 kV
AC test voltage	11 kV	17 kV	24 kV	29 kV	36 kV
Partial discharge	$1.25U_0$/max 20 pC				

Characteristics

Current carrying capacity	DIN VDE 0298-4
Max. conductor operating temperature +90°C	+90°C
Max. conductor temperature during short circuit +250°C	+250°C
Minimum ambient temperature for fixed installation -40°C	-40°C
Minimum ambient temperature for mobile installation	-25°C

Minimum bending radius acc. to DIN VDE 0298-3:

Fixed installation	6xD
On drums	12xD
On deflection pulleys	15xD
Moving freely	10xD
Twist limits	25°/m
Travel speed up to	180m/min (Speeds above 180m/min to be consulted with manufacturer)
Tensile load	See table (Increased tensile load due to additional support element)
Flame propagation	PN-EN 60332-1-2, IEC 60332-1-2
Oil resistant	PN-EN 60811-404, IEC 60811-404
UV resistant	UL 2556, ISO 4892-2
Ozone resistant	PN-ISO 1431-1

Example of standard sheath marking: TFKABLE 3 TFCrane R-(N)TSKCGEWÖU 3x50+3x25/3 6/10 kV year + meter

Parameters

Number of cores x cross-section	Conductor diameter	Overall diameter	Approx. weight	Max. tensile load
mm²	**mm**	**mm**	**kg/km**	**N**
3.6/6 kV				
3x25+3x25/3	6.6	41.6	2571	2205
3x35+3x25/3	7.8	44.2	3020	2955
3x50+3x25/3	9.4	48.3	3705	4080
3x70+3x35/3	11.2	54.0	4936	5580
3x95+3x50/3	12.9	57.7	5939	8125
3x120+3x70/3	14.7	63.9	7482	10000
3x150+3x70/3	16.4	67.6	8616	12250
3x185+3x95/3	18.0	71.1	10013	14875
6/10 kV				
3x25+3x25/3	6.6	43.4	2749	2205
3x35+3x25/3	7.8	45.9	3187	2955
3x50+3x25/3	9.4	51.8	4114	4080
3x70+3x35/3	11.2	55.8	5140	5580
3x95+3x50/3	12.9	59.4	6154	8125
3x120+3x70/3	14.7	65.7	7720	10000
3x150+3x70/3	16.4	69.3	8868	12250
3x185+3x95/3	18.0	72.8	10277	14875
8.7/15 kV				
3x25+3x25/3	6.6	46.8	3061	2205
3x35+3x25/3	7.8	49.4	3538	2955
3x50+3x25/3	9.4	55.2	4508	4080
3x70+3x35/3	11.2	59.2	5567	5580
3x95+3x50/3	12.9	64.7	6893	8125
3x120+3x70/3	14.7	69.1	8215	10000
3x150+3x70/3	16.4	72.8	9390	12250
3x185+3x95/3	18.0	78.0	11167	14875
12/20 kV				
3x25+3x25/3	6.6	51.6	3596	2205
3x35+3x25/3	7.8	54.2	4100	2955
3x50+3x25/3	9.4	58.3	4871	4080
3x70+3x35/3	11.2	64.0	6244	5580

Parameters

Number of cores x cross-section	Conductor diameter	Overall diameter	Approx. weight	Max. tensile load
mm²	**mm**	**mm**	**kg/km**	**N**
3x95+3x50/3	12.9	67.7	7318	8125
3x120+3x70/3	14.7	72.1	8671	10000
3x150+3x70/3	16.4	77.6	10205	12250
3x185+3x95/3	18.0	81.0	11677	14875
14/25 kV				
3x25+3x25/3	6.6	55.5	4043	2205
3x35+3x25/3	7.8	58.1	4570	2955
3x50+3x25/3	9.4	63.9	5652	4080
3x70+3x35/3	11.2	67.9	6796	5580
3x95+3x50/3	12.9	71.6	7895	8125
3x120+3x70/3	14.7	77.8	9622	10000
3x150+3x70/3	16.4	81.5	10868	12250
3x185+3x95/3	18.0	86.7	12744	14875

Standard length cable packing: 500 m on drums. Other forms of packing and delivery are available on request

TFCrane R-(N)TSKCGEWÖU + FO

Based on: DIN VDE 0250-813

— Medium Voltage Flexible Reeling Cable with Cradle Separator and Integrated Fiber-Optics
— Upon request, weights and diameters may be individually adjusted based on end-use applications or customer requirements.

Applications: Specially designed flexible reeling cable with reduced dimensions for high mechanical stresses occur in applications with mono spiral reels and cylindrical reels, extreme high reeling speed, torsional stress. Also for connection of large material handling machines such as excavators, dumpers, crushers in opencast mines. Usable in wet or dry conditions, in industrial units, in underground and opencast mining, in explosion-risk areas. Excellent tear, impact and abrasion resistant.

Construction

Conductors	Flexible stranded annealed tin coated or bare copper conductor class 5 to IEC 60228
Separator	Wrap of semi-conductive tape between the power conductor and insulation and between earth conductor and semi-conductive layer
Conductor screen	Semi-conductive layer of special rubber, developed by TFKable
Insulation	Special EPDM rubber, halogen-free, lead-free compound, exceeding type 3GI3, developed by TFKable
Color of insulation	White
Insulation screen	Semi-conductive. special strippable layer over insulation of power cores. Maximum resistivity of semi-conductive layers -200 [Ω x m]
Earth conductor	Tin coated or bare copper conductor class 5 to IEC 60228 with extruded special semi-conductive rubber compound
Fiber Optic Modulus Identification of the fibers	A-D(ZN)13Y 6, 12, 18 or 24 fibers G50/125, G62, 5/125 or E9/125 Color coded fibres and tubes
Fiber covering	Buffering tube with filling compound
Core arrangement	Power cores. earth conductor split into 2 parts and FO laid up around conductive filler in the centre. Anty-adhesion graphite over assembled cores
Inner sheath	A special synthetic thermosetting compound type 5GM3 acc. to DIN VDE 0207/21
Color of inner sheath	Red
Anti-torsion braid	Braid of polyamide threads between internal and outer layer of sheath
Outer sheath	Special synthetic thermosetting compound. 5GM5 quality acc. to DIN VDE 0207/21 developed by TFKable
Colour of outer jacket	Red

Characteristics

Rated Voltage U_0/U	3.6/6 kV	6/10 kV	8.7/15 kV	12/20 kV	14/25 kV
Max. operating voltage Um	7.2 kV	12 kV	18 kV	24 kV	30 kV
AC test voltage	11 kV	17 kV	24 kV	29 kV	36 kV
Partial discharge	$1.25U_0$/max 20 pC				

Characteristics

Current carrying capacity	DIN VDE 0298-4
Max. conductor operating temperature +90°C	+90°C
Max. conductor temperature during short circuit +250°C	+250°C
Minimum ambient temperature for fixed installation -40°C	-40°C
Minimum ambient temperature for mobile installation	-25°C

Minimum bending radius acc. to DIN VDE 0298-3:

Fixed installation	6xD
On drums	12xD
On deflection pulleys	15xD
Moving freely	10xD
Twist limits	25°/m
Travel speed up to	180m/min (Speeds above 180m/min to be consulted with manufacturer)
Tensile load	See table (Increased tensile load due to additional support element)
Flame propagation	PN-EN 60332-1-2, IEC 60332-1-2
Oil resistant	PN-EN 60811-404, IEC 60811-404
UV resistant	UL 2556, ISO 4892-2
Ozone resistant	PN-ISO 1431-1

Example of standard sheath marking: TFKABLE 3 TFCrane R-(N)TSKCGEWÖU 3x50+2x25/2+FO 6/10 kV year + meter

Parameters

Number of cores x cross-section	Conductor diameter	Overall diameter	Approx. weight	Max. tensile load
mm²	**mm**	**mm**	**kg/km**	**N**
3.6/6 kV				
3x25+2x25/2+FO	6.6	41.6	2571	2205
3x35+2x25/2+FO	7.8	44.2	3020	2955
3x50+2x25/2+FO	9.4	48.3	3705	4080
3x70+2x35/2+FO	11.2	54.0	4936	5580
3x95+2x50/2+FO	12.9	57.7	5939	8125
3x120+2x70/2+FO	14.7	63.9	7482	10000
3x150+2x70/2+FO	16.4	67.6	8616	12250
3x185+2x95/2+FO	18.0	71.1	10013	14875
6/10 kV				
3x25+2x25/2+FO	6.6	43.4	2712	2205
3x35+2x25/2+FO	7.8	45.9	3192	2955
3x50+2x25/2+FO	9.4	51.8	4107	4080
3x70+2x35/2+FO	11.2	55.8	5092	5580
3x95+2x50/2+FO	12.9	59.4	6154	8125
3x120+2x70/2+FO	14.7	65.7	7734	10000
3x150+2x70/2+FO	16.4	69.3	8888	12250
3x185+2x95/2+FO	18.0	72.8	10292	14875
8.7/15 kV				
3x25+2x25/2+FO	6.6	46.8	3050	2205
3x35+2x25/2+FO	7.8	49.4	3548	2955
3x50+2x25/2+FO	9.4	55.2	4508	4080
3x70+2x35/2+FO	11.2	59.2	5582	5580
3x95+2x50/2+FO	12.9	64.7	6891	8125
3x120+2x70/2+FO	14.7	69.1	8236	10000
3x150+2x70/2+FO	16.4	72.8	9417	12250
3x185+2x95/2+FO	18.0	78.0	11190	14875
12/20 kV				
3x25+2x25/2+FO	6.6	51.6	3593	2205
3x35+2x25/2+FO	7.8	54.2	4114	2955
3x50+2x25/2+FO	9.4	58.3	4877	4080
3x70+2x35/2+FO	11.2	64.0	6259	5580

Parameters

Number of cores x cross-section	Conductor diameter	Overall diameter	Approx. weight	Max. tensile load
mm²	**mm**	**mm**	**kg/km**	**N**
3x95+2x50/2+FO	12.9	67.7	7329	8125
3x120+2x70/2+FO	14.7	72.1	8697	10000
3x150+2x70/2+FO	16.4	77.6	10245	12250
3x185+2x95/2+FO	18.0	81.0	11712	14875
14/25 kV				
3x25+2x25/2+FO	6.6	55.5	4045	2205
3x35+2x25/2+FO	7.8	58.1	4590	2955
3x50+2x25/2+FO	9.4	63.9	5664	4080
3x70+2x35/2+FO	11.2	67.9	6823	5580
3x95+2x50/2+FO	12.9	71.6	7910	8125
3x120+2x70/2+FO	14.7	77.8	9663	10000
3x150+2x70/2+FO	16.4	81.5	10912	12250
3x185+2x95/2+FO	18.0	86.7	12784	14875

Standard length cable packing: 500 m on drums. Other forms of packing and delivery are available on request

Fiber data

Parameter	G50/125 multimode	G62.5/125 multimode	E9/125 singlemode
Attenuation at 850 nm	≤3.0 dB/km	≤3.5 dB/km	–
Attenuation at 1300 nm	≤1.0 dB/km	≤1.0 dB/km	–
Attenuation at 1310 nm	–	–	≤0.4 dB/km
Attenuation at 1550 nm	–	–	≤0.25 dB/km
Bandwidth at 850 nm	≥500 MHz*km	≥200 MHz*km	–
Bandwidth at 1300 nm	≥500 MHz*km	≥500 MHz*km	–
Numerical Aperture at 850 nm	0.200 ±0.015	0.275 ±0.015	–
Group refractive index at 850 nm	1.482	1.496	–
Group refractive index at 1300 nm	1.477	1.491	–
Group refractive index at 1310 nm	–	–	1.466
Group refractive index at 1550 nm	–	–	1.467

Vertical Reeling -
0.6/1 kV

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Table of Contents

TFCrane (N)SHTÖU-J/O VR

Based on: DIN VDE 0250-814

— Low Voltage Rubber Insulated Flexible Cable
— Upon request, weights and diameters may be individually adjusted based on end-use applications or customer requirements.

