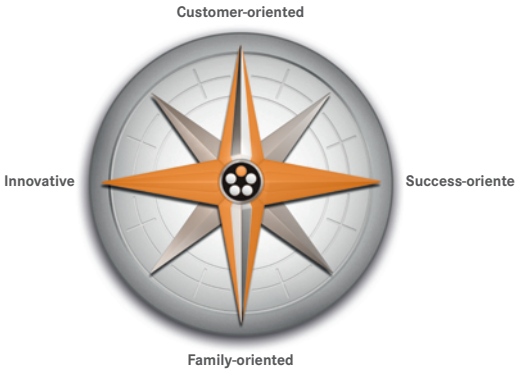
LAPP CABLE GUIDE

LAPP GROUP

Our guiding principles



Welcome

To contact your local Lapp Group representative please visit **www.lappgroup.com/worldwide**

Content

Foreword

Small, handy and filled with all the important information on connection technology – the Lapp Cable Guide simplifies your day-to-day operations using our products.

The updated edition of our practical pocket-size lexicon contains everything you need to know about proper use of cables, connectors and accessories. It also contains a number of technical tables, featuring information on brief type designations, load capacity, chemical resistance, protection ratings and thread dimensions.

The comprehensive specialist lexicon is another particularly helpful feature, enabling you to research the most important terms in the field of electrical engineering. In addition to English, the updated edition of the Lapp Cable Guide is also available in German, Spanish, French, Russian and Romanian – enabling you to enjoy international success with Lapp.

With best regards,

Andreas Lapp

Reliably connecting the world

We want to help you become even more productive and successful. This is why we work tirelessly on optimising our processes. We do everything to make sure we always find the best solution for you and also provide you with quick, efficient and effective support.

No matter where you are – we are always by your side. Our plants, sales companies, partners and, above all, our competent teams of advisers ensure we offer you a comprehensive service on every continent. We do not simply distribute cable technology, we also manufacture our products ourselves – which represents another advantage for you. As a manufacturer with 18 of our own production facilities, you will benefit from our expertise in the development, design and manufacture of cables, system products and cable accessories. Thanks to this expertise, we can guarantee that Lapp will provide you with the quality that you require and that you demand.

You can always rely on quality from Lapp – wherever you are in the world. This is also embodied by our strong brands.

Close proximity to the market

Solar Energy
Automation
Wind Energy
Infrastructure

Mechanical and
Plant Engineering
e-Mobility

Rail
Food & Beverage

Our quality: tested and certified

Certificates and quality seals

Many of our products are certified, just like our companies. Certificates are always awarded by independent bodies. They are both a seal of quality and a certificate of non-objection, representing technical “passports” for international use.

Our most important certificates

www.lappgroup.com/certificates

Our test laboratory

Multimillion bending cycles at maximum speeds and minimum bending radii. This is only one of many tests that a highly-flexible line has to withstand to be accepted into our standard product range.

In addition to load and endurance tests, state-of-the-art analysis methods are employed. For example, we use x-ray methods such as EDX to detect any possible hazardous materials. It is our aim to keep our products safe and to employ substances which are safe to use and represent no health hazard as well as minimise the environmental impact.

e-Services:
easy, efficient, effective

Lapp Group Online provides a huge amount of information surrounding the Lapp Group. From A for “anti-kink” to Z for “zinc”.
www.lappgroup.com

Cable Finder
Make short work of searching for cables.
www.lappgroup.com/cablefinder

Connector Finder
Configure your EPIC® square, circular or solar plugs online, with only a few clicks of the mouse.
www.lappgroup.com/connectorfinder

Cable Gland Finder
Use the SKINTOP® Finder to help you identify the cable gland you need and the required accessories.
www.lappgroup.com/cable-glandfinder

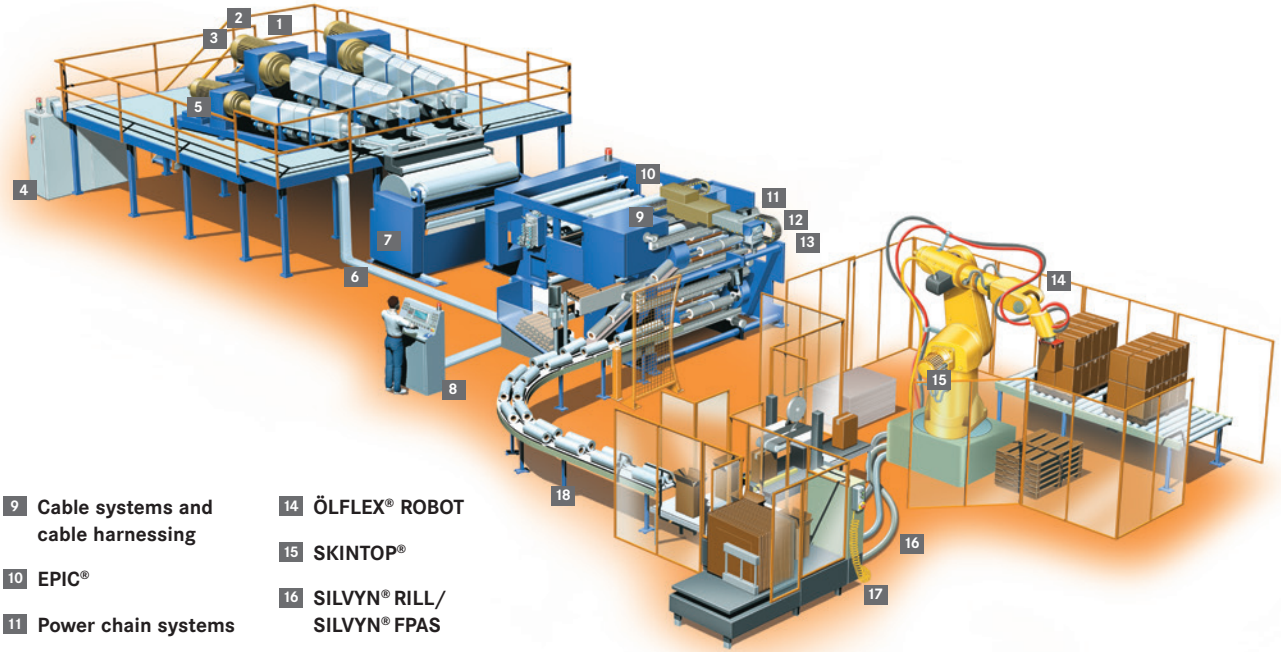
Charging Cable Configurator
The Charging Cable Configurator enables you to find the cables and connectors you need to create the perfect charging cable in no time.
www.lappgroup.com/emobility-cablefinder

CAD Product Catalogue
Design time costs money. Our CAD Product Catalogue enables developers and planners to save both.
www.lappgroup.com/3d-data

The Lapp Group – The System Supplier

Our brands are adjusted exactly to your workflow.
We have got the appropriate product for every application.

1 ÖLFLEX® SERVO FD
2 FLEXILABEL LFL
3 EPIC® CIRCON LS1
4 LCK Wrapping Label + FLEXIMARK® Stainless steel marking
5 SERVO harnessings for drives
6 HITRONIC® program for optical fibres
7 HOT-MELT
8 UNITRONIC® BUS PB



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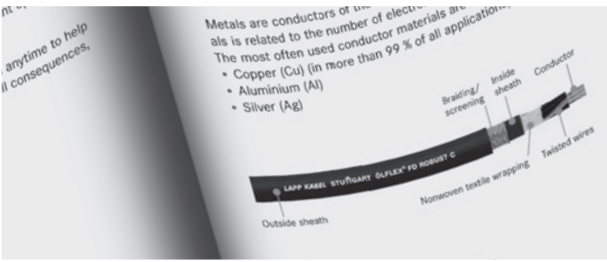
You can reach us anywhere in the world

...or closer to home. To contact your local Lapp Group representative:

please visit

www.lappgroup.com/worldwide

Cable Engineering



Introduction to Cable Engineering

The Fundamentals of Cable Engineering

1. What cables and conductors are required for
2. Explanation of general terms
3. Labelling products of the Lapp Group programme
4. Selection criteria

Introduction to Cable Engineering

Continuous supply of electric power, or faultless data transfer respectively, provided mostly through wiring, are a primary requirement affecting virtually all areas of our life. This results in tough requirements for production, installation and operation of cables. To be able to design the cables suitably and to install them correctly, it is necessary to have good knowledge in various fields, e. g. physics, electrical engineering, mechanic and other applied engineering sciences.

Cable failure can be caused, for example, by mechanical action or electrically by over-voltage, by insulation ageing, corrosion, sneak currents, as well as by unqualified installation or by incorrectly or badly dimensioned design. What is also important is technically correct elaboration of a wiring project and proper crosscheck of all installation work.Then, in operation, it is necessary to observe relevant operating conditions, a cable was designed for.

Employees of the Lapp Group are prepared anytime to help you professionally in preventing any and all consequences, which may be caused by a wiring failure.

The Fundamentals of Cable Engineering

1. What cables and conductors are required for

- Electric power transmission – for power supply
- Transmission of data, signals or impulses – for data communication

Generally, the term of electric cable means a route for transmission of el. power, data or signals betweeen a source and an appliance (for data cables → transmitter and receiver).

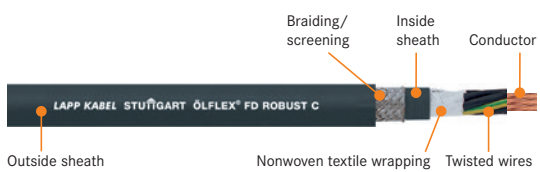
2. Explanation of general terms

2.1 Conductor

Conductor (conductive core) represents a conductive route of electric power and together with insulation it forms a wire. Several wires form a core. A sheath protects a cable from external actions.

Metals are conductors of the 1st class. Conductance of metals is related to the number of electrons in their outer layer. The most often used conductor materials are as follows:

- Copper (Cu) (in more than 99 % of all applications)
- Aluminium (Al)
- Silver (Ag)



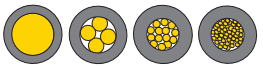
Conductors can be bare or treated (tinned, silver-coated, gold-coated).

Classification according to design:

- Compact core: of a single wire (up to 16 mm²) or of multiple wires
- Stranded core: made of 7 to several hundreds of thin single wires (VDE 0295/ IEC 602258).

Classes of stranded cores are specified in VDE 0295, or from 0.5 mm² in compliance with IEC 60228 respectively. Max. diameter of a single wire and max. conductor resistance are critical for the core design. The larger cross-sectional area, the lower resistance; the larger length, the higher resistance (similarly as for water supply piping).

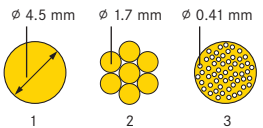
Stranded core classe



Class 1: compact
Class 2: made of multiple wires
Class 5: made of fine wires
Class 6: made of extra-fine wires

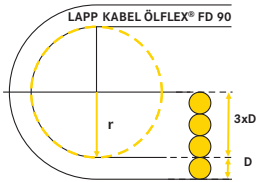
Example of a conductor with nominal cross-sectional area of 16 mm²

$A = \pi r^2$ or $A = \pi d^2/4$
A = geometric cross-sectional area
r = radius
d = diameter



1: solid wire (1 x 4.5 mm)
2: multiple wires (7 x 1.7 mm)
3: fine wires (122 x 0.41 mm)

Minimum bending radius



D = Cable outside diameter

It is a characteristic value, which gives you a degree of possible cable bending without its damaging. It is absolutely necessary to respect this value, when using a cable in tow chains (“FD” cables in the Lapp Group programme). Only maximum outside diameters are shown for highly flexible cables; tolerance is possible only downwards.

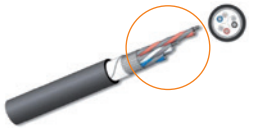
2.2 Insulation

Insulation is electrically non-conducting protective layer around the conductor. Insulating materials are applied on conductors by extrusion. The mostly used insulating materials are compounds of organic elements.
C, H_2, O_2, N_2, S, e. g.:

- Thermoplastics: PVC, PE, PP, PTFE
- Elastomers (rubber): CR, SR
- Thermoplastic elastomers: PUR, TPE-E

An insulated conductor is called a wire.

2.3 Twisting



While producing a multiwire cable the wires are twisted together.

A cable of wires, a bundle of wires or a twisted bundle (cable core) is created.

Reasons for twisting are:
- Lower need for space → smaller outer diameters
- Circular form
- Flexibility

2.4 Identification of wires (wire identification code)

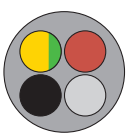
To be able to connect the wires correctly, they must be uniquely identified.

Numbering
- All wires are identified by numbers in ascending order from 1 to ...
- Mostly by white digits on black background (insulation)
- The only exception is a protective conductor, which is always green-yellow

Numbered wires
Protective green-yellow wire
Colour ratio 70:30

Colour code
- All wires are differentiated by different colours of insulation
- Individual colours are specified in the “Wire Identification Code”
- E. g. according to DIN VDE 0293-308/HD 308 S2

Coloured wires
Protective green-yellow wire
Colour ratio 70:30



2.5 Protection, screening, armouring

It has 2 main functions:

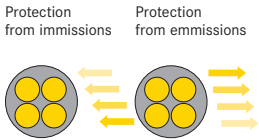
- Mechanical protection by braiding made of steel wires protected from “S” oxidation, e. g. ÖLFLEX® CLASSIC 100 SY

- Electromagnetic protection (EMC) by braiding made of tinned copper “C” wires, e. g. ÖLFLEX® CLASSIC 110 CY black 0.6/1 kV

- Or by braiding made of copper “D” wires, e. g. ÖLFLEX® ROBOT 900 DP

- Or by braiding made of metallized foil (e. g. aluminium bonded (steamed) polyester sheet), e. g. UNITRONIC® BUS EIB

2.6 Sheath



The sheath is a closed cover protecting elements laying under the sheath from external actions (mechanical, thermal, chemical or physical damages). Correct selection of sheath material is decisive.

Mechanical actions:
- Abrasion, impact, bending, tension, twisting (torsional swinging) ...

Examples of protections: braiding of steel wires, bearing members, supporting braiding, protective hoses

Chemical actions:
- Acids, caustics, oils, solvents, water (from 50 °C)

Examples of protections: sheath materials, such as TEFLON®, ROBUST, PUR; protective hoses

Thermal actions:
• Cold, heat
Examples of protections: mixture with thermal stabilisers, TEFLON®, silicone

Physical actions:
• UV radiation, radioactive radiation
Examples of protections: mixture with UV stabilisers

The mostly used sheath materials are as follows: PVC, PUR, SR, CR.

3. Labelling products of the Lapp Group programme

ÖLFLEX® CLASSIC 110 4 G 1.5 mm²
1 2 3 4

1. Brand, identification
2. Number of wires
3. G with a protective conductor or X without a protective conductor (green-yellow)
4. Cross-sectional area or diameter (J-Y(St)Y 4 x 2 x 0.6 mm) ... and relevant quantity

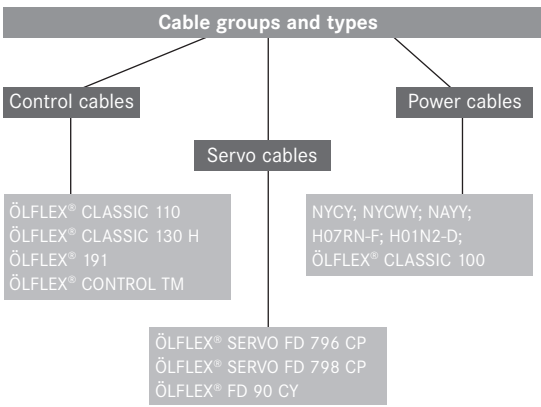
4. Selection criteria

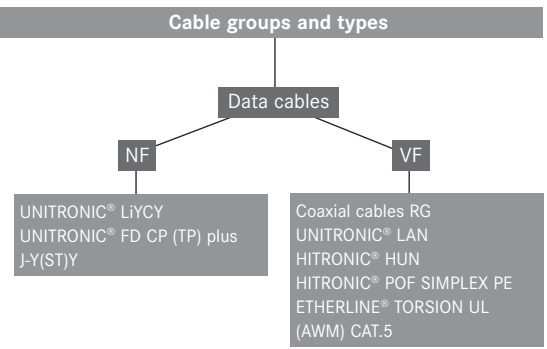
Which criteria are important?

1. What is the purpose of use?
Description of application

2. What nominal voltage is required?
• U_o/U
• 300 V, 500 V, 600/1000 V ...

3. Where the cable will be used?
Environment
Indoor or outdoor
• Thermal resistance
• UV radiation resistance
• Weather resistance





4. How the cable will be laid?
Way of laying
- Fixed or movable, in a tow chain, positively guided (pulleys ...): minimum bending radius, reversed bending cycles, tensile forces
- In open or closed cable systems (troughs, pipes ...): Current-carrying capacity, reduction factors
- In the vicinity of interference fields (EMC): Screening by copper braid

5. What requirements for norms should be fulfilled?
National norms, e. g. VDE, HAR, UL, CSA, NOM ...

6. Other requirements
- Behaviour in case of fire
- Non-halogenity
- Chemical actions: free of compounds harming varnish wettability, free of lead, resistance to oils, acids, water
- Mechanical actions: resistance to torsional strain, to abrasion, to extension strain

5. Standards, approbations, norms

Approbation is a defined special standard for cables issued by an authorised body including description of design (compositions, materials, diameters, etc.) and the use (see Table T6 and T18).

ÖLFLEX®
POWER AND CONTROL CABLES

ÖLFLEX® has become synonymous with power and control cables. Our flexible and oil-resistant cables satisfy the highest demands and can withstand even the very toughest conditions.

Application range

- Industrial machinery, machine tools, plant and equipment engineering
- Measurement, control, heating and air conditioning systems
- Wind power and photovoltaic systems
- Public buildings, airports and stations.
- Medical technology, chemical industry, composting plants and sewage works
- Food and beverage industry
- Construction machinery, vehicles and agricultural equipment
- Stage technology
- Mobile electrical equipment (electric tools, power tools, domestic appliances).

ÖLFLEX® CLASSIC 100

Colour-coded PVC control cable

Application range
- Plant engineering, Industrial machinery, Heating and air-conditioning systems, Power stations

Product features
- Flame-retardant according IEC 60332-1-2
- Good chemical resistance, see catalogue appendix T1

ÖLFLEX® CLASSIC 110

VDE-registered oil-resistant PVC control cable for a wide range of applications

Application range
- Suitable for torsional applications which are typical for the loop in wind turbine generators (WTG)

Product features
- Flame-retardant according IEC 60332-1-2
- Good chemical resistance, see catalogue appendix T1

Photographs are not to scale and do not represent detailed images of the respective products.

ÖLFLEX® CLASSIC 110 H/110 CH

Halogen-free control cable, oil resistant and very flexible

Screened halogen-free control cable, oil resistant and very flexible

Application range
- Plant engineering, Industrial machinery, Heating and air-conditioning systems

Product features
- Oil-resistant according to EN 60811-404 and UL OIL RES I and UL OIL RES II

ÖLFLEX® CONTROL TM CY

Application range
- Industrial machinery, plant engineering
- Wind turbines: USA Wind Turbine Tray Cable (WTTC)

Product features
- Flame-retardant according to CSA FT4 UL Vertical-Tray Flame Test
- Suitable for torsional applications which are typical for the loop in wind turbine generators (WTG)

Photographs are not to scale and do not represent detailed images of the respective products.

ÖLFLEX® ROBUST 210

Proven all-weather control cables –
resistant to a wide range of chemical media

Application range
- Machine tool building, medical technology, laundries, car washing equipment, chemical industry, composting plants, sewage works

Product features
- Halogen-free materials
- Ozone, UV and weather-resistant according to EN 50396 and HD 605 S2
- Flexible down to -40°C
- Number-coded cores

ÖLFLEX® FD 855 CP

Screened, TPE-insulated, numbered, TPE inner sheath,
PUR outer sheath

Application range
- In power chains or moving machine parts
- Particularly in wet areas of machine tools and transfer lines

Product features
- Low-adhesive surface
- Oil-resistant
- Halogen-free and flame-retardant (IEC 60332-1-2)

Photographs are not to scale and do not represent detailed images of the respective products.

ÖLFLEX® SERVO FD 796 CP

High-end servo cable, screened

Application range
- Connecting cable between servo controller and motor
- In power chains or moving machine parts
- For use in assembling & pick-and-place machinery
- Particularly in wet areas of machine tools and transfer lines
- Assembly lines, production lines, in all kinds of machines

Product features
- Dynamic performance in power chains: Acceleration up to 50 m/s². Travel speeds up to 5 m/s. Travel distances up to 100 m.
- Low-capacitance design
- Halogen-free materials
- Flame retardancy: UL/CSA: VW-1, FT1 IEC/EN: 60332-1-2
- Oil-resistant

Photographs are not to scale and do not represent detailed images of the respective products.

ÖLFLEX® ROBOT 900 P

TPE-PUR robot cable for flexing and torsion load

Application range
- Plant engineering
- Machine tools
- Automated handling equipment
- Multi-axis articulated robots
- In power chains or moving machine parts

Product features
- Abrasion and cut-resistant
- Hydrolysis-resistant
- Oil-resistant
- Low-adhesive surface
- Flame-retardant

ÖLFLEX® HEAT 180 SiHF

Silicone cable with extended temperature range

Application range
- Thermal and heating elements
- Lighting technology
- Ventilator engineering
- Air-conditioning technology
- Galvanisation technology
- Plastics processing
- Wind power plant

Product features
- Halogen-free and flame-retardant (IEC 60332-1-2)
- Resistant to a multitude of oils, alcohols and other chemical substances

Photographs are not to scale and do not represent detailed images of the respective products.

UNITRONIC®

DATA COMMUNICATION SYSTEMS

Our high-quality UNITRONIC® data network cables and field bus components provide a forward-looking solution for all applications in industrial machinery and plant engineering. From transmission of simple control signals to field bus signals in complex network structures – we offer a dependable cabling and connection solution for almost every situation.

Application range
- Industrial machinery and plant engineering
- Sensors and actuating elements
- Appliances
- Measurement and control technology
- Automated production processes and industrial robots
- Bus systems
- Computing and communication systems

Low frequency data transmission cables

UNITRONIC® LiYCY

Screened data transmission cable
with colour code acc. to DIN 47100

UNITRONIC® Li2YCY PiMF

Screened data transmission cable with PE
core insulation and pairs in metalfoil

UNITRONIC® LiHCH (TP)

Screened halogen-free data transmission cable
with colour code acc. to DIN 47100 and twisted pairs

UNITRONIC® FD CP (TP) plus

Screened highly flexible data transmission cable
with PUR outer sheath and twisted pairs –
UL/CSA-listed

Photographs are not to scale and do not represent detailed images of the respective products.

Overview of the most common fieldbus systems and their cables

AS-Interface (AS-I)
Simple and cost effective wiring of sensors and actuators.

PROFIBUS DP
Fieldbus for connecting decentralised periphery in manufacturing automation with bit rates of 1.5 Mbit/s to 12 Mbit/s. PROFIBUS DP is standardised in IEC 61158/ IEC 61784.

CAN/CANopen
Originally developed for use in vehicles, CANopen now has multiple applications in the industrial sector.

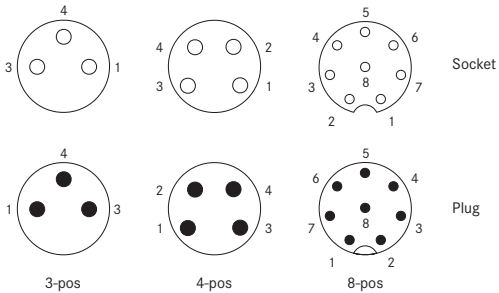
DeviceNet
Leading fieldbus system in the North American market.

FOUNDATION™ Fieldbus
FOUNDATION™ Fieldbus is used in process automation, particularly in intrinsically safe areas.

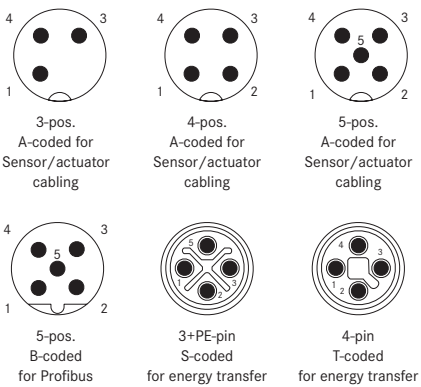
Foundation™ is a trademark of the Fieldbus Foundation.
Photographs are not to scale and do not represent detailed images of the respective products.

Pin figuration connectors for fieldbus and S/A wiring

M8 pin assignments (IEC 61076-2-104)



M12 pin assignments (IEC 61076-2-101)



Good to know: For the M12, 3, 4 and 5-pin connectors and bushings are compatible with one another. If the 4-pin connector is missing, for instance, it can easily be replaced by using a 5-pin connector.

Profibus Fast Connect – the fast connection system

The Fast Connect connection system significantly reduces the amount of time required. Profibus cables and connectors can be quickly and easily connected with three perfectly matched components:

- UNITRONIC® BUS PB FC cables
- FC STRIP stripping tool
- EPIC® DATA PROFIBUS Fast Connect connector

Strip in just one step with the FC STRIP stripping tool

Contact and connection in a matter of seconds using IDC technology.

Product features

- Different connector types
- Optionally also with LED/additional Sub-D connection
- All connectors UL-certified (E331560)
- The right cables for a wide range of applications

Photographs are not to scale and do not represent detailed images of the respective products.

The complete range: Fieldbus and S/A wiring

Sensor/actuator flush-type connectors and configurable connectors
For fast configuration of individual cable lengths for bus and sensor/actuator cables, use the freely configurable UNITRONIC® M8 and M12 connectors. A wide range of appropriate flush-type connectors are available for connecting devices.

Pre-assembled sensor/actuator cables
Do you need to quickly cable sensors and actuators in the field? Not a problem with our pre-assembled cables with M8, M12 and valve plug connections. Signal statuses can be easily monitored thanks to the designs featuring LEDs. Cables with a screened wire also comply with the requirements concerning increased EMC compatibility.

Sensor/actuator boxes
With the help of our S/A boxes, you can receive small-scale decentralised I/O signals in the field and safely pass these on to the control. This assembly concept enables flexibility and reduces installation costs for different surfaces and profiles.

Bus configurations
Pre-assembled bus cables for DeviceNet/CANopen and Profibus with M12 connection. You can find the complete range of fieldbus and sensor/actuator wiring either in the Automation & Network Guide or by using the pre-assembled cable finder on our website: **www.lappkabel.de/konfektionsfinder**

Photographs are not to scale and do not represent detailed images of the respective products.

ETHERLINE®

DATA COMMUNICATION SYSTEMS
FOR ETHERNET TECHNOLOGY

Our ETHERLINE® branded products open up a secure, fast and reliable path to the future of Ethernet applications. The systems are made up of durable and robust cables and connection components for passive network technology, and deliver an effective solution for almost any application, particularly in an industrial environment.

Application range

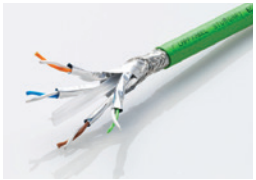
- Industry and building networks
- Industrial machinery and plant engineering
- Automation technology
- Control engineering

With ETHERLINE® products are you fit for future

If you want to avoid failures, down times and quality problems, you can trust on our complete and high quality product system. Lapp takes care to offer products of individuality and costumer requirement as well as long time usability. Our big product range of ETHERLINE® cables are suitable for nearly any application and is tested in our test laboratory, for example in drag chains. If there are special requirements as flexibility for applications in drag chains, with torsion stress, industrial environments with high mechanical or temperature specifications, you can find some real all-rounders in the Lapp product program. If you are at the point where you will connect your cable to a device, you can also find suitable connectors, for example RJ45 or M12 connectors. Nearly for every cable and application you can choose the right connector, mostly with you need no special assembly tool. For some applications and for saving time and money, Lapp offers also a big range of patch cords. There the Industrial Ethernet ETHERLINE® cables are used and are assembled with connectors who are especially produced for industrial requirements. The patch cords are completely tested in our plant and you can trust on Industrial Protection classes and transmission rates.

Application classes (LAN copper cabling)			
Application class	Category	Frequency	Services and applications
Class A	-	Up to 100 kHz	
Class B	-	Up to 1 MHz	Telephone, ISDN
Class C	Cat.3	Up to 16 MHz	Tel, ISDN, TokenRing, Ethernet
Class D	Cat.5/5e	Up to 100 MHz	Fast Ethernet, Gigabit Ethernet
Class E	Cat.6	Up to 250 MHz	Fast Ethernet, Gigabit Ethernet
Class EA	Cat.6_A	Up to 500 MHz	10 Gigabit Ethernet
Class F	Cat.7	Up to 600 MHz	10 Gigabit Ethernet
Class FA	Cat.7_A	Up to 1 GHz	10 Gigabit Ethernet

ETHERLINE® copper cables



- Copper data network cables for transmission in PROFINET® applications
- The right cable for almost every application area
- All current types are available with UL certification
- Special cables for highly flexible applications such as use in drag chains or for torsion applications
- For data transmission rates from 100 Mbit/s up to 10 Gbit/s with Cat.7 cables
- Cables are designed for harsh industrial use

ETHERLINE® assemblies and connectors

- Proven cable quality combined with high-quality connectors
- Highly flexible cables for transmission category Cat.6_A with overmoulded X-coded M12 connectors, suitable for drag chains or torsion applications
- Configurable connectors for field assembly – fast and without the use of special tools
- Straight or angled RJ45 connectors with colour-coded wire manager for easy connection to 2-pair or 4-pair cables

Connector finder

PROFINET® 2-pair up to 100 Mbit/s

Cables			
Application		Article no.	Description
4-pin type A for fixed installation		2170891	ETHERLINE® PN Cat.5e Y 2X2XAWG22
		2170893	ETHERLINE® Y FC Cat.5
		2170494	ETHERLINE® PN Cat.5e YY
4-pin type B for flexible application		2170886	ETHERLINE® PN Cat.5 Y FLEX FC
		2170890	ETHERLINE® PN Cat.5e FRNC FLEX FC
		2170889	ETHERLINE® MARINE FRNC FC Cat.5
4-pin type C for special application	Drag chain	2170894	ETHERLINE® FD P FC Cat.5
	Torsion	2170888	ETHERLINE® TORSION P Cat.5 AWM
	Routing underground	2170496	ETHERLINE® Cat.5 ARM
	Outdoor installation	2170901	ETHERLINE® Y Cat.5e BK
	Increased temperature range	2170636	ETHERLINE® Cat.5e 105 plus

Suitable connectors		
Application	Article no.	Description
M12 plug, D-coded	22260820	AB-C4-M12MSD-SH
M12 socket, D-coded	22261016	AB-C4-M12FSD-SH
RJ45 connector, straight	21700605	ED-IE-AX-5-PN-20-FC
RJ45 connector, angled	21700638	ED-IE-90-6A-PN-20-FC

PROFINET® 4-pair up to 10 Gbit/s

Cables			
Application		Article no.	Description
8-pin type A for fixed installation	Cat.6_A	2170466	ETHERLINE® Cat.6_A H
		2170465	ETHERLINE® Cat.6_A P
		2170464	ETHERLINE® Cat.6_A Y
	Cat.7	2170476	ETHERLINE® H Cat.7 H
		2170475	ETHERLINE® Cat.7 P
		2170474	ETHERLINE® Cat.7 Y
8-pin type B for flexible application	Cat.6_A	2170930	ETHERLINE® PN Cat.6_A Y FLEX 4x2x23/7
		2170931	ETHERLINE® PN Cat.6_A FRNC FLEX 4x2x23/7
8-pin type C for special application	Drag chain, Cat.6_A	2170485	ETHERLINE® FD Cat.6_A 4X2X24/7AWG
		2170484	ETHERLINE® FD P Cat.6_A 4X2X24/7AWG
	Torsion, Cat.6_A	2170483	ETHERLINE® TORSION P Cat.6_A 4X2XAWG24/7
		2170482	ETHERLINE® TORSION Y Cat.6_A 4X2XAWG24/7

Suitable connectors		
Application	Article no.	Description
M12 plug, X-coded	21700602	ED-IE-AX-M12X-6A-67-FC
M12 socket, X-coded	21700621	ED-IE-AX-M12XF-6A-67-FC
M12 socket, X coded, with flange	21700622	ED-IE-AX-M12XF-RM-6A-67-FC
RJ45 connector, straight, TIA568-A	21700600	ED-IE-AX-6A-A-20-FC
RJ45 connector, straight, TIA568-B	21700601	ED-IE-AX-6A-B-20-FC
RJ45 connector, angled, TIA568-A	21700636	ED-IE-90-6A-A-20-FC
RJ45 connector, angled, TIA568-B	21700637	ED-IE-90-6A-B-20-FC

Pre-assembled products

Industrial Ethernet connectors are available as field-configurable designs or as pre-extruded configurations. These factory-tested products combine proven Lapp cable quality with premium connectors. Lapp ETHERLINE® cables are used in all configurations. UL approval also applies for all 2-pair PROFINET® configurations of types A, B and C with M12 connectors in combination with the approved cables that are used.

With 360° shielding, the ETHERLINE® configurations are both protected against external electromagnetic interference and in turn do not affect their devices as a result of electro-magnetic interference.

Double extrusion ensures maximum sealing tightness and optimum appearance. Integrated vibration protection ensures even greater security. Extruded configurations help you save time if you connect the cables yourself, prevent differences in connection quality and even enable a you to attain a higher level of sealing tightness than can be achieved using freely configurable connectors.

HITRONIC®

OPTICAL TRANSMISSION SYSTEMS

HITRONIC® fibre optic cables make transmitting large data volumes easy: fault free, bug proof and at almost light speed. Even electromagnetic radiation does not interfere with the transmission. The HITRONIC® range includes the ideal solution for indoor or outdoor use, for demanding conditions, and even for use in power chains.

Application range

- Telecommunications and network technology
- Industrial cabling and automation level
- Industrial machinery and plant engineering
- Data transmission under harsh conditions (mining and tunnel construction, oil and gas platforms, wind power plants)

Fibre Optic – Transmission Overview

Advantages of Fibre Optical Cables

- high resistance to tapping
- no EMC interference
- no EMC testing required
- long transmission range
- no potential transfer
- no cross-talk
- little space required
- low cable weight
- can be installed in a potentially explosive environment

10 Gbit/s Data Systems – OM3 (and OM4)

- Conventional OM2 multi-mode fibres: 82 m transmission length
- OM3 multi-mode fibres: 300 m
- OM4 multi-mode: 550 m

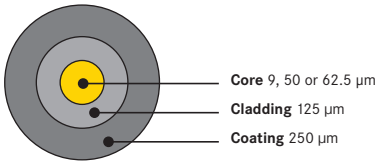
Note

- Special processes in manufacturing the cores
- OM3 cables are backward compatible with OM2 equipment (and vice versa)
- Advantage is only applicable at 850 nm

GOF – Glass Optical Fibre

A distinction is drawn between GOF:

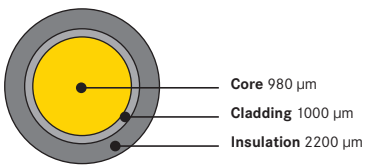
- Singlemode Fibre SM 9 µm
- Multimode Fibre MM 50 µm or 62.5 µm



POF – Polymer Optical Fibre

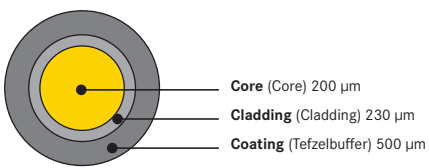
A distinction is drawn between POF:

- SIMPLEX (one fibre)
- DUPLEX (two fibres)

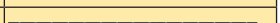
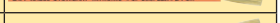
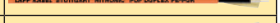
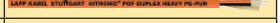
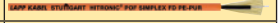
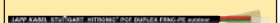
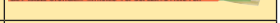
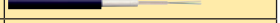
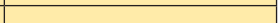


PCF – Plastic Cladded Fibre

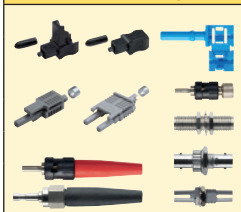
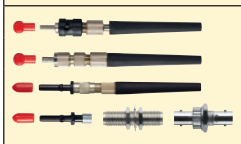
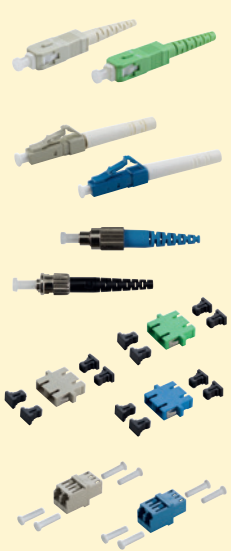
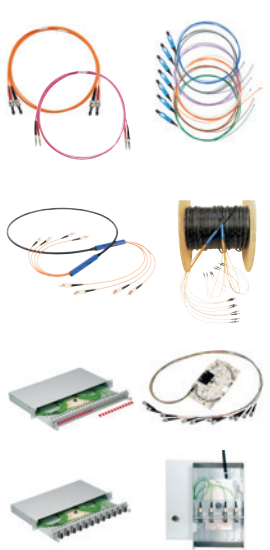
Note:
PCF is also known as HCS
(Hard Cladded Silica Optical Fibre)



HITRONIC® Product Overview

Cables			
Type of fibre	POF	POF SIMPLEX PE	
		POF DUPLEX PE	
		POF SIMPLEX PE-PUR	
		POF DUPLEX PE-PUR	
		POF DUPLEX Heavy	
		POF SIMPLEX FD PE-PUR	
		POF DUPLEX FD PE-PUR	
	PCF	PCF SIMPLEX Outdoor	
		PCF DUPLEX Outdoor	
		PCF DUPLEX Indoor	
		PCF DUPLEX FD Universal	
	GOF	HITRONIC® FIRE	
		HITRONIC® TORSION	
		HRM-FD Flexible	
		HDM Reel	
		HQN Outdoor	
		HVN Stranded Outdoor	
		HVN-Micro Outdoor	
		HQW Armoured Outdoor	
		HVW Armoured Stranded Outdoor	
		HQW-Plus Armoured Outdoor	
		HQA Aerial ADSS	
		HQA-Plus Aerial ADSS	
		HUN Universal	
		HUW Armoured Universal	
		HRH Breakout	
		HDH Mini Breakout	

Photographs are not to scale and do not represent detailed images of the respective products.