Applications: Specially designed flexible cable for power mobile connections, for extremely high mechanical stresses. The cable is used in cable winding reels for winding and unwinding with co-occurrent tensile and torsion stress. Other applications include installation on conveyors, container cranes, harbour cranes, building machinery, handling machines for vertical reeling applications. For use in wet or dry conditions, in industrial units, in underground and open-cast mining, in explosion-risk areas, Excellent tear, impact and abrasion resistant jacket.

Construction

Conductors	Special construction with optimized length lay. Flexible stranded annealed tin coated or bare copper conductor class 5 to IEC 60228
Separator	If needed a suitable tape separator between the conductor and insulation
Insulation	EPDM rubber, halogen-free, lead-free compound, type 3GI3 acc. to DIN VDE 0207/20, developed by TFKable
Circuit identification	Colour coding of power conductors compliant to HD 308. DIN VDE 0293- 308 **-J version:** 3 - core: Green-yellow, blue, brown 4 - core: Green-yellow, brown, black, grey or green-yellow, blue, brown, black 5 - core: Green-yellow, blue, brown, black, grey **-O version:** 3 - core: Brown, black, grey or blue, brown, black 4 - core: Blue, brown, black, grey 5 - core: Blue, brown, black, grey, black
Inner sheath	A special synthetic thermosetting compound type 5GM3 acc. to DIN VDE 0207/21
Color of inner sheath	Yellow
Anti-torsion braid	Braid of polyamide threads between internal and outer layer of sheath
Outer sheath	Special synthetic thermosetting compound, 5GM5 quality acc. to DIN VDE 0207/21 developed by TFKable
Colour of outer jacket	Yellow

Characteristics

Rated Voltage U_0/U	0.6/1 kV
Max. operating voltage Um	1.2 kV
AC test voltage	3 kV

Characteristics

Current carrying capacity	DIN VDE 0298-4
Max. conductor operating temperature	+90°C
Max. conductor temperature during short circuit	+250°C
Minimum ambient temperature for fixed installation	-40°C
Minimum ambient temperature for mobile installation	-25°C

Minimum bending radius acc. to DIN VDE 0298-3:

OD of cable[mm]	>8 ≤ 12	>12≤ 20	>20
Fixed installation	3D	4D	4D
On drums	5D	5D	5D
On deflection pulleys	7.5D	7.5D	7.5D
Moving freely	4D	5D	5D

Twist limits	50°/m
Travel speed up to	100m/min (Speeds above 100m/min to be consulted with manufacturer)
Tensile load	See table (Increased tensile load due to additional support elements)
Flame propagation	PN-EN 60332-1-2, IEC 60332-1-2
Oil resistant	PN-EN 60811-404, IEC 60811-404
UV resistant	UL 2556, ISO 4892-2
Ozone resistant	PN-ISO 1431-1

Example of standard sheath marking: TFKABLE 3 TFCrane CE (N)SHTÖU-J VR 3x35 0.6/1 kV year + meter

Parameters

Number of cores x cross-section	Conductor diameter	Approx. overall diameter	Approx. weight	Max. tensile load
mm²	**mm**	**mm**	**kg/km**	**N**
3x1.5	1.5	11.9	205	135
3x2.5	2.1	13.5	273	225
3x4	2.7	16.9	420	360
3x6	3.2	18.0	508	540
3x10	4.2	21.8	771	900
3x16	5.3	24.3	1038	1440
3x25	6.6	28.8	1500	2250
3x35	7.8	32.9	2005	3150
3x50	9.6	38.9	2841	4500
3x70	11.4	42.7	3673	6300
3x95	13.0	48.8	4808	8550
3x120	14.7	52.5	5792	10800
3x150	16.5	57.2	7043	13500
3x185	18.3	63.8	8682	16650
3x240	20.9	72.0	11247	21600
4x1.5	1.5	12.7	238	180
4x2.5	2.1	15.7	365	300
4x4	2.7	18.1	497	480
4x6	3.2	19.4	608	720
4x10	4.2	23.5	931	1200
4x16	5.3	27.3	1338	1920
4x25	6.6	32.7	1951	3000
4x35	7.8	35.7	2469	4200
4x50	9.6	42.2	3509	6000
4x70	11.4	46.5	4574	8400
4x95	13.0	53.1	5988	11400
4x120	14.7	59.0	7496	14400
4x150	16.5	64.4	9117	18000
4x185	18.3	71.5	11195	22200
5x1.5	1.5	13.6	276	225
5x2.5	2.1	16.8	423	375
5x4	2.7	19.5	583	600

Parameters

Number of cores x cross-section	Conductor diameter	Approx. overall diameter	Approx. weight	Max. tensile load
mm²	**mm**	**mm**	**kg/km**	**N**
5x6	3.2	21.8	761	900
5x10	4.2	25.5	1113	1500
5x16	5.3	29.6	1599	2400
5x25	6.6	35.5	2337	3750
5x35	7.8	40.2	3107	5250
5x50	9.6	45.9	4240	7500
5x70	11.4	52.5	5779	10500

Standard length cable packing: 500 m on drums. Other forms of packing and delivery are available on request

TFCrane (N)SHTÖU-J VR 3 + 3 PE

Based on: DIN VDE 0250-814

— Low Voltage Rubber Insulated Flexible Cable
— Upon request, weights and diameters may be individually adjusted based on end-use applications or customer requirements.

Applications: Specially designed flexible cable for power mobile connections, for extremely high mechanical stresses. The cable is used in cable winding reels for winding and unwinding with co-occurrent tensile and torsion stress. Other applications include installation on conveyors, container cranes, harbour cranes, building machinery, handling machines for vertical reeling applications. For use in wet or dry conditions, in industrial units, in underground and open-cast mining, in explosion-risk areas. Excellent tear, impact and abrasion resistant jacket.

Construction

Conductors	Special construction with optimized length lay. Flexible stranded annealed tin coated or bare copper conductor class 5 to IEC 60228
Separator	If needed a suitable tape separator between the conductor and insulation
Insulation	EPDM rubber, halogen-free, lead-free compound, type 3GI3 acc. to DIN VDE 0207/20, developed by TFKable
Color of insulation*	Colour coding of power conductors compliant to HD 308. DIN VDE 0293- 308 Power cores: 3-core circuit identification: Brown, black, grey Earth cores: Green-yellow
Earth conductor	Rubber insulated, tin coated or bare copper conductor
Core arrangement	Three power cores, earth conductor split into 3 parts and placed into the interstices
Inner sheath	A special synthetic thermosetting compound type 5GM3 acc. to DIN VDE 0207/21
Color of inner sheath	Yellow
Anti-torsion braid	Braid of polyamide threads between internal and outer layer of sheath
Outer sheath	Special synthetic thermosetting compound, 5GM5 quality acc. to DIN VDE 0207/21 developed by TFKable
Colour of outer jacket	Yellow

*other core identification available on request

Characteristics

Rated Voltage U_0/U	0.6/1 kV
Max. operating voltage Um	1.2 kV
AC test voltage	3 kV

** This parameter depends on the application.*

Characteristics

Current carrying capacity	DIN VDE 0298-4
Max. conductor operating temperature	+90°C
Max. conductor temperature during short circuit	+250°C
Minimum ambient temperature for fixed installation	-40°C
Minimum ambient temperature for mobile installation	-25°C

Minimum bending radius acc. to DIN VDE 0298-3:

OD of cable[mm]	>8 ≤ 12	>12≤ 20	>20
Fixed installation	3D	4D	4D
On drums	5D	5D	5D
On deflection pulleys	7.5D	7.5D	7.5D
Moving freely	4D	5D	5D

Twist limits	50°/m
Travel speed up to	Monospiral wheel: 250m/min Cylindrical drum: 180m/min
Tensile load	See table (Increased tensile load due to additional support elements)
Flame propagation	PN-EN 60332-1-2, IEC 60332-1-2
Oil resistant	PN-EN 60811-404, IEC 60811-404
UV resistant	UL 2556, ISO 4892-2
Ozone resistant	PN-ISO 1431-1

Example of standard sheath marking: TFKABLE 3 TFCrane CE (N)SHTÖU-J VR 3x35+3x16/3 0.6/1 kV year + meter

Parameters

Number of cores x cross-section	Conductor diameter	Approx. overall diameter	Approx. weight	Max. tensile load
mm²	**mm**	**mm**	**kg/km**	**N**
3x25+3x16/3	6.6	28.8	1671	2250
3x35+3x16/3	7.8	31.5	2086	3150
3x50+3x25/3	9.6	37.5	2997	4500
3x70+3x35/3	11.4	42.7	4050	6300
3x95+3x50/3	13.0	47.0	5128	8550
3x120+3x70/3	14.7	50.7	6284	10800
3x150+3x70/3	16.5	57.2	7796	13500
3x185+3x95/3	18.3	62.0	9409	16650
3x240+3x120/3	20.9	70.2	12202	21600

Standard length cable packing: 500 m on drums. Other forms of packing and delivery are available on request

TFCrane (N)SHTÖU-J/O VR S

Based on: DIN VDE 0250-814

— Low Voltage Rubber Insulated Flexible Cable
— Upon request, weights and diameters may be individually adjusted based on end-use applications or customer requirements.

Applications: Specially designed flexible reeling cable with reduced dimensions for high mechanical stresses occur in applications with mono spiral reels and cylindrical reels, extreme high reeling speed, torsional stress. Also for connection of large material handling machines such as excavators, dumpers, crushers in opencast mines. Usable in wet or dry conditions, in industrial units, in underground and opencast mining, in explosion-risk areas. Excellent tear, impact and abrasion resistant.