Connectors and adapters	Accessories
	
	
	

Photographs are not to scale and do not represent detailed images of the respective products.

Cabled fibre type	max. attenuation [dB/km]				colour
	660 nm	850 nm	1300 nm	1550 nm	
POF 980 µm	160				
PCF 200 µm	10.0	8.0			
GOF MM 62.5 µm OM1		3.5 (3.0)	1.5 (0.7)		Orange
GOF MM 50 µm OM2		3.5 (2.5)	1.5 (0.7)		Orange
GOF MM 50 µm OM3		3.5 (2.5)	1.5 (0.7)		Aqua
GOF MM 50 µm OM4		3.5 (2.5)	1.5 (0.7)		Violet
GOF SM 9 µm OS2 (G652.D)			0.40 (0.35)	0.40 (0.21)	Yellow

Cabled fibre type	max. transmission length [m]			
	660 nm	850 nm	1300 nm	1550 nm
POF 980 µm	100 Mbit/s: 60			
PCF 200 µm	100 Mbit/s: 550			
GOF MM 62.5 µm OM1		100 Mbit/s: 550 1 Gbit/s: 275 10 Gbit/s: 33	100 Mbit/s: 2.000 1 Gbit/s: 550 10 Gbit/s: 300	
GOF MM 50 µm OM2		100 Mbit/s: 550 1 Gbit/s: 550 10 Gbit/s: 82	100 Mbit/s: 2.000 1 Gbit/s: 550 10 Gbit/s: 300	
GOF MM 50 µm OM3		1 Gbit/s: 1.000 10 Gbit/s: 300 40 Gbit/s: 100 100 Gbit/s: 100	1 Gbit/s: 550 10 Gbit/s: 300	
GOF MM 50 µm OM4		1 Gbit/s: 1.100 10 Gbit/s: 550 40 Gbit/s: 150 100 Gbit/s: 150	1Gbit/s: 550 10 Gbit/s: 300	
GOF SM 9 µm OS2 (G652.D)			1 Gbit/s: 5.000 10 Gbit/s: 10.000	1 Gbit/s: 80.000 10 Gbit/s: 40.000

EPIC®

INDUSTRIAL CONNECTORS

EPIC® industrial connectors can be found everywhere in industrial machinery and plant engineering, for measuring, control and drives. EPIC® is a flexible system of housings, inserts and contacts: all extremely robust, absolutely safe and simplicity itself to assemble.

Application range

- Electronics and telecommunications
- Measurement, testing and control technology
- Industrial machinery and appliances
- Drive technology and industrial automation
- Photovoltaic plants

Housings and Inserts

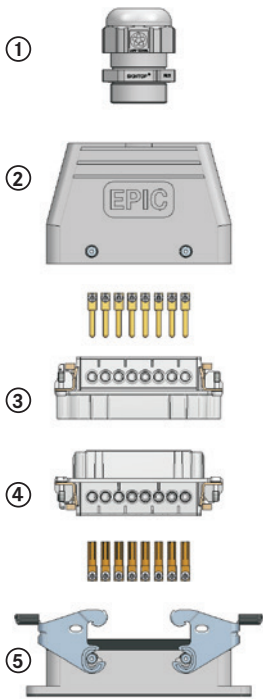
1. Cable Gland
The Cable Gland provides a seal between the cable and the connector housing. It may also be used to offer additional functions like strain relief and and braid continuity for EMC protection.

2. Hood
The connector housing for the cable entry.

3. Male insert
Types of contact termination
- Screw
- Crimp
- Cage clamp
- Push-In

4. Female insert
Types of contact termination
- Screw
- Crimp
- Cage clamp
- Push-In

5. Base
- Panel mounting (cable entry though cut out in panel)
- Surface mounting (cable entry through a gland into the side of the connector base)
- Cable Connector Hood, cable to cable connection
- Lever designs: Single lever, Double lever, Central lever, in stainless steel, in steel, in plastic



EPIC® H-A

Application range
- Machine and equipment manufacturing
- Control engineering
- Electronic laboratory

Product features
- Easy to service screw connection
- Easy cable connection with strait cable entry in the contacts

EPIC® ULTRA

Application range
- In EMC-sensitive environments
- For fixed and flexible applications (e. g. machinery building, wind turbines)

Product features
- Pluggable with standard housings
- Corrosion-resistant according to DIN EN 6988
- High mechanical and chemical stability

Photographs are not to scale and do not represent detailed images of the respective products.

EPIC® MC modular system

Benefits
- The mix of different functions in one plug guarantees high flexibility

Application range
- Robotic
- Switchgears
- Renewable energy
- Industrial machinery

EPIC® M23

Benefits
- Low-resistance screen contact, optimum EMC protection
- Use of high quality materials for increased reliability

Application range
- Plant engineering
- Servo drives and servo assemblies
- Measurement and control technology

EPIC® M12 POWER

Benefits
- To terminate only screw driver is neccessary
- Small and space-saving for narrow available space
- High performance gold plated contacts

Application range
- Power Supply for small devices
- For 1-phase cables or 3-phase wihout N

Photographs are not to scale and do not represent detailed images of the respective products.

EPIC® POWERLOCK

Benefits
- Resistant to mechanical influences in harsh environmental conditions
- Every colour has a different coding to prevent incorrect plugging

Application range
- For renewable energy plants e.g. wind power
- For mobile and stationary power distribution

Photographs are not to scale and do not represent detailed images of the respective products.

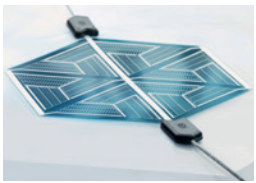
EPIC® SOLAR 4PLUS

Application range
- Photovoltaic systems
- Crystalline and thin-film constructions, organic photovoltaics (OPV)

Product features
- 4 mm connection system with double engagement hook
- For photovoltaic systems up to 1.5 kV operating voltage
- Crimp connection for field mounting
- Connection cross sections up to 10 mm^2

EPIC® SOLAR Box

EPIC® SOLAR provides cabling solutions for photovoltaic systems in all power classes.

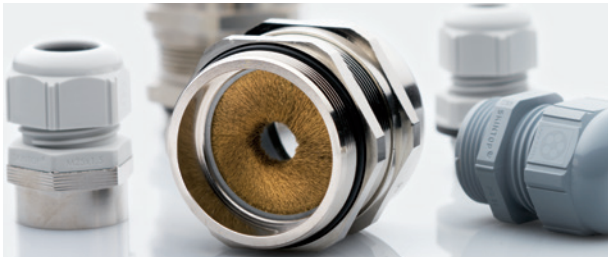


Product features
- System voltage up to 1500 V
- Plastic and aluminum boxes for the best heat dissipation

Photographs are not to scale and do not represent detailed images of the respective products.

SKINTOP®

CABLE GLANDS



Simply feed in the cable and twist. That's it. Our SKINTOP® cable glands provide secure connections in no time. The universal systems are simple but effective. They secure and centre the cable, hermetically seal it and guarantee optimum strain relief.

Application range
- Industrial machinery and plant engineering
- Drive systems
- Measurement and control technology
- Renewable energies
- Wherever cables need to be fastened securely and quickly

SKINTOP® CLICK

Benefits
- Few parts, no lock nuts needed
- Save up to 70 % of your time with the innovative locking system
- Simple, free assembly
- No thread required
- Designs with bending protection

Application range
- Switching cabinet construction
- Air-conditioning technology
- Photovoltaic systems
- Measurement and control technology and electrical engineering

SKINTOP® MS-SC-M

Benefits
- Suitable for cables with and without inner sheath
- Low-resistance screen contact, optimum EMC protection

Application range
- Mechanical and systems engineering
- Measurement and control technology
- Automation engineering

Photographs are not to scale and do not represent detailed images of the respective products.

SKINTOP® INOX/SKINTOP® INOX-R

Benefits
- High corrosion resistance
- Smooth surfaces – without edges
- Compact design
- Seawater resistant
- Wide, variable clamping ranges

Application range
- Pharmaceutical industry
- Food industry (product-free zone, spray zone)
- Onshore and offshore applications
- Bottling plants and breweries

New: SKINTOP® HYGIENIC
The stainless steel cable gland with its HYGIENIC DESIGN, ECOLAB and EHEDG approvals is also available from Lapp Group.

SKINTOP® BS-M METAL

Benefits
- High mechanical stability
- Optimum strain relief
- Maximum reliability

Application range
- In areas where mechanical and chemical stability are critical
- Permanent bending protection under high mechanical loads

Photographs are not to scale and do not represent detailed images of the respective products.

SKINTOP® MS-M ATEX/ SKINTOP® MSR-M ATEX

SKINTOP® MS-M ATEX

SKINTOP® MSR-M ATEX

Benefits

SKINTOP® MS-M ATEX

- Cold impact resistance
- High strain relief
- Wide, variable clamping ranges
- Anti-static
- Maximum reliability
- New: globally recognised IECex approval
- Also available as an EMC solution with the innovative BRUSH system

Application range

SKINTOP® MS-M ATEX

- Devices, machines and systems of enhanced safety protection type “e”
- Equipment group II/ Category 2G+1D
- For mobile applications in offshore and marine industries
- Chemical and petrochemical industry

SKINTOP® MSR-M ATEX

- With reducing seal insert, to seal cables with smaller outer diameters.

Photographs are not to scale and do not represent detailed images of the respective products.

SKINTOP® BRUSH ADD-ON

Benefits

- Optimum, low-resistance 360° screen contact
- Cutting edges cut through the insulating layer of the housing or switch cabinets, thus guaranteeing an optimum contact
- Easy to disassemble
- Visible, large-scale screen contact
- Straightforward and reliable
- The world’s first patented active EMC counter-nut.

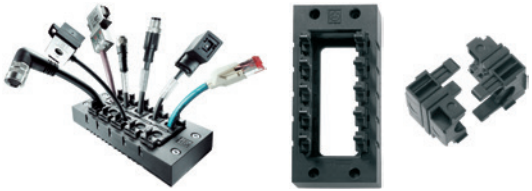
Application range

- For EMC-compliant earthing of the copper braiding, or for cables with copper shaft sheath
- For EMC contact at bore-holes
- Switching cabinet construction
- Automation systems
- Conveyor and transport systems

Photographs are not to scale and do not represent detailed images of the respective products.

SKINTOP® CUBE

Now with UL approval



- Innovative multi-cable bushing system with variable clamping ranges for high flexibility in assembly.
- For installing configured cables
- When disassembling, the frame can remain on the housing and the plug-in module remains securely on the cable.
- 7 different modules cover a clamping range of 1 – 16 mm

SKINTOP® CUBE MULTI

- Push the cable through the innovative gel membrane and connect directly
- Enormous savings potential thanks to quick installation

Photographs are not to scale and do not represent detailed images of the respective products.

SILVYN®

PROTECTIVE CABLE CONDUIT SYSTEMS
AND CABLE CARRIER SYSTEMS

The universal range of SILVYN® protection and guidance systems protect cables effectively against dust, moisture, mechanical, thermal and chemical influences. The versatile SILVYN® CHAIN range of energy supply chains also protects and guides cables in dynamic applications.

Application range

- Industrial machinery and plant engineering
- Automotive industry
- Machine tool manufacture
- Renewable energies
- Wherever cables require additional protection or guidance

SILVYN® CHAIN
overview power chain application

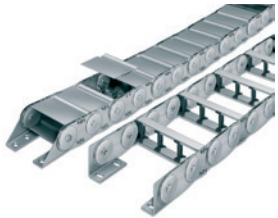
RoHS

As a system provider, we offer one-stop complete systems such as cable guiding systems and suitable wires. You will find more detailed information in the SILVYN® CHAIN catalogue on our web page under:
www.lappgroup.com/catalogues

SILVYN® CHAIN Series Light	
SILVYN® CHAIN Series Medium	
SILVYN® CHAIN Series Heavy	

Characteristics	Application areas
• Light applications • Simple bolt system • Inner hight 12 – 25 mm • 7 types	• Automation • Smaller robot gantries • Textile equipment with long travel • Printing equipment
• Standard applications • Tongue/groove system with yellow pin • Inner hight 18 – 76 mm • 12 types, many widths	• Automation • Handling equipment • CNC machines • Medium sliding applications
• Superior applications • Tongue/groove system with yellow tripple pin • Inner hight 30 – 112 mm • 12 types, many frame versions: Nylon, Aluminium, Inox	• Automation with high travel frequency • Outdoor equipment • Movement with high lateral acceleration

Photographs are not to scale and do not represent detailed images of the respective products.

SILVYN® CHAIN Series Sliding	
SILVYN® CHAIN Series Protection	
SILVYN® CHAIN Series Robot	
SILVYN® CHAIN Series Steel	

Characteristics	Application areas
• Long sliding distances • Tongue/groove system with yellow tripple pin • Inner hight 30 – 70 mm • 12 types, many frame ver-sions: Nylon, Aluminium, Inox	• Sliding with high speed and high charge weight • Long life-cycle applications (very long lifetime)
• Standard applications • Tongue/groove system with yellow pin • Inner hight 35 – 76 mm • 10 types, many withs	• Automation • Dirty environment • Machine tool centers
• Rotative applications • Tongue/groove system patented element construction • Inner hight 35 – 60 mm • Standard rotation angle up to 200° Guided rotation angle up to 400° • 6 types	• Welding robots • Painting robots • Handling robots
• Highest load capacity • Highest chemical resistance • Tongue/groove system in metal • Inner hight 32 – 182 mm • 5 standard types • Customised versions	• Steel mills/steel works • Off-Shore • Long-travel machining centers • Heavy duty environment

Photographs are not to scale and do not represent detailed images of the respective products.

Products in the SILVYN® range

Cable protection conduits made from corrugated polyamide

SILVYN® FPAS
Protective conduit made from polyamide 6 – cost effective – oil/petrol and chemical resistant – flexible.

SILVYN® SPLIT
Polyamide protective conduit 6 – oil/petrol and chemical resistant – separable.

Cable protection conduits made from metal for heavy mechanical loads

SILVYN® SSUE
Protective conduit made from stainless steel – protection against high mechanical loads – flexible – corrosion resistant.

SILVYN® UI 511
Protective conduit made from stainless steel – protection against the greatest mechanical loads – flexible – corrosion resistant.

Cable protection conduits made of metal and plastic outer sheaths

SILVYN® LCC-2
Protective conduit made from galvanised steel with PVC outer sheath – impermeable – flexible.

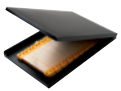
SILVYN® HTDL
Protective conduit made from galvanised steel with PVC outer sheath – impermeable – UL approved.

Photographs are not to scale and do not represent detailed images of the respective products.

FLEXIMARK®
MARKING SYSTEMS

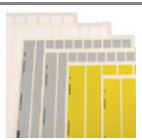
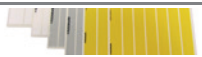
The requirement: Permanent marking. The solution: FLEXIMARK®. These sophisticated systems mean that a clear overview inside a control cabinet is no longer just a pipe dream. From simple labels for manual marking through to electronic markings, the FLEXIMARK® range is guaranteed to be permanent.

Application range
- Control cabinet manufacturing
- Automation technology
- Industrial machinery and plant engineering
- Renewable energies
- Wherever cables are used

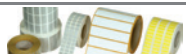
How? / What?		Basic system	Customized system
		Ready made to deliver for each environment	Your demand – we deliver
Cable	Outdoor & Indoor	 MINI character strips  Stainless Steel Marking  Collars  Marking kit DYMO® PL 150	 Stainless Steel FCC  Cablelabel FCC  Marking tags TMB FCC  Cablelabel PUR FCC
	Indoor	 Label cards & Label blocks  Cablelabel LAM  Handheld Printers	 Shrink tube FCC  Cable Marker FCC  Cable tie marking FKBB FCC  Wrapping labels LCK FCC
Wire	before mounting the wire	 Marking rings  Collars  Flexipart	 Shrink tube FCC  Flexiprint FCC  Sleeve FCC  Marking tags TMB FCC
	after mounting the wire	 Snap-On collars	 Marking tags TMB FCC
Component	Device marking	 Character holders MLM  Character holders PGS	 BMK FCC  Stainless steel component marking FCC
	Terminal	 Handheld Printers	 Terminal block marking
	Sensor	 Clip-On collars 	 Marking tags TMB FCC 
Acces-sories		 Stainless steel cable ties  Stainless steel tie gun HT-338	 Pliers FL 52 ERA  Transparent cover  Manual embossing machine

DYMO® is a registered trademark of SANFORD GmbH.

Photographs are not to scale and do not represent detailed images of the respective products.

How? / What?		Data marking
		Laser office printers
Cable	Outdoor & Indoor	 Flexilabel LFL  Labels LMB
	Indoor	 Wrapping labels LCK  Labels LA/LB  Cablelabel LFL
Wire	before mounting the wire	 Flexiprint LF  Labels LMB
	after mounting the wire	 Labels LMB  Wrapping labels LCK
Component	Device marking	 Labels LA/LB  Flexilabel LFL
	Terminal	 Labels LA/LB
	Sensor	 Labels LMB 
Acces-sories		 – Print your own labels & signs – Work with Excel files – Print barcodes & sequences FLEXIMARK® SOFTWARE 10.0

Photographs are not to scale and do not represent detailed images of the respective products.

Data marking
Thermal transfer printer
 Flexilabel TFL  Cablelabel PUR
 Cablelabel MTFL  Marking tags TMB
 Flaglabels  Labels TA  Wrapping labels TCK
 Cablelabel TFL  Organized shrink tube  Shrink tube
 Flexiprint TF  Organized shrink tube  Marking tags TMB
 Wrapping labels TCK  Marking tags TMB
 Labels TA  TA Foam labels  Flexilabel TFL
 Terminal block marking  TA Foam labels
 Marking tags TMB 
 Thermal transfer printer

Photographs are not to scale and do not represent detailed images of the respective products.

Extraction of the FLEXIMARK® range

FLEXIMARK® Stainless steel marking

Application range
- Cable and component marking system
- For marking in tough environments

Product features
- Excellent resistance against chemicals and acids

FLEXIMARK® Wrapping labels LCK

Application range
- For cable marking
- Printing with commercial laser printers in combination with the FLEXIMARK® Software 10.0

Product features
- Transparent foil protects the printing against abrasion and chemicals
- UV-resistant

FLEXIMARK® Flexiprint LF

Application range
- For marking single cores and optical fiber cables
- Printing with commercial laser printers in combination with the FLEXIMARK® Software 10.0

Product features
- Quick and easy assembly
- UV-resistant

Photographs are not to scale and do not represent detailed images of the respective products.

Tools and cable accessories

- Recommendation for conductor crimping
- Interesting facts
- Product information

Recommendation for conductor crimping

All our tools are tested in combination with our conductors and connectors. Background is the size difference between the conductors and the cable lugs/end sleeves. The size difference is explained in the fact that the same connectors can be used for different strands (class 5 and 6) and different designs of the conductors (bunched, twisted and compacted conductors). Despite optically wrong appearing sleeves for the used cross-section a gas-tight crimp can be assured with following tool-connector-combinations.

Tube cable lugs

Our KRF cable lugs are tested for class 2 and class 5 conductors. An excellent crimp quality can be particularly guaranteed in combination with a special patented DUAL-crimp.

Cross-section in mm²	Cable lugs	Cable lugs
16	KRF/16	B9
25	KRF/25	B11
35	KRF/35	B13
50	KRF/50	B14,5
70	KRF/70	B17
95	KRF/95	B20
120	KRF/120	B22
150	KRF/150	B25
185	KRF/185	13B25
240	KRF/240	13B30

Photographs are not to scale and do not represent detailed images of the respective products.

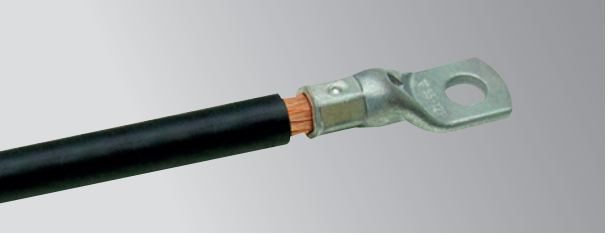
End sleeves

For cimping our end sleeve range we recommend the universal crimp tool PEW 12.

PEW 12 universal tool

For crimping virtually all crimped connections with conductor cross-sections 0.08 – 95 mm².

Photographs are not to scale and do not represent detailed images of the respective products.



Interesting facts

The quality of crimps is especially determined in following norms:

- **DIN EN 60228 (VDE 0295), September 2005**
  “Conductors of insulated cables”

  Contents of the norm are inter alia the maximum wire diameter and the electrical resistance depending on the cross-section (mm²), but not the number of wires or the design of the wires.

  Due to improved technologies the requested electrical resistance could be reached with reduced cross-sections.

- **DIN 46228 – 4, September 1990**
  “Tubular end-sleeves without plastic sleeve”

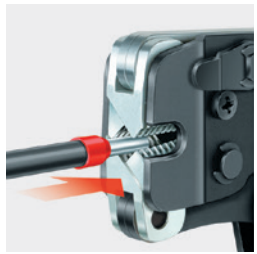
- **Quality of crimps according to DIN 46228 – 1 and DIN EN 50027**

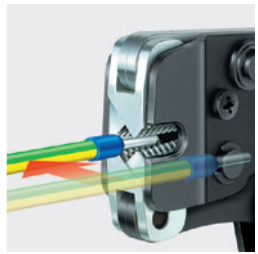
Due to a constant incoming goods inspection of our quality division we prove the compliance with the mentioned standards.

Photographs are not to scale and do not represent detailed images of the respective products.

PEW 8.87

Front crimp pliers with a large range of diameters from 0.08 – 10 mm².





KSA 0760 crimping pliers

Ergonimc shaped crimping pliers for insulated connetions 0.5 – 6 mm².

Photographs are not to scale and do not represent detailed images of the respective products.

STAR STRIP Stripping tool

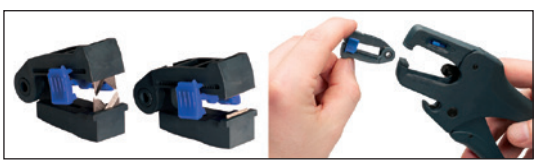
Allrounder-dismantling tool which is also suitable for problematical insulation materials as PUR or PTFE, applicable for circular, longitudinal and spiral cuts.

EASY STRIP stripping tool

Self-adjusting cutting and stripping tool with an increased stripping range and for different materials.

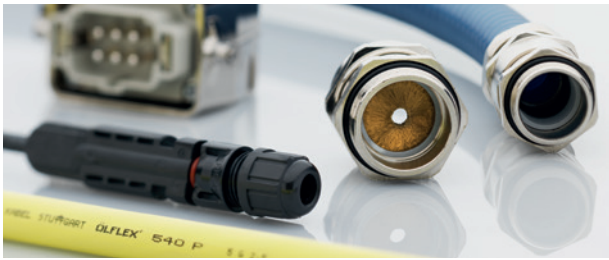
Straight cartridge: 0,02 – 10 mm^2
V-cartridge: 0,1 – 4 mm^2

Please see our main catalogue for further details.



Photographs are not to scale and do not represent detailed images of the respective products.

Selection tables



- Selection Tables
- Technical Tables

Cable designation
(fixed installation and/or occasional flexing)

Page main catalogue 2014/15	24	26	27	28	29	30	31	34	35	36	37	38	39
Usage criteria	ÖLFLEX® CLASSIC 100	ÖLFLEX® CLASSIC 100 Yellow	ÖLFLEX® CLASSIC 100 CY	ÖLFLEX® CLASSIC 100 SY	ÖLFLEX® CLASSIC 100 BK POWER 0,6/1 KV	ÖLFLEX® SMART 108	ÖLFLEX® CLASSIC 110	ÖLFLEX® CLASSIC 110 Cold	ÖLFLEX® CLASSIC 110 Orange	ÖLFLEX® CLASSIC 110 CY	ÖLFLEX® CLASSIC 110 SY	ÖLFLEX® CLASSIC 110 BLACK	ÖLFLEX® CLASSIC 110 CY BLACK
Use													
For non-deactivatable circuits: EN 60204									✔				
For intrinsically safe circuits in hazardous areas/VDE 0165													
Handheld devices and lights on building sites													
Oil-resistant to UL + CSA specification													
Enhanced oil resistance to VDE													
Bio-oil-resistant													
Chemical-resistant cables	See technical table T1												
UV-resistant cables					✔			✔				✔	✔
Servomotors/drive systems			✔							✔			✔
For torsion in wind turbine generators (see catalogue page)	✔	✔			✔		✔	✔	✔			✔	
Standards													
Based on VDE/HAR/DIN	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔
According to standard with VDE certification													
With VDE registration						✔	✔	✔		✔	✔		
With HAR certification													
With UL certification													
With CSA certification													
Temperature range													
+105 °C													
+90 °C													
+80 °C	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
+70 °C	●	●	●	●	●	●	●	●	●	●	●	●	●
+60 °C													

Cable designation
(fixed installation and/or occasional flexing)

Page main catalogue 2014/15	24	26	27	28	29	30	31	34	35	36	37	38	39
Usage criteria	ÖLFLEX® CLASSIC 100	ÖLFLEX® CLASSIC 100 Yellow	ÖLFLEX® CLASSIC 100 CY	ÖLFLEX® CLASSIC 100 SY	ÖLFLEX® CLASSIC 100 BK POWER 0,6/1 KV	ÖLFLEX® SMART 108	ÖLFLEX® CLASSIC 110	ÖLFLEX® CLASSIC 110 Cold	ÖLFLEX® CLASSIC 110 Orange	ÖLFLEX® CLASSIC 110 CY	ÖLFLEX® CLASSIC 110 SY	ÖLFLEX® CLASSIC 110 BLACK	ÖLFLEX® CLASSIC 110 CY BLACK
Temperature range													
-5 °C	●	●	●	●		●			●		●	●	●
-10 °C													
-15 °C							●			●			
-25 °C													
-30 °C					●			●				▲	▲
-40 °C	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲		
-50 °C													
-55 °C													
Installation													
Outdoor use, unprotected, fixed installation					✔			✔				✔	✔
Outdoor use, UV light protection, fixed installation	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Outdoor use, unprotected, occasional flexing					✔			✔				✔	✔
Inside, on plaster, in pipe/conduit, in partitions, fixed installation	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔
Inside, occasional flexing	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Bending radius (occasional flexing)													
5 x D													
10 x D							✔						
12.5 x D													
15 x D	✔	✔			✔	✔		✔	✔			✔	
20 x D			✔	✔						✔	✔		✔
Nominal voltage													
300/500 V	✔		✔	✔		✔	✔	✔	✔	✔	✔		
600 V acc. to UL/CSA													
450/750 V	✔	✔	✔	✔									
600/1000 V	✔		✔	✔	✔							✔	✔

Cable designation
(fixed installation and/or occasional flexing)

Page main catalogue 2014/15	24	26	27	28	29	30	31	34	35	36	37	38	39
Usage criteria	ÖLFLEX® CLASSIC 100	ÖLFLEX® CLASSIC 100 Yellow	ÖLFLEX® CLASSIC 100 CY	ÖLFLEX® CLASSIC 100 SY	ÖLFLEX® CLASSIC 100 BK POWER 0.6/1 KV	ÖLFLEX® SMART 108	ÖLFLEX® CLASSIC 110	ÖLFLEX® CLASSIC 110 Cold	ÖLFLEX® CLASSIC 110 Orange	ÖLFLEX® CLASSIC 110 CY	ÖLFLEX® CLASSIC 110 SY	ÖLFLEX® CLASSIC 110 BLACK	ÖLFLEX® CLASSIC 110 CY BLACK
Design													
Fine wire, VDE class 5, stranded copper conductor	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Extra-fine wire, VDE class 6, stranded copper conductor													
Ultra-fine wire, VDE class 6, stranded copper conductor													
PUR core insulation													
Rubber core insulation													
PVC/special PVC core insulation	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PE/PP core insulation													
Halogen-free core insulation													
Number printing						✔	✔	✔	✔	✔	✔	✔	✔
Colour code acc. to VDE 0293	✔	✔	✔	✔	✔								
ÖLFLEX® colour code	✔		✔	✔									
Screening Cu braid/cover			✔							✔			✔
Shared inner sheath under overall screening/braid			✔	✔						✔	✔		✔
Steel wire braiding				✔							✔		
PVC sheath	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PUR sheath, abrasion-resistant, cut-resistant													
Halogen-free outer sheath													
Bio-oil-resistant outer sheath P4/11													
Rubber compound sheath acc. to standard													

✔ Main application/design
✓ Possible application

● Flexible use
□ Fixed and flexible use
▲ Fixed installation

Cable designation
(fixed installation and/or occasional flexing)

Page main catalogue 2014/15	40	42	43	44	45	46	47	48	49	50	51	52	53	54
Usage criteria	ÖLFLEX® CLASSIC 115 CY	ÖLFLEX® EB	ÖLFLEX® EB CY	ÖLFLEX® 140*	ÖLFLEX® 140 CY*	ÖLFLEX® 150	ÖLFLEX® 150 CY	ÖLFLEX® 191	ÖLFLEX® 191 CY	ÖLFLEX® CONTROL TM	ÖLFLEX® CONTROL TM CY	ÖLFLEX® Tray II	ÖLFLEX® Tray II CY	ÖLFLEX® SF
Use														
For non-deactivatable circuits: EN 60204														
For intrinsically safe circuits in hazardous areas/VDE 0165		✔	✔											
Handheld devices and lights on building sites														
Oil-resistant to UL + CSA specification						✔	✔	✔	✔	✔	✔	✔	✔	
Enhanced oil resistance to VDE				✔	✔	✔	✔	✔	✔					
Bio-oil-resistant														
Chemical-resistant cables							See technical table T1							
UV-resistant cables										✓	✓	✔	✔	
Servomotors/drive systems					✔		✔		✔		✔		✔	
For torsion in wind turbine generators (see catalogue page)										✔	✔	✔	✔	
Standards														
Based on VDE/HAR/DIN	✔	✔	✔					✔	✔					
According to standard with VDE certification				✔	✔	✔	✔							✔
With VDE registration														
With HAR certification				✔	✔	✔	✔							
With UL certification						✔	✔	✔	✔	✔	✔	✔	✔	
With CSA certification						✔	✔	✔	✔	✔	✔	✔	✔	
Temperature range														
+105 °C														
+90 °C										□	□	▲	▲	
+80 °C	▲	▲	▲											
+70 °C	●	●	●	□	□	□	□	□	□					
+60 °C														●

Cable designation
(fixed installation and/or occasional flexing)

Page main catalogue 2014/15	40	42	43	44	45	46	47	48	49	50	51	52	53	54
Usage criteria	ÖLFLEX® CLASSIC 115 CY	ÖLFLEX® EB	ÖLFLEX® EB CY	ÖLFLEX® 140*	ÖLFLEX® 140 CY*	ÖLFLEX® 150	ÖLFLEX® 150 CY	ÖLFLEX® 191	ÖLFLEX® 191 CY	ÖLFLEX® CONTROL TM	ÖLFLEX® CONTROL TM CY	ÖLFLEX® Tray II	ÖLFLEX® Tray II CY	ÖLFLEX® SF
Temperature range														
-5 °C	●	●	●	●	●	●	●	●	●	●	●			
-10 °C														
-15 °C														●
-25 °C														
-30 °C	▲													
-40 °C		▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	
-50 °C														
-55 °C														
Installation														
Outdoor use, unprotected, fixed installation												✔	✔	
Outdoor use, UV light protection, fixed installation	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Outdoor use, unprotected, occasional flexing														✔
Inside, on plaster, in pipe/conduit, in partitions, fixed installation	✔	✔	✔											✔
Inside, occasional flexing	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Bending radius (occasional flexing)														
5 x D														
10 x D														✔
12.5 x D				✔		✔								
15 x D		✔						✔		✔				
20 x D	✔		✔		✔		✔		✔		✔			
Nominal voltage														
300/500 V	✔			✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
600 V acc. to UL/CSA						✔	✔	✔	✔	✔	✔	✔	✔	
450/750 V														
600/1000 V														

Cable designation
(fixed installation and/or occasional flexing)

Page main catalogue 2014/15	40	42	43	44	45	46	47	48	49	50	51	52	53	54
Usage criteria	ÖLFLEX® CLASSIC 115 CY	ÖLFLEX® EB	ÖLFLEX® EB CY	ÖLFLEX® 140*	ÖLFLEX® 140 CY*	ÖLFLEX® 150	ÖLFLEX® 150 CY	ÖLFLEX® 191	ÖLFLEX® 191 CY	ÖLFLEX® CONTROL TM	ÖLFLEX® CONTROL TM CY	ÖLFLEX® Tray II	ÖLFLEX® Tray II CY	ÖLFLEX® SF
Design														
Fine wire, VDE class 5, stranded copper conductor	✔	✔	✔	✔	✔	✔	✔	✔	✔	✓	✓	✓	✓	
Extra-fine wire, VDE class 6, stranded copper conductor														
Ultra-fine wire, VDE class 6, stranded copper conductor														✔
PUR core insulation														
Rubber core insulation														
PVC/special PVC core insulation	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PE/PP core insulation														
Halogen-free core insulation														
Number printing	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✓
Colour code acc. to VDE 0293														✔
ÖLFLEX® colour code														
Screening Cu braid/cover	✔		✔		✔		✔		✔		✔		✔	
Shared inner sheath under overall screening/braid					✔		✔		✔					
Steel wire braiding														
PVC sheath	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PUR sheath, abrasion-resistant, cut-resistant														
Halogen-free outer sheath														
Bio-oil-resistant outer sheath P4/11														
Rubber compound sheath acc. to standard														

✔ Main application/design
✓ Possible application

● Flexible use
□ Fixed and flexible use
▲ Fixed installation

Cable designation

Page main catalogue 2014/15	99	100	101	102	103	104	105
Usage criteria Use in power chains or robot applications	ÖLFLEX® SERVO FD 781 CY	ÖLFLEX® SERVO FD 796 P	ÖLFLEX® SERVO FD 796 CP	ÖLFLEX® SERVO FD 798 CP	SERVO cable acc. to SIEMENS® standard 6FX 8PLUS- green or orange	SERVO cable acc. to INDRAMAT® standard INK	SERVO cable acc. to LENZE® standard
Use							
For industrial mach. acc. to EN 60204 Part 1/VDE 0113	✔	✔	✔	✔	✔	✔	✔
For servo drives powered by frequency converters	✔	✔	✔	✔	✔	✔	✔
For servo drives, low capacitance	✔		✔	✔	✔		✔
For encoders, feedback systems, sensors		✔			✔	✔	✔
For free-arm robots/torsional load							
For indoor application, flexing	✔	✔	✔	✔	✔	✔	✔
For outdoor application, flexing		✔	✔	✔	✔	✔	✔
For fieldbus systems							
For video transmission: RGB signal transmission							
For North America with UL + CSA approval		✔	✔	✔		✔	✔
For use in oily environments, enhanced oil resistance	✔	✔	✔	✔	✔	✔	✔
For use in areas with drilling fluids acc. to NEK 606							
For use in areas with bio-oils					✔		
For torsion in wind turbine generators (see catalogue page)							
Temperature range							
+105 °C							
+90 °C							
+80 °C	▲		□			▲	□
+70 °C	●	□		□		●	●
+60 °C					□		
+5 °C							
-5 °C	●						●
-10 °C							
-20 °C					●		□
-30 °C						●	
-40 °C	▲	●	●	●			
-50 °C		▲	▲	▲	▲	▲	

Cable designation

Page main catalogue 2014/15	99	100	101	102	103	104	105
Usage criteria Use in power chains or robot applications	ÖLFLEX® SERVO FD 781 CY	ÖLFLEX® SERVO FD 796 P	ÖLFLEX® SERVO FD 796 CP	ÖLFLEX® SERVO FD 798 CP	SERVO cable acc. to SIEMENS® standard 6FX 8PLUS- green or orange	SERVO cable acc. to INDRAMAT® standard INK	SERVO cable acc. to LENZE® standard
Minimum bending radius (for continuous flexing)							
5 x D							
6.5 x D							
7.5 x D	✔	✔	✔	✔	✔		
10 x D			✔			✔	✔
12.5 x D							
15 x D							
Installation							
For chains with low radii	✔	✔	✔	✔	✔	✔	✔
For chains with minimal space	✔	✔	✔	✔	✔	✔	✔
For lower power/weight ratio in chain	✔	✔	✔	✔	✔	✔	✔
For 24-hour operation with high cycle numbers	✔	✔	✔	✔	✔	✔	✔
For high acceleration > 10 m/s²	✔	✔	✔	✔	✔	✔	✔
For very high acceleration up to 50 m/s²		✔	✔	✔	✔		
For travel speeds up to 5 m/s, travel lengths up to 10 m	✔	✔	✔	✔	✔	✔	✔
For travel speeds up to 10 m/s, travel lengths up to 10 m	✔	✔	✔	✔	✔	✔	✔
For travel speeds up to 5 m/s, travel lengths up to 100 m		✔	✔	✔	✔	✔	✔
Nominal voltage							
350 Vss					✔	✔	✔
30/300 V AC							
300/500 V AC							
600/1000 V AC	✔		✔	✔	✔	✔	✔
600 V acc. to UL/CSA			✔	✔	✔	✔	✔

Cable designation

Page main catalogue 2014/15	99	100	101	102	103	104	105
Usage criteria Use in power chains or robot applications	ÖLFLEX® SERVO FD 781 CY	ÖLFLEX® SERVO FD 796 P	ÖLFLEX® SERVO FD 796 CP	ÖLFLEX® SERVO FD 798 CP	SERVO cable acc. to SIEMENS® standard 6FX 8PLUS- green or orange	SERVO cable acc. to INDRAMAT® standard INK	SERVO cable acc. to LENZE® standard
Design							
Fine wire, VDE class 5, stranded copper conductor							✓
Extra-fine wire, VDE class 6, stranded copper conductor	✓	✓	✓	✓		✓	✓
Ultra-fine wire, VDE class 6, stranded copper conductor							
PVC/special PVC core insulation							
Elastomer core insulation							
PE/cellular PE/ cellular PE foam skin core insulation							✓
Polyethylene/polypropylene core insulation	✓	✓	✓	✓	✓	✓	
TPE core insulation						✓	✓
Special TPE (P4/11) core insulation							
Halogen-free compound					✓		
Number printing	✓	✓	✓	✓		✓	✓
VDE colour code							
DIN 47100 colour code/special colour code		✓			✓	✓	✓
Pair screening PiCY/PiMF/STP		✓	✓	✓	✓	✓	✓
Overall screening	✓	✓	✓		✓	✓	✓
Special PVC sheath	✓						✓
PUR sheath, abrasion-resistant, cut-resistant		✓	✓	✓	✓	✓	✓
Rubber sheath							
Special TPE (P4/11) sheath, bio-oil-resistant							
Halogen-free compound		✓	✓	✓	✓		

✓ Main application/design
✓ Possible application

● Flexible use
□ Fixed and flexible use
▲ Fixed installation

Cable designation

Page main catalogue 2014/15	106	116	117	107	108	118	119	123	124	122
Usage criteria Use in power chains or robot applications	Special Encoder & Resolver cables	ÖLFLEX® CHAIN 808 P	ÖLFLEX® CHAIN 808 CP	ÖLFLEX® CLASSIC FD 810	ÖLFLEX® CLASSIC FD 810 CY	ÖLFLEX® CLASSIC FD 810 P	ÖLFLEX® CLASSIC FD 810 CP	ÖLFLEX® ROBUST FD	ÖLFLEX® ROBUST FD C	ÖLFLEX® PETRO FD 865 CP
Use										
For industrial mach. acc. to EN 60204 Part 1/VDE 0113	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
For servo drives powered by frequency converters	✓				✓		✓	✓	✓	✓
For servo drives, low capacitance								✓	✓	✓
For encoders, feedback systems, sensors	✓									✓
For free-arm robots/torsional load										
For indoor application, flexing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
For outdoor application, flexing	✓							✓	✓	✓
For fieldbus systems										
For video transmission: RGB signal transmission										
For North America with UL + CSA approval	✓									
For use in oily environments, enhanced oil resistance	✓	✓	✓			✓	✓	✓	✓	✓
For use in areas with drilling fluids acc. to NEK 606										✓
For use in areas with bio-oils								✓	✓	
For torsion in wind turbine generators (see catalogue page)										
Temperature range										
+105 °C								□	□	
+90 °C	□									
+80 °C		▲	▲	▲	▲	▲	▲			□
+70 °C		●	●	●	●	●	●			
+60 °C										
+5 °C				●	●					
-5 °C		●	●			●	●			
-10 °C										
-20 °C							●			
-30 °C	●									
-40 °C		▲	▲	▲	▲	▲	▲	●	●	●
-50 °C	▲							▲	▲	▲

Cable designation

Page main catalogue 2014/15	106	116	117	107	108	118	119	123	124	122
Usage criteria Use in power chains or robot applications	Special Encoder & Resolver cables	ÖLFLEX® CHAIN 808 P	ÖLFLEX® CHAIN 808 CP	ÖLFLEX® CLASSIC FD 810	ÖLFLEX® CLASSIC FD 810 CY	ÖLFLEX® CLASSIC FD 810 P	ÖLFLEX® CLASSIC FD 810 CP	ÖLFLEX® ROBUST FD	ÖLFLEX® ROBUST FD C	ÖLFLEX® PETRO FD 865 CP
Minimum bending radius (for continuous flexing)										
5 x D										
6.5 x D										
7.5 x D				✔	✔	✔	✔	✔	✔	✔
10 x D	✔	✓	✓							
12.5 x D		✓	✓							
15 x D										
Installation										
For chains with low radii	✔			✔	✔	✔	✔	✔	✔	✔
For chains with minimal space	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
For lower power/weight ratio in chain	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
For 24-hour operation with high cycle numbers	✔			✔	✔	✔	✔	✔	✔	✔
For high acceleration > 10 m/s²	✔			✔	✔	✔	✔	✔	✔	✔
For very high acceleration up to 50 m/s²										
For travel speeds up to 5 m/s, travel lengths up to 10 m	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
For travel speeds up to 10 m/s, travel lengths up to 10 m	✔			✔	✔	✔	✔	✔	✔	✔
For travel speeds up to 5 m/s, travel lengths up to 100 m	✔			✓	✓	✓	✓	✔	✔	✔
Nominal voltage										
350 Vss	✔									
30/300 V AC	✔									
300/500 V AC		✔	✔	✔	✔	✔	✔	✔	✔	✔
600/1000 V AC										
600 V acc. to UL/CSA										

Cable designation

Page main catalogue 2014/15	106	116	117	107	108	118	119	123	124	122
Usage criteria Use in power chains or robot applications	Special Encoder & Resolver cables	ÖLFLEX® CHAIN 808 P	ÖLFLEX® CHAIN 808 CP	ÖLFLEX® CLASSIC FD 810	ÖLFLEX® CLASSIC FD 810 CY	ÖLFLEX® CLASSIC FD 810 P	ÖLFLEX® CLASSIC FD 810 CP	ÖLFLEX® ROBUST FD	ÖLFLEX® ROBUST FD C	ÖLFLEX® PETRO FD 865 CP
Design										
Fine wire, VDE class 5, stranded copper conductor	✓	✔	✔							
Extra-fine wire, VDE class 6, stranded copper conductor	✓			✔	✔	✔	✔	✔	✔	✔
Ultra-fine wire, VDE class 6, stranded copper conductor										
PVC/special PVC core insulation		✔	✔	✔	✔	✔	✔			
Elastomer core insulation										
PE/cellular PE/ cellular PE foam skin core insulation										
Polyethylene/polypropylene core insulation										
TPE core insulation	✔									✔
Special TPE (P4/11) core insulation								✔	✔	
Halogen-free compound										
Number printing		✔	✔	✔	✔	✔	✔	✔	✔	
VDE colour code										✔
DIN 47100 colour code/special colour code	✓									
Pair screening PiCY/PiMF/STP	✓									
Overall screening	✓		✔		✔		✔		✔	✔
Special PVC sheath				✔	✔					
PUR sheath, abrasion-resistant, cut-resistant	✔	✔	✔			✔	✔			✔
Rubber sheath										
Special TPE (P4/11) sheath, bio-oil-resistant								✔	✔	
Halogen-free compound										

✔ Main application/design
✓ Possible application

● Flexible use
□ Fixed and flexible use
▲ Fixed installation

Cable designation

Page main catalogue 2014/15	155	162	160	161	157	158	159	156	152	153	154
Usage criteria	ÖLFLEX® CRANE	ÖLFLEX® LIFT F*	ÖLFLEX® CRANE F	ÖLFLEX® CRANE CF	ÖLFLEX® LIFT	ÖLFLEX® LIFT T	ÖLFLEX® LIFT S	ÖLFLEX® CRANE 2S	ÖLFLEX® CRANE NSHTÖU**	ÖLFLEX® CRANE VS (N)SHTÖU	ÖLFLEX® CRANE PUR
Use											
For cable trailer guide systems	✔	✔	✔	✔							
Fixing via rollers, drum motors	See separate selection table "Applications" A3-2										
Reeling/re-routing under tensile load	See separate selection table "Applications" A3-2										
For free-hanging use in lifting/conveying systems	✔	✓	✓	✓	✔	✔	✔			✔	✔
For free-hanging use with additional load	✔							✔		✔	✔
For outdoor use	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔
For short travel distances, inside	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔
For short travel distances, outside	✔		✔	✔	✔	✔	✔		✔	✔	✔
For use in power chains	See separate selection table "FD" A3-2										
Standards											
In accordance with VDE/HAR/DIN	✔	✔	✔	✔			✔	✔		✔	✔
With VDE approval									✔		
With VDE registration					✔	✔					
Flame-retardant acc. to IEC 60332.1-2	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Temperature range											
+90 °C			□	□							
+80 °C	□								□	□	□
+70 °C		□			□	□	□	□			
+60 °C											
+5 °C											
0 °C		●									

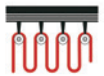
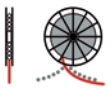
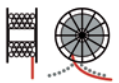
*Min. conductor temperature -15 °C with flexible application and nominal voltage U_0/U = 450/750 V_{ac}, only from nominal conductor cross-section of 1.5 mm²
**Min. bending radius 5 x D only if outer diameter < 21.5 mm

Cable designation

Page main catalogue 2014/15	155	162	160	161	157	158	159	156	152	153	154
Usage criteria	ÖLFLEX® CRANE	ÖLFLEX® LIFT F*	ÖLFLEX® CRANE F	ÖLFLEX® CRANE CF	ÖLFLEX® LIFT	ÖLFLEX® LIFT T	ÖLFLEX® LIFT S	ÖLFLEX® CRANE 2S	ÖLFLEX® CRANE NSHTÖU**	ÖLFLEX® CRANE VS (N)SHTÖU	ÖLFLEX® CRANE PUR
Temperature range											
-5 °C											
-10 °C											
-15 °C		●			●	●	●	●			
-20 °C											
-25 °C	●		●	●					●	●	
-30 °C											
-40 °C	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	□
Bending radius											
7.5 x D									✔	✔	✔
10 x D		✔	✔	✔							
12.5 x D	✔										
20 x D					✔	✔	✔	✔			
Nominal voltage											
300/500 V	✔	✔	✔	✔	✔	✔	✔	✔			
450/750 V		✔									
600/1000 V									✔	✔	✔
Design											
PVC core insulation		✔			✔	✔	✔	✔			
TPE core insulation											✔
Rubber core insulation	✔		✔	✔					✔	✔	
Supporting element: hemp/textile rope	✔				✔	✔					✔
Supporting element: steel rope, internal							✔				
Supporting element: steel rope, external								✔			
Supporting element: Kevlar rope					✔	✔				✔	✔
Outer sheath with supporting braid									✔	✔	✔
PVC sheath		✔			✔	✔	✔	✔			
PUR-Mantel											✔
Rubber sheath	✔		✔	✔					✔	✔	

✔ Main application/design
✓ Possible application
● Flexible use
□ Fixed and flexible use
▲ Fixed installation

Cable designation

Page main catalogue 2014/15	152	153	154	155	161	156	157	158	159	160	162
Usage criteria ÖLFLEX® CRANE application areas	ÖLFLEX® CRANE NSHTÖU	ÖLFLEX® CRANE VS (N)SHTÖU	ÖLFLEX® CRANE PUR	ÖLFLEX® CRANE	ÖLFLEX® CRANE CF	ÖLFLEX® CRANE 2S	ÖLFLEX® LIFT	ÖLFLEX® LIFT T	ÖLFLEX® LIFT S	ÖLFLEX® CRANE F	ÖLFLEX® LIFT F
Application											
Cable trailer systems 				✔	✔					✔	✔
Reeling, light stress (monospiral configuration – stacked) 	✔	✓	✔								
Reeling, moderate stress (multispiral configuration – single layer) 	✔	✓	✔								
Reeling, heavy stress (multispiral configuration – multilayer) 		✔	✔								

Cable designation

Page main catalogue 2014/15	152	153	154	155	161	156	157	158	159	160	162
Usage criteria ÖLFLEX® CRANE application areas	ÖLFLEX® CRANE NSHTÖU	ÖLFLEX® CRANE VS (N)SHTÖU	ÖLFLEX® CRANE PUR	ÖLFLEX® CRANE	ÖLFLEX® CRANE CF	ÖLFLEX® CRANE 2S	ÖLFLEX® LIFT	ÖLFLEX® LIFT T	ÖLFLEX® LIFT S	ÖLFLEX® CRANE F	ÖLFLEX® LIFT F
Application											
Vertical reeling 		✔	✔								
Reel storage (horizontal) 		✔	✔								
Reel storage (vertical) 			✔								
Re-routing under tensile load 		✔	✔								
Push-button control unit 		✔	✔			✔					
Drag chain 	✓	✓	✓	✓						✓	✓
Lift							✔	✔	✔	✔	✔

✔ Main application/design
✓ Possible application

Cable designation

Page main catalogue 2014/15	244	244	246	248	250	251	253	254	255	256	257	258	259	260
Usage criteria Data network cables for low-frequency analogue/ digital signal transmission	UNITRONIC® 100	UNITRONIC® 100 CY	UNITRONIC® LiYY	UNITRONIC® LiYCY	UNITRONIC® LiYY (TP)	UNITRONIC® LiYCY (TP)	UNITRONIC® LiYCY-CY	UNITRONIC® LiFYCY (TP)	UNITRONIC® CY PiDY (TP)	UNITRONIC® ST	UNITRONIC® LiYD 11Y	UNITRONIC® PUR CP	UNITRONIC® PUR CP (TP)	UNITRONIC® Li2YCY(TP)- Li2YCYv (TP)
Use														
Access control/time recording system (ZK/ZE)						✓				✓	✓		✓	
Production data acquisition systems (BDE)						✓				✓			✓	
Clock systems												✓	✓	
Intrusion detection systems (EMA)			✓	✓		✓	✓				✓			✓
Fire alarm systems (BMA)											✓			✓
Telephone private branch exchanges											✓			✓
Intercom systems			✓	✓		✓	✓	✓			✓	✓	✓	✓
Electro-acoustic systems (ELA/PA)											✓			✓
Recording studio cables/ microphone cables		✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓
Printers/plotters						✓		✓			✓		✓	✓
DC stepper motors						✓							✓	✓
Encoders (position or angle)						✓			✓				✓	✓
Industrial sensors, $U < 50\ V_{eff}$	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Industrial actuators, $U < 50\ V_{eff}$	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓
Measurement and control purposes, analogue (MSR)	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
MSR, digital	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓	✓
In electronic devices	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
For cutting/ clamping technology (0.34 mm²/AWG 22)	✓	✓	✓	✓								✓	✓	✓

Cable designation

Page main catalogue 2014/15	244	244	246	248	250	251	253	254	255	256	257	258	259	260
Usage criteria Data network cables for low-frequency analogue/ digital signal transmission	UNITRONIC® 100	UNITRONIC® 100 CY	UNITRONIC® LiYY	UNITRONIC® LiYCY	UNITRONIC® LiYY (TP)	UNITRONIC® LiYCY (TP)	UNITRONIC® LiYCY-CY	UNITRONIC® LiFYCY (TP)	UNITRONIC® CY PiDY (TP)	UNITRONIC® ST	UNITRONIC® LiYD 11Y	UNITRONIC® PUR CP	UNITRONIC® PUR CP (TP)	UNITRONIC® Li2YCY(TP)- Li2YCYv (TP)
Temperature range														
+80 °C	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
+70 °C	●	●	●	●	●	●	●	●			●	●	●	●
+50 °C														
-5 °C	●	●	●	●	●	●	●	●			●	●	●	●
-30 °C	▲	▲					▲	▲	▲	▲	▲	▲	▲	▲
-40 °C			▲	▲	▲	▲								
Installation														
For fixed installation outdoors											✓			✓
For direct routing underground														✓
For fixed installation indoors	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
For flexing applications (indoors), occasional	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓
For permanent flexing (indoors/outdoors)														
Design														
Halogen-free														
Flame-retardant, self-extinguishing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
For el. symmetrical signal transmission (TP), twisted pair					✓	✓		✓	✓				✓	✓
For high pair decoupling, pair screening									✓					
For el. screening effect, overall screening		✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓

Cable designation

Page main catalogue 2014/15	244	244	246	248	250	251	253	254	255	256	257	258	259	260
Usage criteria Data network cables for low-frequency analogue/ digital signal transmission	UNITRONIC® 100	UNITRONIC® 100 CY	UNITRONIC® LiYY	UNITRONIC® LiYCY	UNITRONIC® LiYY (TP)	UNITRONIC® LiYCY (TP)	UNITRONIC® LiYCY-CY	UNITRONIC® LiFYCY (TP)	UNITRONIC® CY PiDY (TP)	UNITRONIC® ST	UNITRONIC® LiYD 11Y	UNITRONIC® PUR CP	UNITRONIC® PUR CP (TP)	UNITRONIC® Li2YCY (TP)- LI2YCYv (TP)
Design														
For low-attenuation transmission, low-capacitance														✔
With individually screened cores							✔							
With colour code DIN 47100			✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔
With UNITRONIC® colour code	✔	✔												
With industrial electronics colour code as per VDE 0815														
With star quad colour code “BD” as per VDE 0815/0816														
With pair colour code “LG” as per VDE 0815														
With special colour code										✔				
With PVC/special PVC outer sheath	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔				✔
With PUR sheath, abrasion-resistant, cut-resistant											✔	✔	✔	
With PE outer sheath (not flame-retardant)														
With halogeen-free outer sheath														

✔ Main application/design
✓ Possible application

● Flexible use
□ Fixed and flexible use
▲ Fixed installation

Cable designation

Page main catalogue 2014/15	262	263	264	265	270	271	272	273	274	279	280	281	284	285	285
Usage criteria Data network cables for low-frequency analogue/ digital signal transmission	UNITRONIC® Li2YCY PiMF	UNITRONIC® LiHH	UNITRONIC® LiHGH	UNITRONIC® LiHCH (TP)	UNITRONIC® FD	UNITRONIC® FD CY	UNITRONIC® FD P plus	UNITRONIC® FD CP plus	UNITRONIC® FD CP (TP) plus	JE-Y(ST)Y...BD	JE-LiYCY...BD	Indoor telephone cable J-Y(ST)Y	Fire alarm cable J-Y(ST)Y red	J-2Y(ST)Y...ST III BD	Outdoor telephone cable
Use															
Access control/time recording system (ZK/ZE)				✓						✔	✔	✔		✔	✓
Production data acquisition systems (BDE)				✓						✔	✔	✔		✔	✓
Clock systems										✔	✔	✔		✔	✓
Intrusion detection systems (EMA)	✓	✓	✓	✓						✓	✓	✓		✔	✓
Fire alarm systems (BMA)	✓											✓	✔	✓	✓
Telephone private branch exchanges	✓											✔		✔	✓
Intercom systems	✔	✓	✓	✓						✓	✓	✔		✔	✓
Electro-acoustic systems (ELA/PA)	✔									✓		✔		✔	✓
Recording studio cables/ microphone cables	✔	✓	✓	✓											
Printers/plotters	✔			✓	✓	✓	✓	✓	✓						
DC stepper motors	✔			✔					✔		✓				
Encoders (position or angle)	✔			✔					✔		✓				
Industrial sensors, $U < 50\ V_{eff}$	✔	✔	✔	✔	✔	✔	✔	✔	✔	✓	✓				
Industrial actuators, $U < 50\ V_{eff}$	✔	✔	✔	✔	✔	✔	✔	✔	✔		✓				
Measurement and control purposes, analogue (MSR)	✔	✔	✔	✔	✔	✔	✔	✔	✔	✓	✓			✓	✓
MSR, digital	✔	✓	✓	✓	✔	✔	✔	✔	✔		✓			✓	✓
In electronic devices	✔	✔	✔	✔	✔	✔	✔	✔	✔						
For cutting/ clamping technology (0.34 mm²/AWG 22)	✓	✔	✔								✔				

Cable designation

Page main catalogue 2014/15	262	263	264	265	270	271	272	273	274	279	280	281	284	285	285
Usage criteria Data network cables for low-frequency analogue/ digital signal transmission	UNITRONIC® LI2YCY PiMF	UNITRONIC® LiHH	UNITRONIC® LiHCH	UNITRONIC® LiHCH (TP)	UNITRONIC® FD	UNITRONIC® FD CY	UNITRONIC® FD P plus	UNITRONIC® FD CP plus	UNITRONIC® FD CP (TP) plus	JE-Y(ST)Y...BD	JE-LiYCY...BD	Indoor telephone cable J-Y(ST)Y	Fire alarm cable J-Y(ST)Y red	J-2Y(ST)Y...ST III BD	Outdoor telephone cable
Temperature range															
+80 °C	▲	▲	▲	▲	▲	▲	□	□	□						
+70 °C	●	●	●	●	●	●				▲	▲	▲	▲	▲	▲
+50 °C										●	●				
-5 °C	●	●	●	●	●	●				●	●				
-30 °C	▲	▲	▲	▲						▲	▲	▲	▲	▲	
-40 °C					▲	▲	□	□	□						
Installation															
For fixed installation outdoors															✔
For direct routing underground													✔		✓
For fixed installation indoors	✔	✔	✔	✔	✓	✓	✓	✓	✓	✔	✔	✔	✔	✔	
For flexing applications (indoors), occasional	✔	✔	✔	✓	✔	✔	✔	✔	✔		✓				
For permanent flexing (indoors/outdoors)							✔	✔	✔						
Design															
Halogen-free		✔	✔	✔			✔	✔	✔						✔
Flame-retardant, self-extinguishing	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✓	✓
For el. symmetrical signal transmission (TP), twisted pair	✔								✔	✔	✔	✔			
For high pair decoupling, pair screening	✔														
For el. screening effect, overall screening	✔		✔	✔		✔		✔	✔	✔	✔	✔	✔	✔	✔

Cable designation

Page main catalogue 2014/15	262	263	264	265	270	271	272	273	274	279	280	281	284	285	285
Usage criteria Data network cables for low-frequency analogue/ digital signal transmission	UNITRONIC® LI2YCY PiMF	UNITRONIC® LiHH	UNITRONIC® LiHCH	UNITRONIC® LiHCH (TP)	UNITRONIC® FD	UNITRONIC® FD CY	UNITRONIC® FD P plus	UNITRONIC® FD CP plus	UNITRONIC® FD CP (TP) plus	JE-Y(ST)Y...BD	JE-LiYCY...BD	Indoor telephone cable J-Y(ST)Y	Fire alarm cable J-Y(ST)Y red	J-2Y(ST)Y...ST III BD	Outdoor telephone cable
Design															
For low-attenuation transmission, low-capacitance	✔						✔	✔	✔					✔	
With individually screened cores															
With colour code DIN 47100	✔	✔	✔	✔	✔	✔	✔	✔	✔						
With UNITRONIC® colour code															
With industrial electronics colour code as per VDE 0815										✔	✔				
With star quad colour code “BD” as per VDE 0815/0816											✓			✔	✔
With pair colour code “LG” as per VDE 0815												✔	✔		
With special colour code															
With PVC/special PVC outer sheath	✔				✔	✔				✔	✔	✔	✔	✔	
With PUR sheath, abrasion-resistant, cut-resistant							✔	✔	✔						
With PE outer sheath (not flame-retardant)															✔
With halogeen-free outer sheath		✔	✔	✔			✔	✔	✔						✔

✔ Main application/design
✓ Possible application

● Flexible use
□ Fixed and flexible use
▲ Fixed installation

Halogen-free accessories:

Cable protection hoses
SILVYN® RILL PA6
SILVYN® RILL PA12
SILVYN® FPAS
SILVYN® HCC
SILVYN® LCCH-2
SILVYN® AS
SILVYN® EDU-AS
SILVYN® TC
SILVYN® EMC AS-CU
SILVYN® SSUE
SILVYN® UI 511
SILVYN® HFX
SILVYN® CHAIN
SILVYN® CHAIN STEEL
SILVYN® HIPROJACKET

Cable entries
SKINTOP® ST-HF-M
SKINTOP® GMP-HF-M
SKINTOP® BLK-GL-M
SKINTOP® GMP-GL-M
SKINDICHT® KW-M
SKINDICHT® KU-M
SKINDICHT® EKU-M

Marking
FLEXIMARK® single core marking
Flexipart, marking sleeves, Flexiprint
FLEXIMARK® cable labelling
MINI system, shrink tube labelling
FLEXIMARK® component labelling
LB LA labels
DYMO® label strips

Accessories
Embossed metal plates,
insulated conductor end sleeves
Insulated cable lugs, TBTA insulating tape
Shrink hoses CMP/PKG/HSB/PLG
TEC end caps
TEB branch joints
KW plastic coil
Cable ties Basic Tie/TY-RAP®/TY-FAST®

Cable designation

Page main catalogue 2014/15	323	324	325	323	324	325	310	311	288	295	292
Usage criteria BUS/LAN cable interfaces	UNITRONIC® BUS IBS	UNITRONIC® BUS IBS FD P	UNITRONIC® BUS IBS Yv	UNITRONIC® BUS IBS P COMBI	UNITRONIC® BUS IBS FD P COMBI	UNITRONIC® BUS IBS Yv COMBI	UNITRONIC® BUS LD	UNITRONIC® BUS LD FD P	UNITRONIC® BUS PB	UNITRONIC® BUS PB FD P	UNITRONIC® BUS PB Yv
Use											
Suitable for network type as per:											
IEEE 802.3 (Ethernet)											
IEEE 802.4 (MAP)											
IEEE 802.5 (IBM)											
ISDN 64 K Bit											
IBM 3270, 3600, 4300											
IBM AS 400, 36, 38											
IBM PC Network											
10 base 5 Ethernet											
10 base 2 Cheapernet											
10 base T (UTP) 100 ohms											
Token Ring (STP) 150 ohms											
Token Bus											
Radio/TV											
Video BAS/FBAS											
Video RGB monitors											
EIA RS 232/V.24							✓✓	✓✓			
EIA RS 422/V.11							✓✓	✓✓			
EIA RS 485							✓✓	✓✓			
EIA RS 232/20 mA (TTY)											
Standards											
PROFIBUS									✓	✓	✓
INTERBUS® (Phoenix Contact)	✓	✓	✓	✓	✓	✓					
BITBUS (Intel)							✓✓	✓✓			
For LAN installations (IBM, Ethernet etc.)											
With IBM reference approval											
PROFINET®											
Temperature range											
+205 °C											
+90 °C											
+80 °C			▲			▲	▲	▲		▲	
+70 °C	▲	●	▲		●			●	▲	●	▲
+60 °C											

Cable designation

Page main catalogue 2014/15	323	324	325	323	324	325	310	311	288	295	292
Usage criteria BUS/LAN cable interfaces	UNITRONIC® BUS IBS	UNITRONIC® BUS IBS FD P	UNITRONIC® BUS IBS Yv	UNITRONIC® BUS IBS P COMBI	UNITRONIC® BUS IBS FD P COMBI	UNITRONIC® BUS IBS Yv COMBI	UNITRONIC® BUS LD	UNITRONIC® BUS LD FD P	UNITRONIC® BUS PB	UNITRONIC® BUS PB FD P	UNITRONIC® BUS PB Yv
Temperature range											
-5 °C											
-20 °C		●			●			●			
-30 °C	▲		▲	▲		▲	▲	▲		●	
-40 °C									▲	▲	
-50 °C											
-90 °C											
Installation											
Installation outdoors in open air		✔			✔					✔	
Indirect routing underground		✔			✔					✔	
Indoor use	✔		✔	✔		✔	✔	✔	✔		✔
Direct routing underground			✔			✔					✔
Characteristic impedance											
≥ 150 ohms									✔	✔	✔
≥ 120 ohms											
≥ 100 ohms	✔	✔	✔	✔	✔	✔	✔	✔			
≥ 93 ohms											
≥ 75 ohms											
≥ 60 ohms											
≥ 50 ohms											
Output category											
Cat.5 ≤ 100 MHz											
Cat.6 ≤ 250 MHz											
Cat.6_A ≤ 500 MHz											
Cat.7 ≤ 600 MHz											
Cat.7_A ≤ 1200 MHz											
Design											
PVC sheath			✔			✔	✔		✔		✔
Halogen-free sheath											
PE sheath											
PUR sheath, abrasion-resistant, cut-resistant	✔	✔		✔	✔			✔		✔	
FEP outer sheath											

✔ Main application/design
✓ Possible application

● Flexible use
□ Fixed and flexible use
▲ Fixed installation

Cable designation

Page main catalogue 2014/15	294	299	288	298	300	301	300	287	326
Usage criteria BUS/LAN cable interfaces	UNITRONIC® BUS PB 7-W	UNITRONIC® BUS PB FD P COMBI	UNITRONIC® BUS PB PE	UNITRONIC® BUS PB FD FRNC FC	UNITRONIC® BUS PB TORSION	UNITRONIC® BUS PB FESTOON	UNITRONIC® BUS PB FD Y HYBRID	UNITRONIC® BUS ASI FD P	UNITRONIC® BUS EIB
Use									
Suitable for network type as per:									
IEEE 802.3 (Ethernet)									
IEEE 802.4 (MAP)									
IEEE 802.5 (IBM)									
ISDN 64 K Bit									
IBM 3270, 3600, 4300									
IBM AS 400, 36, 38									
IBM PC Network									
10 base 5 Ethernet									
10 base 2 Cheapernet									
10 base T (UTP) 100 ohms									
Token Ring (STP) 150 ohms									
Token Bus									
Radio/TV									
Video BAS/FBAS									
Video RGB monitors									
EIA RS 232/V.24									
EIA RS 422/V.11									
EIA RS 485									
EIA RS 232/20 mA (TTY)									
Standards									
PROFIBUS	✔	✔	✔	✔	✔	✔			
INTERBUS® (Phoenix Contact)									
BITBUS (Intel)									
AS-Interface								✔	
EIB/KNX									✔
PROFINET®									
Temperature range									
+205 °C									
+90 °C									
+80 °C		▲	▲	▲	▲	▲	▲	▲	
+70 °C	▲			●	●	●	●	●	▲
+60 °C		●							

Cable designation

Page main catalogue 2014/15	294	299	288	298	300	301	300	287	326
Usage criteria BUS/LAN cable interfaces	UNITRONIC® BUS PB 7-W	UNITRONIC® BUS PB FD P COMBI	UNITRONIC® BUS PB PE	UNITRONIC® BUS PB FD FRNC FC	UNITRONIC® BUS PB TORSION	UNITRONIC® BUS PB FESTOON	UNITRONIC® BUS PB FD Y HYBRID	UNITRONIC® BUS ASI FD P	UNITRONIC® BUS EIB
Temperature range									
-5 °C		●		●		●	●		
-20 °C					●				
-30 °C	▲							●	▲
-40 °C		▲	▲	▲	▲	▲	▲	▲	
-50 °C									
-90 °C									
Installation									
Installation outdoors in open air	✔	✓					✓		
Indirect routing underground									
Indoor use	✔	✔	✔	✔	✔	✔	✔	✔	✔
Direct routing underground									
Characteristic impedance									
≥ 150 ohms	✔	✔	✔	✔	✔	✔	✔		
≥ 120 ohms									
≥ 100 ohms									
≥ 93 ohms									
≥ 75 ohms									✔
≥ 60 ohms									
≥ 50 ohms									
Output category									
Cat.5 ≤ 100 MHz									
Cat.6 ≤ 250 MHz									
Cat.6_A ≤ 500 MHz									
Cat.7 ≤ 600 MHz									
Cat.7_A ≤ 1200 MHz									
Design									
PVC sheath	✔					✔	✔		✔
Halogen-free sheath								✔	
PE sheath			✔						
PUR sheath, abrasion-resistant, cut-resistant		✔		✔	✔			✔	
FEP outer sheath									

✔ Main application/design
✓ Possible application

● Flexible use
□ Fixed and flexible use
▲ Fixed installation

Cable designation

Page main catalogue 2014/15	290	426	426	426	427	427	433	431	428	429	430	432
Usage criteria BUS/LAN cable interfaces	UNITRONIC® BUS PB HEAT 180	UNITRONIC® LAN 200 U/UTP Cat.5e	UNITRONIC® LAN 200 F/UTP Cat.5e	UNITRONIC® LAN 200 SF/UTP Cat.5e	UNITRONIC® LAN 250 U/UTP Cat.6	UNITRONIC® LAN 250 F/UTP Cat.6	UNITRONIC® LAN Flex, Cat.5e, Cat.7	UNITRONIC® LAN 1500 Cat.7_A	UNITRONIC® LAN 500 Cat.6_A U/FTP, F/FTP, S/FTP	UNITRONIC® LAN 1000 S/FTP Cat.7	UNITRONIC® LAN 1200 Cat.7_A	UNITRONIC® LAN Outdoor Cat.7
Use												
Suitable for network type as per:												
IEEE 802.3 (Ethernet)		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
IEEE 802.4 (MAP)												
IEEE 802.5 (IBM)												
IEEE 802.3 at POE		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
ISDN 64 K Bit		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
IBM 3270, 3600, 4300												
IBM AS 400, 36, 38												
IBM PC Network												
10 Base 5 Ethernet												
10 Base 2 Cheapernet												
10 Base-T 100 ohms		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
100 Base-T 100 ohms		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
1000 Base-T		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
10 G Base-T							✔	✔	✔	✔	✔	✔
Token Ring (STP) 150 ohms												
Token Bus												
Radio/TV								✓				
Video BAS/FBAS												
Video RGB monitors												
EIA RS 232/V.24		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	
EIA RS 422/V.11		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
EIA RS 485		✔	✔	✔	✔	✔	✔	✔	✔	✓	✔	
EIA RS 232/20 mA (TTY)		✓	✓	✓	✓	✓	✓	✔	✓	✓		

Cable designation

Page main catalogue 2014/15	290	426	426	426	427	427	433	431	428	429	430	432
Usage criteria BUS/LAN cable interfaces	UNITRONIC® BUS PB HEAT 180	UNITRONIC® LAN 200 U/UTP Cat.5e	UNITRONIC® LAN 200 F/UTP Cat.5e	UNITRONIC® LAN 200 SF/UTP Cat.5e	UNITRONIC® LAN 250 U/UTP Cat.6	UNITRONIC® LAN 250 F/UTP Cat.6	UNITRONIC® LAN Flex, Cat.5e, Cat.7	UNITRONIC® LAN 1500 Cat.7$_A$	UNITRONIC® LAN 500 Cat.6$_A$ U/FTP, F/FTP, S/FTP	UNITRONIC® LAN 1000 S/FTP Cat.7	UNITRONIC® LAN 1200 Cat.7$_A$	UNITRONIC® LAN Outdoor Cat.7
Standards												
PROFIBUS	✔											
INTERBUS® (Phoenix Contact)												
CAN ISO 11898												
BITBUS (Intel)												
For LAN installations (IBM, Ethernet etc.)		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
With IBM reference approval												
PROFINET®												
Temperature range												
+180 °C	▲											
+90 °C												
+80 °C												
+70 °C												
+60 °C		▲	▲	▲	▲	▲	▲	▲	□	▲	▲	▲
-5 °C												
-20 °C		▲	▲	▲	▲	▲	▲	▲	□	▲	▲	▲
-30 °C		▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
-40 °C												
-50 °C												
-90 °C												
Installation												
Installation outdoors in open air												✔
Indirect routing underground												✔
Indoor use	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	
Direct routing underground												✔