Construction

Conductors	Special construction with optimized length lay. Flexible stranded annealed tin coated or bare copper conductor class 5 to IEC 60228
Separator	If needed a suitable tape separator between the conductor and insulation
Insulation	EPDM rubber, halogen-free, lead-free compound, type 3GI3 acc. to DIN VDE 0207/20, developed by TFKable
Circuit identification	Colour coding of power conductors compliant to HD 308, DIN VDE 0293- 308 **J- version** Above 5 cores: Green-yellow, other cores black with white numbering **O-version:** Above 5 cores: Black with white numbering
Inner sheath	A special synthetic thermosetting compound type 5GM3 acc. to DIN VDE 0207/21
Color of inner sheath	Yellow
Anti-torsion braid	Braid of polyamide threads between internal and outer layer of sheath
Outer sheath	Special synthetic thermosetting compound, 5GM5 quality acc. to DIN VDE 0207/21 developed by TFKable
Colour of outer jacket	Yellow

Characteristics

Rated Voltage U_0/U	0.6/1 kV
Max. operating voltage Um	1.2 kV
AC test voltage	3 kV

Characteristics

Current carrying capacity	DIN VDE 0298-4
Max. conductor operating temperature +90°C	+90°C
Max. conductor temperature during short circuit +250°C	+250°C
Minimum ambient temperature for fixed installation -40°C	-40°C
Minimum ambient temperature for mobile installation	-25°C

Minimum bending radius acc. to DIN VDE 0298-3:

OD of cable[mm]	>8 ≤ 12	>12≤ 20	>20
Fixed installation	3D	4D	4D
On drums	5D	5D	5D
On deflection pulleys	7.5D	7.5D	7.5D
Moving freely	4D	5D	5D

Twist limits	50°/m
Travel speed up to	100m/min
Flame propagation	PN-EN 60332-1-2, IEC 60332-1-2
Oil resistant	PN-EN 60811-404, IEC 60811-404
UV resistant	UL 2556, ISO 4892-2
Ozone resistant	PN-ISO 1431-1

Example of standard sheath marking: TFKABLE 3 TFCrane CE (N)SHTÖU-J VR S 7x2.5 0.6/1 kV year + meter

Parameters

Number of cores x cross-section	Conductor diameter	Overall diameter	Approx. weight	Max. tensile load
mm²	**mm**	**mm**	**kg/km**	**N**
7x1.5	1.5	16.9	412	2315
7x2.5	2.1	19.4	560	2525
12x1.5	1.5	22.6	720	2540
12x2.5	2.1	26.2	1001	2900
18x1.5	1.5	24.9	865	2810
18x2.5	2.1	30.1	1289	3350
24x1.5	1.5	25.9	1022	3080
24x2.5	2.1	31.3	1537	3800
30x1.5	1.5	29.8	1323	3350
30x2.5	2.1	36.3	2008	4250
36x1.5	1.5	32.4	1485	3620
36x2.5	2.1	39.4	2251	4700
42x1.5	1.5	34.8	1765	3890
42x2.5	2.1	42.0	2657	5150
44x1.5	1.5	34.8	1800	3980
44x2.5	2.1	42.0	2738	5300
50x1.5	1.5	36.7	2010	4250
50x2.5	2.1	44.4	3035	5750
56x2.5	2.1	47.1	3412	6200

Standard length cable packing: 500 m on drums. Other forms of packing and delivery are available on request

Festoon Cable circular - 0.6/1 kV

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Table of Contents

TFCrane (N)GRDGÖU-J/O

Based on: DIN VDE 0250-814

— Low Voltage Rubber Insulated Flexible Cable
— Upon request, weights and diameters may be individually adjusted based on end-use applications or customer requirements.

Applications: Flexible cable designed for high mechanical stresses, especially for applications with frequent bending. For festoon systems and connecting moveable parts of container cranes, industrial units, material handling equipment. For use in wet or dry conditions, outdoors, indoors.

Construction

Conductors	Flexible stranded annealed bare copper conductor class 5 to IEC 60228
Separator	If needed a suitable tape separator between the conductor and insulation
Insulation	EPDM rubber, halogen-free, lead-free compound, type 3GI3 acc. to DIN VDE 0207/20, developed by TFKable
Circuit identification	Colour coding of power conductors compliant to HD 308, DIN VDE 0293- 308 **-J version:** 3 - core: Green-yellow, blue, brown 4 - core: Green-yellow, brown, black, grey or green-yellow, blue, brown, black 5 - core: Green-yellow, blue, brown, black, grey Above 5 cores: Green-yellow, other cores black with white numbering **-O version:** 3 - core: Brown. black. grey or blue. brown. black 4 - core: Blue. brown. black. grey 5 - core: Blue. brown. black. grey. black Above 5 cores: Black with white numbering
Inner sheath	A synthetic thermosetting compound type Gm1b acc. to DIN VDE 0207/21
Color of inner sheath	Black
Outer sheath	Designed by TFKable, synthetic thermosetting compound, type 5GM3 acc. to DIN VDE 0207/21
Colour of outer jacket	Black

Characteristics

Rated Voltage U_0/U	0.6/1 kV
Max. operating voltage Um	1.2 kV
AC test voltage	3 kV

Characteristics

Current carrying capacity	DIN VDE 0298-4
Max. conductor operating temperature +90°C	+90°C
Max. conductor temperature during short circuit +250°C	+250°C
Minimum ambient temperature for fixed installation -40°C	-40°C
Minimum ambient temperature for mobile installation	-25°C 1x25mm²-240mm²: -35°C 4-5 x 1,5mm²-70mm²: -35°C

Minimum bending radius acc. to DIN VDE 0298-3:

OD of cable[mm]	>8 ≤ 12	>12≤ 20	>20
Fixed installation	3D	4D	4D
On drums	5D	5D	5D
On deflection pulleys	7.5D	7.5D	7.5D
Moving freely	4D	5D	5D

Twist limits	25°/m
Travel speed up to	250m/min
Tensile load	15N/mm²
Flame propagation	PN-EN 60332-1-2, IEC 60332-1-2
Oil resistant	PN-EN 60811-404, IEC 60811-404
UV resistant	UL 2556, ISO 4892-2
Ozone resistant	PN-ISO 1431-1

Example of standard sheath marking: TFKABLE 3 CE TFCrane (N)GRDGÖU-J 4x10 0.6/1 kV year + meter

Parameters

Number of cores x cross-section	Conductor diameter	Approx. overall diameter	Approx. weight	Max. tensile load
mm²	**mm**	**mm**	**kg/km**	**N**
1x25	6.6	12.8	346	375
1x35	7.8	14.0	450	525
1x50	9.6	16.1	625	750
1x70	11.4	18.3	853	1050
1x95	13.0	20.3	1091	1425
1x120	14.7	22.4	1363	1800
1x150	16.5	24.6	1678	2250
1x185	18.3	27.6	2074	2775
1x240	20.9	30.6	2660	3600
4x1.5	1.5	12.1	208	90
4x2.5	2.1	14.9	317	150
4x4	2.7	16.9	421	240
4x6	3.2	18.1	525	360
4x10	4.2	22.2	821	600
4x16	5.3	25.8	1189	960
4x25	6.6	31.0	1746	1500
4x35	7.8	34.0	2236	2100
4x50	9.6	40.3	3196	3000
4x70	11.4	44.6	4213	4200
4x95	13.0	51.0	5521	5700
4x120	14.7	56.8	6919	7200
5x4	2.7	18.2	499	300
5x6	3.2	20.4	662	450
5x10	4.2	24.1	984	750
5x16	5.3	28.0	1432	1200
5x25	6.6	33.7	2108	1875
5x35	7.8	38.2	2819	2625
10x2.5	2.1	23.0	762	375
10x4	2.7	28.0	1111	600
12x1.5	1.5	19.6	533	270
12x2.5	2.1	25.4	914	450
16x2.5	2.1	27.9	1097	600

Parameters

Number of cores x cross-section	Conductor diameter	Overall diameter	Approx. weight	Max. tensile load
mm²	**mm**	**mm**	**kg/km**	**N**
16x6	3.2	33.6	1891	1440
18x1.5	1.5	22.2	718	405
18x2.5	2.1	29.1	1166	675
24x1.5	1.5	25.3	913	540
24x2.5	2.1	30.3	1411	900
30x1.5	1.5	27.4	1104	675
30x2.5	2.1	35.1	1843	1125
36x1.5	1.5	29.3	1285	810
36x2.5	2.1	35.6	1963	1350

Standard length cable packing: 500 m on drums. Other forms of packing and delivery are available on request

TFCrane (N)GRDGÖU-J 3 + 3 PE

Based on: DIN VDE 0250-814

— Low Voltage Rubber Insulated Flexible Cable
— Upon request, weights and diameters may be individually adjusted based on end-use applications or customer requirements.

Applications: Flexible cable designed for high mechanical stresses, especially for applications with frequent bending . For festoon systems and connecting moveable parts of container cranes, industrial units, material handling equipment. For use in wet or dry conditions, outdoors, indoors.

Construction

Conductors	Flexible stranded annealed bare copper conductor class 5 to IEC 60228
Separator	If needed a suitable tape separator between the conductor and insulation
Insulation	EPDM rubber, halogen-free, lead-free compound, type 3GI3 acc. to DIN VDE 0207/20, developed by TFKable
Color of insulation*	Colour coding of power conductors comply to HD 308, DIN VDE 0293- 308 Power cores: 3-core circuit identification: Brown, black, grey Earth cores: Green-yellow
Earth conductor	Rubber insulated. bare copper conductor
Core arrangement	Three power cores, earth conductor split into 3 parts and laid up around rubber filler in the centre
Inner sheath	A synthetic thermosetting compound type Gm1b acc. to DIN VDE 0207/21
Color of inner sheath	Black
Outer sheath	Synthetic thermosetting compound, type 5GM3 acc. to DIN VDE 0207/21. developed by TFKable
Colour of outer jacket	Black

**other core identification available on request*

Characteristics

Rated Voltage U_0/U	0.6/1 kV
Max. operating voltage Um	1.2 kV
AC test voltage	3 kV

Characteristics

Current carrying capacity	DIN VDE 0298-4
Max. conductor operating temperature +90°C	+90°C
Max. conductor temperature during short circuit +250°C	+250°C
Minimum ambient temperature for fixed installation -40°C	-40°C
Minimum ambient temperature for mobile installation	-25°C

Minimum bending radius acc. to DIN VDE 0298-3:

OD of cable[mm]	>8 ≤ 12	>12≤ 20	>20
Fixed installation	3D	4D	4D
On drums	5D	5D	5D
On deflection pulleys	7.5D	7.5D	7.5D
Moving freely	4D	5D	5D

Twist limits	25°/m
Travel speed up to	240m/min
Tensile load	15N/mm²
Flame propagation	PN-EN 60332-1-2, IEC 60332-1-2
Oil resistant	PN-EN 60811-404, IEC 60811-404
UV resistant	UL 2556, ISO 4892-2
Ozone resistant	PN-ISO 1431-1

Example of standard sheath marking: TFKABLE 3 TFCrane (N)GRDGÖU-J 3x70 + 3x50/3 0.6/1 kV year + meter

Parameters

Number of cores x cross-section	Conductor diameter	Approx. overall diameter	Approx. weight	Max. tensile load
mm²	**mm**	**mm**	**kg/km**	**N**
3x35+3x16/3	7.8	30.0	1912	1575
3x50+3x25/3	9.6	35.8	2747	2250
3x70+3x35/3	11.4	40.9	3735	3150
3x95+3x50/3	13.0	45.2	4791	4275

Standard length cable packing: 500 m on drums. Other forms of packing and delivery are available on request

TFCrane (N)GRDGCGÖU-J

Based on: DIN VDE 0250-814

— Low Voltage Screened Rubber Insulated Flexible Cable
— Upon request, weights and diameters may be individually adjusted based on end-use applications or customer requirements.

Applications: Screened flexible cable designed for use on festoon systems. on hall gantry cranes, gantry cranes, rack material handling equipment, transportation system or machine tools. Suitable where the maximum emission values are required or where power cables are expected to cause interference and disruption on data cables. Power cables are the cable is used under high mechanical stresses, especially for applications with frequent bending. Usable in wet or dry conditions, outdoors, indoors.

Construction

Conductors	Flexible stranded annealed bare copper conductor class 5 to IEC 60228
Separator	If needed a suitable tape separator between the conductor and insulation
Insulation	EPDM rubber, halogen-free, lead-free compound, type 3GI3 acc. to DIN VDE 0207/20. developed by TFKable
Color of insulation*	Colour coding of power conductors comply to HD 308. DIN VDE 0293- 308 Power cores: 3-core circuit identification: Green-yellow, blue, brown 4-core circuit identification: Green-yellow, brown, black, grey 5-core circuit identification: Green-yellow, blue, brown, black, grey
Inner sheath	A synthetic thermosetting compound type Gm1b acc. to DIN VDE 0207/21
Color of inner sheath	Black
Screen over inner sheath	Braid screen made of tinned copper wires - covering min. 80%
Outer layer of sheath	Designed by TFKable, synthetic thermosetting compound, type 5GM3 acc. to DIN VDE 0207/21
Colour of outer jacket	Black

**other core identification available on request*

Characteristics

Rated Voltage U_0/U	0.6/1 kV
Max. operating voltage Um	1.2 kV
AC test voltage	3 kV
Current carrying capacity	DIN VDE 0298-4
Max. conductor operating temperature	+90°C
Max. conductor temperature during short circuit	+250°C
Minimum ambient temperature for fixed installation	-40°C
Minimum ambient temperature for mobile installation	-35°C

Minimum bending radius acc. to DIN VDE 0298-3:

OD of cable[mm]	>8 ≤ 12	>12≤ 20	>20
Fixed installation	3D	4D	4D
On drums	5D	5D	5D
On deflection pulleys	7.5D	7.5D	7.5D
Moving freely	4D	5D	5D
Travel speed up to	250m/min		
Tensile load	15N/mm^2		
Flame propagation	PN-EN 60332-1-2, IEC 60332-1-2		
Oil resistant	PN-EN 60811-404, IEC 60811-404		
UV resistant	UL 2556, ISO 4892-2		
Ozone resistant	PN-ISO 1431-1		

Example of standard sheath marking: TFKABLE 3 TFCrane (N)GRDGCGÖU-J 4x10 0.6/1 kV CE year + meter

Parameters

Number of cores x cross-section	Conductor diameter	Approx. overall diameter	Approx. weight	Max. tensile load
mm²	**mm**	**mm**	**kg/km**	**N**
4x1.5	1.5	13.2	267	90
4x2.5	2.1	15.9	392	150
4x4	2.7	18.3	548	240
4x6	3.2	19.6	659	360
4x10	4.2	23.7	991	600
4x16	5.3	26.8	1416	960
4x25	6.6	31.6	2025	1500
4x35	7.8	35.4	2485	2100
4x50	9.6	41.8	3496	3000
4x70	11.4	46.1	4550	4200
5x1.5	1.5	14.5	346	112.5
5x2.5	2.1	17.5	497	187.5
5x4	2.7	19.6	636	300
5x6	3.2	21.0	780	450
5x10	4.2	25.5	1180	750
5x16	5.3	29.4	1659	1200
5x25	6.6	35.1	2371	1875
5x35	7.8	38.5	3021	2625
5x50	9.6	45.4	4238	3750
5x70	11.4	50.2	5551	5250

Standard length cable packing: 500 m on drums. Other forms of packing and delivery are available on request

TFCrane (N)GRDGCGÖU-J 3 + 3 PE

Based on: DIN VDE 0250-814

— Low Voltage Rubber Insulated Flexible Cable
— Upon request, weights and diameters may be individually adjusted based on end-use applications or customer requirements.

Applications: Screened flexible cable designed for use on festoon systems. on hall gantry cranes, gantry cranes, rack material handling equipment, transportation system or machine tools. Suitable where the maximum emission values are required or where power cables are expected to cause interference and disruption on data cables. The cable is used under high mechanical stresses, especially for applications with frequent bending. Usable in wet or dry conditions, outdoors, indoors.

Construction

Conductors	Flexible stranded annealed bare copper conductor class 5 to IEC 60228
Separator	If needed a suitable tape separator between the conductor and insulation
Insulation	EPDM rubber, halogen-free, lead-free compound, type 3GI3 acc. to DIN VDE 0207/20, developed by TFKable
Color of insulation*	Colour coding of power conductors comply to HD 308, DIN VDE 0293- 308 Power cores: 3-core circuit identification: Brown, black, grey Earth cores: Green-yellow
Earth conductor	Rubber insulated. bare copper conductor
Core arrangement	Three power cores, earth conductor split into 3 parts and laid up around rubber filler in the centre
Inner sheath	A synthetic thermosetting compound type Gm1b acc. to DIN VDE 0207/21
Color of inner sheath	Black
Screen over inner sheath	Braid screen made of tinned copper wires - covering min. 80%
Outer sheath	Synthetic thermosetting compound, type 5GM3 acc. to DIN VDE 0207/21. developed by TFKable
Colour of outer jacket	Black

**other core identification available on request*

Characteristics

Rated Voltage U_0/U	0.6/1 kV
Max. operating voltage Um	1.2 kV
AC test voltage	3 kV

Characteristics

Current carrying capacity	DIN VDE 0298-4
Max. conductor operating temperature	+90°C
Max. conductor temperature during short circuit	+250°C
Minimum ambient temperature for fixed installation	-40°C
Minimum ambient temperature for mobile installation	-25°C

Minimum bending radius acc. to DIN VDE 0298-3:

OD of cable[mm]	>8 ≤ 12	>12≤ 20	>20
Fixed installation	3D	4D	4D
On drums	5D	5D	5D
On deflection pulleys	7.5D	7.5D	7.5D
Moving freely	4D	5D	5D
Travel speed up to	240m/min		
Tensile load	15N/mm^2		
Flame propagation	PN-EN 60332-1-2, IEC 60332-1-2		
Oil resistant	PN-EN 60811-404, IEC 60811-404		
UV resistant	UL 2556, ISO 4892-2		
Ozone resistant	PN-ISO 1431-1		

Example of standard sheath marking: TFKABLE 3 TFCrane (N)GRDGCGÖU-J 3x70+3x10 0.6/1 kV year + meter

Parameters

Number of cores x cross-section	Conductor diameter	Approx. overall diameter	Approx. weight	Max. tensile load
mm²	**mm**	**mm**	**kg/km**	**N**
3x16+3x2.5	5.3	24.4	1192	720
3x25+3x4	6.6	28.8	1698	1125
3x35+3x6	7.8	31.5	2154	1575
3x50+3x10	9.6	37.3	3104	2250
3x70+3x10	11.4	42.3	4048	3150
3x95+3x16	13.0	46.6	5197	4275
3x120+3x16	14.7	50.3	6189	5400
3x150+3x25	16.5	56.6	7836	6750

Standard length cable packing: 500 m on drums. Other forms of packing and delivery are available on request

UV

I

250 m/min

MIN −35°C

O_3

Insulation Pb Free

TFCrane FOMFLEX Festoon

Based on: EN 60794-3

— Flexible rubber sheathed cables with optical fibres
— Upon request, weights and diameters may be individually adjusted based on end-use applications or customer requirements.

Applications: Flexible cable designed for high mechanical stresses, especially for applications with frequent bending. For festoon systems and connecting moveable parts of container cranes, industrial units, material handling equipment. For use in wet or dry conditions, outdoors, indoors.

Construction

Element	Type	Material	Dimension
Fibers	2-24 fibers G50/125, G62,5/125 or E9/125		
Identification of fibres	Comply to IEC 60304: red; green, blue, white, violet, orange, grey, yellow, brown, pink, black turquoise		
Identification of tubes/elements	First tube - red, second tube/filler - natural		
Support elements	Dielectric rod	FRP	Ø 0.5 mm
FRP coating	Natural	PBT	Ø 0.5 mm
Secondary coating	Loose tube - thermoplastic material 2-12 fibres	PBT	Ø 2.6 mm (approx.)
Filling of the tube	Gel	Tixotropic gel	
Inner sheath	Black	TPE	Thickness: minimum spot 0.8 mm, average 1.0 mm
The wrap and braid	The wrap of glass tape. Special braid of Kevlar threads, tensile-strength reinforcement by means of longitudinal Kevlar threads. Surface covered: approx. 80%		
Outer sheath	Special synthetic thermosetting compound, 5GM5 quality acc. to DIN VDE 0207/21		
Colour of outer jacket	Orange		

Characteristics

Minimum ambient temperature for fixed installation:	-40°C
Minimum ambient temperature for mobile installation:	-35°C

Minimum bending radius acc. to DIN VDE 0298-3:

Thickness of flat cable [mm]	10xD
Fixed installation	15xD
Twist limits	100°/m
Tensile load	Up to 2000 N
Travel speed up to	250m/min
Flame propagation	PN-EN 60332-1-2, IEC 60332-1-2
Oil resistant	PN-EN 60811-404, IEC 60811-404
UV resistant	UL 2556, ISO 4892-2
Ozone resistant	PN-ISO 1431-1

Example of standard sheath marking: TFKABLE 3 TFCrane FOMFLEX 24G62.5/125 year + meter

Parameters

Number of fibres in a cable	Outer diameter of tube	No. of elements in a cable (tubes/filers)	Cable dimensions	
			Approx. outer diameter	Approx.weigh
n	**[mm]**	**(tubes/filers)**	**[mm]**	**[kg/km]**
2-24	2.6	4	10.9	120

Standard length cable packing: 1000 m on drums. Other forms of packing and delivery are available on request

Fiber data

Parameter	G50/125 multimode	G62.5/125 multimode	E9/125 singlemode
Attenuation at 850 nm	≤3.0 dB/km	≤3.5 dB/km	–-
Attenuation at 1300 nm	≤1.0 dB/km	≤1.0 dB/km	–
Attenuation at 1310 nm	–	–	≤0.4 dB/km
Attenuation at 1550 nm	–	–	≤0.25 dB/km
Bandwidth at 850 nm	≥500 MHz*km	≥200 MHz*km	–
Bandwidth at 1300 nm	≥500 MHz*km	≥500 MHz*km	–-
Numerical Aperture at 850 nm	0.200 ±0.015	0.275 ±0.015	–-
Group refractive index at 850 nm	1.482	1.496	–-
Group refractive index at 1300 nm	1.477	1.491	–-
Group refractive index at 1310 nm	–	–	1.466
Group refractive index at 1550 nm	–	–	1.467

Festoon Cable flat - 300/500 V

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TFCrane NGFLGÖU-J/O

DIN VDE 0250-809

— Low Voltage Flat Rubber Flexible Cable for Festoon Applications
— Upon request, weights and diameters may be individually adjusted based on end-use applications or customer requirements.