Cable designation

Page main catalogue 2014/15	290	426	426	426	427	427	433	431	428	429	430	432
Usage criteria BUS/LAN cable interfaces	UNITRONIC® BUS PB HEAT 180	UNITRONIC® LAN 200 U/UTP Cat.5e	UNITRONIC® LAN 200 F/UTP Cat.5e	UNITRONIC® LAN 200 SF/UTP Cat.5e	UNITRONIC® LAN 250 U/UTP Cat.6	UNITRONIC® LAN 250 F/UTP Cat.6	UNITRONIC® LAN Flex, Cat.5e, Cat.7	UNITRONIC® LAN 1500 Cat.7$_A$	UNITRONIC® LAN 500 Cat.6$_A$ U/FTP, F/FTP, S/FTP	UNITRONIC® LAN 1000 S/FTP Cat.7	UNITRONIC® LAN 1200 Cat.7$_A$	UNITRONIC® LAN Outdoor Cat.7
Characteristic impedance												
≥ 150 ohms	✔											
≥ 120 ohms												
≥ 100 ohms		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
≥ 93 ohms												
≥ 75 ohms												
≥ 60 ohms												
≥ 50 ohms												
Output category												
Cat.5 ≤ 100 MHz		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	
Cat.6 ≤ 250 MHz					✔	✔	✔	✔	✔	✔	✔	
Cat.6$_A$ ≤ 500 MHz							✔		✔			
Cat.7 ≤ 600 MHz								✔		✔	✔	✔
Cat.7$_A$ ≤ 1200 MHz								✔			✔	
Cat.7$_A$ ≤ 1500 MHz								✔				
Design												
PVC sheath		✔	✔	✔	✔	✔	✔	✔	✔	✔		
Halogen-free sheath		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	
PE sheath												✔
PUR sheath, abrasion-resistant, cut-resistant												
FEP outer sheath	✔											

✔ Main application/design
✓ Possible application

● Flexible use
□ Fixed and flexible use
▲ Fixed installation

Cable designation

Page main catalogue 2014/15	260	262	390	391	392	393	394	394	315	315	316	397	398
Usage criteria BUS/LAN cable interfaces	UNITRONIC® LI2YCY(TP)-LI2YCYv(TP)	UNITRONIC® LI2YCY PiMF	ETHERLINE® Cat.5e, fixed	ETHERLINE® Cat.5e, flex.	ETHERLINE® Cat.5e FD	ETHERLINE® Cat.5e FD BK	ETHERLINE® Cat.5 ARM	ETHERLINE® Cat.5 FRNC HYBRID	UNITRONIC® BUS CAN	UNITRONIC® BUS CAN FD P	UNITRONIC® BUS CAN BURIAL	ETHERLINE® PN Cat.5	ETHERLINE® PN Flex
Use													
Suitable for network type as per:													
IEEE 802.3 (Ethernet)	✔		✔	✔	✔	✔	✔	✔				✔	✔
IEEE 802.4 (MAP)													
IEEE 802.5 (IBM)													
IEEE 802.3 at POE	✔		✔	✔	✔	✔	✔	✔				✔	✔
ISDN 64 K Bit	✔	✔											
IBM 3270, 3600, 4300													
IBM AS 400, 36, 38													
IBM PC Network													
10 Base 5 Ethernet													
10 Base 2 Cheapernet													
10 Base-T 100 ohms	✔		✔	✓	✓	✓	✓	✓				✔	✔
100 Base-T 100 ohms			✔	✔	✔	✔	✓	✓				✔	✔
1000 Base-T			✔	✔	✔	✓							
10 G Base-T													
Token Ring (STP) 150 ohms													
Token Bus													
Radio/TV													
Video BAS/FBAS													
Video RGB monitors													
EIA RS 232/V.24	✔	✔											
EIA RS 422/V.11	✓	✓							✓	✓			
EIA RS 485	✓	✓											
EIA RS 232/20 mA (TTY)	✓	✓											

Cable designation

Page main catalogue 2014/15	260	262	390	391	392	393	394	394	315	315	316	397	398
Usage criteria BUS/LAN cable interfaces	UNITRONIC® LI2YCY(TP)-LI2YCYv(TP)	UNITRONIC® LI2YCY PiMF	ETHERLINE® Cat.5e, fixed	ETHERLINE® Cat.5e, flex.	ETHERLINE® Cat.5e FD	ETHERLINE® Cat.5e FD BK	ETHERLINE® Cat.5 ARM	ETHERLINE® Cat.5 FRNC HYBRID	UNITRONIC® BUS CAN	UNITRONIC® BUS CAN FD P	UNITRONIC® BUS CAN BURIAL	ETHERLINE® PN Cat.5	ETHERLINE® PN Flex
Standards													
PROFIBUS													
INTERBUS® (Phoenix Contact)													
CAN ISO 11898									✔	✔	✔		
BITBUS (Intel)													
For LAN installations (IBM, Ethernet etc.)		✔	✔	✔	✔	✔	✔	✔				✔	✔
With IBM reference approval													
PROFINET®							✔	✔				✔	✔
Temperature range													
+180 °C													
+90 °C													
+80 °C	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲			▲
+70 °C	●	●		□	□		●	●	●	●		▲	▲
+60 °C												▲	●
-5 °C	●	●		□	□				●				
-20 °C					●								●
-30 °C				▲	▲	▲	●	●	▲	●			
-40 °C	▲	▲	▲				▲	▲		▲		▲	▲
-50 °C													
-90 °C													
Installation													
Installation outdoors in open air	✓					✓							
Indirect routing underground	✓						✓						
Indoor use	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔
Direct routing underground							✓						

Cable designation

Page main catalogue 2014/15	260	262	390	391	392	393	394	394	315	315	316	397	398
Usage criteria BUS/LAN cable interfaces	UNITRONIC® LI2YCY(TP)-LI2YCYV(TP)	UNITRONIC® LI2YCY PiMF	ETHERLINE® Cat.5e, fixed	ETHERLINE® Cat.5e, flex.	ETHERLINE® Cat.5e FD	ETHERLINE® Cat.5e FD BK	ETHERLINE® Cat.5 ARM	ETHERLINE® Cat.5 FRNC HYBRID	UNITRONIC® BUS CAN	UNITRONIC® BUS CAN FD P	UNITRONIC® BUS CAN BURIAL	ETHERLINE® PN Cat.5	ETHERLINE® PN Flex
Characteristic impedance													
≥ 150 ohms													
≥ 120 ohms									✔	✔	✔		
≥ 100 ohms	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔
≥ 93 ohms													
≥ 75 ohms													
≥ 60 ohms													
≥ 50 ohms													
Output category													
Cat.5 ≤ 100 MHz			✔	✔	✔	✔	✔	✔	✔			✔	✔
Cat.6 ≤ 250 MHz													
Cat.6_A ≤ 500 MHz													
Cat.7 ≤ 600 MHz													
Cat.7_A ≤ 1200 MHz													
Cat.7_A ≤ 1500 MHz													
Design													
PVC sheath	✔	✔		✔					✔			✔	✔
Halogen-free sheath			✔	✔	✔	✓		✔					✔
PE sheath							✔				✔		
PUR sheath, abrasion-resistant, cut-resistant			✔	✔	✔	✔		✔		✔			
FEP outer sheath													

✔ Main application/design
✓ Possible application

● Flexible use
□ Fixed and flexible use
▲ Fixed installation

Cable designation

Page main catalogue 2014/15	399	400	401	405	406	407	408	395	396	404	405
Usage criteria BUS/LAN cable interfaces	ETHERLINE® PN Cat.5 FD	ETHERLINE® Y Cat.5e BK	ETHERLINE® TORSION Cat.5	ETHERLINE® Cat.6_A	ETHERLINE® PN Cat.6_A Flex	ETHERLINE® FD Cat.6_A	ETHERLINE® TORSION Cat.6_A	ETHERLINE® EC Flex Cat.5e	ETHERLINE® EC FD Cat.5e	ETHERLINE® Cat.6 FD	ETHERLINE® Cat.7
Use											
Suitable for network type as per:											
IEEE 802.3 (Ethernet)	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
IEEE 802.4 (MAP)											
IEEE 802.5 (IBM)											
IEEE 802.3 at POE	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔
ISDN 64 K Bit											
IBM 3270, 3600, 4300											
IBM AS 400, 36, 38											
IBM PC Network											
10 Base 5 Ethernet											
10 Base 2 Cheapernet											
10 Base-T 100 ohms	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
100 Base-T 100 ohms	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
1000 Base-T				✔	✔	✔	✔			✔	✔
10 G Base-T				✔	✔	✔	✔				✔
Token Ring (STP) 150 ohms											
Token Bus											
Radio/TV											
Video BAS/FBAS											
Video RGB monitors											
EIA RS 232/V.24											
EIA RS 422/V.11											
EIA RS 485											
EIA RS 232/20 mA (TTY)											

Cable designation

Page main catalogue 2014/15	399	400	401	405	406	407	408	395	396	404	405
Usage criteria BUS/LAN cable interfaces	ETHERLINE® PN Cat.5 FD	ETHERLINE® Y Cat.5e BK	ETHERLINE® TORSION Cat.5	ETHERLINE® Cat.6$_A$	ETHERLINE® PN Cat.6$_A$ Flex	ETHERLINE® FD Cat.6$_A$	ETHERLINE® TORSION Cat.6$_A$	ETHERLINE® EC Flex Cat.5e	ETHERLINE® EC FD Cat.5e	ETHERLINE® Cat.6 FD	ETHERLINE® Cat.7
Standards											
PROFIBUS											
INTERBUS® (Phoenix Contact)											
CAN ISO 11898											
BITBUS (Intel)											
For LAN installations (IBM, Ethernet etc.)	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	
With IBM reference approval											
PROFINET®	✔	✔	✔	✔	✔	✔	✔				✔
Temperature range											
+180 °C											
+90 °C											
+80 °C	▲	▲		▲	▲	▲	▲	▲	▲	▲	▲
+70 °C		●	●		●	●	●	●	●	●	●
+60 °C	●										
-5 °C											
-20 °C	●	●	●	●	●	●	●	●	●	●	●
-30 °C											
-40 °C	▲	▲		▲	▲	▲	▲	▲	▲	▲	▲
-50 °C											
-90 °C											
Installation											
Installation outdoors in open air											
Indirect routing underground											
Indoor use	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Direct routing underground											

Cable designation

Page main catalogue 2014/15	399	400	401	405	406	407	408	395	396	404	405
Usage criteria BUS/LAN cable interfaces	ETHERLINE® PN Cat.5 FD	ETHERLINE® Y Cat.5e BK	ETHERLINE® TORSION Cat.5	ETHERLINE® Cat.6$_A$	ETHERLINE® PN Cat.6$_A$ Flex	ETHERLINE® FD Cat.6$_A$	ETHERLINE® TORSION Cat.6$_A$	ETHERLINE® EC Flex Cat.5e	ETHERLINE® EC FD Cat.5e	ETHERLINE® Cat.6 FD	ETHERLINE® Cat.7
Characteristic impedance											
≥ 150 ohms											
≥ 120 ohms											
≥ 100 ohms	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
≥ 93 ohms											
≥ 75 ohms											
≥ 60 ohms											
≥ 50 ohms											
Output category											
Cat.5 ≤ 100 MHz	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Cat.6 ≤ 250 MHz				✔	✔	✔	✔			✔	✔
Cat.6$_A$ ≤ 500 MHz				✔	✔	✔	✔			✔	
Cat.7 ≤ 600 MHz											✔
Cat.7$_A$ ≤ 1200 MHz											
Cat.7$_A$ ≤ 1500 MHz											
Design											
PVC sheath		✔		✔	✔	✔	✔	✔			✔
Halogen-free sheath				✔	✔						✔
PE sheath											
PUR sheath, abrasion-resistant, cut-resistant	✔		✔	✔		✔	✔	✔	✔	✔	✔
FEP outer sheath											

✔ Main application/design
✓ Possible application

● Flexible use
□ Fixed and flexible use
▲ Fixed installation

Cable designation

Page main catalogue 2014/15	323	323	324	324	325	311	288	288	288	312	295	300	301
Usage criteria Which cable suits which fieldbus system?	UNITRONIC® BUS IBS + A	UNITRONIC® BUS IBS P COMBI A	UNITRONIC® BUS IBS FD P	UNITRONIC® BUS IBS FD P COMBI	UNITRONIC® BUS IBS Yv COMBI	UNITRONIC® BUS LD A + BUS FD P A	UNITRONIC® BUS PB A	UNITRONIC® BUS PB PE	UNITRONIC® BUS PB 7-W A	UNITRONIC® BUS PA	UNITRONIC® BUS PB FD P	UNITRONIC® BUS PB TORSION	UNITRONIC® BUS PB FESTOON
Standards													
UL/CSA-approved	✔	✔	✔	✔	✔	✔	✔		✔			✔	✔
Installation													
Fixed installation	✔	✔				✔	✔	✔	✔	✔			
Flexible									✔				
Highly flexible			✔	✔		✔					✔	✔	✔
Suitable for outdoor use/ direct burial, UV-resistant					✔								
Characteristic impedance													
100–120 ohms	✔	✔	✔	✔	✔	✔				✔			
150 ohms							✔	✔	✔		✔	✔	✔
Dimensions													
In mm², or diameter in mm, or AWG size													
3 x 2 x 0.22	✔												
3 x 2 x 0.25			✔										
3 x 2 x 0.25 + 3 x 1.0		✔		✔									
3 x 2 x 0.22 + 3 x 1.0					✔								
1 x 2 x 0.22/2 x 2 x 0.22/ 3 x 2 x 0.22						✔							
1 x 2 x 0.64							✔	✔	✔		✔		✔
1 x 2 x 1.0										✔			
1 x 2 x 0.8												✔	
1 x 2 x 0.64 + 4 x 1.5													
1 x 2 x 0.25/2 x 2 x 0.25													

Cable designation

Page main catalogue 2014/15	323	323	324	324	325	311	288	288	288	312	295	300	301
Usage criteria Which cable suits which fieldbus system?	UNITRONIC® BUS IBS + A	UNITRONIC® BUS IBS P COMBI A	UNITRONIC® BUS IBS FD P	UNITRONIC® BUS IBS FD P COMBI	UNITRONIC® BUS IBS Yv COMBI	UNITRONIC® BUS LD A + BUS FD P A	UNITRONIC® BUS PB A	UNITRONIC® BUS PB PE	UNITRONIC® BUS PB 7-W A	UNITRONIC® BUS PA	UNITRONIC® BUS PB FD P	UNITRONIC® BUS PB TORSION	UNITRONIC® BUS PB FESTOON
Dimensions													
1 x 2 x 0.34/2 x 2 x 0.34													
1 x 2 x 0.5/2 x 2 x 0.5													
1 x 2 x 0.75/2 x 2 x 0.75													
2 x 6 + 2 x 2.5 + 1 x 4 x 0.5													
Bus systems													
INTERBUS® DIN 19258 EN 50251 sensor/actuator bus	✔												
INTERBUS® (Phoenix Contact)	✔	✔	✔	✔	✔								
SUCOnet p® (Klöckner-Möller), Modulink® P (Weidmüller) MODBUS VariNet®-P (Pepperl + Fuchs)						✔							
PROFIBUS-DP, FMS, FIP							✔	✔	✔		✔	✔	✔
PROFIBUS-PA, Foundation™ Fieldbus										✔			
CAN ISO 11898, CAN open													
AS-INTERFACE													
EIB													
CC-Link®													
Device Net™ (Allen-Bradley/ Rockwell Automation)													
Industrial Ethernet/Fast Ethernet													
ISOBUS (ISO 11783-2)													

Cable designation

Page main catalogue 2014/15	299	293	288	288	288	312	297	293	315	315	316	290	319
Usage criteria Which cable suits which fieldbus system?	UNITRONIC® BUS PB FD P HYBRID	UNITRONIC® BUS PB Yv, PB YY	UNITRONIC® BUS PB PE FC	UNITRONIC® BUS PB H FC	UNITRONIC® BUS PB P FC	UNITRONIC® BUS PA FC	UNITRONIC® BUS PB FD P FC	UNITRONIC® BUS PB BURIAL FC	UNITRONIC® BUS CAN	UNITRONIC® BUS CAN FD P	UNITRONIC® BUS CAN BURIAL	UNITRONIC® BUS PB HEAT 180	UNITRONIC® BUS IS
Standards													
UL/CSA-approved	✔			✔	✔	✔	✔		✔	✔			
Installation													
Fixed installation		✔	✔	✔	✔	✔			✔		✔	✔	
Flexible									✔		✔		✔
Highly flexible	✔						✔			✔			
Suitable for outdoor use/ direct burial, UV-resistant		✔	✔					✔			✔		✔
Characteristic impedance													
100 – 120 ohms						✔			✔	✔	✔		
150 ohms	✔	✔	✔	✔	✔		✔	✔				✔	
Dimensions													
In mm², or diameter in mm, or AWG size													
3 x 2 x 0.22													
3 x 2 x 0.25													
3 x 2 x 0.25 + 3 x 1.0													
3 x 2 x 0.22 + 3 x 1.0													
1 x 2 x 0.22/2 x 2 x 0.22/ 3 x 2 x 0.22													
1 x 2 x 0.64		✔	✔	✔	✔		✔	✔				✔	
1 x 2 x 1.0													
1 x 2 x 0.8						✔							
1 x 2 x 0.64 + 4 x 1.5	✔												
1 x 2 x 0.25/2 x 2 x 0.25									✔	✔			

Cable designation

Page main catalogue 2014/15	299	293	288	288	312	297	293	315	315	316	290	319
Usage criteria Which cable suits which fieldbus system?	UNITRONIC® BUS PB FD P HYBRID	UNITRONIC® BUS PB Yv, PB YY	UNITRONIC® BUS PB PE FC	UNITRONIC® BUS PB H FC	UNITRONIC® BUS PB P FC	UNITRONIC® BUS PA FC	UNITRONIC® BUS PB FD P FC	UNITRONIC® BUS PB BURIAL FC	UNITRONIC® BUS CAN	UNITRONIC® BUS CAN FD P	UNITRONIC® BUS CAN BURIAL	UNITRONIC® BUS PB HEAT 180	UNITRONIC® BUS IS
Dimensions													
1 x 2 x 0.34/2 x 2 x 0.34									✔	✔			
1 x 2 x 0.5/2 x 2 x 0.5									✔	✔	✔		
1 x 2 x 0.75/2 x 2 x 0.75									✔				
2 x 6 + 2 x 2.5 + 1 x 4 x 0.5													✔
Bus systems													
INTERBUS® DIN 19258 EN 50251 sensor/actuator bus													
INTERBUS® (Phoenix Contact)													
SUCOnet p® (Klöckner-Möller), Modulink® P (Weidmüller) MODBUS													
VariNet®-P (Pepperl + Fuchs)													
PROFIBUS-DP, FMS, FIP	✔	✔	✔	✔	✔		✔	✔				✔	
PROFIBUS-PA, Foundation™ Fieldbus						✔							
CAN ISO 11898, CAN open									✔	✔	✔		
AS-INTERFACE													
EIB													
CC-Link®													
Device Net™ (Allen-Bradley/ Rockwell Automation)													
Industrial Ethernet/Fast Ethernet													
ISOBUS (ISO 11783-2)													✔

Legend

7-W	= 7-wire braided conductor
AS-I	= AS-INTERFACE
COMBI IBS	= Installation bus cable for INTERBUS®
DN	= Device Net
EIB	= European Installation Bus
FD	= Cable suitable for drag chains
FRNC	= Flame Retardant Non Corrosive
G	= Rubber outer sheath (EPDM)
H	= Halogen-free material
IBS	= Remote bus cable for INTERBUS®
L2	= Abbr. for SINEC L2-DP
LD	= Long distance
P	= Polyurethane outer sheath
PB	= PROFIBUS
PE	= Polyethylene outer sheath
PROFIBUS-DP	= Decentralised Periphery
PROFIBUS-FMS	= Fieldbus Message Specification
PROFIBUS-PA	= Process Automation
TPE	= Thermoplastic elastomer
Yv	= Cable for routing outdoors/ underground with reinforced PVC outer sheath
YY	= Twin PVC outer sheath

Trademarks

CC-Link®	= is a registered trademark of CLPA, Japan
DeviceNet™	= is a registered trademark of Open Device Vendors Association (ODVA)
Foundation™	= is a registered trademark of Foundation Fieldbus
INTERBUS®	= is a registered trademark of Phoenix Contact GmbH & Co.
Modulink® P	= is a registered trademark of Weidmüller GmbH & Co.
SIMATIC®	= is a registered trademark of SIEMENS AG
SINEC®	= is a registered trademark of SIEMENS AG
SUCOnet P®	= is a registered trademark of Klöckner + Moeller GmbH
VariNet®-P	= is a registered trademark of Pepperl + Fuchs GmbH

Cable glands

Page main catalogue 2014/15	654	657	662	669	686	728	728	660
Usage criteria	SKINTOP® ST-M/STR-M/ ST(R) M ISO	SKINTOP® CLICK/CLICK-R	SKINTOP® CLICK BS	SKINTOP® COLD/COLD-R	SKINTOP® CUBE	SKINTOP® ST and STR	SKINTOP® ST (NPT) and STR (NPT)	SKINTOP® ST-HF-M
Properties								
IP protection rating/NEMA	68/69K	68	68	68	64	68	68	68
Metric connection thread	✔			✔				✔
PG connection thread						✔		
NPT connection thread							✔	
For round cables	✔	✔	✔	✔	✔	✔	✔	✔
For flat cables								
Metal			✔	✔				
Plastic	✔	✔			✔	✔	✔	✔
Angled								
Strain relief	✔	✔	✔	✔	✔	✔	✔	✔
Vibration protection	✔	✔	✔		✔	✔	✔	✔
Anti-kink protection			✔					
Screening connection								
Suitable for Ex safety area								
Halogen-free								✔
Approval								
cULus, cURus, TÜV, VDE, DNV	✔							
VDE, cULus, cURus, DNV		✔	✔					
VDE				✔				✔
UL, UR, CSA, TÜV						✔		
UL, UR, CSA					✔		✔	
cULus, cURus, VDE, DNV								
cULus, cURus, DNV								
VDE, cULus, DNV								
DNV, ATEX								
cULus, cURus, DNV, ATEX								
ATEX, DNV								
cULus								

Cable glands

Page main catalogue 2014/15	659	661	729	724	663	666	731	725
Usage criteria	SKINTOP® SOLAR (plus)	SKINTOP® BS-M/BS M ISO	SKINTOP® BS	SKINTOP® BS (NPT)	SKINTOP® BT and BT-M	SKINTOP® MS-M, MSR-M / MS-M-XL and MSR-M-XL	SKINTOP® MS and MSR	SKINTOP® MS (NPT) and MSR (NPT)
Properties								
IP protection rating/NEMA	68	68	68	68	68	**	68	68
Metric connection thread	✔	✔			✔	✔		
PG connection thread			✔		✔		✔	
NPT connection thread				✔				✔
For round cables	✔	✔	✔	✔	✔	✔	✔	✔
For flat cables								
Metal						✔	✔	✔
Plastic	✔	✔	✔	✔	✔			
Angled								
Strain relief	✔	✔	✔	✔	✔	✔	✔	✔
Vibration protection	✔	✔	✔	✔	✔			
Anti-kink protection		✔	✔	✔	✔			
Screening connection								
Suitable for Ex safety area								
Halogen-free								
Approval								
cULus, cURus, TÜV, VDE, DNV								
VDE, cULus, cURus, DNV								
VDE								
UL, UR, CSA, TÜV								
UL, UR, CSA	✔		✔					✔
cULus, cURus, VDE, DNV		✔				✔		
cULus, cURus, DNV								
VDE, cULus, DNV								
DNV, ATEX								
cULus, cURus, DNV, ATEX								
ATEX, DNV								
cULus								

**68/69K, NEMA 4x/NEMA 6

Cable glands

Page main catalogue 2014/15	670	674	675	733	665	665	671	671
Usage criteria	SKINTOP® MS-iS-M	SKINTOP® MS-SC-M	SKINTOP® MS-M BRUSH/ BRUSH plus	SKINTOP® MS-SC	SKINTOP® K-M ATEX plus/ plus blue	SKINTOP® KR-M ATEX plus/ plus blue	SKINTOP® MS-M ATEX/ MS-M-XL ATEX	SKINTOP® MSR-M ATEX
Properties								
IP protection rating/NEMA	68	68	68/69K	68	68	68	68	68
Metric connection thread	✔	✔	✔		✔	✔	✔	✔
PG connection thread				✔				
NPT connection thread								
For round cables	✔	✔	✔	✔	✔	✔	✔	✔
For flat cables								
Metal	✔	✔	✔	✔			✔	✔
Plastic					✔	✔		
Angled								
Strain relief	✔	✔	✔	✔	✔	✔	✔	✔
Vibration protection					✔	✔		
Anti-kink protection								
Screening connection		✔	✔	✔				
Suitable for Ex safety area					✔	✔	✔	✔
Halogen-free								
Approval								
cULus, cURus, TÜV, VDE, DNV								
VDE, cULus, cURus, DNV								
VDE								
UL, UR, CSA, TÜV								
UL, UR, CSA								
cULus, cURus, VDE, DNV								
cULus, cURus, DNV		✔						
VDE, cULus, DNV			✔					
DNV, ATEX					✔	✔		
cULus, cURus, DNV, ATEX							✔	✔
ATEX, DNV								
cULus								

Cable glands

Page main catalogue 2014/15	672	699	700	698	727	726	677	668
Usage criteria	SKINTOP® MS-M BRUSH ATEX/ SKINDICHT® SHVE-M ATEX	SKINDICHT® MINI	SKINDICHT® CN and CN-M	SKINDICHT® SHV-M	SKINTOP® MS-NPT BRUSH	SKINTOP® MS-SC NPT	SKINTOP® INOX/INOX-R	SKINTOP® BS-M METALL
Properties								
IP protection rating/NEMA	68	68	68	68	68	68	68	68
Metric connection thread	✔	✔	✔	✔			✔	✔
PG connection thread			✔					
NPT connection thread					✔	✔		
For round cables	✔	✔	✔	✔	✔	✔	✔	✔
For flat cables								
Metal	✔	✔	✔	✔	✔	✔	✔	✔
Plastic								
Angled								
Strain relief	✔	✔	✔	✔	✔	✔	✔	✔
Vibration protection								
Anti-kink protection								✔
Screening connection	✔				✔	✔		
Suitable for Ex safety area	✔							
Halogen-free								
Approval								
cULus, cURus, TÜV, VDE, DNV								
VDE, cULus, cURus, DNV								
VDE								
UL, UR, CSA, TÜV								
UL, UR, CSA								
cULus, cURus, VDE, DNV								
cULus, cURus, DNV								
VDE, cULus, DNV								
DNV, ATEX								
cULus, cURus, DNV, ATEX								
ATEX, DNV	✔							
cULus					✔			
Ecolab®			✔				✔	

EPIC® rectangular connectors/inserts

Page main catalogue 2014/15	488	488	489	489	489
Usage criteria	EPIC® H-A 3	EPIC® H-A 4	EPIC® H-A 10	EPIC® H-A 16	EPIC® H-A 32
Parameter					
Number of contacts	3 + PE	4 + PE	10 + PE	16 + PE	32 + PE
Connection system:					
• Screw	✔	✔	✔	✔	✔
• Solder					
• Crimp					
• Cage clamp					
Suitable contacts:					
• H-BE 2.5, machined					
• H-D 1.6, machined					
• H-D 1.6, stamped					
Cross-section [mm²]	0.5 – 2.5	0.5 – 2.5	0.5 – 2.5	0.5 – 2.5	0.5 – 2.5
IEC: rated voltage [V]					
• 400	✔	✔			
• 250			✔	✔	✔
• 24 AC/60 DC					
• 230/400					
• 24 AC/60 DC/250					
• 500					
IEC: rated current [A]	23	23	16	16	16
UL: rated voltage [V]	600	600	600	600	600
UL: rated current [A]	10	10	14	14	14
CSA: rated voltage [V]	400	400	600	600	600
CSA: rated current [A]	10	10	16	16	16
Suitable housing	H-A 3	H-A 3	H-A 10	H-A 16	H-A 32

EPIC® rectangular connectors/inserts

Page main catalogue 2014/15	489	490	490	491	491
Usage criteria	EPIC® H-A 48	EPIC® STA 6	EPIC® STA 6	EPIC® STA 14	EPIC® STA 14
Parameter					
Number of contacts	48 + PE	6	6	14	14
Connection system:					
• Screw	✔	✔		✔	
• Solder			✔		✔
• Crimp					
• Cage clamp					
Suitable contacts:					
• H-BE 2.5, machined					
• H-D 1.6, machined					
• H-D 1.6, stamped					
Cross-section [mm²]	0.5 – 2.5	0.5 – 1.5	max. 1.5	0.5 – 1.5	max. 1.5
IEC: rated voltage [V]					
• 400					
• 250	✔				
• 24 AC/60 DC		✔	✔	✔	✔
• 230/400					
• 24 AC/60 DC/250					
• 500					
IEC: rated current [A]	16	10	10	10	10
UL: rated voltage [V]	600	48	48	48	48
UL: rated current [A]	14	10	10	10	10
CSA: rated voltage [V]	600	48	48	48	48
CSA: rated current [A]	16	10	10	10	10
Suitable housing	H-A 48	H-A 3	H-A 3	H-A 10	H-A 10

EPIC® rectangular connectors/inserts

Page main catalogue 2014/15	492	492	493	494	494	493
Usage criteria	EPIC® STA 20	EPIC® STA 20	EPIC® H-Q 5	EPIC® H-D 7	EPIC® H-D 7	EPIC® H-D 8
Parameter						
Number of contacts	20	20	5 + PE	7 + PE	7 + PE	8
Connection system:						
• Screw	✔					
• Solder		✔				
• Crimp			✔	✔	✔	✔
• Cage clamp						
Suitable contacts:						
• H-BE 2.5, machined			✔			
• H-D 1.6, machined				✔		✔
• H-D 1.6, stamped					✔	
Cross-section [mm²]	0.5 – 1.5	max. 1.5	0.5 – 2.5	0.14 – 2.5	0.14 – 2.5	0.14 – 2.5
IEC: rated voltage [V]						
• 400						
• 250						
• 24 AC/60 DC	✔	✔				
• 230/400			✔			
• 24 AC/60 DC/250				✔	✔	✔
• 500						
IEC: rated current [A]	10	10	16	10	10	10
UL: rated voltage [V]	48	48	600	250	250	250
UL: rated current [A]	10	10	16	10	10	10
CSA: rated voltage [V]	48	48	600	–	–	–
CSA: rated current [A]	10	10	16	–	–	–
Suitable housing	H-A 16	H-A 16	H-A 3	H-A 3	H-A 3	H-A 3

EPIC® rectangular connectors/inserts

Page main catalogue 2014/15	495	495	496	496	497
Usage criteria	EPIC® H-D 15	EPIC® H-D 15	EPIC® H-D 25	EPIC® H-D 25	EPIC® H-D 40
Parameter					
Number of contacts	15 + PE	15 + PE	25 + PE	25 + PE	40 + PE
Connection system:					
• Screw					
• Solder					
• Crimp	✔	✔	✔	✔	✔
• Cage clamp					
Suitable contacts:					
• H-BE 2.5, machined					
• H-D 1.6, machined	✔		✔		✔
• H-D 1.6, stamped		✔		✔	
Cross-section [mm²]	0.14 – 2.5	0.14 – 2.5	0.14 – 2.5	0.14 – 2.5	0.14 – 2.5
IEC: rated voltage [V]					
• 400					
• 250	✔	✔	✔	✔	✔
• 24 AC/60 DC					
• 230/400					
• 24 AC/60 DC/250					
• 500					
IEC: rated current [A]	10	10	10	10	10
UL: rated voltage [V]	250	250	250	250	250
UL: rated current [A]	10	10	10	10	10
CSA: rated voltage [V]	–	–	–	–	–
CSA: rated current [A]	–	–	–	–	–
Suitable housing	H-A 10	H-A 10	H-A 16	H-A 16	H-B 16

	Plastic fibre-optic cables (POF)						PCF fib. op. cable range			
Page main catalogue 2014/15	454	454	456	456	456	455	462	463	463	464
Usage criteria At a glance	HITRONIC® POF SIMPLEX PE	HITRONIC® POF SIMPLEX PE-PUR	HITRONIC® POF DUPLEX PE	HITRONIC® POF DUPLEX PE-PUR	HITRONIC® POF DUPLEX Heavy PE-PUR	HITRONIC® POF FD PE-PUR	HITRONIC® PCF SIMPLEX Outdoor	HITRONIC® PCF DUPLEX FRNC-PUR Indoor	HITRONIC® PCF DUPLEX FRNC-PE Outdoor	HITRONIC® PCF DUPLEX FD
Properties										
For indoor use	✔	✔	✔	✔	✔	✔		✔		✔
For outdoor use							✔		✔	
For aerial use										
Installation by blowing/ compressed air										
Direct burial										
Armoured										
Rodent protection										
Heavy duty					✔					
Flame-retardant (IEC 60332-3)		✔		✔	✔	✔		✔		✔
Fire-resistant (IEC 60331-25)										
Water-resistant									✔	
UV-resistant	✔		✔				✔		✔	
Power/drag chain						✔				✔
Flexible						✔				✔
Torsion-resistant										
Reelable										
Halogen-free	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Low-smoke emission	✔		✔				✔		✔	

GOF fib. op. cable range

Page main catalogue 2014/15	450	451	453	452	467	468	469	470	471
Usage criteria At a glance	HITRONIC® FIRE	HITRONIC® TORSION, A/J-V(ZN)H11Y	HITRONIC® HRM-FD, A/J-V(ZN)H(ZN)11Y	HITRONIC® HDM, A/J-V(ZN)11Y	HITRONIC® HQN Outdoor Cable, A-DQ(ZN)B2Y	HITRONIC® HVN Outdoor Cable, A-DQ(ZN)B2Y	HITRONIC® HVN-Micro Outdoor Cable, A-DQ(ZN)B2Y	HITRONIC® HQW Armoured Outdoor Cable, A-DQ(ZN)(SR)2Y	HITRONIC® HVW Armoured Outdoor Cable, A-DQ(ZN)(SR)2Y
Properties									
For indoor use	✔	✔	✔	✔					
For outdoor use	✔	✔	✔	✔	✔	✔	✔	✔	✔
For aerial use									
Installation by blowing/ compressed air							✔		
Direct burial					✔	✔		✔	✔
Armoured	✔							✔	✔
Rodent protection	✔				✔	✔	✔	✔	✔
Heavy duty	✔							✔	✔
Flame-retardant (IEC 60332-3)	✔	✔	✔	✔					
Fire-resistant (IEC 60331-25)	✔								
Water-resistant	✔				✔	✔	✔	✔	✔
UV-resistant	✔	✔	✔	✔	✔	✔	✔	✔	✔
Power/drag chain			✔						
Flexible		✔	✔	✔					
Torsion-resistant		✔							
Reelable				✔					
Halogen-free	✔	✔	✔	✔	✔	✔	✔	✔	✔
Low-smoke emission	✔				✔	✔	✔	✔	✔

GOF fib. op. cable range

Page main catalogue 2014/15	472	473	473	474	475	476	477
Usage criteria At a glance	HITRONIC® HQW-Plus Armoured Outdoor Cable, A-DQ(ZN)2Y(SR)2Y	HITRONIC® HQA Aerial Cable, A-DQ(ZN)B2Y	HITRONIC® HQA-Plus Aerial Cable, A-DQ2Y(ZN)B2Y	HITRONIC® HUN Universal Cable, A/J-DQ(ZN)BH	HITRONIC® HUW Armoured Outdoor Cable, A/J-DQ(ZN)(SR)H	HITRONIC® HRH Breakout Cable, J-V(ZN)HH	HITRONIC® HDH Mini Breakout Cable, J-V(ZN)H
Properties							
For indoor use				✔	✔	✔	✔
For outdoor use	✔	✔	✔	✔	✔		
For aerial use		✔	✔				
Installation by blowing/ compressed air							
Direct burial	✔						
Armoured	✔				✔		
Rodent protection	✔			✔	✔		
Heavy duty	✔				✔		
Flame-retardant (IEC 60332-3)				✔	✔	✔	✔
Fire-resistant (IEC 60331-25)							
Water-resistant	✔	✔	✔	✔	✔		
UV-resistant	✔	✔	✔				
Power/drag chain							
Flexible							✔
Torsion-resistant							
Reelable							
Halogen-free	✔	✔	✔	✔	✔	✔	✔
Low-smoke emission	✔	✔	✔	✔	✔	✔	✔

Please note: the standard lengths for fibre-optic cables are 100 m and 500 m; any other lengths will incur a surcharge. O. r. = on request

Cable designation
(permanent flexing, e.g. in power chains)

Page main catalogue 2014/15		99	100	101	102	103	104	105
Usage criteria Applications of servo cables in electrical power drive systems (PDS)		ÖLFLEX® SERVO FD 781 CY	ÖLFLEX® SERVO FD 796 P	ÖLFLEX® SERVO FD 796 CP	ÖLFLEX® SERVO FD 798 CP	Servo cable as per SIEMENS® FX8PLUS series	Servo cable as per INDRAMAT® standard INK	Servo cable as per LENZE® standard
Use								
Power drive systems	Mains							
	Motor	✔	✔	✔	✔			
SEW®	Power							
	Signal							
SIEMENS®	Power		✔	✔		✔		
	Signal				✔	✔		
INDRAMAT®	Power		✔	✔			✔	
	Signal				✔		✔	
LENZE®	Power			✔				✔
	Signal							✔
Heidenhain®	Power		✔					
	Signal							
ELAU®	Power			✔				
	Signal							
KEB®	Power							
	Signal							
Controles Techniques®	Power							
	Signal							
Berger Lahr®	Power							
	Signal							
B & R®	Power							
	Signal							
FANUC®	Power							
	Signal							