Applications: Flexible flat cable designed for mechanical stresses, especially for applications with frequent bending during operation and for bending in one plane only. The cable is used on festoon systems and for connecting moveable parts of machine tools, material handling equipment. Usable in wet or dry conditions, outdoors and indoors.

Construction

Conductors	Special design ensuring higher flexibility. Flexible stranded annealed bare copper conductor: • Up to 25 mm^2 - extra flexible, class 6 acc. to IEC 60228 • Above 35 mm^2 - flexible, class 5 to IEC 60228
Separator	If needed a suitable tape separator between the conductor and insulation
Insulation	Special EPDM rubber. halogen-free. lead-free compound. type 3GI3 quality, developed by TFKable
Circuit identification	Colour coding of power conductors compliant to HD 308, DIN VDE 0293- 308 **-J version:** 3 - core: Green-yellow, blue, brown 4 - core: Green-yellow, brown, black, grey or green-yellow, blue, brown, black 5 - core: Green-yellow, blue, brown, black, grey Above 5 cores: Green-yellow, other cores black with white numbering **-O version:** 3 - core: Brown, black, grey or blue, brown, black 4 - core: Blue, brown, black, grey 5 - core: Blue, brown, black, grey, black Above 5 cores: Black with white numbering
Core arrangement	Parallel
Outer sheath	Special synthetic thermosetting compound, 5GM3 quality acc. to DIN VDE 0207/21. developed by TFKable
Colour of outer jacket	Black

Characteristics

Rated Voltage U_0/U	300/500 V (600 V)
Max. operating voltage Um	0.7/1.2 kV
AC test voltage	2.5 kV

*This parameter depends on the product scope.

Characteristics

Current carrying capacity	DIN VDE 0298-4
Max. conductor operating temperature	+90°C
Max. conductor temperature during short circuit	+250°C
Minimum ambient temperature for fixed installation	-40°C
Minimum ambient temperature for mobile installation	-35°C 4 x 150mm^2 - 240mm^2: -25°C

Minimum bending radius acc. to DIN VDE 0298-3:

Thickness of flat cable [mm]	>8 ≤ 12	>12≤ 20	>20
Fixed installation	3D	4D	4D
On drums	5D	5D	5D
On deflection pulleys	7.5D	7.5D	7.5D
Moving freely	4D	5D	5D
Travel speed up to	250m/min 4 x 150mm^2 - 240mm^2: 240m/min		
Tensile load	15N/mm^2		
Flame propagation	PN-EN 60332-1-2, IEC 60332-1-2		
Oil resistant	PN-EN 60811-404, IEC 60811-404		
UV resistant	UL 2556, ISO 4892-2		
Ozone resistant	PN-ISO 1431-1		

Example of standard sheath marking: TFKABLE 3 TFCrane NGFLGÖU-J 4x50 300/500 V CE year + meter

Parameters

Number of cores x cross-section	Conductor diameter	Approx. height of flat cable	Approx. width of flat cable	Approx. weight	Max. tensile load
mm²	**mm**	**mm**	**mm**	**kg/km**	**N**
4x10	4.0	10.3	30.4	684	600
4x16	5.0	12.3	35.4	1004	960
4x25	6.1	14.4	41.9	1465	1500
4x35	7.3	16.0	47.2	1933	2100
4x50	9.0	18.1	55.6	2655	3000
4x70	10.8	20.2	62.9	3558	4200
4x95	12.9	23.3	73.5	4691	5700
4x120*	14.0	25.0	78.4	5766	7200
4x150*	15.8	27.9	88.0	7175	9000
4x185*	18.1	31.1	99.1	8778	11100
4x240*	19.6	34.0	107.7	11220	14400

**Based on standard*

Standard length cable packing: 500 m on drums. Other forms of packing and delivery are available on request

TFCrane (N)GFLCGÖU-J/O

Based on: DIN VDE 0250-809

— Low Voltage Flat Cable with individual screen
— Upon request, weights and diameters may be individually adjusted based on end-use applications or customer requirements.

Applications: Flexible, screened flat cable designed for festoon application, for medium mechanical stresses, in particular for hoisting gear transportation systems. machine tools, for bending in one plane only. Usable in wet or dry conditions. outdoors and indoors.

Construction

Conductors	Special design ensuring higher flexibility. Flexible stranded annealed bare copper conductor: • Up to 25 mm² - extra flexible, class 6 acc. to IEC 60228 • Above 35 mm² - flexible, class 5 to IEC 60228
Separator	If needed a suitable tape separator between the conductor and insulation
Insulation	Special EPDM rubber, halogen-free, lead-free compound, type 3GI3 quality, developed by TFKable
Circuit identification	Colour coding of power conductors compliant to HD 308. DIN VDE 0293- 308 **-J version:** 3 - core: Green-yellow, blue, brown 4 - core: Green-yellow, brown, black, grey or green-yellow, blue, brown, black 5 - core: Green-yellow, blue, brown, black, grey Above 5 cores: Green-yellow, other cores black with white numbering **-O version:** 3 - core: Brown, black, grey or blue, brown, black 4 - core: Blue, brown, black, grey 5 - core: Blue, brown, black, grey, black
Individual screen	Aluminium/polyester tape under the metallic screen. Spinning of tinned copper wires with a few polyamide yarns in opposite direction. Wrapping with polyester tape. For shielded cores and twisted and shielded pairs - covering min. 85%
Core arrangement	Parallel
Outer sheath	Special synthetic thermosetting compound, 5GM3 quality acc. to DIN VDE 0207/21. developed by TFKable
Colour of outer jacket	Black

Characteristics

Rated Voltage U_0/U	0.6/1 kV
Max. operating voltage Um	1.2 kV
AC test voltage	2.5 kV

Characteristics

Current carrying capacity	DIN VDE 0298-4
Max. conductor operating temperature	+90°C
Max. conductor temperature during short circuit	+250°C
Minimum ambient temperature for fixed installation	-40°C
Minimum ambient temperature for mobile installation	-35°C

Minimum bending radius acc. to DIN VDE 0298-3:

OD of cable[mm]	>8 ≤ 12	>12≤ 20	>20
Fixed installation	3D	4D	4D
On drums	5D	5D	5D
On deflection pulleys	7.5D	7.5D	7.5D
Moving freely	4D	5D	5D
Travel speed up to	250m/min		
Tensile load	15N/mm^2		
Flame propagation	PN-EN 60332-1-2, IEC 60332-1-2		
Oil resistant	PN-EN 60811-404, IEC 60811-404		
UV resistant	UL 2556, ISO 4892-2		
Ozone resistant	PN-ISO 1431-1		

Example of standard sheath marking: TFKABLE 3 TFCrane (N)GFLCGÖU-J 4x50 300/500 V year + meter

Parameters

Number of cores x cross-section	Conductor diameter	Approx. height of flat cable	Approx. width of flat cable	Approx. weight	Max. tensile load
mm²	**mm**	**mm**	**mm**	**kg/km**	**N**
4x10	4.0	10.9	32.9	828	600
4x16	5.0	13.2	39.1	1252	960
4x25	6.1	15.3	45.6	1766	1500
4x35	7.3	16.9	50.9	2267	2100
4x50	9.0	19.0	59.3	3047	3000
4x70	10.8	21.2	66.9	4014	4200
4x95	12.9	24.3	77.5	5218	5700

Standard length cable packing: 500 m on drums. Other forms of packing and delivery are available on request

Chain Cable -

0.6/1 kV

6

Table of Contents (Application Drag chain)

TFCrane (N)GRDGÖU-J/O

Based on: DIN VDE 0250-814

— Low Voltage Rubber Insulated Flexible Cable
— Upon request, weights and diameters may be individually adjusted based on end-use applications or customer requirements.

Applications: Flexible cable designed for use on gantry high mechanical stresses, especially for applications with frequent bending. Usable in wet or dry conditions, outdoors, indoors.

Construction

Conductors	Flexible stranded annealed bare copper conductor class 5 acc. to IEC 60228
Separator	If needed a suitable tape separator between the conductor and insulation
Insulation	EPDM rubber, halogen-free, lead-free compound, type 3GI3 acc. to DIN VDE 0207/20, developed by TFKable
Circuit identification	Colour coding of power conductors compliant to HD 308, DIN VDE 0293- 308 **-J version:** 3 - core: Green-yellow, blue, brown 4 - core: Green-yellow, brown, black, grey or green-yellow, blue, brown, black 5 - core: Green-yellow, blue, brown, black, grey Above 5 cores: Green-yellow, other cores black with white numbering **-O version:** 3 - core: Brown, black, grey or blue, brown, black 4 - core: Blue, brown, black, grey 5 - core: Blue, brown, black, grey, black Above 5 cores: Black with white numbering
Inner sheath	A synthetic thermosetting compound type Gm1b acc. to DIN VDE 0207/21
Color of inner sheath	Black
Outer sheath	Designed by TFKable, synthetic thermosetting compound, type 5GM3 acc. to DIN VDE 0207/21
Colour of outer jacket	Black

Characteristics

Rated Voltage U_0/U	0.6/1 kV
Max. operating voltage Um	1.2 kV
AC test voltage	3 kV

Characteristics

Current carrying capacity	DIN VDE 0298-4
Max. conductor operating temperature	+90°C
Max. conductor temperature during short circuit	+250°C
Minimum ambient temperature for fixed installation	-40°C
Minimum ambient temperature for mobile installation	-35°C

Minimum bending radius acc. to DIN VDE 0298-3:

OD of cable[mm]	>8 ≤ 12	>12≤ 20	>20
Fixed installation	3D	4D	4D
On drums	5D	5D	5D
On deflection pulleys	7.5D	7.5D	7.5D
Moving freely	4D	5D	5D

Twist limits	25°/m
Travel speed up to	250m/min
Tensile load	15N/mm²
Flame propagation	PN-EN 60332-1-2, IEC 60332-1-2
Oil resistant	PN-EN 60811-404, IEC 60811-404
UV resistant	UL 2556, ISO 4892-2
Ozone resistant	PN-ISO 1431-1

Example of standard sheath marking: TFKABLE 3 CE TFCrane (N)GRDGÖU-J 4x10 0.6/1 kV year + meter

Parameters

Number of cores x cross-section	Conductor diameter	Approx. overall diameter	Approx. weight	Max. tensile load
mm²	**mm**	**mm**	**kg/km**	**N**
1x25	6.6	12.8	346	375
1x35	7.8	14.0	450	525
1x50	9.6	16.1	625	750
1x70	11.4	18.3	853	1050
1x95	13.0	20.3	1091	1425
1x120	14.7	22.4	1363	1800
1x150	16.5	24.6	1678	2250
1x185	18.3	27.6	2074	2775
1x240	20.9	30.6	2660	3600

Standard length cable packing: 500 m on drums. Other forms of packing and delivery are available on request

TFCrane (N)GRDGCGÖU-J

Based on: DIN VDE 0250-814

— Low Voltage Screened Rubber Insulated Flexible Cable
— Upon request, weights and diameters may be individually adjusted based on end-use applications or customer requirements.

Applications: Screened flexible cable designed for use on gantry. Suitable where the maximum emission values are required or where power cables are expected to cause interference and disruption on data cables, power cables are The cable is used under high mechanical stresses, especially for applications with frequent bending. Usable in wet or dry conditions, outdoors, indoors.

Construction

Conductors	Flexible stranded annealed bare copper conductor class 5 to IEC 60228
Separator	If needed a suitable tape separator between the conductor and insulation
Insulation	EPDM rubber, halogen-free, lead-free compound, type 3GI3 acc. to DIN VDE 0207/20, developed by TFKable
Color of insulation*	Colour coding of power conductors comply to HD 308. DIN VDE 0293- 308 Power cores: 3-core circuit identification: Green-yellow, blue, brown 4-core circuit identification: Green-yellow, brown, black, grey 5-core circuit identification: Green-yellow, blue, brown, black, grey
Inner sheath	A synthetic thermosetting compound type Gm1b acc. to DIN VDE 0207/21
Color of inner sheath	Black
Screen over inner sheath	Braid screen made of tinned copper wires - covering min. 80%
Outer layer of sheath	Designed by TFKable, synthetic thermosetting compound, type 5GM3 acc. to DIN VDE 0207/21
Colour of outer jacket	Black

**other core identification available on request*

Characteristics

Current carrying capacity	DIN VDE 0298-4
Max. conductor operating temperature	+90°C
Max. conductor temperature during short circuit	+250°C
Minimum ambient temperature for fixed installation	-40°C
Minimum ambient temperature for mobile installation	-35°C

Minimum bending radius acc. to DIN VDE 0298-3:

OD of cable[mm]	>8 ≤ 12	>12≤ 20	>20
Fixed installation	3D	4D	4D
On drums	5D	5D	5D
On deflection pulleys	7.5D	7.5D	7.5D
Moving freely	4D	5D	5D
Travel speed up to	250m/min		
Tensile load	15N/mm^2		
Flame propagation	PN-EN 60332-1-2, IEC 60332-1-2		
Oil resistant	PN-EN 60811-404, IEC 60811-404		
UV resistant	UL 2556, ISO 4892-2		
Ozone resistant	PN-ISO 1431-1		

Example of standard sheath marking: TFKABLE 3 TFCrane (N)GRDGCGÖU-J 4x10 0.6/1 kV CE year + meter

Parameters

Number of cores x cross-section	Conductor diameter	Approx. overall diameter	Approx. weight	Max. tensile load
mm^2	**mm**	**mm**	**kg/km**	**N**
4x1.5	1.5	13.2	267	90
4x2.5	2.1	15.9	392	150
4x4	2.7	18.3	548	240
4x6	3.2	19.6	659	360
4x10	4.2	23.7	991	600
4x16	5.3	26.8	1416	960
5x1.5	1.5	14.5	346	112.5
5x2.5	2.1	17.5	497	187.5
5x4	2.7	19.6	636	300
5x6	3.2	21.0	780	450
5x10	4.2	25.5	1180	750
5x16	5.3	29.4	1659	1200

Standard length cable packing: 500 m on drums. Other forms of packing and delivery are available on request

UV

I

250 m/min

MIN −35°C

O_3

Insulation Pb Free

TFCrane FOMFLEX

Based on: EN 60794-3

— Flexible rubber sheathed cables with optical fibres
— Upon request, weights and diameters may be individually adjusted based on end-use applications or customer requirements.

Applications: Rubber sheathed flexible cable for data transmission, immune to electromagnetic interference with special application requirements on mobile materials handling equipment.

Construction

Element	Type	Material	Dimension
Fibers	2-24 fibers G50/125, G62,5/125 or E9/125		
Identification of fibres	Comply to IEC 60304: red; green, blue, white, violet, orange, grey, yellow, brown, pink, black turquoise		
Identification of tubes/elements	First tube - red, second tube/filler - natural		
Support elements	Dielectric rod	FRP	Ø 0.5 mm
FRP coating	Natural	PBT	Ø 0.5 mm
Secondary coating	Loose tube - thermoplastic material 2-12 fibres	PBT	Ø 2.6 mm (approx.)
Filling of the tube	Gel	Tixotropic gel	
Inner sheath	Black	TPE	Thickness: minimum spot 0.8 mm, average 1.0 mm
The wrap and braid	The wrap of glass tape. Special braid of Kevlar threads, tensile-strength reinforcement by means of longitudinal Kevlar threads. Surface covered: approx. 80%		
Outer sheath	Special synthetic thermosetting compound, 5GM5 quality acc. to DIN VDE 0207/21		
Colour of outer jacket	Orange		

Characteristics

Minimum ambient temperature for fixed installation:	-40°C
Minimum ambient temperature for mobile installation:	-35°C

Minimum bending radius acc. to DIN VDE 0298-3:

Thickness of flat cable [mm]	10xD
Fixed installation	15xD
Twist limits	100°/m
Tensile load	Up to 2000 N
Travel speed up to	250m/min
Flame propagation	PN-EN 60332-1-2, IEC 60332-1-2
Oil resistant	PN-EN 60811-404, IEC 60811-404
UV resistant	UL 2556, ISO 4892-2
Ozone resistant	PN-ISO 1431-1

Example of standard sheath marking: TFKABLE 3 TFCrane FOMFLEX 24G62.5/125 year + meter

Parameters

Number of fibres in a cable	Outer diameter of tube	No. of elements in a cable (tubes/filers)	Cable dimensions	
			Approx. outer diameter	Approx.weigh
n	**[mm]**	**(tubes/filers)**	**[mm]**	**[kg/km]**
2-24	2.6	4	10.9	120

Standard length cable packing: 1000 m on drums. Other forms of packing and delivery are available on request

Fiber data

Parameter	G50/125 multimode	G62.5/125 multimode	E9/125 singlemode
Attenuation at 850 nm	≤3.0 dB/km	≤3.5 dB/km	–
Attenuation at 1300 nm	≤1.0 dB/km	≤1.0 dB/km	–
Attenuation at 1310 nm	–	–	≤0.4 dB/km
Attenuation at 1550 nm	–	–	≤0.25 dB/km
Bandwidth at 850 nm	≥500 MHz*km	≥200 MHz*km	–
Bandwidth at 1300 nm	≥500 MHz*km	≥500 MHz*km	–
Numerical Aperture at 850 nm	0.200 ±0.015	0.275 ±0.015	–
Group refractive index at 850 nm	1.482	1.496	–
Group refractive index at 1300 nm	1.477	1.491	–
Group refractive index at 1310 nm	–	–	1.466
Group refractive index at 1550 nm	–	–	1.467

Electrical Parameters

Power Conductor Resistance

Cross-section	Max. conductor resistance at 20°C Plain wires	Tin-coated wires
mm²	**Ω/km**	**Ω/km**
1,5	13.3	13.7
2,5	7.98	8.21
4	4.95	5.09
6	3.30	3.39
10	1.91	1.95
16	1.21	1.24
25	0.780	0.795
35	0.554	0.565
50	0.386	0.393
70	0.272	0.277
95	0.206	0.210
120	0.161	0.164
150	0.129	0.132
185	0.106	0.108
240	0.0801	0.0817
300	0.0641	0.0654

Electrical Parameters

CURRENT-CARRYING CAPACITY FOR CONTINUOUS OPERATION (ACC. TO VDE 0298-4) AT 30°C AMBIENT TEMPERATURE (3 CORE CABLES)

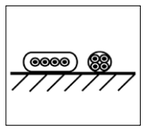
Low Voltage cables up to 0.6/1 kV and Medium Voltage cables up to 10 kV

Laying on the floor | Festoon cable | Monospiral reels | Flat cables | One layer | Two layers | Three layers

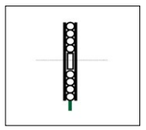
Parameters

Cross-section mm²	One cable	Festoon	Monospiral reels	Festoon	Cylindrical reels						
	Laying on the floor A	Suspended freely in air A	Round cables A	Flat cables A	1 layer A	2 layers A	3 layers A	4 layers A	5 layers A	6 layers A	7 layers A
	(Factor) 1	1.05	0.8	0.49	0.8	0.61	0.49	0.42	0.38	0.27	0.22
1	18	19	14	9	14	11	9	8	7	5	4
1.5	23	24	18	11	18	14	11	10	9	6	5
2.5	30	32	24	15	24	18	15	13	11	8	7
4	41	43	33	20	33	25	20	17	16	11	9
6	53	56	42	26	42	32	26	22	20	14	12
10	74	78	59	36	59	45	36	31	28	20	16
16	99	104	79	49	79	60	49	42	38	27	22
25	131	138	105	64	105	80	64	55	50	35	29
35	162	170	130	79	130	99	79	68	62	44	36
50	202	212	162	99	162	123	99	85	77	55	44
70	250	263	200	123	200	153	123	105	95	68	55
95	301	316	241	147	241	184	147	126	114	81	66
120	352	370	282	172	282	215	172	148	134	95	77
150	404	424	323	198	323	246	198	170	154	109	89
185	461	484	369	226	369	281	226	194	175	124	101
240	540	567	432	265	432	329	265	227	205	146	119
300	620	651	496	304	496	378	304	260	236	167	136