Cable designation
(permanent flexing, e.g. in power chains)

Page main catalogue 2014/15		106	106	106		106	106	106	274
Usage criteria Applications of servo cables in electrical power drive systems (PDS)		Servo cable as per Heidenhain® standard	Servo cable as per ELAU® standard	Servo cable as per KEB® standard	Servo cable as per Controles Techniques® standard	Servo cable as per Berger Lahr® standard	Servo cable as per B & R® standard	Servo cable as per FANUC® standard	UNITRONIC® FD CP (TP) plus
Use									
Power drive systems	Mains								
	Motor								
SEW®	Power								
	Signal								✔
SIEMENS®	Power								
	Signal								
INDRAMAT®	Power								
	Signal								
LENZE®	Power								
	Signal								
Heidenhain®	Power								
	Signal	✔							
ELAU®	Power								
	Signal		✔						
KEB®	Power								
	Signal			✔					
Controles Techniques®	Power								
	Signal				✔				
Berger Lahr®	Power								
	Signal					✔			
B & R®	Power								
	Signal						✔		
FANUC®	Power								
	Signal							✔	

Cable designation
(fixed installation or occasional flexing)

Page main catalogue 2014/15		91	92	95	93	38	39	94	96	98	97
Usage criteria Applications of servo cables in electrical power drive systems (PDS)		ÖLFLEX® SERVO 700	ÖLFLEX® SERVO 700 CY	ÖLFLEX® SERVO 709 CY	ÖLFLEX® SERVO 720 CY	ÖLFLEX® CLASSIC 110 BLACK 0.6/1 KV	ÖLFLEX® CLASSIC 110 CY BLACK 0.6/1 KV	ÖLFLEX® SERVO 2YSLCY low capacitance	ÖLFLEX® SERVO 9YSLCY low capacitance	Servo cable as per SEW® standard, static	Servo cable as per SIEMENS® FX5 series
Use											
Power drive systems	Mains	✔				✔					
	Motor	✔	✔	✔			✔	✔	✔		
SEW®	Power									✔	
	Signal										
SIEMENS®	Power										✔
	Signal										✔
INDRAMAT®	Power			✓							
	Signal										
LENZE®	Power							✓	✓		
	Signal										
Heidenhain®	Power										
	Signal				✓						

✔ Main application/design
✓ Possible application

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Cable designation

Page main catalogue 2014/15	163	164	165	166	167	168	169	170	171	172
Usage criteria	ÖLFLEX® HEAT 105 MC	ÖLFLEX® HEAT 145 MC*	ÖLFLEX® HEAT 145 C MC*	ÖLFLEX® HEAT 180 SIHF	ÖLFLEX® HEAT 180 H05SS-F EWKF	ÖLFLEX® HEAT 180 MS	ÖLFLEX® HEAT 180 C MS	ÖLFLEX® HEAT 180 EWKF	ÖLFLEX® HEAT 180 EWKF C	ÖLFLEX® HEAT 180 GLS
Use										
Internal and external machine cabling	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Internal wiring of control units/machinery										
In dry rooms	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
In dry and damp rooms	✔	✔	✔	✔	✔	✔	✔	✔	✔	
Outdoors, fixed installation (mech. protection)	✔	✔	✔	✔	✔	✔	✔	✔	✔	
Chemical resistance	See technical table T1									
In EMC-sensitive environments			✔				✔		✔	
Suitable for extreme applications in paint shops										
Standards										
Halogen-free according to IEC 60754-1		✔	✔	✔	✔	✔	✔	✔	✔	✔
Low smoke density according to IEC 601034		✔	✔							
Low smoke toxicity according to NES 02-713		✔	✔							
Flame-retardant according to IEC 60332-1-2	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Flame-retardant according to IEC 60332.3		✔	✔							
In line with VDE/HAR/DIN	✔			✔				✔	✔	✔
With VDE/HAR certification					✔					
With UL/CSA certification						✔	✔			
With GL/DNV certification		✔	✔							

Cable designation

Page main catalogue 2014/15	163	164	165	166	167	168	169	170	171	172
Usage criteria	ÖLFLEX® HEAT 105 MC	ÖLFLEX® HEAT 145 MC*	ÖLFLEX® HEAT 145 C MC*	ÖLFLEX® HEAT 180 SiHF	ÖLFLEX® HEAT 180 H05SS-F EWKF	ÖLFLEX® HEAT 180 MS	ÖLFLEX® HEAT 180 C MS	ÖLFLEX® HEAT 180 EWKF	ÖLFLEX® HEAT 180 EWKF C	ÖLFLEX® HEAT 180 GLS
Temperature range										
+1565 °C										
+400 °C										
+350 °C										
+300 °C										
+260 °C										
+200 °C				◆	◆	◆	◆	◆	◆	◆
+180 °C				□	□	□	□	□	□	□
+145 °C		◆	◆							
+125 °C		●	●							
+105 °C	◆									
+90 °C	▲									
-20 °C	▲									
-35 °C		●	●							
-50 °C		▲	▲	□	□	□	□	□	□	□
-80 °C										
-100 °C										
-140 °C										
-190 °C										
Nominal voltage										
300/500 volts	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
450/750 volts		✔	✔							
600/1000 volts		✓	✓							
10 kV										
600 volts as per UL/CSA						✔	✔			

Cable designation

Page main catalogue 2014/15	163	164	165	166	167	168	169	170	171	172
Usage criteria	ÖLFLEX® HEAT 105 MC	ÖLFLEX® HEAT 145 MC*	ÖLFLEX® HEAT 145 C MC*	ÖLFLEX® HEAT 180 SiHF	ÖLFLEX® HEAT 180 H05SS-F EWKF	ÖLFLEX® HEAT 180 MS	ÖLFLEX® HEAT 180 C MS	ÖLFLEX® HEAT 180 EWKF	ÖLFLEX® HEAT 180 EWKF C	ÖLFLEX® HEAT 180 GLS
Design										
Solid wire as per VDE 0295, class 1										
Fine-wire according to VDE 0295, class 5	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
PVC core insulation/sheath, heat-resistant	✔									
Halogen-free special core insulation/sheath		✔	✔							
Silicone core insulation/sheath				✔	✔	✔	✔	✔	✔	✔
Silicone, notch-resistant (EWKF) sheath					✔			✔	✔	
Fluoropolymer core insulation/ sheath (FEP/PTFE)										
Glass fibre core insulation/sheath										
Printed numbers according to VDE 0293		✔	✔	✔		✔	✔	✔	✔	✔
Colour code according to VDE 0293-308	✔	✔		✔	✔	✔	✔	✔	✔	✔
Individual colours										
Overall screening			✔				✔		✔	
Steel wire armouring										✔

✔ Main application/design
✓ Possible application
● Flexible use
□ Fixed and flexible use
▲ Fixed installation
◆ Fixed installation (briefly)

Page main catalogue 2014/15	876	874	893	894	895	870	879	880	886	887	889	877
Resistance of FLEXIMARK® Labels	Stainless steel FCC marking	Characters strips plastic MINI	Character holders PTE	Character holders PTEF Cab	Collars	Flexiprint LF	Wrapping labels LCK	Cable label LFL	Cable label TFL	LA/LB Labels	TA Labels	Cable marker FCC
Temperature range												
max. +500 °C	✔											
-20 °C bis +65 °C		✔										
-20 °C bis +45 °C			✔									
-75 °C bis +80 °C				✔								
-40 °C bis +80 °C					✔							
-40 °C bis +125 °C						✔	✔	✔	✔	✔		
-40 °C bis +150 °C											✔	
-30 °C bis +70 °C												✔
Resistance test												
UV-light	●	●	●	●	●	●	●	●	●	●	●	●
Ageing	●	●	●	●	●	●	●	●	●	●	●	●
Abrasion of the marketing text	▲	●	●	▲	▲	●	●	●	●	●	●	▲
Chemical resistance test												
Diesel	●	□	□	●	●	◆	□	□	◆	□	□	●
Acid (H_2SO_4), 25%	●	□	□	●	●	◆	□	□	□	□	□	●
Alkali (Detergent solution, 10%)	●	□	□	●	●	□	□	□	◆	□	◆	●
Distilled water	●	□	□	●	●	□	□	□	□	□	□	●
Salt water (5% NaCl)	●	□	□	●	●	□	□	□	□	□	□	●
Transformer oil (Nytro 10X)	●	□	□	●	●	□	□	□	□	□	□	●
Ethanol	●	□	□	●	●	◆	□	□	□	□	□	●
Chemical resistance test with abrasion												
Diesel	▲	●	●	▲	▲	◆	●	●	◆	●	●	▲
Acid (H_2SO_4), 25%	▲	●	●	▲	▲	◆	●	●	●	●	●	▲
Alkali (Detergent solution, 10%)	▲	●	●	▲	▲	●	●	●	◆	●	◆	▲
Distilled water	▲	●	●	▲	▲	●	●	●	●	●	●	▲
Salt water (5% NaCl)	▲	●	●	▲	▲	●	●	●	●	●	●	▲
Transformer oil (Nytro 10X)	▲	●	●	▲	▲	●	●	●	●	●	●	▲
Ethanol	▲	●	●	▲	▲	◆	●	●	●	●	●	▲

To meet the high requirements of our products and to ensure our quality standard all FLEXIMARK® products are subjected to a series of strict tests. These are made by the independent SP Technical Research Institute of Sweden using the SP 2171 Test Method which is used especially for collars and plastic information carrier which mark electric wires, cables, components and clamps. For receiving an impression, some of the tests are listed below:

Test	Method and criteria
Ageing resistance	Accelerated ageing in heat oven (2000 days at 90 °C (194 °F)) corresponding to use at 20 °C (+68 °F) for 30 years. Check for cracks, breaks or similar damage. (Max 50% reduction in elongation before breakage.) Also check for mountability and dismountability.
UV-resistance	Accelerating test corresponding to ISO 4892-2 exposure 1 year outdoors in southern Sweden. Check for brittleness and change in colour and readability.
Abrasion resistance of marking text	According to SP Method 2172 (rubbing machine). Load 75 g per mm mandrel diameter. 200 + 200 cycles.
Chemical resistance	Mounted sleeves kept for 24 hours at +23 °C & -2 °C (+73.4 °F & 28.4 °F) immersed in the chemical. Drying for 2 hours then check for functionality, colour fastness and print legibility. **Chemicals used:** Synthetic diesel oil, Sulphuric acid 25%, basic cleaning agent (Berol 226, 10%), Distilled water, Sea water (5% NaCl), Transformer oil (Nytro 10x), Ethanol, other chemicals on request.
Chemical resistance with abrasion test	Combination of abrasion-test and chemical resistance-test.

Note: actual version and further information are available on www.lappgroup.com.

● Tested and recommended
□ Not tested. A Chemical resistance test with abrasion has been performed instead
▲ Not tested. Marking text has an automatic protection in form of a holder or similar
◆ Not recommended

2. Cables and wires

The applications of cables and wires are extremely diverse and thus governed by a whole range of application standards in the various standard groups (IEC, EN, NEC...). One example is the international standard IEC 60204-1:2009, (Electrical equipment of machines – Part 1: General requirements) with reference to the requirements of cables and wires as well as their application conditions.

In all cases, meeting these general specifications requires the user to perform a professional examination as to the existence of specific product standards with other/extended requirements that may take precedence.

In this case, support is provided by the products pages in the current main catalogue in the form of product and application standards – e. g. “Oil resistance according to VDE 0473-811” or “Railway applications: DIN EN 50306-2”. In the area of low voltage harmonised cables (e. g.H05VV5-F/ ÖLFLEX® 140), DIN VDE 0298-300 in table A4 provides a list of requirements and criteria that are largely applicable to other low voltage cables as well as notes on recommended applications.

DIN VDE 0298-300 is the German version of the harmonisation document HD 516 S2:1997 + A1:2003 + A2:2008.

In addition, the application information provided in IEC publication 62440:2008-02 Ed. 1.0 must be observed for electrical cables with nominal voltages up to 450/750 V.

A summary of the most important information on cable and wire applications contained in the aforementioned documents is provided below.

General

Conductors, cables and wires must be selected such that they are suitable for the relevant operating conditions (e. g. voltage, current, protection against electric shock, bundling of cables and wires) and external influences (e. g. ambient temperature, presence of water or corrosive materials, mechanical stress, incl. stress experienced during installation, fire risks).

Electrical voltage

The control and connecting cables listed in the catalogue are subject to the “low voltage directive” 2006/95/EC for electrical equipment with a nominal voltage between 50 and 1000 V (alternating current) and between 75 and 1500 V (direct current).

The nominal voltage is the reference voltage for which cables and wires are constructed and tested. The nominal voltage of cables and wires used with AC supplies must be greater than or equal to the nominal supply voltage. In the case of a DC supply, the nominal supply voltage must not exceed the nominal voltage of the cable by a factor greater than 1.5. The continuous operating voltage of AC and DC supplies must not exceed the nominal supply voltage by more than 10 %.

The nominal voltage of cables and wires is expressed by the ratio U/U_0 in volts, whereby:

- U_0 is the effective voltage between a phase conductor and the earth (metal sheath/screening of the cable or surrounding medium)
- U is the effective voltage between two phase conductors of a multi-core cable or a system of single core cables

The dielectric strength of the insulation of cables, conductors and wires must be sufficient for the required test voltage. For cables and wires subjected to voltages over 50 V AC or 120 V DC, the test voltage is a minimum of 2000 V AC for a

duration of 5 minutes. For alternating currents with a maximum of 50 V and direct currents with a maximum of 120 V (typical values for SELV or PELV systems), the test voltage must be a minimum of 500 V AC for a duration of 5 minutes. The AC test voltages are detailed on the individual products pages in our current main catalogue under "technical data" and can also be used to make selections in cases where no meaningful U/U_0 ratio can be provided.

Conductor cross-sections with different measurement systems

IEC 60228 is an important international standard that describes cables with metric cross-sections. North America and other regions currently employ conductor cross-sections according to the AWG (American Wire Gauge) system with kcmil" used for larger cross-sections. A table is provided under T16 to support safe, alternative usage of cables from both these measurement systems.

Tensile strain

The following applies to all conductors up to maximum tensile strain of 1000 N: Max. 15 N per mm^2 conductor cross-section (excl. screening, concentric conductors and divided protective conductors) for static tensile strain when using moving/flexible cables and cables for/in fixed installation. Max. 50 N per mm^2 conductor cross-section (excl. screening, concentric conductors and divided protective conductors) for static tensile strain when assembling cables for/in fixed installation.

Flexible use – stationary use/Definitions

- **Continuous Flexing**
  Cables are in constant linear motion in automated applications. They are subjected to continuous forces applied during bending motions.
  Typical application:
  Horizontal and vertical c-tracks power chains, automated assemblies, etc.

- **Flexible/occasional flexing**
  Cables are moved randomly in a non-automated application. They are susceptible to occasional uncontrolled conditions of movement.
  Typical application:
  Flexible cable tray routings, machine tools, residential electronics, portable power equipment, etc.

- **Stationary use/fixed installation**
  Cables are installed and left in their original position. They are only moved for purposes of maintenance, repair or retrofitting.
  Typical application:
  Cable trays, conduits, wire ways installed in buildings, machines, manufacturing facilities, etc.

Cables for use in power/drag chains

These cables are indicated by the code "FD" or "CHAIN" in their product names. In addition to the generally applicable information on assembly and project planning contained in technical table T3, particular attention must be paid to the specifications relating to individual cables that are provided on the relevant products pages in the current main catalogue.

These are specifically:

- Restrictions of the traversing path length (e. g.: "... up to 10 m").
- Restrictions of the minimum bending radius for flexible applications. The radius implemented with the power/drag chain must not be lower than the minimum bending radius! The minimum bending radius is defined as the inner radius relative to the surface of the curved cable.

Torsion movement in wind turbine generators

The torsional motion of wind turbines is very different from those in robotic applications. In comparison to the quick, highly dynamic movements of robots, the motion in the loop between the nacelle and tower of a wind turbine is slow. Moreover, the rotation of the cable on its axis about 150° per 1 m cable and the rotational speed with 1 revolution per minute is less than usual robotic applications.

To confirm these requirements, our cables are tested in our in-house testing facility. To take the different materials into account, different tests are performed in order to achieve meaningful results even at the temperature resistance of the cables.

Based on the test results the cables are classified to the Lapp-internal rating for torsion in wind turbine generators which is adapted to the requirements of leading manufacturers of wind turbines:

	number of cycles	temperature range	torsion angle
TW-0	5.000	≥ +5 °C	± 150° / 1 m
TW-1	2.000	≥ -20 °C	± 150° / 1 m
TW-2	2.000	≥ -40 °C	± 150° / 1 m

Transport and storage

Cables and wires that are not designated for outdoor use must be stored indoors, in dry conditions and protected from direct sunlight. If stored outside, all cable and wire ends must be sealed to prevent the ingress of water.

The ambient temperature for transport and storage must be between -25 °C and +55 °C (max. +70 °C for no longer than 24 hours). Particularly in the lower temperature ranges, mechanical stress through vibration, shock, bending and twisting must be avoided. This is especially important for PVC-insulated cables and wires. The following guidelines apply for the maximum storage of cables and wires before use and without prior testing:

- One year if stored outdoors
- Two years if stored indoors

3. Industrial connectors

Connectors must not be joined or separated under load! Provision of the protective conductor function must be assured by the installation type of the connector. This can be achieved by means of metallically conductive EPIC® connector housings or through the implementation of suitable measures on the part of the operator prior to installation.

Safety note:
In the case of EPIC® inserts such as H-BE or H-BS, the protective conductor connection can be changed. When connecting the protective conductor, the low-resistance connection to the protective conductor of the counter piece must not be interrupted. Terminal screw changes must be performed on both sides to ensure that the protective function is maintained.

Otherwise, the relevant specifications apply in accordance with: DIN EN 50110-1 (VDE 0105-1) – Operation of electrical installations.

It is up to the user to assess whether, in specific areas of application not covered by us, the components listed in this catalogue comply with regulations other than those specified here. We reserve the right to make constructional and design modifications due to quality improvements, enhancements or manufacturing requirements. The information in this catalogue serves to specify the components and does not guarantee properties. Assurance of the technical properties can only be given if all components are supplied by Lapp. Otherwise, any testing and approval is the responsibility of the operator.

Certificates:
VDE, certificate number 40016270, 40011894, 40013251, 40019264
UL, file number: E75770, E249137, E192484
CSA files: E75770, E249137, E192484
TÜV

4. Cable glands and cable bushings

SKINTOP® and SKINDICHT® cable glands and cable entries represent highest quality levels and 40-years of expertise in the relevant areas of application.

Along with quality, the correct usage of these products with regard to operational safety is the most important factor. For this reason, we would like to remind you to observe all relevant standards for your intended application. In addition to the technical data on the product pages, please also refer to the technical tables in the main catalogue (T21 – thread dimensions for cable glands, tightening torques and installation dimensions for cable glands/T22 – protection ratings according to EN 60529), as well as the supplied package leaflets describing product usage (e. g. package leaflet for products acc. to DIN EN 60079-0, DIN EN 60079-7).

5. Cable protection and guiding systems

SILVYN® cable protection systems offer additional protection for cables and wires. If used in a specified system and professionally fitted by a certified electrician, SILVYN® products will meet the properties detailed on the products pages in the current main catalogue.

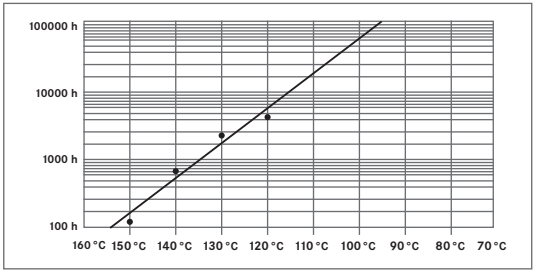
When configuring and assembling the SILVYN® CHAIN energy supply systems, the assembly instructions detailed in table T3 “Assembly guidelines for ÖLFLEX® FD and UNITRONIC® FD cables in power chains” must be followed. With regards to the correct installation of a SILVYN® CHAIN energy supply system, please refer to the information in our current special SILVYN® CHAIN catalogue.

6. Ready-to-use parts, tools and printers

Products in the area of cable accessories are system-tested to ensure optimal assembly. The commissioning and processing of these products must only be performed by authorised electricians and following the supplied information.

7. Service life

The average service life of cables is dictated not just by the mechanical and chemical stress, but also by the operating or ambient temperature. As is customary in mechanical engineering, the continuous temperature range of a cable, as specified in our technical data, refers almost exclusively to a period of at least 20,000 h. The adjacent example of an ageing curve according to Arrhenius illustrates the behaviour of an insulating material on the basis of time and temperature. The material tested here has a temperature index of approx. +110 °C at 20,000 h. The material can also be specified with an index of +135 °C, but in this case only for a duration of approx. 3000 h..



10. Fire properties

The behaviour of products in the case of a fire (reaction to fire) is of great importance to building installation. The EU has converted the various national regulations throughout Europe into a uniform rating system.

The Construction Products Regulation (directive (EU) no. 305/2011) of 09/03/2011 came into force on 01/07/2013 and is binding for all member states.

Please find more details in the current main catalogue in the appendix under Technical tables T14.

Cable designations

All data is for a temperature of + 20 °C	ÖLFLEX® SMART 108, ÖLFLEX® CLASSIC 100, 110, 115 CY, 100 BK POWER, 110 BK, ÖLFLEX® SERVO 700, 700 CY, 2YSLCY, 720, 9YSLCY, UNITRONIC® 100, 100 CY, EB	ÖLFLEX® FD 90, FD 90 CY, ÖLFLEX® 140, 140 CY, ÖLFLEX® CHAIN 809 SC, ÖLFLEX® 150, 150 CY, 191, 191 CY, ÖLFLEX® FD 891/891 CY, Tray II, ÖLFLEX® SERVO 709 CY, ÖLFLEX® SERVO FD 781 CY, ÖLFLEX® CONTROL TM/TM CY, SERVO cables as per SEW®, SIEMENS® FX 5008 Standard
Inorganic chemicals		
Alums, cold-saturated concentration	⊠	⊠
Aluminium salts, any concentration	⊠	⊠
Ammonia, aqueous, 10 % concentration	⊠	⊠
Ammonium acetate, aqueous, any concentration	⊠	⊠
Ammonium carbonate, aqueous, any concentration	⊠	⊠
Ammonium chloride, aqueous, any concentration	⊠	⊠
Barium salts, any concentration	⊠	⊠
Boric acid, aqueous	⊠	⊠
Calcium chloride, aqueous, cold-saturated concentration	⊠	⊠
Calcium nitrate, aqueous, cold-saturated concentration	⊠	⊠
Chromium salts, aqueous, cold-saturated concentration	⊠	⊠
Potassium carbonate, aqueous (potash)	⊠	⊠
Potassium chlorate, aqueous, cold-saturated concentration	⊠	⊠
Potassium chloride, aqueous, cold-saturated concentration	⊠	⊠
Potassium dichromate, aqueous	⊠	⊠
Potassium iodide, aqueous	⊠	⊠
Potassium nitrate, aqueous, cold-saturated concentration	⊠	⊠

Cable designations

All data is for a temperature of + 20 °C	ÖLFLEX® SMART 108, ÖLFLEX® CLASSIC 100, 110, 115 CY, 100 BK POWER, 110 BK, ÖLFLEX® SERVO 700, 700 CY, 2YSLCY, 720, 9YSLCY, UNITRONIC® 100, 100 CY, EB	ÖLFLEX® FD 90, FD 90 CY, ÖLFLEX® 140, 140 CY, ÖLFLEX® CHAIN 809 SC, ÖLFLEX® 150, 150 CY, 191, 191 CY, ÖLFLEX® FD 891/891 CY, Tray II, ÖLFLEX® SERVO 709 CY, ÖLFLEX® SERVO FD 781 CY, ÖLFLEX® CONTROL TM/TM CY, SERVO cables as per SEW®, SIEMENS® FX 5008 Standard
Inorganic chemicals		
Potassium permanganate, aqueous	✖	✖
Potassium sulphate, aqueous	⊠	⊠
Copper salts, aqueous, cold-saturated concentration	⊠	⊠
Magnesium salts, aqueous, cold-saturated concentration	⊠	⊠
Sodium bicarbonate, aqueous (natron)	⊠	⊠
Sodium bisulphite, aqueous	⊠	⊠
Sodium chloride, aqueous (table salt)	⊠	⊠
Sodium thiosulphate, aqueous (fixing salt)	⊠	⊠
Nickel salts, aqueous, cold-saturated concentration	⊠	⊠
Phosphoric acid, 50 % concentration	⊠	⊠
Mercury, 100 % concentration	⊠	⊠
Mercury salts, aqueous, cold-saturated concentration	⊠	⊠
Nitric acid, 30 % concentration	✖	✖
Hydrochloric acid, concentrated	✖	✖
Sulphur, 100 % concentration	⊠	⊠
Sulphur dioxide, gaseous	⊠	⊠
Carbon disulphide	✖	✖
Hydrogen sulphide	⊠	⊠
Sea water	⊠	⊠
Silver salts, aqueous	⊠	⊠

Cable designations

All data is for a temperature of + 20 °C	ÖLFLEX® SMART 108, ÖLFLEX® CLASSIC 100, 110, 115 CY, 100 BK POWER, 110 BK, ÖLFLEX® SERVO 700, 700 CY, 2YSLCY, 720, 9YSLCY, UNITRONIC® 100, 100 CY, EB	ÖLFLEX® FD 90, FD 90 CY, ÖLFLEX® 140, 140 CY, ÖLFLEX® CHAIN 809 SC, ÖLFLEX® 150, 150 CY, 191, 191 CY, ÖLFLEX® FD 891/891 CY, Tray II, ÖLFLEX® SERVO 709 CY, ÖLFLEX® SERVO FD 781 CY, ÖLFLEX® CONTROL TM/TM CY, SERVO cables as per SEW®, SIEMENS® FX 5008 Standard
Inorganic chemicals		
Hydrogen peroxide, 3 % concentration	⛒	⛒
Zinc salts, aqueous	⛒	⛒
Tin(II) chloride	⛒	⛒
Organic chemicals		
Ethanol, 100 % concentration	✖	✖
Formic acid, 30 % concentration	✖	✖
Petrol	✖	✖
Succinic acid, aqueous, cold-saturated concentration	⛒	⛒
Acetic acid, 20 % concentration	✖	✖
Hydraulic oil	✖	✖
Isopropanol, 100 % concentration	✖	✖
Machinery oil	✖	⛒
Methanol, 100 % concentration	✖	✖
Oxalic acid, aqueous, cold-saturated concentration	⛒	⛒
Cutting oil	✖	⛒
Plant-based oils + fats	✖	⛒
Tartaric acids, aqueous	⛒	⛒
Citric acid	⛒	⛒

⛒ no or slight reaction = good resistance
✖ slight to moderate reaction = moderate resistance
✖ moderate to strong reaction = low/no resistance

Cable designations

All data is for a temperature of + 20 °C	ÖLFLEX® CLASSIC 100 SY, ÖLFLEX® CLASSIC 100 CY, ÖLFLEX® CLASSIC 110 SY, 110 CY	ÖLFLEX® CLASSIC 400 P, 400 CP, 415 CP, 440 P, 440 CP, 450 P, 500 P, 540 CP, 540 P, 550 P, ÖLFLEX® PETRO C HFFR, ÖLFLEX® SERVO FD 796 P, 796 CP, 798 CP, CLASSIC 810 P, 810 CP, 855 P, 855 CP, ÖLFLEX® FD 891 P, ÖLFLEX® CHAIN 896 P, ÖLFLEX® Robot 900, F1, ÖLFLEX® CRANE PUR, UNIRONIC® LiYD11Y, UNITRONIC® FD P, UNITRONIC® FD CP, UNITRONIC® FD CP (TP), HITRONIC® with PUR sheath, UNITRONIC® PUR, SERVO cable as per SIEMENS® FX8 PLUS Standard
Inorganic chemicals		
Alums, cold-saturated concentration	⛒	
Aluminium salts, any concentration	⛒	
Ammonia, aqueous, 10 % concentration	⛒	⛒
Ammonium acetate, aqueous, any concentration	⛒	
Ammonium carbonate, aqueous, any concentration	⛒	✖
Ammonium chloride, aqueous, any concentration	⛒	⛒
Barium salts, any concentration	⛒	⛒
Boric acid, aqueous	⛒	✖
Calcium chloride, aqueous, cold-saturated concentration	⛒	✖
Calcium nitrate, aqueous, cold-saturated concentration	⛒	
Chromium salts, aqueous, cold-saturated concentration	⛒	⛒
Potassium carbonate, aqueous (potash)	⛒	
Potassium chlorate, aqueous, cold-saturated concentration	⛒	
Potassium chloride, aqueous, cold-saturated concentration	⛒	✖
Potassium dichromate, aqueous	⛒	✖
Potassium iodide, aqueous	⛒	
Potassium nitrate, aqueous, cold-saturated concentration		

Cable designations

All data is for a temperature of + 20 °C	ÖLFLEX® CLASSIC 100 SY, ÖLFLEX® CLASSIC 100 CY, ÖLFLEX® CLASSIC 110 SY, 110 CY	ÖLFLEX® CLASSIC 400 P, 400 CP, 415 CP, 440 P, 440 CP, 450 P, 500 P, 540 CP, 540 P, 550 P, ÖLFLEX® PETRO C HFFR, ÖLFLEX® SERVO FD 796 P, 796 CP, 798 CP, CLASSIC 810 P, 810 CP, 855 P, 855 CP, ÖLFLEX® FD 891 P, ÖLFLEX® CHAIN 896 P, ÖLFLEX® Robot 900, F1, ÖLFLEX® CRANE PUR, UNIRONIC® LiYD 11Y, UNITRONIC® FD P, UNITRONIC® FD CP, UNITRONIC® FD CP (TP), HITRONIC® with PUR sheath, UNITRONIC® PUR, SERVO cable as per SIEMENS® FX8 PLUS Standard
Inorganic chemicals		
Potassium permanganate, aqueous	✖	✖
Potassium sulphate, aqueous	⊠	⊠
Copper salts, aqueous, cold-saturated concentration	⊠	⊠
Magnesium salts, aqueous, cold-saturated concentration	⊠	✖
Sodium bicarbonate, aqueous (natron)	⊠	✖
Sodium bisulphite, aqueous	⊠	⊠
Sodium chloride, aqueous (table salt)	⊠	⊠
Sodium thiosulphate, aqueous (fixing salt)	⊠	✖
Nickel salts, aqueous, cold-saturated concentration	⊠	⊠
Phosphoric acid, 50 % concentration	⊠	✖
Mercury, 100 % concentration	⊠	⊠
Mercury salts, aqueous, cold-saturated concentration	⊠	⊠
Nitric acid, 30 % concentration	✖	✖
Hydrochloric acid, concentrated	✖	✖
Sulphur, 100 % concentration	⊠	⊠
Sulphur dioxide, gaseous	⊠	
Carbon disulphide	✖	✖
Hydrogen sulphide	⊠	⊠
Sea water	⊠	⊠
Silver salts, aqueous	⊠	⊠

Cable designations

All data is for a temperature of + 20 °C	ÖLFLEX® CLASSIC 100 SY, ÖLFLEX® CLASSIC 100 CY, ÖLFLEX® CLASSIC 110 SY, 110 CY	ÖLFLEX® CLASSIC 400 P, 400 CP, 415 CP, 440 P, 440 CP, 450 P, 500 P, 540 CP, 540 P, 550 P, ÖLFLEX® PETRO C HFFR, ÖLFLEX® SERVO FD 796 P, 796 CP, 798 CP, CLASSIC 810 P, 810 CP, 855 P, 855 CP, ÖLFLEX® FD 891 P, ÖLFLEX® CHAIN 896 P, ÖLFLEX® Robot 900, F1, ÖLFLEX® CRANE PUR, UNIRONIC® LiYD 11Y, UNITRONIC® FD P, UNITRONIC® FD CP, UNITRONIC® FD CP (TP), HITRONIC® with PUR sheath, UNITRONIC® PUR, SERVO cable as per SIEMENS® FX8 PLUS Standard
Inorganic chemicals		
Hydrogen peroxide, 3 % concentration	⊠	⊠
Zinc salts, aqueous	⊠	✖
Tin(II) chloride	⊠	
Organic chemicals		
Ethanol, 100 % concentration	✖	✖
Formic acid, 30 % concentration	✖	✖
Petrol	✖	⊠
Succinic acid, aqueous, cold-saturated concentration	⊠	⊠
Acetic acid, 20 % concentration	✖	✖
Hydraulic oil	✖	✖
Isopropanol, 100 % concentration	✖	✖
Machinery oil	✖	⊠
Methanol, 100 % concentration	✖	✖
Oxalic acid, aqueous, cold-saturated concentration	⊠	
Cutting oil	✖	⊠
Plant-based oils + fats	✖	⊠
Tartaric acids, aqueous	⊠	
Citric acid	⊠	✖

⊠ no or slight reaction = good resistance
✖ slight to moderate reaction = moderate resistance
✖ moderate to strong reaction = low/no resistance

Whilst this information is accurate to the best of our knowledge and experience, it must be treated as a non-binding guideline only. In many cases, tests must be carried out under working conditions to reach a definitive conclusion.

Cable designations

All data is for a temperature of + 20 °C	ÖLFLEX® CRANE, round and flat	ÖLFLEX® LIFT T, LIFT S, ÖLFLEX® CRANE 2S, ÖLFLEX® LIFT F, ÖLFLEX® SF, Single-core products LIFY, LIFY 1 kV	ÖLFLEX® HEAT 105	ÖLFLEX® HEAT 180	ÖLFLEX® HEAT 205/260
Inorganic chemicals					
Alums, cold-saturated concentration	⊠	⊠	⊠	⊠	⊠
Aluminium salts, any concentration	⊠	⊠	⊠	⊠	⊠
Ammonia, aqueous, 10 % concentration	⊠	⊠	⊠	⊠	⊠
Ammonium acetate, aqueous, any concentration		⊠	⊠	⊠	⊠
Ammonium carbonate, aqueous, any concentration	⊠	⊠	⊠		⊠
Ammonium chloride, aqueous, any concentration	⊠	⊠	⊠		⊠
Barium salts, any concentration	⊠	⊠	⊠	⊠	⊠
Boric acid, aqueous	⊠	⊠	⊠	⊠	⊠
Calcium chloride, aqueous, cold-saturated concentration	⊠	⊠	⊠	⊠	⊠
Calcium nitrate, aqueous, cold-saturated concentration	⊠	⊠	⊠	✖	⊠
Chromium salts, aqueous, cold-saturated concentration	⊠	⊠	⊠		⊠
Potassium carbonate, aqueous (potash)	✖	⊠	⊠	⊠	⊠
Potassium chlorate, aqueous, cold-saturated concentration	⊠	⊠	⊠		⊠
Potassium chloride, aqueous, cold-saturated concentration	⊠	⊠	⊠	⊠	⊠
Potassium dichromate, aqueous	⊠	⊠	⊠	⊠	⊠
Potassium iodide, aqueous	⊠	⊠	⊠	⊠	⊠
Potassium nitrate, aqueous, cold-saturated concentration					

Cable designations

All data is for a temperature of + 20 °C	ÖLFLEX® CRANE, round and flat	ÖLFLEX® LIFT T, LIFT S, ÖLFLEX® CRANE 2S, ÖLFLEX® LIFT F, ÖLFLEX® SF, Single-core products LIFY, LIFY 1 kV	ÖLFLEX® HEAT 105	ÖLFLEX® HEAT 180	ÖLFLEX® HEAT 205/260
Inorganic chemicals					
Potassium permanganate, aqueous	⊠	✖	⊠	⊠	⊠
Potassium sulphate, aqueous	⊠	⊠	⊠	⊠	⊠
Copper salts, aqueous, cold-saturated concentration	⊠	⊠	⊠	⊠	⊠
Magnesium salts, aqueous, cold-saturated concentration	⊠	⊠	⊠	⊠	⊠
Sodium bicarbonate, aqueous (natron)	⊠	⊠	⊠	⊠	⊠
Sodium bisulphite, aqueous	✖	⊠	⊠	⊠	⊠
Sodium chloride, aqueous (table salt)	⊠	⊠	⊠	⊠	⊠
Sodium thiosulphate, aqueous (fixing salt)	⊠	⊠	⊠	⊠	⊠
Nickel salts, aqueous, cold-saturated concentration	⊠	⊠	⊠	⊠	⊠
Phosphoric acid, 50 % concentration	⊠	⊠	⊠	✖	⊠
Mercury, 100 % concentration	⊠	⊠	⊠	⊠	⊠
Mercury salts, aqueous, cold-saturated concentration	⊠	⊠	⊠	⊠	⊠
Nitric acid, 30 % concentration	✖	✖	✖	✖	⊠
Hydrochloric acid, concentrated	✖	✖	✖	✖	⊠
Sulphur, 100 % concentration	⊠	⊠	⊠	✖	⊠
Sulphur dioxide, gaseous	⊠	⊠	⊠	✖	⊠
Carbon disulphide	✖	✖	✖	✖	⊠
Hydrogen sulphide	⊠	⊠	⊠	✖	⊠
Sea water	⊠	⊠	⊠	⊠	⊠
Silver salts, aqueous	⊠	⊠	⊠	⊠	⊠

Cable designations

All data is for a temperature of + 20 °C	ÖLFLEX® CRANE, round and flat	ÖLFLEX® LIFT T, LIFT S, ÖLFLEX® CRANE 2S, ÖLFLEX® LIFT F, ÖLFLEX® SF, Single-core products LIFY, LIFY 1 kV	ÖLFLEX® HEAT 105	ÖLFLEX® HEAT 180	ÖLFLEX® HEAT 205/260
Inorganic chemicals					
Hydrogen peroxide, 3 % concentration	⊠	⊠	⊠	⊠	⊠
Zinc salts, aqueous	⊠	⊠	⊠	✖	⊠
Tin(II) chloride	⊠	⊠	⊠	⊠	⊠
Organic chemicals					
Ethanol, 100 % concentration	⊠	✖	✖	⊠	⊠
Formic acid, 30 % concentration	⊠	✖	✖		⊠
Petrol	✖	✖	✖	✖	⊠
Succinic acid, aqueous, cold-saturated concentration	⊠	⊠	⊠		⊠
Acetic acid, 20 % concentration	⊠	✖	✖	⊠	⊠
Hydraulic oil	✖	✖	✖		⊠
Isopropanol, 100 % concentration	⊠	✖	✖	✖	⊠
Machinery oil	✖	✖	✖	✖	⊠
Methanol, 100 % concentration	⊠	✖	✖	⊠	⊠
Oxalic acid, aqueous, cold-saturated concentration	✖	⊠	⊠	✖	⊠
Cutting oil	✖	✖	✖		⊠
Plant-based oils + fats	✖	✖	✖	✖	⊠
Tartaric acids, aqueous	⊠	⊠	⊠	⊠	⊠
Citric acid	⊠	⊠	⊠	⊠	⊠

⊠ no or slight reaction = good resistance
✖ slight to moderate reaction = moderate resistance
✖ moderate to strong reaction = low/no resistance

Whilst this information is accurate to the best of our knowledge and experience, it must be treated as a non-binding guideline only. In many cases, tests must be carried out under working conditions to reach a definitive conclusion.