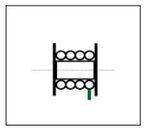
MEDIUM VOLTAGE CABLES ABOVE 10 kV



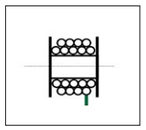
Laying on the floor



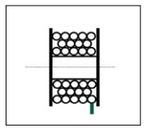
Monospiral reels



One layer



Two layers



Three layers

Parameters

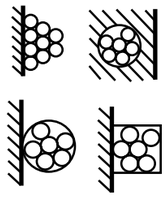
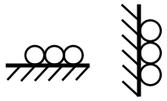
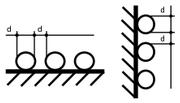
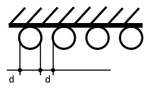
Cross-section mm²	One cable	Monospiral reels	Cylindrical reels						
	Laying on the floor A	Round cables A	1 layer A	2 layers A	3 layers A	4 layers A	5 layers A	6 layers A	7 layers A
	(Factor) 1	0.8	0.8	0.61	0.49	0.42	0.38	0.27	0.22
16	105	84	84	64	51	44	40	28	23
25	139	111	111	85	68	58	53	38	31
35	172	138	138	105	84	72	65	46	38
50	216	173	173	132	106	91	82	58	48
70	265	212	212	162	130	111	101	72	58
95	319	255	255	195	156	134	121	86	70
120	371	297	297	226	182	156	141	100	82
150	428	342	342	261	210	180	163	116	94
185	488	390	390	298	239	205	185	132	107
240	574	459	459	350	281	241	218	155	126
300	660	528	528	403	323	277	251	178	145

DE-RATING FACTOR FOR AMBIENT TEMPERATURES OTHER THAN 30°C

Ambient temperature °C

10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85
1.15	1.12	1.08	1.04	1.0	0.96	0.91	0.87	0.82	0.76	0.71	0.65	0.58	0.50	0.41	0.29

DE-RATING FACTORS FOR GROUPING

Arrangement cables	Number of multi-core cables or number of single or three-phase circuits made up of single-core cables (2 or 3 loaded conductors)														
	1	2	3	4	5	6	7	8	9	10	12	14	16	18	20
	De-rating factors														
Bunched directly at the wall. on the floor. in conduit or ducts. on or in the wall 	1.00	0.80	0.70	0.65	0.60	0.57	0.54	0.52	0.50	0.48	0.45	0.43	0.41	0.39	0.38
Single layer on the wall or floor. touching 	1.00	0.85	0.79	0.75	0.73	0.72	0.73	0.71	0.70	0.70	0.70	0.70	0.70	0.70	0.70
Single layer on the wall or floor. spaced with a clearance of 1 x d (cable diameter) 	1.00	0.94	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Single layer under ceiling. touching 	0.95	0.81	0.72	0.68	0.66	0.64	0.63	0.62	0.61	0.61	0.61	0.61	0.61	0.61	0.61
Single layer under ceiling. spaced with a clearance of 1 x d (cable diameter) 	0.95	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85

DE-RATING FACTORS FOR MULTI-CORE CABLES WITH CONDUCTOR CROSS-SECTIONS UP TO 10 mm²

Number of loaded cores	5	7	10	14	19	24	40	61
De-rating factors	0.75	0.65	0.55	0.50	0.45	0.40	0.35	0.30

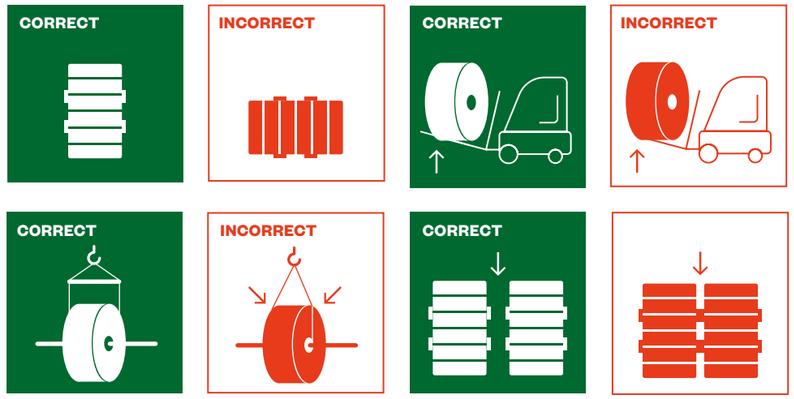
Guide to use of TFCrane cables

1. Introduction

This manual contains information relevant to the handling of cables, including transport, storage, installation and maintenance. However, additional questions may arise, therefore we always encourage you to contact our team.

2. Transportation and storage

Be careful when transporting the drums to avoid damage to the cable or personal injury. Particular attention should be paid to the weight of the drum, as well as to the method and direction of turning and the lifting method. During storage, the drum flanges must not come into contact with the cable on the adjacent drum. If the storage temperature of cables is lower than recommended during installation, they should be protected against such mechanical loads as: shocks, knocks, bending or twisting.
If the cable is not fully protected, for example by battens or plastic foil, it must be stored in a place protected from the weather. The ends of the cables should be sealed to prevent moisture penetration during transport and storage.

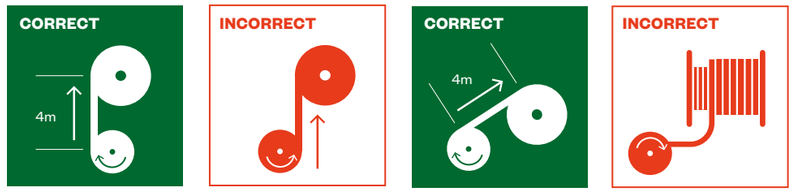


3. Installation and use

3.1 CABLE INSTALLATION

Generally, when the cable is installed onto a force guidance system through a reel or festoon, the delivery drum should be raised above the ground level. The recommended method of proceeding with installing the cable on site is to lift the delivery drum (original one) and then unwind the cable along its entire route. We perform this task using standard cable pulling tools and rollers. It happens that the environmental conditions do not allow us to perform these actions. Then you need to rewind the cable directly from the drum onto the drum/reel. This operation is also recommended when the location of the drum/reel and/or cable travel route are not available. In this case, „S" -shaped deflections between the drum and the drum/reel should be avoided. Whenever possible, the cable should be rewound directly without changing direction. Direct scrolling from the delivery drum to the final drum/reel must be performed slowly and at the minimum tension. Doing so will prevent the cable from twisting during installation. The following instructions show the general rules for unwinding the cable. The correct method of installation should be done by unwinding the cable along the machine using a standard cable pulling system and rollers. If this is not possible due to the existing conditions, the transfer should be carried out directly to the working drum, while avoiding

the cable bending and keeping the distance between the drums/reels at least 4m.

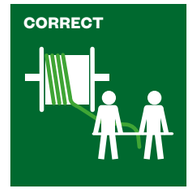


3.1.1 Twist removal

If cable twisting will take place during transport or installation, it is recommended to eliminate it. The methods described below are recommended as the most effective to reduce it.

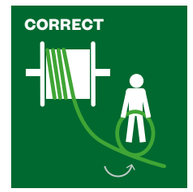
3.1.1.1 Wave motion

This method requires the involvement of two people who, holding the roller on which the cable is placed, move towards the free end of the cable, thereby shifting the „wave" of the turn. This operation should be performed until the effect of turning is completely removed.



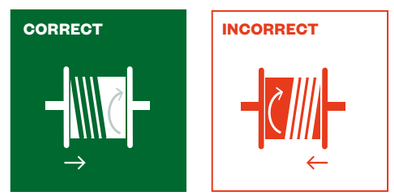
3.1.1.2 Spiral method

Removal of a twist by this method is performed by one person. To do this, create a spiral from the cable wound on the drum and roll/unscrew it to the free end of the cable. Depending on the turn, rolling/unscrewing should be done to the right or left. Repeat these steps if the turn has not been eliminated after the first attempt.



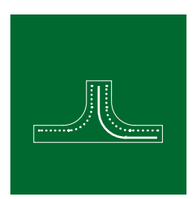
3.1.2 Cable installation on cylindrical reels

Crane cables of the TFCrane series may be produced in a left, or right hand direction, therefore we recommend to contact with TFK engineers to determine the direct way of winding. This will allow you to take advantage of the natural tendency of the cable to move to the left/right when it is rewound and keep the scrolls close to each other.



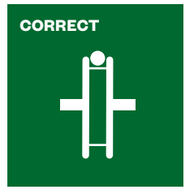
3.1.3 Reducing the friction

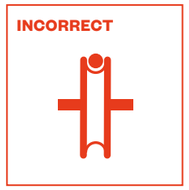
For cables with a larger diameter it is recommended to use rollers that will reduce the friction of the coating during the change of the scrolling direction.



3.2 REELS

Attention should be paid to the disadvantage of using the guide rollers which is the negative effect on the outer coating of the cable that is in contact with the roll profile. The contact surface is additionally increased if the rim profile has a hollow shape (basin). This is important because it significantly reduces the lifespan of the cable, therefore it is recommended to use a flat roller as shown in the graphics below.





Invalid roll profile
In this case, the twisting effect is induced as a result of rolling the cable over the roll, which leads to its faster wear.

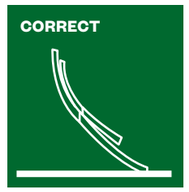
The correct roll profile
The construction used in this way minimizes the twisting effect.

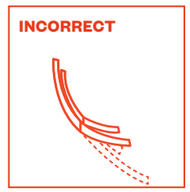
3.3 CHANGE OF DIRECTION

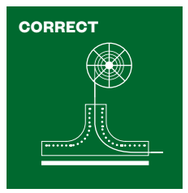
At the stage of designing the cable winding system, appropriate distances should be assumed due to the change of the winding direction. The recommended distance should be equivalent to at least 20 times the cable diameter (or larger at high speed systems). This approach will allow the cable to recover its initial shape before the next rewinding.

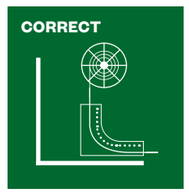
3.4 CABLE GUIDES

The next step after determining the winding system is the selection of cable guides. Their incorrect selection may lead to incorrect operation of the winding system. Among the available solutions, the best in use are guides that ensure large bending radii with minimal deflection of the cable. The arrangement of the guides should be in one axis with the cable tray. Any misalignment will lead to increased twisting of the cable.