PROFIBUS (UNITRONIC® BUS PB) and Industrial Ethernet cables (ETHERLINE®)

- Use only cables that have been designed for the relevant type of application (fixed installation, flexible or highly flexible application, torsional load, cable trailer systems, routing outdoors/underground). These cables have a specific design and have undergone the corresponding testing.
- For PROFINET®, a distinction is made between type A (fixed installation, solid conductor), type B (flexible applications, e. g. 7-wire stranded conductor) and type C (highly flexible applications, Torsion, Trailing applications, e. g. 19-wire stranded conductor). As a rule, the conductor cross-section for PROFINET® with two pairs is 22 AWG. For PROFINET® with four pairs cable, the cross-selection for Type A and B is min. 23 AWG. PROFINET® Type C has the min. cross-selection of 24 AWG.
- We recommend routing different cable categories (e. g. for the network power supply, auxiliary power supply, data network cables and sensitive cables for measurement) as separate bundles in a system.
- Ensure there is a minimum clearance of 10 cm between cables used for power applications and data network cables. Alternatively, fit a metallic partition between the two, or route the data network cable in a metal pipe. If this is not possible, use separate cable carrier systems.
- Cables must always cross one another at an angle of 90°.
- Ground the screening of all cables running into a control cabinet at the entry to the control cabinet or at the connector.
- We recommend the use of fibre-optic cables when installing cables outdoors. Use only approved outdoor cables. Observe all warning signs (power lines, gas pipes etc.).

- Always route backup cables along a separate path to ensure they remain undamaged, should damage occur to the main cable.
- Protect copper and fibre-optic cables located outside cable carrier systems by routing them through plastic pipes (or through metal pipes if subject to high mechanical loads).
- Replace any cables that have been overloaded or damaged.
- Observe the temperature range for the cables. Deviations from these temperatures will result in a lower mechanical and electrical cable rating and will damage the cable.
- Data network cables (Cu + fibre-optic cables) must only be subjected to a defined tensile load in order to maintain the transmission characteristics. For this reason, a strain relief must also be used.
- Applications involving torsion require a special cable design, as do cables for drag chains and cable trailer systems. These cables cannot be swapped.
- For drag chain cables, it is imperative that the minimum bending radius is complied with and that this does not fall below the prescribed values, otherwise the cable may be damaged and there is a risk of system failure.

- When unreeling cables from cable drums, make sure the cable does not grind against any objects. Likewise, make sure the cable is not pulled over sharp edges.
- For Cu cables, implement an equipotential bonding concept and ensure a distinction is made between hazardous (ex) and non-hazardous areas.
- Electrical, magnetic and electromagnetic fields affect signal transmission and may disrupt electronic components. “Electromagnetic compatibility” (EMC) is now a basic requirement to be fulfilled during installation. As such, include all metal system parts in the equipotential bonding concept and use only screened cables and connectors, or alternatively use fibre-optic cables and fibre-optic connectors that are resistant to electromagnetic interference.
- Recommendation: a detailed “Planning and Installation Guide” for PROFIBUS and/or PROFINET® is available from the PROFIBUS User Organisation (PNO) in Karlsruhe, Germany.

Website: www.profibus.com
E-mail: info@profibus.com

ÖLFLEX® FD/CHAIN, UNITRONIC® FD, ETHERLINE® FD and HITRONIC® FD cables in power chains

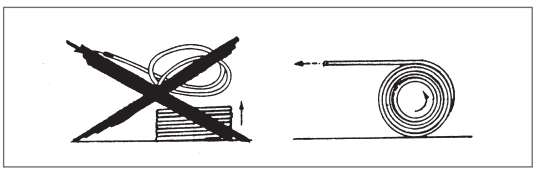
1. Power chains must be selected in line with the requirements for the necessary cables.

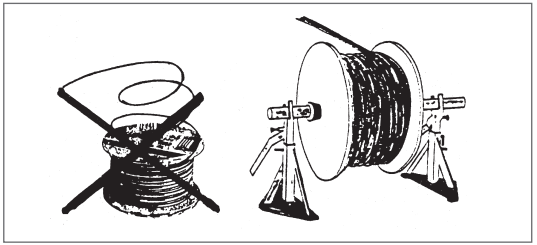
   Please note: If possible, we recommend avoiding a multi-layer cable configuration, i.e. > 25 cores, and instead distributing the number required amongst several cables.

2. The values for the minimum permissible bending radii of the cables must not fall below the prescribed values (stated in the Technical Data of this catalogue as the bending radius for flexible use).

3. The cables must be free of twists when laid out in the power chain. As such, never pull a cable overhead from drums and coils resting on their side, but rather unroll the cables from the drum or the coil and lay them out or suspend them, if necessary. We recommend only taking cables to be used for power chain applications directly from the drums.

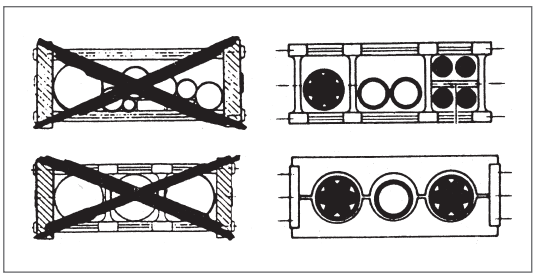
   Please note: Due to the manufacturing process, the marking on the cables runs in a gentle spiral round the cables. As such, it cannot be used as an indicator of whether the cable is free of twists. When the cables are drawn in, the chain should be laid out longitudinally. It can then be brought into the operating position once the cables are in position.





4. The cables must lie loosely next to each another in the cable stays. As far as possible they should be arranged individually, divided by separating pins or placed within individual holders in the neutral zone of the chain. The free space for the cables in the chain stay must be at least 10% of the cable diameter. Avoid arranging the cables above one another without the use of separating pins.

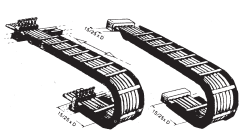
   Please note: If the chain configuration is suspended vertically, additional free space must be provided in terms of the stay height, as the cables are extended during operation. After brief periods of operation, check the length adjustment of the cables and correct if necessary.

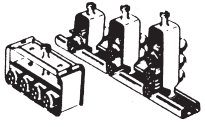


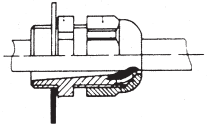
5. The cables must not be secured or bound together in the chain.

6. The cable should be secured at both ends of the chain. For long drag chains where the return side comes to lie on the carrying side, only secure the cable at the driver end. Under no circumstances may the cable bending include the fastening points.

   The distance between the end point of the bending movement and the fastening must be as large as possible. For UNITRONIC® FD, ETHERLINE® FD and HITRONIC® FD, a minimum of 20 x the cable diameter applies. For ÖLFLEX® FD/CHAIN, ÖLFLEX® CLASSIC FD, ÖLFLEX® SERVO and ÖLFLEX® ROBUST FD, a minimum of 10 x the cable diameter applies.



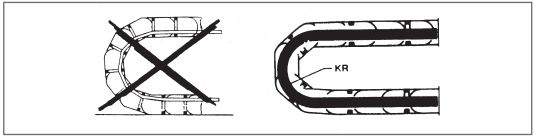




SKINTOP® Verschraubung nur von Hand (ohne Hilfsmittel) anziehen. **Quetschungen der Leitung vermeiden.**

7. Make sure that cables in the bending section have complete freedom of movement, i.e. there must be no forced guidance, so that the cables can still move relative to one another and to the chain. We recommend checking the position of the cable after a brief period of operation.

   This check must be carried out after the thrust and pull movements.



8. If a chain breaks, also replace the cables as damage caused by excess stretching cannot be ruled out.

9. If, for a horizontal configuration, the return side lies against and slides along the carrying side, it is particularly important that the weight of the cables is distributed symmetrically throughout the chain, in order to safeguard the service life of the entire configuration. If it is not, weight exerted on one side will cause the return side to twist or tilt and will prevent a level, parallel movement along the carrying side. Failure to comply with this instruction may substantially reduce the service life of the drag chain configuration as a whole.

10. The power chain must be selected, assembled, maintained and repaired in compliance with the currently applicable guidelines specified by the chain manufacturer, in line with the intended application. For critical applications, for example where high acceleration speeds are involved (>10 m/s^2), we recommend that you consult our system specialists as early on as possible, or take advantage of the expertise of the chain manufacturer.

November 2013

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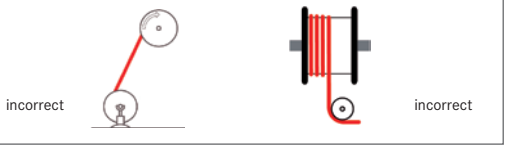


ÖLFLEX® CRANE NSHTÖU, ÖLFLEX® CRANE VS (N)SHTÖU and ÖLFLEX® CRANE PUR

1. The delivery drum must be transported to (or as close as possible to) the installation location. If possible, avoid rolling the drum unnecessarily. If it is not possible to transport the delivery drum to the system, we recommend unreeling the cable from the drum using guide pulleys, together with a drag rope and cable grip.

2. To unreel the cable, the drum must be mounted such that it can rotate, and the cable must only be unreeled from the top. When doing so, the cable must also be stretched out straight, and must not be deflected or pulled over any edges. During the unreeling process, the cable temperature must not be less than + 5 °C (Lapp's recommendation).

3. The entire length of cable to be assembled must be laid out in full prior to installation. Avoid rewinding the cable from the shipping drum onto the unit drum (please see chapter 4). When laying the cable, avoid S-shaped bends or other similar deflections. See figure 1.

4. The cable must be free of twists when wound on the unit drum. Likewise, the cable must not be twisted when connecting and fastening it to the feed-in point. The core layer structure of windable ÖLFLEX® CRANE cables has an "S"-shaped core stranding design. Depending on the position of the cable attachment side or feed-in point on the motor-driven drum, we therefore trongly recommend that you ensure the cable is wound onto the unit drum in the correct direction, as shown above in the figure 2.

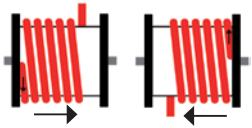
5. If the feed-in point is passed over during operation, use a compensating pulley with an appropriate diameter carrying 1 to 2 cable windings. If the feed-in point is underground below the surface, fit a deflection funnel to the compensating pulley.

6. To prevent the cable being crushed, it is imperative that sufficiently sized clamps or cable support grips are used to secure the cable to the end of the travel length (length ≥ 4 x D). The length of cable left unreeled before the fastening point must be at least 40 x D, however, we also recommend the use of a compensating pulley here.

7. If the cable is fully unreeled and the maximum travel distance has been reached, at least 2 cable windings must remain on the unit drum.

8. The inner bending diameter for ÖLFLEX® CRANE NSHTÖU, on cables with an outer diameter of up to 21.5 mm, must not be less than 10 times the cable diameter, and 12.5 times for cables with larger outer diameters. For ÖLFLEX® CRANE VS (N)SHTÖU, the inner bending diameter must generally be at least 15 times the cable diameter. For ÖLFLEX® CRANE PUR, the inner bending diameter must not be less than 15 times the cable diameter.

2



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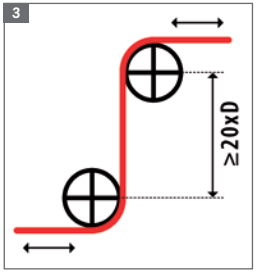

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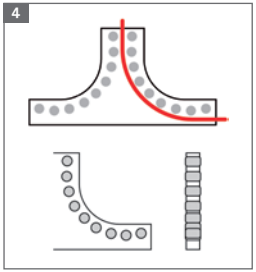
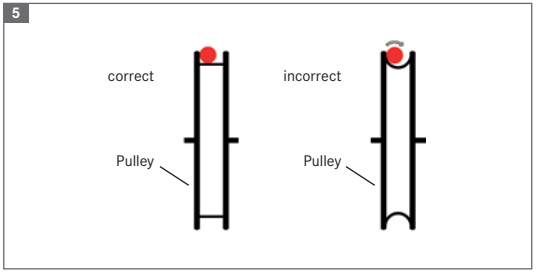


The minimum bending radius can be found on the relevant products pages in the current main catalogue or the product data sheet.

9. Avoid “S”-shaped bends in the cable. However, if the configuration involved renders this impossible, the space between the two deflection pulley axes must be at least 20 times the cable diameter for cables with an outer diameter of up to 21.5 mm, and at least 25 times for cables with larger outer diameters. Definitely, Lapp can not warrant “S”-shaped bending for ÖLFLEX® CRANE NSHTÖU. See figure 3.

10. During installation and operation of the cables (ÖLFLEX® CRANE VS (N)SHTÖU and ÖLFLEX® CRANE PUR), the maximum tensile strength of the cable based on the integrated tensile strain relief elements has to be respected, depending on the cable dimension (please, see the products pages in the current main catalogue). For cables with very large outer diameters, we recommend using guide pulleys to minimise friction on the outer sheath when changing direction. See figure 4.

5



11. The inner contact surface of the pulley must not have a concave shape in order to prevent the cable twisting, which could be caused by extensive contact between the sheath and the inside of the pulley. To ensure that the cable runs smoothly, the inner width of the guiding groove must be 10 to 15 % larger than the cable outer diameter. See figure 5.

12. The actual current rating (I) in continuous operation also depends on:
    - the conductor cross-section (I_{max})
    - the ambient temperature (f_1)
    - the amount of cable reeled onto the drum (f_2)

In case of theoretical limitation of the calculation of final current rating and hereby, focus on the three above mentioned influencing factors, for better understanding and independently from reality, the maximum permissible load that can be exerted on the installed cable will be based on the following simplified formula: $\mathbf{I = I_{max} \times f_1 \times f_2}$

13. These cables meet the requirements stipulated by VDE 0250 and VDE 0298-3 (application/installation). Any loads going beyond those specified will reduce the service life of the cables.

Lift/elevator control cables – ÖLFLEX® LIFT, ÖLFLEX® LIFT T, ÖLFLEX® LIFT S

A General information

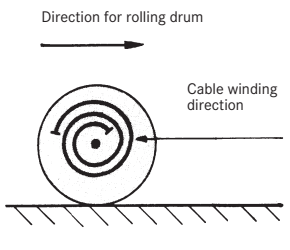
1. The cables must be free of twists when being installed, and this should be done at temperatures of at least +5 °C. VDE 0298-4/Lapp table T12, column C applies for the current rating values.

2. The inner bending radius of the cable must not be less than 20 times the outer cable diameter.

3. The maximum suspension length depends on the supporting element in the cable in each case (see the products pages to the current main catalogue).

4. The delivery drum must be transported to (or as close as possible to) the installation location. If possible, avoid rolling the drum. If the drum must be rolled, only move the drum in the specified direction (see figure 6).

6



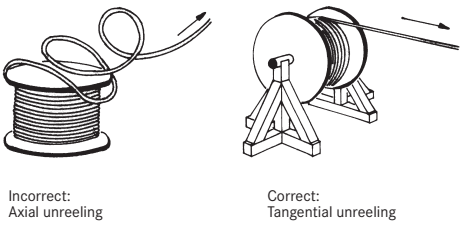
B Suspending the cables

1. When pulling the cables into the shaft, unreel them tangentially from the drum. Unreeling the cable axially from the drum will result in the cable twisting and will affect the core stranding, which may in turn cause malfunctions (see figure 7).

2. To ensure the cable is fitted without twists, allow the cable to briefly hang freely in the shaft. The best way to do this is to pull the control cable into the lift shaft from the bottom of the shaft.

3. The gap between the lift cabin and bottom of the shaft must be sufficiently large, and must be used in full for the cable loop height (see figure 8 on the next page).

7



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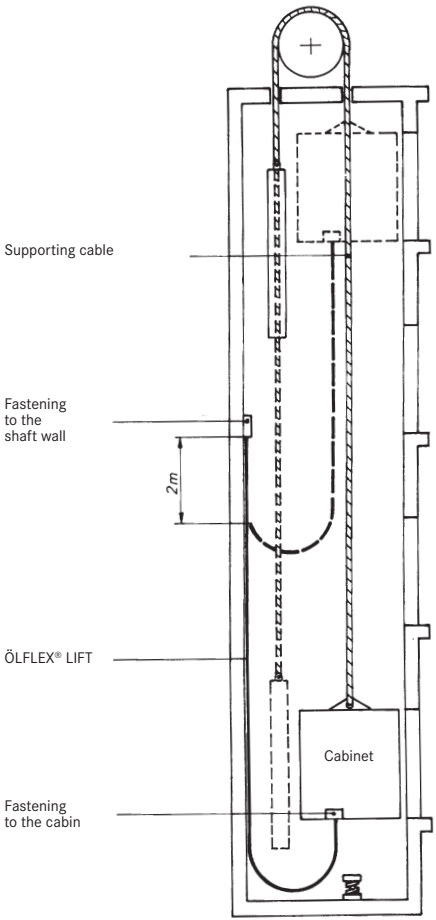


C General information

1. It is essential that sufficiently large clamps are used to secure the cables (e. g. Lapp cable wedge clamps type EKK or DKK). For suspension lengths greater than 50 m, the supporting element must also be damped separately.

2. The fastening point on the shaft wall must be at least 2 m above the centre of the travel distance (see figure 8).

3. If the cable does not run smoothly, i.e. if the cable leaves the max. gradient line during operation, rotate the control cable slightly at one of the fastening points until the cable runs smoothly again.

4. If several control cables need to be installed for the lift unit, for technical reasons we recommend suspending the individual cables such that the height of the various loops differs by approx. 15 cm (stepped suspension).

Control cables

1. Basic type
- N VDE standard (N) in line with VDE

2. Insulating material
- Y Thermoplastic resins
- X Cross-linked thermoplastic resins
- G Elastomers
- HX Halogen-free materials

3. Cable designation
- A Core cable
- D Solid wire
- AF Fine-wire core cable
- F Socket core
- L Fluorescent tube cable
- LH Connecting cable, light mechanical loads
- MH Connecting cable, moderate mechanical loads
- SH Connecting cable, heavy mechanical loads
- SSH Connecting cable for special loads
- SL Control cable/welding cable
- S Control cable
- LS Light control cable
- FL Flat cable
- Si Silicone cable
- Z Twin cable
- GL Glass fibre
- Li Braided conductor as per VDE 0812
- LiF Braided conductor as per VDE 0812, extra-fine wire

4. Special features
- T Supporting element
- Ö Enhanced oil resistance
- U Flame-retardant
- w Heat-resistant, weather-resistant
- FE Insulation retained for a limited time
- C Screening braid
- D Screening as Cu wire wrapping
- S Steel wire braiding as mech. protection

5. Sheaths
As point 2. "Insulating material" P/PUR polyurethane

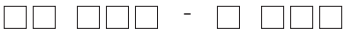
6. Protective conductor
- -O Without protective conductor
- -J With protective conductor

7. Number of cores
... number of cores

8. Conductor cross-section
Figures in mm²

Example: NSHTÖU 24G 1.5
ÖLFLEX® CRANE NSHTÖU cable, 24-core, with protective cond., cross-section: 1.5 mm²

Harmonised cables



1. Basic type
- H Harmonised type
- A National type
- X or S in the style of a harmonized type

2. Nominal voltage
- 01 100/100 volts
- 03 300/300 volts
- 05 300/500 volts
- 07 450/750 volts

3. Insulating material
- V PVC
- V2 PVC +90 °C
- V3 PVC flexible at cold temperatures
- B Ethylene propylene rubber
- E PE polyethylene
- X XPE, cross-linked PE
- R Rubber
- S Silicone rubber

4. Outer/inner sheath material
- V PVC
- V2 PVC +90 °C
- V3 PVC flexible at cold temperatures
- V5 PVC with enhanced oil resistance
- R Rubber
- N Chloroprene based rubber
- Q Polyurethane
- J Glass fibre braiding
- T Textile braiding
- S Silicone rubber

5. Special features
- C4 Copper wire screen braiding
- H Flat cable, divisible
- H2 Flat cable, not divisible
- H6 Flat cable, not divisible, for lifts
- H8 Helical/spiral cable

6. Conductor type
- U Single-wire
- R Multi-wire
- K Fine-wire (fixed installation)
- F Fine-wire (flexible installation)
- H Extra-fine wire
- Y Tinsel wire
- D Fine-wire conductor for welding cable
- E Extra-fine wire conductor for welding cable

7. Number of cores
... number of cores

8. Protective conductor
- X Without protective conductor
- G With protective conductor

9. Conductor cross-section
Figures in mm²

Example: H05 VV-F 3G 1.5
Medium PVC hose, 3-core, with protective cond., cross-section: 1.5 mm²

Telecommunications cables

1. Basic type
- A- Outdoor cable
- G- Mining cable
- J- Installation cable
- Li Stranded conductor, flexible cable
- S- Jumper cable

2. Additional designation
- J Induction protection
- E Electronics

3. Insulating material
- Y PVC
- 11Y PUR
- 2Y Polyethylene
- O2Y Cellular PE
- 9Y PP
- 5Y PTFE
- 6Y FEP
- 7Y ETFE
- H Halogen-free compound

4. Special features
- C Copper screen braiding
- D Copper wrapping
- (ST) Metal foil screening
- (L) Aluminium strip
- F Petroleum jelly filling
- LD Corrugated aluminium sheath
- (K) Copper strip screening
- (Z) Steel wire braiding
- W Corrugated steel sheath
- b Armouring

5. Sheathing
(see point 3. “Insulating material”)

6. Number of elements
... number of stranding elements

7. Stranding element
- 1 Single core
- 2 Pair
- 3 Triple

8. Conductor diameter or cross section
... in mm or mm^2

9. Stranding element
- St Star quad (phantom)
- StI Star quad (trunk cable)
- StIII Star quad (local cable)
- TF Star quad for TF
- S Signal cable (railway)
- PiMF Screened pair
- (TP) Twisted Pair
- PiD Pairs in copper wrapping

10. Stranding type
- Lg Twisted into layers
- Bd Twisted into bundles

Example: A2Y(L)2Y 6 x 2 x 0.8 Bd
Telephone cable for local network
with PE insulation and layered sheath

Fibre optic cables – DIN VDE 0888

1. Product application area
- A Outdoor cable
- AT Outdoor cable, divisible
- J Indoor cable
- U or A/J Universal cable (for outdoor and indoor)

2. Buffered fibre type
- B Loose tube, unfilled
- D Loose tube, filled
- V Tight-buffered fibre

3. Cable construction (in the cable from inside to outside)
- B Armouring
- F Grease-filled
- Q Swelling tape, dry core
- (L) Aluminium tape
- S Optical cable with copper elements
- (SR) Corrugated steel tape
- (ZN) Non-metallic strain relief elements
- (ZS) metallic strain relief elements

4. Sheath materials
- H Halogen-free sheath
- Y PVC sheath
- 2Y PE sheath
- 4Y PA sheath
- 11Y PUR sheath

5. Number of fibres
- X Number of fibres or number of loose tubes X numbers of fibres per loose tube

6. Fibre type/ fibre dimensions
- E Single-mode fibre (glass core/glass cladding) 9/125 µm SM GOF (OS2)
- G Multimode fibre (glass core/glass cladding) 50/125 µm or 62.5/125 µm MM GOF (OM1, OM2, OM3, OM4)
- K Plastic cladded fibre (glass core/plastic cladding) 200/230 µm PCF
- P Polymer optical fibre (polymer core/ polymer cladding) 980/1000 µm POF

7. Optical quality/ transmission properties

Example 1: A-DQ(ZN)(SR)2Y 12G 50/125 OM3
Outdoor cable with corrugated steel tape armour and PE sheath, central loose tube, non-metallic strain relief made of glass yarns, 12 fibres, 50/125 µm OM3 multimode fibres

Example 2: J-V2Y(ZN)11Y 2P 980/1000
Plastic fibre-optic cable, two-fibre (DUPLEX),
indoor cable with PE inner sheath, non-metallic strain relief, PUR outer sheath

Colour code for ÖLFLEX® cables

The colour code applies to the following cables starting from 6 cores: ÖLFLEX® CLASSIC 100, ÖLFLEX® CLASSIC 100 CY, ÖLFLEX® CLASSIC 100 SY and ÖLFLEX® CLASSIC 100 BK Power 0.6/1 KV. It contains colours and colour combinations for up to 102 cores, and consists of 11 basic colours. The different variations of the basic colours are achieved by using one or two coloured stripes, meaning each core can be easily distinguished from the rest. The VDE colour code applies for cables with up to 5 cores (inclusive). Please also see T9. The cores are counted from the inside to the outside, and the green/yellow core is always the last core in the outer layer.

Basic colours
0 green/yellow
1 white
2 black
3 blue
4 brown
5 grey
6 red
7 violet
8 pink
9 orange
10 transparent
11 beige

Basic colours with white stripe
12 black/white
13 blue/white
14 brown/white
15 grey/white
16 red/white
17 violet/white
18 pink/white
19 orange/white
20 transparent/white
21 beige/white

Basic colours with black stripe
22 blue/black
23 brown/black
24 grey/black
25 red/black
26 violet/black
27 pink/black
28 orange/black
29 transparent/black
30 beige/black

Basic colours with blue stripe
31 brown/blue
32 grey/blue
33 red/blue
34 pink/blue
35 orange/blue
36 transparent/blue
37 beige/blue

Basic colours with brown stripe
38 grey/brown
39 red/brown
40 violet/brown
41 pink/brown
42 orange/brown
43 transparent/brown
44 beige/brown

Basic colours with grey stripe
45 rot-grau
46 violett-grau
47 rosa-grau
48 orange-grau
49 transparent-grau
50 beige-grau

Basic colours with red stripe
51 orange/red
52 transparent/red
53 beige/red

Colour code for UNITRONIC® 100 cables

It contains colours and colour combinations for up to 102 cores, and consists of 10 basic colours. The different variations of the basic colours are achieved by using one or two coloured stripes, or by ring marking, meaning each core can be easily distinguished from the rest. The cores are counted from the inside to the outside, and the green/yellow core is always the last core in the outer layer.

Basic colours
0 green/yellow
1 black
2 blue
3 brown
4 beige
5 yellow
6 green
7 violet
8 pink
9 orange
10 transparent

Basic colours with white stripe
11 red/white
12 blue/white
13 yellow/white
14 green/white
15 violet/white
16 orange/white
17 brown/white

Basic colours with red stripe
18 blue/red
19 yellow/red
20 green/red
21 white/red
22 orange/red
23 brown/red

Basic colours with black stripe
24 red/black
25 blue/black
26 yellow/black
27 green/black
28 violet/black
29 white/black
30 orange/black
31 brown/black

Basic colours with green stripe
32 red/green
33 grey/green
34 violet/green
35 white/green
36 orange/green
37 brown/green

Basic colours with yellow stripe
38 red/yellow
39 blue/yellow
40 violet/yellow
41 white/yellow
42 brown/yellow

Basic colours with blue stripe
43 red/blue
44 white/blue
45 orange/blue
46 brown/blue

Basic colours with violet stripe
47 yellow/violet
48 green/violet
49 white/violet
50 orange/violet
51 brown/violet

Basic colour: black, coloured stripe
52 black/white
53 black/yellow
54 black/red
55 black/green
56 black/blue
57 black/violet

Thermo couple		IEC 60584-3		DIN 43710*	
Material ⊕ ⊖		Designation TEC	CC	Designation TEC	CC
T	Cu – CuNi	TX -25 °C up to +100 °C			
U	Cu – CuNi			UX 0 °C up to +200 °C	
J	Fe – CuNi	JX -25 °C up to +200 °C			
L	Fe – CuNi			LX 0 °C up to +200 °C	
E	NiCr – CuNi	EX -25 °C up to +200 °C			
K	NiCr – Ni	KX -25 °C up to +200 °C		KX 0 °C up to +200 °C	
	NiCr – Ni	KCA 0 °C up to +150 °C		KCA 0 °C up to +150 °C	
	NiCr – Ni	KCB 0 °C up to +100 °C			
N	NiCrSi – NiSi	NX -25 °C up to +200 °C	NC 0 °C up to +150 °C		
R S	PtRh13 – Pt PtRh10 – Pt	RCB SCB 0 °C up to +200 °C		RCB SCB 0 °C up to +200 °C	
B	PtRh30 – PtRh6				

*DIN 43710 was withdrawn in April 1994.
TEC = thermoelectric cables
CC = compensating cables

	ANSI MC 96.1		BS 4937		NF C 42-324	
	Designation TEC	CC	Designation TEC	CC	Designation TEC	CC
	TX 0 °C up to +100 °C		TX 0 °C up to +100 °C		TX -25 °C up to +100 °C	
	JX 0 °C up to +200 °C		JX 0 °C up to +200 °C		JX -25 °C up to +200 °C	
	EX 0 °C up to +200 °C		EX 0 °C up to +200 °C		EX -25 °C up to +200 °C	
	KX 0 °C up to +200 °C		KX 0 °C up to +200 °C		KX -25 °C up to +200 °C	
					WC 0 °C up to +150 °C	
			VX 0 °C up to +100 °C		VC 0 °C up to +100 °C	
	SX 0 °C up to +200 °C		SX 0 °C up to +200 °C		SC 0 °C up to +200 °C	
	BX 0 °C up to +100 °C				BC 0 °C up to +100 °C	

The stated temperature specifies the application temperature range for each type. The application temperature range must be reduced if it is required by the insulation material used for the cable.

VDE 0293-308/HD 308 S2
Core ID code for colour-coded low-voltage cables

For marking cores in multi- and several-core cables for use in electrical systems and distribution systems. For the supply of permanently secured or portable supplies and for portable equipment cables. 3a and 4a: only suitable for specific applications.

Number of cores	Cables with protective conductor (code J or G)	Cables without protective conductor (code O or X)	Cables with concentric conductor
2	–	BU/BN	BU/BN
3	GNYE/BN/BU	BN/BK/GY	BN/BK/GY
3a	–	BU/BN/BK	BU/BN/BK
4	GNYE/BN/BK/GY	BU/BN/BK/GY	BU/BN/BK/GY
4a	GNYE/BU/BN/BK	–	–
5	GNYE/BU/BN/BK/GY	BU/BN/BK/GY/BK	BU/BN/BK/GY/BK
6 and above	GNYE/BK with printed numbers	BK with printed numbers	BK with printed numbers

Colour code for power cables as per VDE 0293 (old) – (colour codes are listed in IEC 60757)

For marking cores in multi- and several-core cables for connecting portable power consumers.

Number of cores	Cables with green/yellow core (harmonised)	Cables without green/yellow core (currently not yet harmonised)	Cables with concentric conductor
2	–	BU/BN	–
3	GNYE/BN/BU	BU/BN/BK	–
3	–	BU/BN/BK	–
4	GNYE/BK/BU/BN	BU/BN/BK/GY	–
5	GNYE/BK/BU/BN/BK	BU/BN/BK/GY/BK	–
6 and above	GNYE/further cores in BK with printed numbers, starting from the inside with 1, GNYE in the outer layer	BK with printed numbers	–

For marking cores in multi- and several-core cables and in multi-core cables for fixed installation.

Number of cores	Cables with green/yellow core (code -J-)	Cables without green/yellow core (code -O-)	Cables with concentric conductor
2	–	BK/BU	BK/BU
3	GNYE/BK/BU	BN/BU/BK	BK/BU/BN
3	–	BN/BK/BU	–
4	GNYE/BK/BU/BN	BK/BN/BU/BK	BK/BU/BN/BK
5	GNYE/BK/BU/BN/BK	BK/BN/BU/BK/BK	–
6 and above	GNYE/further cores in BK with printed numbers, starting from the inside with 1, GNYE in the outer layer	Cores in BK with printed numbers, starting from the inside with 1	Cores in BK with printed numbers, starting from the inside with 1

DIN 47100/January 1988 – colour code for UNITRONIC® twisted pair

Each pair has an a-core and a b-core. The marking is repeated for the first time as from 23 pairs, and for the second time as from 45 pairs. The first colour is always the basic colour of the core, and the second colour is printed in rings.

Pair no.	Colour of a-core	Colour of b-core
1	white	brown
2	green	yellow
3	grey	pink
4	blue	red
5	black	violet
6	grey/pink	red/blue
7	white/green	brown/green
8	white/yellow	yellow/brown
9	white/grey	grey/brown
10	white/pink	pink/brown
11	white/blue	brown/blue
12	white/red	brown/red
13	white/black	brown/black
14	grey/green	yellow/grey
15	pink/green	yellow/pink
16	green/blue	yellow/blue
17	green/red	yellow/red
18	green/black	yellow/black
19	grey/blue	pink/blue
20	grey/red	pink/red
21	grey/black	pink/black
22	blue/black	red/black
23-44	see 1 – 22	see 1 – 22
45-66	see 1 – 22	see 1 – 22

DIN 47100 colour code (but differs from DIN as the colours are not repeated after the 44th core)

Exception: 4-core line, which has a sequence of white, yellow, brown, green.

Core no.	Colour
1	white
2	brown
3	green
4	yellow
5	grey
6	pink
7	blue
8	red
9	black
10	violet
11	grey/pink
12	red/blue
13	white/green
14	brown/green
15	white/yellow
16	yellow/brown
17	white/grey
18	grey/brown
19	white/pink
20	pink/brown
21	white/blue
22	brown/blue
23	white/red
24	brown/red
25	white/black
26	brown/black
27	grey/green
28	yellow/grey
29	pink/green
30	yellow/pink
31	green/blue

Core no.	Colour
32	yellow/blue
33	green/red
34	yellow/red
35	green/black
36	yellow/black
37	grey/blue
38	pink/blue
39	grey/red
40	pink/red
41	grey/black
42	pink/black
43	blue/black
44	red/black
45	white/brown/black
46	yellow/green/black
47	grey/pink/black
48	red/blue/black
49	white/green/black
50	brown/green/black
51	white/yellow/black
52	yellow/brown/black
53	white/grey/black
54	grey/brown/black
55	white/pink/black
56	pink/brown/black
57	white/blue/black
58	brown/blue/black
59	white/red/black
60	brown/red/black
61	black/white

Colour code for UNITRONIC® 300 & 300 S (20 – 16 AWG)

Core no.	Colour	Core no.	Colour
1	black	26	white/black/green
2	red	27	white/black/yellow
3	white	28	white/black/blue
4	green	29	white/black/brown
5	orange	30	white/black/orange
6	blue	31	white/black/grey
7	brown	32	white/black/violet
8	yellow	33	white/black/black
9	violet	34	white/red/black
10	grey	35	white/red/red
11	pink	36	white/red/green
12	light brown	37	white/red/blue
13	red/green	38	white/red/brown
14	red/yellow	39	white/red/violet
15	red/black	40	white/green/black
16	white/black	41	white/green/red
17	white/red	42	white/green/green
18	white/green	43	white/green/blue
19	white/yellow	44	white/green/brown
20	white/blue	45	white/green/violet
21	white/brown	46	white/blue/black
22	white/orange	47	white/blue/red
23	white/grey	48	white/blue/green
24	white/violet	49	white/blue/blue
25	white/black/red	50	white/blue/brown

Technical tables | Excerpt
T9: core ID code as per DIN colour code
T9

Colour code for UNITRONIC® 300 & 300 S (24 – 22 AWG)

Core no.	Colour	Core no.	Colour
1	black	26	white/black/violet
2	brown	27	white/black/grey
3	red	28	white/brown/red
4	orange	29	white/brown/orange
5	yellow	30	white/brown/yellow
6	green	31	white/brown/green
7	blue	32	white/brown/blue
8	violet	33	white/brown/violet
9	grey	34	white/brown/grey
10	white	35	white/red/orange
11	white/black	36	white/red/yellow
12	white/brown	37	white/red/green
13	white/red	38	white/red/blue
14	white/orange	39	white/red/violet
15	white/yellow	40	white/red/grey
16	white/green	41	white/orange/yellow
17	white/blue	42	white/orange/green
18	white/violet	43	white/orange/blue
19	white/grey	44	white/orange/violet
20	white/black/brown	45	white/orange/grey
21	white/black/red	46	white/yellow/green
22	white/black/orange	47	white/yellow/blue
23	white/black/yellow	48	white/yellow/violet
24	white/black/green	49	white/yellow/grey
25	white/black/blue	50	white/green/blue

Conductor resistances and conductor stranding (metric)

Conductor resistances: up to 0.38 mm² as per DIN VDE 0812 and DIN VDE 0881 for stranded conductors, from 0.5 mm² as per IEC 60228/DIN EN 60228 (VDE 0295) for conductors made of soft-annealed copper and single and multi-core cables.