3.4.1 Cable feeding point

The one-way guides are often used even for two-directional feeders for purely economic reasons. However, due to the significant extension of the cable life cycle, a better solution is to use two-way guides: in fact, the twisting and "massage" effects transmitted by the cable guide are balanced using a symmetrical two-directional guide. The problem does not occur if the winding system is installed at the end. In this case, the one-way guide makes contact with the cable regardless of the direction of machine movement. The preferred solution is the use of two-directional guides or a multi-roll system. These solutions should be designed to hold the curve beyond the angle of deflection. In this way, the minimum bending radii are always maintained. It is also necessary to avoid sudden changes in the bending radius (this is often due to the insufficiently wide angle of the arc of the roller guide). These changes lead to local pressure and as a result to possible cable breakage.

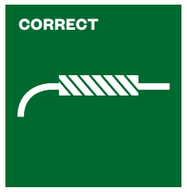
The cable should be fed at the center point above the cable guide, regardless of one or two-way guidance.

3.5 PROTECTION AGAINST TOO HIGH OR TOO LOW STRESS

It is strongly recommended that cable guiding systems include protective devices against both excessive and too low stress. Even short-term exposure to excessive stress caused by mechanical failure or accidents may cause the cable to stop working due to permanent deformation of the cores or breake off. At the same time, the other way around it is desirable that the stresses are not too small so that the cable does not hang freely on the drum/reel. This protection is particularly important for high positioned cable drums/reels. All overload and underload protection devices should be set for maximum continuous safe operation at the working stresses defined for each section of the cable.

3.6 CABLE MESH GRIP

Optimal strain relief for the cable at the feed point. Safe and easy to use, where forces are spread over a larger surface to prevent damage to the cable.

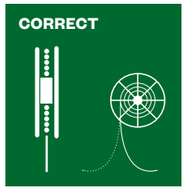


3.7 CABLE REELS/DRUM TYPES

Cable durability and efficiency is closely related to a properly designed winding system. A well-designed system together with a properly selected cable ensures optimal efficiency of the entire system, guaranteeing continuity of work and increased life and reliability. Today's market offers a wide range of winding systems, which are briefly described below.

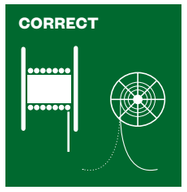
3.7.1 Monospiral reel

In the case of this type of cable drums, due to the better heat dissipation, the cross section of the power cable is generally smaller compared to other types of drums. The diameter and length of the cable are the main factors to consider when using monospiral drums: a well-saved balance between the inside and outside diameter of the reel/drum allows you to optimize and better control the cable tension.



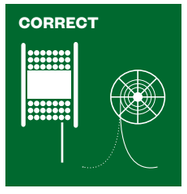
3.7.2 Cylindrical drum

This solution is especially recommended for cables with large lengths and diameters. Its biggest advantage is the ability to drag a large amount of cable (with increased diameter) over long distances with constant tension. It is important that the guide mechanism does not damage the cable during unrolling, for example, to prevent unusual friction against the surface of the spiral or irregular twist. It is recommended to use a maximum of two layers to allow thermal balance.

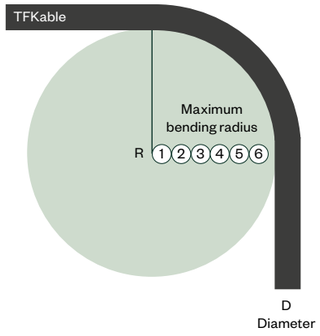


3.7.3 Standard drum

It is the simplest and cheapest solution, but it does not guarantee full control over the cable layers and does not ensure proper operation at high speeds. There may be situations in which the cable is wound unevenly or only on one side, which can cause serious operational difficulties. This solution can only be recommended for cables with small diameters keeping in mind the mentioned work speed.



3.8 MINIMUM BENDING RADIUS



The minimum bending radius describe how tight can be a cable bend without kinking it, damaging it or shortening its lifetime. Minimum bending radius express the smallest possible bend. The smaller the bending radius, the shorter bends you can make. The bending radius is expressed as a multiple of the outer diameter of the cable, for example 6xD, where D is the cable outer diameter.
Cable bends, especially tight bends, can restrict a cable's ability to equalize forces between stresses. It is not uncommon for someone to consider how to route and dress out a cable to ensure that any bend does not exceed the minimum bending radius. The temptation is to see these specifications as guidance only and to make a compromise. All too often this can lead to a premature cable failure. Such a situation may result in machine downtime due to cable failure and the cost of downtime and replacement cable assemblies far outweighs the added cost to do it right the first time.
The permissible minimum bending radius are available in technical data sheets for each type of cable.

3.9 EXCESSIVE TENSION

Excessive tension on the cable can cause the conductors to be pulled out of their "lay." Once conductors are pulled out of their lay, they are no longer properly configured within the cable build, and the cable will begin to corkscrew. This may lead to the cable core puncturing through the jacket. Remember to ensuring that tensions applied equally to all conductors.

3.10 STRAIN RELIEF

There is strongly recommended to implement in moving reel cable the systems with tension relief. During winding, the conductors should be able to move within the cable to ensure compensation of the length in their lay.
Each of system, central or the end feeds should use tension relief reels comply with the cable minimum bending radius and that relief section are provided. The tension relief is ensured when at least two, 2 ½ windings are in place on the motorized cable reel and on the tension relief drum.
Another options which can be applied to relief the cable tension is to use the correct cable mesh grips. Its choose depends on application, system.
The cable service time will be reduced if there would not be correctly implemented tension relief. Use the clamps only for guiding purposes.

3.11 FESTOON SYSTEMS

The recommended method of installing the cable on trolleys is to unwind the cable from the drum/reel along its working path using standard cable pulling tools. If it is not possible to unwind the cable, it is acceptable to install directly from the drum.
It should be noted that cable trolleys are built with several levels with saddles of a certain diameter. The cable should be mounted on a saddle with a diameter adapted to the diameter of the tested cable and to the bending radius of the cable.
Special attention should be paid to the clamps that tighten the mounted cables in order to prevent them from slipping off the trolley. Also, the screws on the cable clamps must not be overtightened as this may damage the outer sheath of the cable.

The weight of the cables should be distributed evenly on the saddles of the cable trolley.
Cables should be installed with equal spacing between trolleys.
When installing cables, pay particular attention to protruding elements that could damage the cable during operation.
For festoon cables, clamps should be used to stabilize the cable bundle to keep the cables in the correct position during operation (figure 3.2 and 3.3). The number and type of used clamps should be in accordance with the crane manufacturer's recommendations.

Figure 3.1

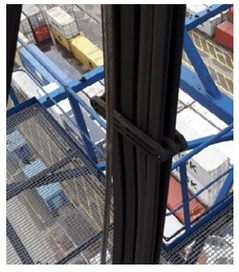


Figure 3.2

Figure 3.3

3.12 REELING SYSTEMS – MONOSPIRAL DRUM

The recommended method of installation for this application is to unwind the cable from the drum/reel along its working path using standard cable pulling tools. If it is not possible to unwind the cable, it is acceptable to install directly from the drum.
It is recommended that the cable is wound onto the reel with a length reserve. Once the device has reached the end of the track, there should be a sufficient number of rolls left on the reel according to the manufacturer's recommendation. The cable should be prevented from unwinding completely, as this may damage the monospiral reel and the cable.
In applications where a monospiral reel is used, attention should be paid to the selection of the cable wheel diameter, so that the installed cable can move freely and lay on the reel. To avoid damaging the sheath of the installed cable by non-rotating rollers, check the condition of the roller track.
Check the way the cable is laid when the crane passes through the funnel. Correctly installed cable should be located in the centre of the funnel, away from the walls and edges. Otherwise, the cable sheath may be damaged.
During installation, special attention should be paid to the proper fixing, minimising the forces impacted the cable.
It is recommended to apply the usage of tensile relief drum.

Figure 3.4
Crane position at the end of the track - Reserve number of coils wound on the mono-spiral wheel.

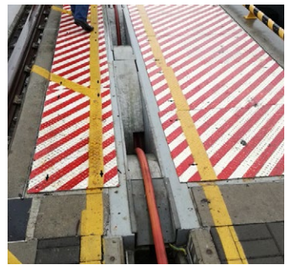


Figure 3.5
Correct placement of the cable in the funnel.

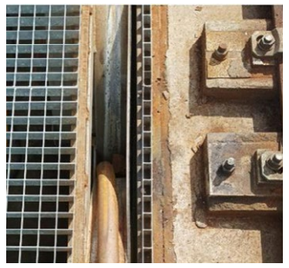


Figure 3.6

3.13 DRAG CHAIN

During installation, place the cable in the drag chain, leaving free space around it as recommended by the manufacturer. It is advisable to provide a minimum gap to allow the cable to move freely, minimising the effect of tensile forces.
Cables should be laid so that each of them can move freely in both directions. Note that cables should not be twisted and ensure that they are stacked straight, avoiding bends. Each cable should find its place in the separator to minimize potential problems such as corkscrew effect, cable displacement between separators or even cable damage.
It is necessary to check whether the cables are correctly installed in the chain application. The cables should adhere to half the height of the guide housing. It is necessary to check that the wires are correctly installed in the chain application. The wires should adhere to half the height of the guide casing. Above half the height of the guide, the wires should move away from the housing. It is also important to ensure that the cable is not installed too rigidly (the cable must be able to move freely inside) or too loosely.
Cables of different diameters should be installed separately and the weight of the cable should be evenly distributed over the entire width of the cable guide. For this purpose, modular separators can be used.
When using drag chain applications with high speed and frequency of cycles, it is forbidden to place them vertically in relation to each other without using horizontal separation.
Cables with different sheath materials should not come into contact with each other and should be separated when possible.
Note to tighten the cable clamps installed in the cable drag chain. Special attention should be paid to the direction of the clamps in accordance with the manufacturer's recommendations.

Figure 3.7
Correct placement of the cable in drag chain

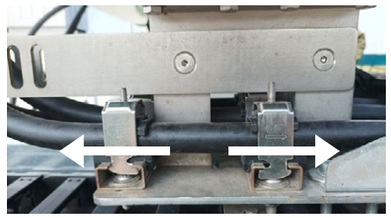


Figure 3.8
Clamps's correct direction

3.14 WORK STANDARD

Establish the standard of work, so different operators are not doing termination differently from one another.

GLOBAL ENGAGEMENT: DRIVING TECHNOLOGICAL EXCELLENCE IN THE CABLE INDUSTRY

We participate in meetings of international cable industry organisations (**Europacable, PEMA, BCA, ICF, PSEW, CIGRE, PIGE, EDA, BSI, CMPS, LEA, ACI, PPC, PTMEW, Cooper Mark**). This means we have access to knowledge about new industry trends, as well as market needs and expectations. Based on this, we deliver technologically advanced products of the highest quality.

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