Nominal cross-section in mm²	Conductor resistances at 20 °C for 1 km in Ω (max. value)			
	Made of wires with metal sheath		Made of bare wires	
	Class 2	Class 5 + 6	Class 2	Class 5 + 6
0.08		252.0		243.0
0.14		148.0		138.0
0.25		79.9		79.0
0.34		57.5		57.0
0.38		52.8		48.5
0.5	36.7	40.1	36.0	39.0
0.75	24.8	26.7	24.5	26.0
1	18.2	20.0	18.1	19.5
1.5	12.2	13.7	12.1	13.3
2.5	7.56	8.21	7.41	7.98
4	4.70	5.09	4.61	4.95
6	3.11	3.39	3.08	3.30
10	1.84	1.95	1.83	1.91
16	1.16	1.24	1.15	1.21
25	0.734	0.795	0.727	0.780
35	0.529	0.565	0.524	0.554
50	0.391	0.393	0.387	0.386
70	0.270	0.277	0.268	0.272
95	0.195	0.210	0.193	0.206
120	0.154	0.164	0.153	0.161
150	0.126	0.132	0.124	0.129
185	0.100	0.108	0.0991	0.106
240	0.0762	0.0817	0.0754	0.0801
300	0.0607	0.0654	0.0601	0.0641
400	0.0475		0.0470	
500	0.0369		0.0366	
630	0.0286		0.0283	
800	0.0224		0.0221	
1000	0.0177		0.0176	

Example conductor stranding (metric)

Cross-section in mm²	Multi-wire conductor	Several-wire conductor	Fine-wire conductor
0.14			
0.25			~ 14 x 0.15
0.34		7 x 0.25	~ 19 x 0.15
0.38		7 x 0.27	~ 19 x 0.16
0.5	7 x 0.30	7 x 0.30	~ 16 x 0.20
0.75	7 x 0.37	7 x 0.37	~ 24 x 0.20
1.0	7 x 0.43	7 x 0.43	~ 32 x 0.20
1.5	7 x 0.52	7 x 0.52	~ 30 x 0.25
2.5	7 x 0.67	~ 19 x 0.41	~ 50 x 0.25
4	7 x 0.85	~ 19 x 0.52	~ 56 x 0.30
6	7 x 1.05	~ 19 x 0.64	~ 84 x 0.30
10	7 x 1.35	~ 49 x 0.51	~ 80 x 0.40
16	7 x 1.70	~ 49 x 0.65	~ 128 x 0.40
25	7 x 2.13	~ 84 x 0.62	~ 200 x 0.40
35	7 x 2.52	~ 133 x 0.58	~ 280 x 0.40
50	~ 19 x 1.83	~ 133 x 0.69	~ 400 x 0.40
70	~ 19 x 2.17	~ 189 x 0.69	~ 356 x 0.50
95	~ 19 x 2.52	~ 259 x 0.69	~ 485 x 0.50
120	~ 37 x 2.03	~ 336 x 0.67	~ 614 x 0.50
150	~ 37 x 2.27	~ 392 x 0.69	~ 765 x 0.50
185	~ 37 x 2.52	~ 494 x 0.69	~ 944 x 0.50
240	~ 37 x 2.87	~ 627 x 0.70	~ 1225 x 0.50
300	~ 61 x 2.50	~ 790 x 0.70	~ 1530 x 0.50
400	~ 61 x 2.89		~ 2035 x 0.50
500	~ 61 x 3.23		~ 1768 x 0.60
630	~ 91 x 2.97		~ 2286 x 0.60

Cross-section in mm²	Extra-fine wire conductor			
0.14	~ 18 x 0.10	~ 18 x 0.1	~ 36 x 0.07	~ 72 x 0.05
0.25	~ 32 x 0.10	~ 32 x 0.1	~ 65 x 0.07	~ 128 x 0.05
0.34	~ 42 x 0.10	~ 42 x 0.1	~ 88 x 0.07	~ 174 x 0.05
0.38	~ 19 x 0.16	~ 48 x 0.1	~ 100 x 0.07	~ 194 x 0.05
0.5	~ 28 x 0.15	~ 64 x 0.1	~ 131 x 0.07	~ 256 x 0.05
0.75	~ 42 x 0.15	~ 96 x 0.1	~ 195 x 0.07	~ 384 x 0.05
1.0	~ 56 x 0.15	~ 128 x 0.1	~ 260 x 0.07	~ 512 x 0.05
1.5	~ 84 x 0.15	~ 192 x 0.1	~ 392 x 0.07	~ 768 x 0.05
2.5	~ 140 x 0.15	~ 320 x 0.1	~ 651 x 0.07	~ 1280 x 0.05
4	~ 224 x 0.15	~ 512 x 0.1	~ 1040 x 0.07	
6	~ 192 x 0.20	~ 768 x 0.1	~ 1560 x 0.07	
10	~ 320 x 0.20	~ 1280 x 0.1	~ 2600 x 0.07	
16	~ 512 x 0.20	~ 2048 x 0.1		
25	~ 800 x 0.20	~ 3200 x 0.1		
35	~ 1120 x 0.20			
50	~ 705 x 0.30			
70	~ 990 x 0.30			
95	~ 1340 x 0.30			
120	~ 1690 x 0.30			
150	~ 2123 x 0.30			
185	~ 1470 x 0.40			
240	~ 1905 x 0.40			
300	~ 2385 x 0.40			
400				
500				
630				

Note on standards:

For single-wire conductors ...	(class 1), please see DIN EN 60228 (VDE 0295), table 1
For multi-wire conductors ...	(class 2), please see DIN EN 60228 (VDE 0295), table 2
For fine-wire conductors ...	(class 5), please see DIN EN 60228 (VDE 0295), table 3
For extra-fine wire conductors ...	(class 6), please see DIN EN 60228 (VDE 0295), table 4


single-wire


multi-/several-wire


fine-wire


extra-fine wire

Table 12-1: current rating

For cables with a nominal voltage of up to 1000 V and for heat-resistant cables at an ambient temperature of +30 °C. You can find general regulations and recommended values in DIN VDE 0298 part 2 and part 4. The values given in the table below are reference values and in a simplified form took out of the DIN VDE 0298 part 4, 2013-06, table 11 and 15, and based on DIN VDE 0891, 1990-05, part 1. For copyright reasons, only excerpts from DIN VDE 0298 part 4 can be mapped at this point.

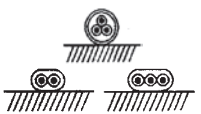
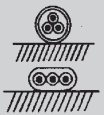
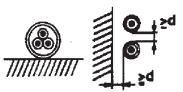
	Cable category		
	A **Single-core cables** • Rubber insulation • PVC insulation • TPE insulation • Heat-resistant	**B** **Multi-core cables for domestic/handheld equipment** • Rubber insulation • PVC insulation • TPE insulation	
Installation type			
Number of cores under load	**1**[3]	**2**	**3**
Nominal cross-section in mm²	**Current rating in A**	**Current rating in A**	
0.08[1]	1.5	-	-
0.14[1]	3	-	-
0.25[1]	5	-	-
0.34[1]	8	-	-
0.5	12[2]	3	3
0.75	15	6	6
1.0	19	10	10
1.5	24	16	16
2.5	32	25	20
4	42	32	25

Table 12-1: current rating

	Cable category		
	C **Multi-core cables excl. domestic/handheld equipment** • Rubber insulation • PVC insulation • TPE insulation • Heat-resistant	**D** **Multi-core rubber-sheathed cables** min. 0.6/1 kV **Single-core Special rubber core cables** 0.6/1 or 1.8/3 kV	
Installation type			
Number of cores under load	**2** or **3**	**3**	**1**[3]
Nominal cross-section in mm²	**Current rating in A**	**Current rating in A**	
0.08[1]	1	-	-
0.14[1]	2	-	-
0.25[1]	4	-	-
0.34[1]	6	-	-
0.5	9[2]	-	-
0.75	12	-	-
1.0	15	-	-
1.5	18	23	30
2.5	26	30	41
4	34	41	55

1) Current rating values for small conductor cross-sections taken from VDE 0891-1 (0.08 mm² – 0.34 mm²)
2) Extended range for 0.5 mm² in line with VDE 0298-4, 2003-08, table 11
3) When bundling single-core, touching or bundled cables, when installed on surfaces, in the open air or on cable conduits, please observe DIN VDE 0298-4, 2013-06, Table 10

Table 12-1: current rating

Important
The information portrayed in this table differs from that in DIN VDE 0298-4, 2013-06. As such, in the event of any uncertainty the current version of DIN VDE 0298-4 always applies.

Please observe all applicable conversion factors going beyond table 12-1 for
- Differing ambient temperature: table 12-2
- Several-core cables up to 10 mm² with more than 3 cores under load: table 12-3
- Heat-resistant cables for ambient temperatures exceeding 50 °C: table 12-4
- For wound cables: table 12-5
- Bundling of single-core or multi-core cables in pipes, ducts, walls or flooring: table 12-6
- Bundling of multi-core cables on troughs or conduits: table 12-7
- Bundling of single-core cables on troughs or conduits: table 12-8

Please also observe all applicable current ratings going beyond table 12-1 for
- Flexible cables with cross-linked Elastomer insulation for industrial applications: table 12-9
- Welding cable H01N2-D: table 12-10
- Operating current and power loss of copper conductors: table 12-11
- Current rating for cables in the USA: see NEC excerpt in table 13
- Cables for fixed installation in buildings: see DIN VDE 0298-3, 2013-06, table 3 and 4
- ESUY earthing cable: see DIN VDE 0105-1
- Cables in machinery: see DIN EN 60204-1/VDE 0113-1

Table 12-2: conversion factors

For ambient temperatures other than +30 °C. The values given in the table below are reference values and in a simplified form took out of the DIN VDE 0298 part 4, 2013-06, table 17. For copyright reasons, only excerpts from DIN VDE 0298 part 4 can be mapped at this point.

Permissible/recommended operating temperature at the conductor
(Details of the maximum value in °C can be found in the field "Technical data, temperature range for fixed or flexible installation" on the relevant products pages in the current main catalogue)

	60 °C	70 °C	80 °C	85 °C	90 °C
Ambient temperature in °C	Conversion factors to be applied to the current rating values in T12-1				
30	1.00	1.00	1.00	1.00	1.00
40	0.82	0.87	0.89	0.90	0.91
50	0.58	0.71	0.77	-	0.82
60	-	0.50	0.63	-	0.71
70	-	-	0.45	-	0.58
80	-	-	-	-	0.41

Table 12-3: conversion factors

For several-core cables with conductor cross-sections up to 10 mm². The values given in the table below are reference values and in a simplified form took out of the DIN VDE 0298 part 4, 2013-06, table 26. For copyright reasons, only excerpts from DIN VDE 0298 part 4 can be mapped at this point.

Number of cores under load	Conversion factor for installation in the open air	Conversion factor for installation underground
5	0.75	0.70
7	0.65	0.60
10	0.55	0.50
14	0.50	0.45
24	0.40	0.35

Table 12-4: conversion factors for heat-resistant cables

The values given in the table below are reference values and in a simplified form took out of the DIN VDE 0298 part 4, 2013-06, table 18. For copyright reasons, only excerpts from DIN VDE 0298 part 4 can be mapped at this point.

Permissible/recommended operating temperature at the conductor
(Details of the maximum value in °C can be found in the field "Technical data, temperature range for fixed or flexible installation" on the relevant products pages in the current main catalogue)

	90 °C	110 °C	135 °C	180 °C
Ambient temperature in °C	Conversion factors to be applied to the current rating values for heat-resistant cables in T 12-1, column A, C or D.			
up to 50	1.00	1.00	1.00	1.00
75	0.61	1.00	1.00	1.00
85	0.35	0.91	1.00	1.00
105	-	0.41	0.87	1.00
130	-	-	0.35	1.00
175	-	-	-	0.41

Table 12-5: conversion factors for wound cables

The values given in the table below are reference values and in a simplified form took out of the DIN VDE 0298 part 4, 2013-06, table 27.

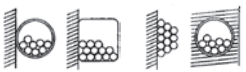
Number of layers on the coil, drum, reel	1	2	3	4	5
Conversion factor	0.80	0.61	0.49	0.42	0.38

A conversion factor of 0.8 applies to spiral winding (in one layer).

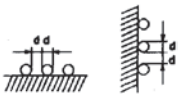
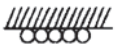
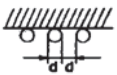
Table 12-6: conversion factors

For bundling on walls, in pipes and ducts, on flooring and under ceilings. The values given in the table below are reference values and in a simplified form took out of the DIN VDE 0298 part 4, 2013-06, table 21. For copyright reasons, only excerpts from DIN VDE 0298 part 4 can be mapped at this point.

Number of multi-core cables or number of AC or three-phase circuits formed by single-core cables
(2 or 3 live conductors)

Configuration for installation	1	2	3	4	6	10
	Conversion factors to be applied to the current rating values in table 12-1					
Bundled directly on the wall, on the floor, in pipes or ducts for electrical installations. 	1.00	0.80	0.70	0.65	0.57	0.48
In a single layer on the wall or floor, touching. 	1.00	0.85	0.79	0.75	0.72	0.70

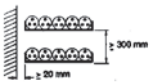
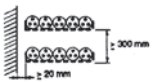
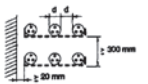
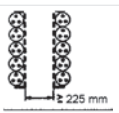
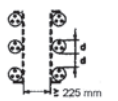
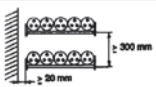
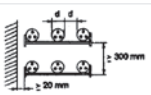
Number of multi-core cables or number of AC or three-phase circuits formed by single-core cables
(2 or 3 live conductors)

Configuration for installation	1	2	3	4	6	10
	Conversion factors to be applied to the current rating values in table 12-1					
In a single layer on the wall or floor, with a gap equal to outer diameter d. 	1.00	0.94	0.90	0.90	0.90	0.90
In a single layer under the ceiling, touching. 	0.95	0.81	0.72	0.68	0.64	0.61
In a single layer under the ceiling, with a gap equal to outer diameter d. 	0.95	0.85	0.85	0.85	0.85	0.85

○ = Symbol for single-core or multi-core cable

Important: The conversion factors must be applied in order to determine the current rating for cables of the same type and under the same load, when bundled in the same installation type. In the process, the nominal conductor cross-sections must not vary by more than one cross-section classification.

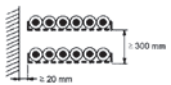
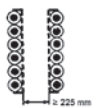
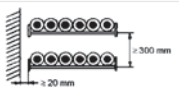
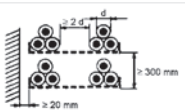
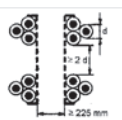
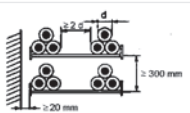
Table 12-7: conversion factors

Configuration for installation			Number of troughs or conduits	Number of multi-core cables					
				1	2	3	4	6	9
				Conversion factors					
Non-perforated cable troughs	touching		1	0.97	0.84	0.78	0.75	0.71	0.68
Perforated cable troughs	touching		1	1.00	0.88	0.82	0.79	0.76	0.73
	with gap		1	1.00	1.00	0.98	0.95	0.91	–
	touching		1	1.00	0.88	0.82	0.78	0.73	0.72
	with gap		1	1.00	0.91	0.89	0.88	0.87	–
Cable conduits	touching		1	1.00	0.87	0.82	0.80	0.79	0.78
	with gap		1	1.00	1.00	1.00	1.00	1.00	–

For bundling multi-core cables on troughs and conduits. The values given in the table below are reference values and in a simplified form took out of the DIN VDE 0298 part 4, 2013-06, table 22. For copyright reasons, only excerpts from DIN VDE 0298 part 4 can be mapped at this point.

Important: The factors stated in this table apply only to groups of cables installed in a single layer in configurations as specified above. However, they do not apply if the cables are touching and installed over one another, or if the actual gap dimensions between the cable troughs or cable conduits fall short of the specified gaps. If this is the case, reduce the conversion factors (e. g. as per table 12-6).

Table 12-8: conversion factors

Configuration for installation			Number of troughs or conduits	Number of 3-pin circuits formed by single-core cables			
				1	2	3	To be used as the multiplier for the measurement value of
				Conversion factors			
Perforated cable troughs	touching		1	0.98	0.91	0.87	Three cables arranged horizontally and level
Perforated cable troughs	touching		1	0.96	0.86	–	Three cables arranged vertically and level
Cable conduits	touching		1	1.00	0.97	0.96	Three cables arranged horizontally and level
Perforated cable troughs			1	1.00	0.98	0.96	Three cables arranged in a horizontal, triangular configuration
Perforated cable troughs			1	1.00	0.91	0.89	Three cables arranged in a vertical, triangular configuration
Cable conduits			1	1.00	1.00	1.00	Three cables arranged in a horizontal, triangular configuration

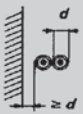
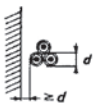
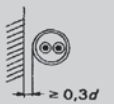
For bundling single-core cables on troughs and conduits. The values given in the table below are reference values and in a simplified form took out of the DIN VDE 0298 part 4, 2013-06, table 23. For copyright reasons, only excerpts from DIN VDE 0298 part 4 can be mapped at this point.

Important: The factors stated in this table apply only to groups of single-core cables installed in a single layer in configurations as specified above. However, they do not apply if the cables are touching and installed over one another, or if the actual gap dimensions between the cable troughs or cable conduits fall short of the specified gaps. If this is the case, reduce the conversion factors (e. g. as per table 12-6). If circuits are connected in parallel, each three-conductor bundle of the parallel connection is to be considered as one circuit.

Technical tables | Excerpt
T12: current ratings – reduction tables

Table 12-9: current rating of rubber-sheathed cables

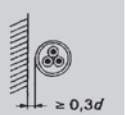
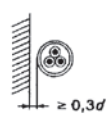
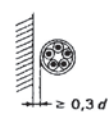
Permissible operating temperature at the conductor 60 °C/ Ambient temperature 30 °C

Installation type: in the open air			
Number of cores under load	**2**	**3**	**2**
Nominal cross-section of copper cond. in mm²	**Rating A**		
1	–	–	15
1.5	19	16.5	18.5
2.5	26	22	25
4	34	30	34
6	43	38	43
10	60	53	60
Conversion factors for:			
Differing ambient temperature	see table T 12-2		
Bundling	–	T 12-8	
Wound cables	–	–	
Several-core cables	–	–	–

Conversion factors for other ambient temperatures for heat-resistant cables with cross-linked Elastomer insulation. The values given in the table below are reference values and in a simplified form took out of the DIN VDE 0298 part 4, 2013-06, table 18.1.

Current rating of flexible cables with cross-linked Elastomer insulation for industrial applications (H07RN-F und A07RN-F). The values given in the table below are reference values and in a simplified form took out of the DIN VDE 0298 part 4, 2013-06, table 13. For copyright reasons, only excerpts from DIN VDE 0298 part 4 can be mapped at this point.

Permissible operating temperature at the conductor 60 °C/ Ambient temperature 30 °C

			
2	**3**	**3**	**3**
Rating A			
15.5	12.5	13	13.5
19.5	15.5	16	16.5
26	21	22	23
35	29	30	30
44	36	37	38
62	51	52	54
see table T 12-2			
	T 12-7		
	T 12-5		
–	T12-3	–	–

Permissible operating temperature 90 °C

Ambient temperature in °C	**conversion factors to be applied to the current rating values in 12-9**
up to 60	1.00
75	0.71
80	0.58
85	0.41

Table 12-10: operating conditions and ratings for welding cables

Permissible operating temperature at the conductor 85 °C/ Ambient temperature 30 °C	
Installation type: in the open air	
Number of cores under load	**1**
Mode of operation	**Continuous operation**
Run time	-
Switch-on duration (ED)	100%
Nominal cross-section of copper cond. in mm²	**Rating A**
10	96
16	130
25	173
35	216
50	274
Mode of operation	**Continuous operation**
Run time	-
Switch-on duration (ED)	100%
Nominal cross-section of copper cond. in mm²	**Rating A**
10	96
16	130
25	173
35	216
50	274
Conversion factors for differing ambient temperature	Tabelle T 12-2

H01N2-D and H01N2-E

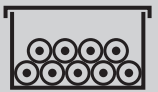
The values given in the table below are reference values and in a simplified form took out of the DIN VDE 0298 part 4, 2013-06, table 16. For copyright reasons, only excerpts from DIN VDE 0298 part 4 can be mapped at this point.

Permissible operating temperature at the conductor 85 °C/ Ambient temperature 30 °C					
					
1					
Intermittent operation					
5 minutes					
85%	80%	60%	35%	20%	8%
Rating A					
97	98	102	114	137	198
132	134	142	166	204	301
179	181	196	234	293	442
226	229	250	304	384	584
287	293	323	398	508	779
Intermittent operation					
10 minutes					
85%	80%	60%	35%	20%	8%
Rating A					
96	96	97	102	113	152
131	131	133	144	167	233
175	176	182	204	244	351
220	222	233	268	324	477
281	284	303	356	439	654
Tabelle T 12-2					

Table 12-11: operating current and power loss of copper conductors

The illustration is taken out of DIN EN 61439-1 (VDE 0660-600-1), 2012-06, Annex H. The following table provides reference values for operating currents and power losses of conductors inside an assembly of switchgears and controlgears under idealised conditions. The computational methods used to create the values are given in order to calculate values for other conditions.

Operating current and power loss of single copper conductors with a permissible conductor temperature of 70 °C
(ambient temperature inside of assemblies of switchgears and controlgears: 55 °C)

Configuration for installation		 Single-core cable, in a conduit, on walls, arranged horizontally. 6 cables (2 three-phase circuits) continously charged	
Conductor cross section	**Conductor resistance at 20 °C, R_{20} [a]**	**Max. operating current I_{max} [b]**	**Power loss per core P_v**
mm^2	mΩ/m	A	W/m

Operating current and power loss of single copper conductors with a permissible conductor temperature of 70 °C
(ambient temperature inside of assemblies of switchgears and controlgears: 55 °C)

 Single-core cable, touching, installed in the open air or on a perforated cable trough. 6 cables (2 three-phase circuits) continously charged		Gap of at least one cable diameter  Single-core cable, installed horizontally in the open air with a specified gap	
Max. operating current I_{max} [b]	**Power loss per core P_v**	**Max. operating current I_{max} [b]**	**Power loss per core P_v**
A	W/m	A	W/m

Table 13-1: current rating of cables in the USA

Excerpt from NEC table T310.15 (B)(16) page 336
Permissible current rating of insulated copper conductors with a nominal voltage of 0 to 2000 V, 60 °C to 90 °C (140 °F to 194 °F). No more than three current-carrying conductors in any one cable duct, pipe, hose or in one (multi-core) cable or installed underground (direct routing underground), based on an ambient temperature of 30 °C (86 °F).

Excerpt from NEC T310.15 (B)(17) page 337
Permissible current rating of single-core cables with copper conductor with a nominal voltage of 0 to 2000 V, installed in the open air, based on an ambient temperature of 30 °C.

(NEC edition 2011)

Excerpt from NEC T310.15 (B)(16) | **Excerpt from NEC T310.15 (B)(17)**

Conductor cross-section	Rating in A with a permissible continuous temperature at the conductor			Conductor cross-section	Rating in A with a permissible continuous temperature at the conductor		
AWG or kcmil (MCM)	60 °C (140 °F)	75 °C (167 °F)	90 °C (194 °F)	AWG or kcmil (MCM)	60 °C (140 °F)	75 °C (167 °F)	90 °C (194 °F)
18	–	–	14	18	–	–	18
16	–	–	18	16	–	–	24
14	20*	20*	25*	14	25*	30*	35*
12	25*	25*	30*	12	30*	35*	40*
10	30	35*	40*	10	40*	50*	55*
8	40	50	55	8	60	70	80
6	55	65	75	6	80	95	105
4	70	85	95	4	105	125	140
3	85	100	115	3	120	145	165
2	95	115	130	2	140	170	190
1	110	130	145	1	165	195	220
1/0	125	150	170	1/0	195	230	260
2/0	145	175	195	2/0	225	265	300
3/0	165	200	225	3/0	260	310	350
4/0	195	230	260	4/0	300	360	405
250	215	255	290	250	340	405	455
300	240	285	320	300	375	445	500
350	260	310	350	350	420	505	570
400	280	335	380	400	455	545	615
500	320	380	430	500	515	620	700
600	350	420	475	600	575	690	780

*__Important:__ Unless explicitly approved elsewhere in the NEC, the overload protection of the values marked with an * (including consideration of the correction values for a different ambient temperature and, if necessary, a different number of current-carrying conductors) must not exceed 15 amps for AWG 14 conductors, or 20 amps for AWG 12 and 30 amps for AWG 10.

Correction factors for ambient temperatures other than 30 °C

Ambient temperature in °C	60 °C	75 °C	90 °C
21 – 25	1.08	1.05	1.04
26 – 30	1.00	1.00	1.00
31 – 35	0.91	0.94	0.96
36 – 40	0.82	0.88	0.91
41 – 45	0.71	0.82	0.87
46 – 50	0.58	0.75	0.82
51 – 55	0.41	0.67	0.76
56 – 60	–	0.58	0.71
61 – 70	–	0.33	0.58
71 – 80	–	–	0.41

Correction factors for more than 3 current-carrying conductors in any one cable duct, pipe or in a multi-core cable

Ambient temperature in °C	Number of current-carrying conductors	Correction factor
21 – 25	4 to 6	0.80
26 – 30	7 to 9	0.70
31 – 35	10 to 20	0.50
36 – 40	21 to 30	0.45
41 – 45	31 to 40	0.40
46 – 50	41 and over	0.35
51 – 55		
56 – 60		
61 – 70		
71 – 80		

Note: The current rating of cables in industrial machinery and equipment can be found in section 12, NFPA 79 Edition 2012.

Applies only to the base materials. Deviations are possible depending on the use/design. Please refer to the relevant page in the current main catalogue.

Usage criteria Properties of cable insulation and sheathing	Material resistant to org. oils	Polyvinylchloride	Polyethylene
	Material		
Parameter			
Abbreviations	Special TPE	PVC	PE
Code as per VDE	–	Y	2Y
Operating temperature	-50 +120	-30 +70	-50 +70
Dielectric constant (10–3)	2.4	4.0	2.3
Volume resistivity (Ω x cm)	10^{15}	10^{12} – 10^{15}	10^{17}
Tensile strength in N/mm² (MPa)	5 – 20	10 – 25	15 – 30
Elongation at break in %	400 – 600	150 – 400	400 – 800
Water absorption (20 °C) in %	1 – 2	0.4	0.1
Weather resistance	very good	good	good
Fuel resistance	good	moderate	moderate
Oil resistance	Resistance to org. oil: very good	moderate	moderate
Flammability	flammable	self-extinguishing	flammable

Polyurethane	Polytetrafluoroethylene	Tetrafluoroethylene Hexafluoropropylene copolymer
Material		
PUR	PTFE	FEP
11Y	5Y	6Y
-50 +90	-190 +260	-100 +200
4.0 – 6.0	2.1	2.1
10^{12}	10^{18}	10^{18}
15 – 45	15 – 40	20 – 25
300 – 600	240 – 400	250 – 350
1.5	0.01	0.01
very good	very good	very good
good	very good	very good
good	very good	very good
self-extinguishing*	non-flammable	non-flammable

*only with additional flame retardant

Usage criteria Properties of cable insulation and sheathing	Material: Ethylene tetrafluoroethylene	Chloroprene rubber	Silicone rubber
Parameter			
Abbreviations	ETFE	CR	SI
Code as per VDE	7Y	5G	2G
Operating temperature	-100 +150	-40 +100	-60 +180
Dielectric constant (10–3)	2.6	6.0 – 8.0	2.8 – 3.2
Volume resistivity (Ω x cm)	10^{16}	10^{13}	10^{15}
Tensile strength in N/mm² (MPa)	40 – 50	10 – 25	5 – 10
Elongation at break in %	100 – 300	300 – 450	200 – 350
Water absorption (20 °C) in %	0.01	1	1.0
Weather resistance	very good	very good	very good
Fuel resistance	very good	moderate	low
Oil resistance	very good	good	moderate
Flammability	non-flammable	self-extinguishing	hardly flammable

Usage criteria Properties of cable insulation and sheathing	Material: Ethylene propylene dien rubber	Thermoplastic elastomer polyolefin based	Thermoplastic elastomer polyester based
Parameter			
Abbreviations	EPDM	TPE-O	TPE-E
Code as per VDE	3G	–	12Y
Operating temperature	-30 +120	-40 +120	-70 +125
Dielectric constant (10–3)	3.2	2.7 – 3.6	3.7 – 5.1
Volume resistivity (Ω x cm)	10^{14}	5 x 10^{14}	10^{12}
Tensile strength in N/mm² (MPa)	5 – 25	≥ 6	3 – 25
Elongation at break in %	200 – 450	≥ 400	280 – 650
Water absorption (20 °C) in %	0.02	1.5	0.3 – 0.6
Weather resistance	good	moderate	very good
Fuel resistance	moderate	moderate	good
Oil resistance	moderate	moderate	very good
Flammability	flammable	flammable	flammable

General dimensions*

The base units are as follows:
In the British gravitational system:
Length (ft) – force (lbf = Lb) – time (s)
In the British absolute system:
Length (ft) – mass (lb) – time (s)

1. Measures of length

1 mil	= 0.0254 mm
1 inch (in;")	= 25.4 mm
1 foot (ft;')	= 0.305 m
1 yard (yd)	= 0.914 m
1 chain (ch)	= 20.1 m
1 statue mile	= 1.61 km
1 nautical mile	= 1.835 km
1 statute mile	= 1760 yards

2. Measures of volume

1 cubic inch	= 16.39 cm^3
1 cubic foot	= 0.0283 m^3
1 cubic yard	= 0.765 mm^3
1 US liquid gallon	= 3.79 l
1 pint	= 0.473 l
1 quart	= 0.946 l
1 brit gallon	= 4.53 l
1 barrel	= 119.2 l

3. Measures of area

1 circ. mil (CM)	= 0.507 · 10^{-3} mm^2
1 kcmil (MCM)	= 0.5067 mm^2
1 square inch (sq. in.)	= 645.16 mm^2
1 square foot (sg.ft.)	= 0.0929 m^2
1 square yard	= 0.836 m^2
1 acre	= 0.00405 km^2
1 square mile	= 2.59 km^2
1 m^2	= 10.764 sq. ft.

4. Units of mass

British gravitational system:
1 slug = 1 lbs · s^2/ft
British absolute system:
1 pound = 1 lb
1 slug = 32.174 lb, with 32.174 ft/s^2
as the standard value of gravitational acceleration

1 grain	= 64.80 mg	
1 dram	= 1.770 g	
1 ounce (oz)	= 16 drams	= 28.35 g
1 pound (lb)	= 16 oz	= 453.59 g
1 stone	= 14 lbs	= 6.35 kg
1 US ton (short ton)	= 0.907 t	
1 Brit. ton (long ton)	= 1.016 t	

5. Units of force

British gravitational system:
pound-force 1 lbf = 1 Lb
British absolute system:
poundal 1 pdl = 1 lb · ft/s^2

1 lbf = 32.174 pdl – 9.80665 lb · m/s^2

6. Conversion to metric units

1 pound-force (lbf)	= 0.454 kp
1 Brit. ton-force	= 1016 kp
1 poundal (pdl)	= 0.1383 N
1 lbf	= 4.445 N

7. Electrical units per unit of length

1µf per mile	= 0.62 µF/km
1 megohm per mile	= 1.61 MΩ · km
1 megohm per 1000 ft	= 3.28 Ω · km
1 ohm per 1000 yd	= 1.0936 Ω/km

* Most of these units are no longer in use and are provided purely for information purposes.

8. Weights per unit of length

1 lb per foot	= 1.488 kg/m
1 lb per yard	= 0.469 kg/m
1 lb per mile	= 0.282 kg/m

9. Density

1 lb/ft^3	= 16.02 kg/m^3

10. Specific weight

1 lbf/ft^3	= 16.02 kp/m^3

11. Copper wire weight per mile

lb/mile	= Ø mm
5	= 0.404
6.5	= 0.51
7.5	= 0.55
10	= 0.64
20	= 0.90
40	= 1.27

12. Units of energy

1 horsepower	= 0.746 kW (H.P.)
1 Brit. therm. unit	= 0.252 kcal

Insulation wall thickness is often expressed in n/64 inches with n/64 inch equalling approx. 0.4 mm.

13. Further dimensions for wire weights and electrical field strengths:

lbf pr. MFeet	= 1.488 kg/km
lbf pr. Mile	= 0.282 kg/km
40 V/mil	= 1.6 kV/mm
80 V/mil	= 3.2 kV/mm
100 V/mil	= 4.0 kV/mm
250 V/mil	= 10.0 kV/mm

Table 17-1: example using “copper”

Copper prices

Cables, wires and piece goods are sold at daily copper prices (DEL). DEL is the stock exchange listing for German electrolytic copper for conducting purposes, i. e. 99.5 % pure copper. The DEL is expressed in euros per 100 kg and can usually be found in the business section of daily newspapers under “Commodity markets”.

For example: DEL 576.93 means: 100 kg copper (Cu) costs EUR 576.93. Currently a 1 % procurement surcharge is added to the daily quotation for cables, wires and piece goods. Further information, particularly concerning the DEL quote, can be obtained from the ZVEI professional association for cables and insulated wires: www.zvei.org

Copper price basis

A proportion of the copper price is already included in the list price for many cables and almost all wires and piece goods. This is also expressed in euros per 100 kg.

- EUR 150.00 / 100 kg for most flexible cables (e. g. ÖLFLEX® CLASSIC 100) and piece goods (e. g. ÖLFLEX® SPIRAL 540 P)
- EUR 100.00 / 100 kg for telephone cables (e. g. J -Y(St)Y)
- EUR 0.00 / 100 kg for underground cables (e. g. power cable NYY), i. e. hollow price.

Exact details can be found on each page of our current main catalogue beneath the article table.

Copper index
The copper index is the calculated copper weight of a cable, wire (kg/km) or piece good (kg/1000 pc) and is specified for each catalogue item.

Example I:
Calculating the copper surcharge for goods sold by the metre:
Cable ÖLFLEX® CLASSIC 100, 3G1.5 mm²
Copper index as per catalogue 43 kg/km
The calculated copper weight of the cable is 43 kg per 1 km.

$$\text{Copper index (kg/km)} \times \frac{\text{(DEL + 1\% procurement costs) – copper price basis}}{1000} = \text{Copper surcharge in Euro/100 m}$$

ÖLFLEX® CLASSIC 110, 3G1.5 mm².
DEL: EUR 576.93/100 kg. Cu basis EUR 150.00/100 kg.
Cu index: 43 kg/km

$$43\ \text{kg/km} \times \frac{(576{,}93 + 5{,}77) - 150{,}00}{1000} = 18{,}61\ \text{Euro/100 m}$$

Assuming a DEL quotation of EUR 576.93/100 kg, this figure represents the copper surcharge for 100 m ÖLFLEX® CLASSIC 110 3G1.5 mm².

Example II:
Calculating the copper surcharge for piece goods:
ÖLFLEX®SPIRAL 540P 3G1.5 mm² (item no.: 73220150).
Copper index as per catalogue: 605.5 kg/1000 pc.
Copper price basis as per catalogue: EUR 150.00/100 kg
The calculated copper weight (copper index) of the piece good spiral cable is 605.5 kg/1000 pc.
Formula for calculating the copper surcharge for piece goods:

$$\text{Copper index (kg/1000 pc)} \times \frac{\text{(DEL + 1\% procurement costs) – copper price basis}}{1000} = \text{Copper surcharge in Euro/100 pc}$$

$$605{,}5\ \text{kg (kg/1000 Stk)} \times \frac{(576{,}93 + 5{,}77) - 150{,}00}{1000} = 261{,}78\ \text{Euro/100 Stk}$$

Price including copper:
The net price is calculated as follows:

Gross price – % discount + copper surcharge = net price including copper.

The copper surcharge is shown separately on the invoice.

Other metals
This same method is also used for other metals, e.g. “aluminium”. In this case, replace “copper” with “aluminium”. General term: “metal”.

Table 17-2: background information on cables

For the majority of our product range, the construction of conductors for cables and insulated wires is governed by the international standard DIN EN 60228 (VDE 0295)/ IEC 60228. Normative threshold values are defined for the nominal cross sections and the conductor materials copper/ aluminium/aluminium alloy listed in the standard. The application of these threshold values varies for the different conductor classes, however, they all exhibit a maximum conductor resistance at 20 °C.

Conductor resistance at 20 °C is an important normative compliance value. Other geometric requirements in DIN EN 60228 et seqq. and in product standards that reference DIN EN 60228 et seqq., serve to ensure the compatibility of conductors and connectors and do not contain any requirements concerning the weight of the conductor materials used in the wire or cable.

For example, the density of copper used in the manufacture of cables and wires is specified as 8.89 g/cm^3 in accordance with DIN EN 13602. Therefore, a single-core cable with a nominal cross section of 1 mm^2 has a copper content of 8.89 kg/km. This simple formula for calculating the copper content provides an indication. However, the actual value may be lower than this, as it is the maximum conductor resistance at 20 °C that is important. The extent of the (+/-) deviation from this calculation value depends on the production process employed by individual manufacturers and the semifinished conductors they use.

When it comes to invoicing, e. g. for copper surcharges, the copper index is used. You may also see the term “calculated copper weight” being used instead of “copper index”. This typical industry value* is 9.6 kg/km** – based on the nominal cross section of 1 mm^2 – and factors in the necessary increased use of material/copper.

This increase generalises individual (manufacturer-dependent) additional expenditure during the manufacturing process. In particular, this includes irreversible losses resulting from lead-in lengths and abrasion on the drawing dies as well as from the widening (wearing) of the dies during wire production. It also includes additional expenditure due to twisting of the conductors and the resulting enlargement of the stretched length. There are also surcharges to ensure the conductor resistance at unavoidable manufacturing tolerances – e. g. cross section reduction due to the tensile load during extrusion and twisting. It should also be mentioned that the copper index calculated in this manner is the only way to enable standardisation across manufacturers – particularly in the case of unshielded cables – and therefore serves as the basis for price comparisons, particularly when calculating copper surcharges.

The aim of this customer information is to explain the technical and commercial background for determining and using the copper index and to demonstrate the benefits and efficiency of its use for manufacturers, traders and customers alike.

*U.I. Lapp GmbH is a member of the professional association for cables and insulated wires of ZVEI

**The corresponding figure to be used for aluminium is 2.9 kg/km

Trademark approvals

Thanks to their outstanding characteristics, many of our products have been tested and approved by the following approval associations. You will find the certification marks on the individual product pages in our current main catalogue, if applicable.

VERBAND DER ELEKTROTECHNIK, ELEKTRONIK UND INFORMATIONSTECHNIK
Germany

SCHWEIZERISCHER ELEKTROTECHNISCHER VEREIN
Switzerland

UNDERWRITERS LABORATORIES INC.
USA

CANADIAN STANDARDS ASSOCIATION
Canada

GERMANISCHER LLOYD
Germany

LLOYD'S REGISTER OF SHIPPING
United Kingdom

DET NORSKE VERITAS
Norway

GOST R STANDARD
Russia

TÜV RHEINLAND GROUP
Germany

VERBAND DER TÜV e.V.
Germany

Laying guidelines for cables and wires

Cables must be selected in accordance with the laying and operating conditions. They must be protected against mechanical, thermal and chemical effects as well against moisture penetrating through the cable ends.

Insulated power cables must not be laid underground. Temporary covering of NSSHÖU rubber-sheathed cables or trailing cables with soil, sand or a similar material, e. g. on building sites, does not constitute underground installation.

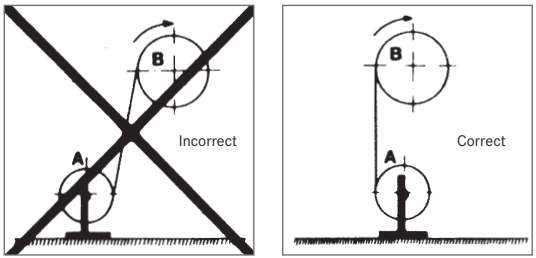
Fasteners and fixtures must not cause any damage to fixed wires and cables. Where cables or wires running horizontally along walls or ceilings are fixed using clips, the following guidelines regarding clip spacing must be observed:

For non-reinforced cables and wires, 20 x outside diameter.

These spacing guidelines also apply when laying cables in conduits and racks. When laying cables vertically, the spacing between clips can be increased depending on the type of cable or clip.

When connecting flexible cables (e. g. ÖLFLEX® cables, UNITRONIC® cables) to portable power consumers, there must be no strain or thrust at the insertion points and the cables must be secured against twisting and kinking. Outer cable sheaths must not be damaged at the insertion points or by the strain relief devices. Standardversion flexible PVC cables are not designed for outdoor use.

Flexible rubber-sheathed cables (e. g. ÖLFLEX® CRANE cables) are only suitable for permanent outdoor use if their outer sheath is made of a compound, generally based on polychloroprene (NEOPRENE®). Special cables must be deployed for permanent underwater use.



Winding and unwinding cables

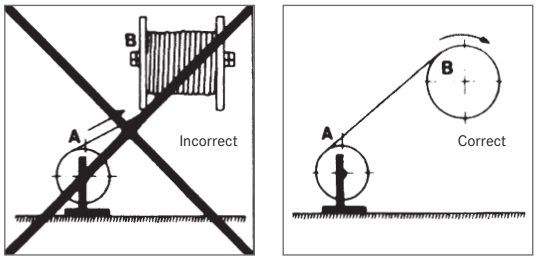
Thermal stress

The temperature limits for the respective cable designs can be found in the technical data. The upper temperature limits must not be exceeded as a result of the cable heating up due to current heat and thermal environmental factors. The lower temperature limits denote the lowest permitted ambient temperature.

Tensile strain

Tensile strain on the conductor should be as low as possible. The following tensile strains for conductors must not be exceeded for cables.

- When laying and operating copper cables for portable equipment:
  15 N per mm^2 conductor cross-section; this does not include screening, concentric conductors and divided protective conductors. In the case of cables that are subjected to dynamic stresses, e. g. in crane systems with high acceleration or power chains subject to frequent movement, appropriate measures must be taken, e. g. enlargement of the bending radius in individual cases. A shorter service life may be expected.



- Cables for static installation. When laying permanent cables, 50 N per mm^2 conductor cross-section.
- For fibre optic cables, BUS, LAN, industrial and Ethernet cables, the respective permitted strain must be observed. These values can be found in the product data sheets or are available on request.

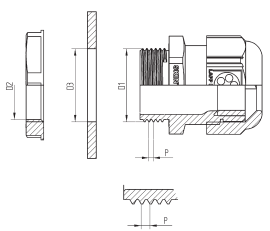
For more information on this subject, see tables T3, T4 and T5.

Neoprene® is a registered trademark of DuPont de Nemour.

Thread and hole dimensions – technical data for installation

Metric thread to EN 60423
(for screw connections to DIN EN 62 444)

Nominal size	Ø D1	P	Ø D2	Hole Ø D3
M12 x 1.5	12	1.5	10.6	12.3 – 0.2
M16 x 1.5	16	1.5	14.6	16.3 – 0.2
M20 x 1.5	20	1.5	18.6	20.3 – 0.2
M25 x 1.5	25	1.5	23.6	25.3 – 0.2
M32 x 1.5	32	1.5	30.6	32.3 – 0.2
M40 x 1.5	40	1.5	38.6	40.4 – 0.3
M50 x 1.5	50	1.5	48.6	50.4 – 0.3
M63 x 1.5	63	1.5	61.6	63.4 – 0.3
M75 x 1.5	75	1.5	73.6	75.4 – 0.3
M90 x 2	90	2	88.8	90.4 – 0.3
M110 x 2	110	2	108.8	110.4 – 0.3



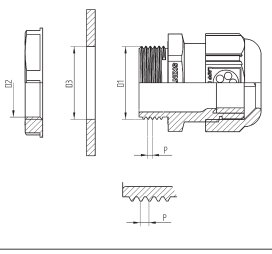
D1 = External Ø
D2 = Core Ø internal thread
D3 = Hole Ø
P = Pitch

Metric thread to DIN 13 part 6 and 7
(for screw connections to DIN 89 280)

Nominal size	Ø D1	P	Ø D2	Hole Ø D3
M18 x 1.5	18	1.5	16.4	18.3 – 0.2
M24 x 1.5	24	1.5	22.4	24.3 – 0.2
M30 x 2	30	2	27.8	30.3 – 0.2
M36 x 2	36	2	33.8	36.3 – 0.2
M45 x 2	45	2	42.8	45.4 – 0.3
M56 x 2	56	2	53.8	56.4 – 0.3
M72 x 2	72	2	69.8	72.5 – 0.4
M80 x 2	80	2	77.8	80.5 – 0.4
M105 x 2	105	2	102.8	105.5 – 0.4

PG thread to DIN 40430

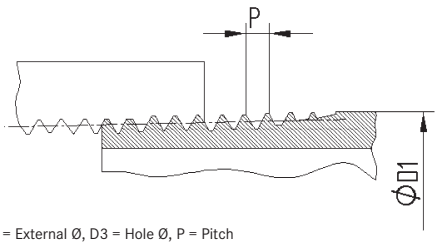
Nominal size	Ø D1	P	Ø D2	Hole Ø D3
PG 7	12.5	1.27	11.3	12.8 ± 0.2
PG 9	15.2	1.41	13.9	15.5 ± 0.2
PG 11	18.6	1.41	17.3	18.9 ± 0.2
PG 13.5	20.4	1.41	19.1	20.7 ± 0.2
PG 16	22.5	1.41	21.2	22.8 ± 0.2
PG 21	28.3	1.588	26.8	28.6 ± 0.2
PG 29	37.0	1.588	35.5	37.4 ± 0.3
PG 36	47.0	1.588	45.5	47.4 ± 0.3
PG 42	54.0	1.588	52.5	54.4 ± 0.3
PG 48	59.3	1.588	57.8	59.7 ± 0.3



D1 = External Ø
D2 = Core Ø internal thread
D3 = Hole Ø
P = Pitch

NPT thread to ANSI B1.20.2 – 1983

Nominal size	Ø D1	P	Hole Ø D3
NPT 1/4"	13.7	1.41	14.1 – 0.2
NPT 3/8"	17.1	1.41	17.4 – 0.2
NPT 1/2"	21.3	1.81	21.6 – 0.2
NPT 3/4"	26.7	1.81	27.0 – 0.2
NPT 1"	33.4	2.21	33.7 – 0.2
NPT 1 1/4"	42.2	2.21	42.5 – 0.2
NPT 1 1/2"	48.3	2.21	48.7 – 0.2
NPT 2"	60.3	2.21	60.7 – 0.2



D1 = External Ø, D3 = Hole Ø, P = Pitch

Definition of protection ratings to EN 60529 (DIN 0470) and DIN 40050

The protection ratings are indicated by a code that is always made up of the same two identification letters IP and the code numbers for the degree of protection, e. g. IP 54.

Degrees of protection against solid foreign bodies

First code number	Short description	Definition
0	Not protected	
1	Protected against solid foreign bodies 50 mm diameter and above	The object probe, sphere of 50mm diameter, shall not fully penetrate.
2	Protected against solid foreign bodies 12.5 mm diameter and above	The object probe, sphere of 12.5 mm diameter, shall not fully penetrate.
3	Protected against solid foreign bodies 2.5 mm diameter and above	The object probe, sphere of 2.5 mm diameter, shall not penetrate at all.
4	Protected against solid foreign bodies 1.0 mm diameter and above	The object probe, sphere of 1.0 mm diameter, shall not penetrate at all.
5	Protected against dust	Intrusion of dust is not completely prevented but dust shall not penetrate in a quantity that would interfere with the satisfactory operation of the device or impair safety.
6	Dust-tight	No penetration of dust.

For example:
Identification letters **IP 65**

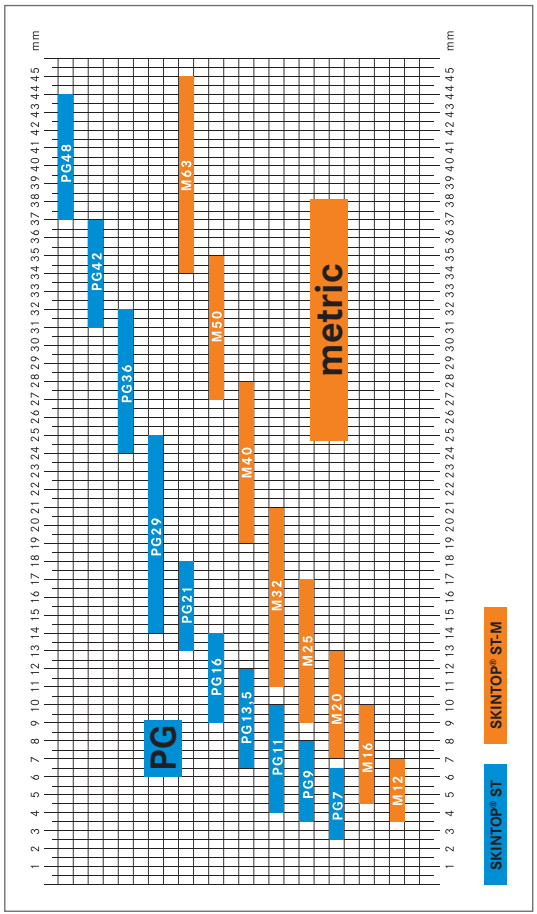
Second code number:
Protection against liquids.

First code number:
Protection against contact with and penetration of foreign bodies.

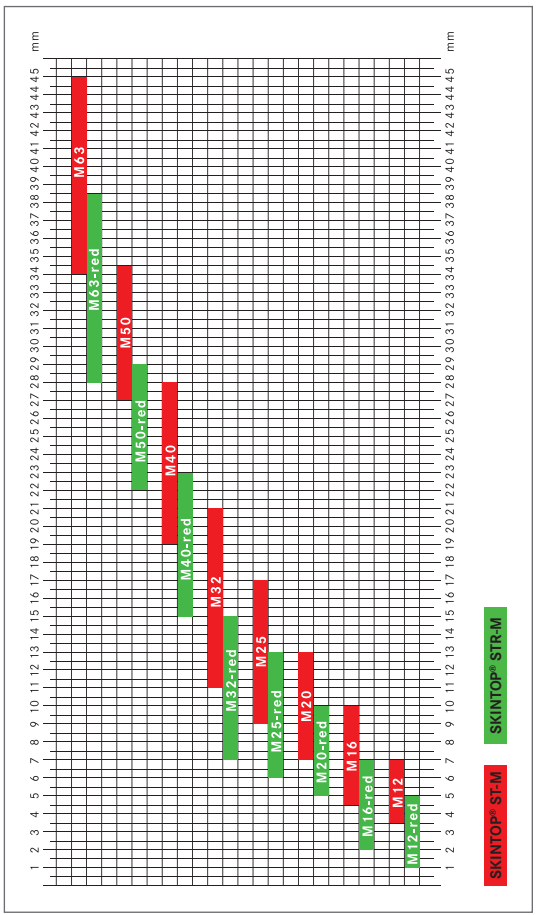
Degrees of protection against water

Second code number	Short description	Definition
0	Not protected	
1	Protected against drops of water	Vertically falling drops shall have no harmful effects.
2	Protected against drops of water if the housing is tilted by up to 15°.	Vertically falling drops shall have no harmful effects if the housing is tilted by up to 15° on either side of the vertical.
3	Protected against spraying water	Water sprayed at an angle of up to 60° on either side of the vertical shall have no harmful effects.
4	Protected against splashing water	Water splashed against the housing from any direction shall have no harmful effects.
5	Protected against jets of water	Water projected in jets against the housing from any direction shall have no harmful effects.
6	Protected against powerful jets of water	Water projected in powerful jets against the housing from any direction shall have no harmful effects.
7	Protected against the effects of temporary immersion in water	Water must not penetrate in quantities causing harmful effects when the housing is temporarily immersed in water under standardised pressure and time conditions.
8	Protected against the effects of permanent immersion in water	Water must not penetrate in quantities causing harmful effects when the housing is continually immersed in water under conditions that must be agreed upon between the manufacturer and the user. However, the conditions must be more difficult than for number 7.
9K	High-pressure/ steam-jet cleaning	Water projected against the housing from any direction under very high pressure shall have no harmful effects.

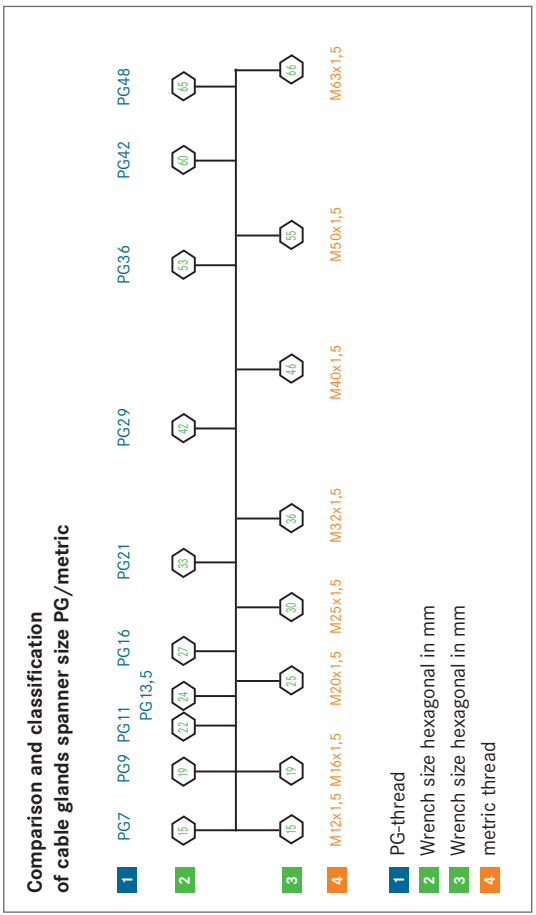
Table of clamping ranges PG/metric



Clamping ranges SKINTOP® metric



SKINTOP® ST/SKINTOP® ST-M



Reagent	Concentration	at +°C	Polyamide PA 6	Polyamide PA 6.6
Exhaust gases containing carbon dioxide	all	60		
Exhaust gases, containing SO2	low	60		
Acetaldehyde	40 %	20	✖	✖
Acetone	100 %	20	⛒	⛒
Acrylic acid	100 %	> 30	✖	✖
Alums, aqueous	diluted	40		
Allyl alcohol	96 %	20	✖	✖
Aluminium chloride, aqueous	diluted	40		
Aluminium sulphate, aqueous	diluted	40		
Formic acid, aqueous	10 %	20	✖	✖
Ammonia, aqueous	saturated	20	20 % ⛒	20 % ⛒
Ammonium chloride, aqueous	saturated	60		
Ammonium nitrate, aqueous	diluted	40		
Ammonium sulphate, aqueous	diluted	40		
Aniline, pure	100 %	20	✖	✖
Aniline hydrochloride, aqueous	saturated			
Benzaldehyde, aqueous	saturated	20	pure ✖	pure ✖
Benzine	100 %	20	⛒	⛒
Benzoic acid, aqueous	all	40	20 % ✖	20 % ✖
Benzole	100 %	20	⛒	⛒
Bleaching liquor	12.5 Cl	20	✖	✖
Drilling oil	all	20	✖	✖
Chrome alum, aqueous	diluted	40		
Cyclohexanol	–	20	⛒	⛒
Diesel fuel		85	⛒	⛒
Ferric chloride, aqueous, neutral	10 %	20	⛒	⛒

Reagent	Polyamide PA 12	Thermoplastic polyurethane PU	Polypropylene PP	Polyethylene HD-PE	Polyethylene LD-PE	Polystyrene PS	Nitrile butadiene rubber NBR
Exhaust gases containing carbon dioxide				⛒	⛒		
Exhaust gases, containing SO2				⛒	⛒		
Acetaldehyde	⛒		⛒				20 °C ⛒
Acetone	⛒	✖	⛒	✖	✖		✖
Acrylic acid	✖						✖
Alums, aqueous			⛒	⛒	⛒	⛒	20 °C ⛒
Allyl alcohol	⛒	⛒	⛒	⛒	20 % ⛒		
Aluminium chloride, aqueous			⛒	⛒	⛒	⛒	20 °C ⛒
Aluminium sulphate, aqueous			⛒	⛒	⛒	⛒	20 °C ⛒
Formic acid, aqueous	⛒		⛒	⛒		⛒	
Ammonia, aqueous	20 % ⛒		⛒	⛒	⛒	25 % ⛒	
Ammonium chloride, aqueous		3 % ✖	⛒	⛒	⛒		20 °C ⛒
Ammonium nitrate, aqueous			⛒	⛒	⛒	⛒	20 °C ⛒
Ammonium sulphate, aqueous			⛒	⛒	⛒		✖
Aniline, pure	✖		⛒	⛒	⛒	✖	
Aniline hydrochloride, aqueous			⛒	✖	✖		
Benzaldehyde, aqueous	pure ✖		⛒			✖	✖
Benzine	⛒		✖	⛒	✖	✖	⛒
Benzoic acid, aqueous			⛒	⛒	⛒	⛒	✖
Benzole	⛒		✖	✖	✖	✖	✖
Bleaching liquor	✖	3 % ✖	⛒	⛒	⛒	⛒	✖
Drilling oil	✖		✖	✖	✖	✖	✖
Chrome alum, aqueous			⛒	⛒	⛒		20 °C ⛒
Cyclohexanol	⛒		⛒	⛒	⛒	⛒	⛒
Diesel fuel	⛒	20 °C ⛒	20 °C ⛒	20 °C ⛒	20 °C ⛒		
Ferric chloride, aqueous, neutral	⛒		⛒	⛒	⛒	⛒	⛒

Reagent	Concentration	at +°C	Polyamide PA 6	Polyamide PA 6.6
Glacial acetic acid	100 %	20		
Acetic acid	10 %	20	✖	✖
Ethyl alcohol, aqueous	10 %	20	40 vol % ⛒	40 vol % ⛒
Ethylene chloride	100 %	20		
Ethylene oxide	100 %	20		
Ethyl ether	100 %	20		
Potassium ferrocyanide, aqueous	saturated	60		
Fluorine	50 %	40	pure ✖	pure ✖
Formaldehyde, aqueous	diluted	40	pure ⛒	pure ⛒
Glucose, aqueous	all	50		
Urea, aqueous	to 10 %	40	20 % ⛒	20 % ⛒
Flame-retardant hydraulic fluid		80	⛒	⛒
Hydraulic oils H and HL (DIN 51524)		100	⛒	⛒
Hydroxylamine sulphate, aqueous	to 12 %	30		
Caustic potash, aqueous	50 %	20	⛒	⛒
Potassium bromide, aqueous	all	20	10 % ⛒	10 % ⛒
Potassium chloride, aqueous	10 %	20	⛒	⛒
Potassium dichromate, aqueous	40 %	20	5 % ✖	5 % ✖
Potassium nitrate, aqueous	all	20	10 % ⛒	10 % ⛒
Potassium permanganate, aqueous	saturated	20		
Hydrosilicofluoric acid, aqueous	to 30%	20	✖	✖

⛒ Highly resistant
✖ Limited resistance
✖ Not resistant

Reagent	Polyamide PA 12	Thermoplastic polyurethane PU	Polypropylene PP	Polyethylene HD-PE	Polyethylene LD-PE	Polystyrene PS	Nitrile butadiene rubber NBR
Glacial acetic acid			⛒	⛒	⛒		✖
Acetic acid	⛒	3 % ✖	⛒	⛒	⛒	✖	
Ethyl alcohol, aqueous	40 vol % ⛒			⛒		⛒	
Ethylene chloride			✖	✖	✖		✖
Ethylene oxide			✖				
Ethyl ether			✖				✖
Potassium ferrocyanide, aqueous			⛒	⛒	⛒		
Fluorine	pure ✖	✖	✖	✖			
Formaldehyde, aqueous	pure ✖		40 % ⛒	40 % ⛒	40 % ⛒	30 % ⛒	20 °C ✖
Glucose, aqueous			⛒	⛒	⛒		
Urea, aqueous	20 % ⛒		⛒	⛒	⛒	⛒	
Flame-retardant hydraulic fluid	⛒						
Hydraulic oils H and HL (DIN 51524)	⛒						
Hydroxylamine sulphate, aqueous			⛒				
Caustic potash, aqueous	⛒		⛒	⛒	⛒	⛒	
Potassium bromide, aqueous	10 % ⛒		⛒	⛒	⛒	⛒	
Potassium chloride, aqueous	⛒		⛒	⛒	⛒	⛒	⛒
Potassium dichromate, aqueous	5 % ✖		⛒	⛒	⛒		⛒
Potassium nitrate, aqueous	10 % ⛒		⛒	⛒	⛒	⛒	⛒
Potassium permanganate, aqueous			⛒			⛒	
Hydrosilicofluoric acid, aqueous			⛒	⛒	⛒		

The information is given to the best of our knowledge and experience, however, it must be regarded as being for guidance purposes only. In many cases, a final judgement can only be made by performing tests under actual working conditions.

Reagent	Concentration	at +°C %	Polyamide PA 6	Polyamide PA 6.6
Carbon dioxide, dry	100 %	60		
Carbonic acid	100 %	60	⛒	⛒
Cresylic acid, aqueous	to 90 %	20	pure ✖	pure ✖
Coolant DIN 53521		120	✖	✖
Copper chloride, aqueous	saturated	20		
Copper sulphate, aqueous	saturated	60		
Magnesium carbonate, aqueous	saturated	100		
Magnesium chloride, aqueous	saturated	20	10 % ⛒	10 % ⛒
Methyl alcohol	100 %	20	⛒	⛒
Methylene chloride	100 %	20	✖	✖
Lactic acid, aqueous	to 90 %	20	10 % ⛒	10 % ⛒
Mineral oil			⛒	⛒
Sodium chlorate, aqueous	saturated	20	10 % ✖	10 % ✖
Sodium hydroxide, aqueous	10 %	20	⛒	⛒
Nickel chloride, aqueous	saturated	20	10 % ✖	10 % ✖
Nickel sulphate, aqueous	saturated	20	10 % ✖	10 % ✖
Nitroglycerin	diluted	20		
Oil and grease		20	⛒	⛒
Oleic acid	–	20	⛒	⛒
Oxalic acid	all	20	10 % ✖	10 % ✖
Ozone	pure		✖	✖
Petroleum	100 %	80	⛒	⛒
Phosgene, gaseous	100 %	20		
Phosphoric acid, aqueous	diluted	20	10 % ✖	10 % ✖
Phosphorus pentoxide	100 %	20		
Mercury	pure	20	⛒	⛒

Reagent	Polyamide PA 12	Thermoplastic polyurethane PU	Polypropylene PP	Polyethylene HD-PE	Polyethylene LD-PE	Polystyrene PS	Nitrile butadiene rubber NBR
Carbon dioxide, dry			⛒	⛒	⛒	50 °C ⛒	20 °C ⛒
Carbonic acid	⛒						20 °C ⛒
Cresylic acid, aqueous			⛒	⛒	✖	✖	✖
Coolant DIN 53521							
Copper chloride, aqueous			⛒	⛒	⛒		⛒
Copper sulphate, aqueous			⛒	⛒	⛒		20 °C ⛒
Magnesium carbonate, aqueous			⛒			50 °C ⛒	
Magnesium chloride, aqueous	10 % ⛒		⛒	⛒	⛒	⛒	⛒
Methyl alcohol	⛒		40 °C ⛒	⛒	⛒	⛒	⛒
Methylene chloride	✖		✖	✖	✖		
Lactic acid, aqueous	10 % ⛒	3 % ✖	⛒	⛒	⛒	80 % ⛒	⛒
Mineral oil	⛒		20 °C ⛒	20 °C ⛒	20 °C ⛒		
Sodium chlorate, aqueous	10 % ✖		⛒	⛒	⛒		
Sodium hydroxide, aqueous	⛒	3 % ✖	⛒	⛒	⛒	⛒	
Nickel chloride, aqueous	10 % ✖		⛒			⛒	⛒
Nickel sulphate, aqueous	10 % ✖		⛒	⛒	⛒		⛒
Nitroglycerin				✖	✖		
Oil and grease	⛒		✖				
Oleic acid	⛒		⛒	⛒	⛒	⛒	✖
Oxalic acid	10 % ✖	3 % ✖	⛒	⛒	⛒	⛒	✖
Ozone	✖		✖	✖	✖		
Petroleum	⛒		20 °C ⛒	20 °C ⛒	20 °C ✖	✖	
Phosgene, gaseous			✖	✖	✖		
Phosphoric acid, aqueous	10 % ✖	3 % ✖	⛒	⛒	⛒	86 % ⛒	✖
Phosphorus pentoxide			⛒				
Mercury	⛒		⛒	⛒	⛒	⛒	⛒

Reagent	Concentration	at +°C	Polyamide PA 6	Polyamide PA 6.6
Nitric acid, aqueous	50 %	20	✖	✖
Hydrochloric acid, aqueous	30 %	20	20 % ✖	20 % ✖
Lubricating grease, ester oil base		110	✖	✖
Polyphenyl ester base		110	⛒	⛒
Lubricating grease, silicone oil base		110	⛒	⛒
Carbon disulphide	100 %	20	⛒	⛒
Sodium sulfide, aqueous	diluted	40		
Sulphuric acid, aqueous	10 %	20	✖	✖
Sea water		40	⛒	⛒
Soap solution, aqueous	all	20	diluted ⛒	diluted ⛒
Carbon tetrachloride	100 %	20	⛒	⛒
Toluene	100 %	20	⛒	⛒
Trichloroethylene	100 %	20	✖	✖
Vinyl acetate	100 %	20		
Hydrogen	100 %	60	20 °C ⛒	20 °C ⛒
Xylene	100 %	20	⛒	⛒
Zinc chloride, aqueous	diluted	60	10 % ✖	10 % ✖
Zinc sulphate, aqueous	diluted	60		
Zinc chloride, aqueous	diluted	40		
Citric acid	to 10 %	40	20 °C ⛒	20 °C ⛒

⛒ Highly resistant
✖ Limited resistance
✖ Not resistant

Polyamide PA 12	Thermoplastic polyurethane PU	Polypropylene PP	Polyethylene HD-PE	Polyethylene LD-PE	Polystyrene PS	Nitrile butadiene rubber NBR
✖	3 % ✖	✖	✖	✖	30 % ⛒	✖
20 % ✖	3 % ✖	⛒	⛒	⛒	15 % ⛒	✖
⛒						
⛒						
⛒		⛒	✖	✖	✖	✖
		⛒	⛒	⛒		
✖	3 % ✖	50 % ⛒	50 % ⛒	50 % ⛒	⛒	✖
⛒	20 °C ⛒	⛒	⛒	⛒	⛒	20 °C ⛒
diluted ⛒	⛒	⛒	⛒		⛒	
⛒		✖	✖	✖	✖	
⛒	✖		✖	✖	✖	✖
✖		✖	✖	✖		
		⛒				
20 °C ⛒		⛒	⛒	⛒		20 °C ⛒
⛒		✖	✖	✖	✖	✖
		⛒	⛒	⛒	50 °C ⛒	20 °C ⛒
		⛒	⛒	⛒		20 °C ⛒
		⛒	⛒	⛒	✖	20 °C ⛒
20 °C ⛒	3 % ✖	⛒	⛒	⛒	⛒	20 °C ⛒

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Certificate type				
Product	**Page***	**Gost R**	**Fire protection**	**EAC R**
ÖLFLEX® CLASSIC 100	24	✔	✔	
ÖLFLEX® CLASSIC 100 Yellow	26	✔	✔	
ÖLFLEX® CLASSIC 100 CY	27	✔	✔	
ÖLFLEX® CLASSIC 100 SY	28	✔	✔	
ÖLFLEX® CLASSIC 100 BK 0,6/1 kV	29	✔	✔	
ÖLFLEX® SMART 108	30	✔	✔	
ÖLFLEX® CLASSIC 110	31	✔	✔	
ÖLFLEX® CLASSIC 110 COLD	34	✔	✔	
ÖLFLEX® CLASSIC 110 Orange	35	✔	✔	
ÖLFLEX® CLASSIC 110 CY	36	✔	✔	
ÖLFLEX® CLASSIC 110 SY	37	✔	✔	
ÖLFLEX® CLASSIC 110 Black	38	✔	✔	
ÖLFLEX® CLASSIC 110 CY Black	39	✔	✔	
ÖLFLEX® CLASSIC 115 CY	40	✔	✔	
ÖLFLEX® EB	42	✔	✔	
ÖLFLEX® EB CY	43	✔	✔	
ÖLFLEX® 140	44	✔	✔	
ÖLFLEX® 140 CY	45	✔	✔	
ÖLFLEX® 150	46	✔	✔	
ÖLFLEX® 150 CY	47	✔	✔	
ÖLFLEX® 191	48	✔	✔	
ÖLFLEX® 191 CY	49	✔	✔	
ÖLFLEX® CONTROL TM	50	✔	✔	
ÖLFLEX® CONTROL TM CY	51	✔	✔	
ÖLFLEX® Tray II	52	✔	✔	
ÖLFLEX® Tray II CY	53	✔	✔	
ÖLFLEX® SF	54	✔	✔	
ÖLFLEX® CLASSIC 100 H	55	✔	✔	
ÖLFLEX® CLASSIC 110 H	56	✔	✔	
ÖLFLEX® CLASSIC 110 CH	57	✔	✔	

Certificate type				
Product	**Page***	**Gost R**	**Fire protection**	**EAC R**
ÖLFLEX® 120 H	58	✔	✔	
ÖLFLEX® 120 CH	59	✔	✔	
ÖLFLEX® CLASSIC 130 H	60	✔	✔	
ÖLFLEX® CLASSIC 135 CH	61	✔	✔	
ÖLFLEX® CLASSIC 130 H BK 0,6/1 kV	63	✔	✔	
ÖLFLEX® CLASSIC 135 CH BK 0,6/1 kV	64	✔	✔	
ÖLFLEX® PETRO C HFFR	65	✔	✔	
ÖLFLEX® ROBUST 200	66	✔		
ÖLFLEX® ROBUST 210	67	✔		
ÖLFLEX® ROBUST 215 C	68	✔		
ÖLFLEX® CLASSIC 400 P	69	✔		
ÖLFLEX® CLASSIC 400 CP	70	✔		
ÖLFLEX® CLASSIC 415 CP	71	✔		
ÖLFLEX® 440 P	72	✔	✔	
ÖLFLEX® 440 CP	73	✔	✔	
ÖLFLEX® 491 P	74	✔	✔	
ÖLFLEX® 450 P	75	✔	✔	
ÖLFLEX® 500 P	76	✔	✔	
ÖLFLEX® 540 P	77	✔	✔	
ÖLFLEX® 540 CP	78	✔	✔	
ÖLFLEX® 550 P	79	✔	✔	
H05RR-F	80	✔		
H05RN-F	81	✔	✔	
H07RN-F	82	✔	✔	
H07ZZ-F	85	✔	✔	
H01N2-D	86	✔	✔	
NSSHÖU	87	✔	✔	
NSGAFÖU 1,8/3kV	88	✔	✔	
NSHXAFÖ 1,8/3kV	89	✔	✔	
H07RN8-F	90	✔	✔	

Certificate type				
Product	**Page***	**Gost R**	**Fire protection**	**EAC R**
ÖLFLEX® SERVO 700	91	✔	✔	
ÖLFLEX® SERVO 700 CY	92	✔	✔	
ÖLFLEX® SERVO 720 CY	93	✔	✔	
ÖLFLEX® SERVO 2YSLCY-JB	94	✔	✔	
ÖLFLEX® SERVO 2YSLCYK-JB	94	✔	✔	
ÖLFLEX® SERVO 709 CY	95	✔	✔	
ÖLFLEX® SERVO 9YSLCY-JB	96	✔	✔	
ÖLFLEX® SERVO 9YSLCY-JB BK	96	✔	✔	
SERVO LK SMS 6FX 5 (SIEMENS® Standard)	97	✔	✔	
SERVO LK SEWX STATIC (SEW® Standard)	98	✔	✔	
ÖLFLEX® SERVO FD 781 CY	99	✔	✔	
ÖLFLEX® SERVO FD 796 CP	101	✔	✔	
SERVO LK SMS 6FX 8PLUS (SIEMENS® Standard)	103	✔	✔	
SERVO LK INX (INDRAMAT® Standard)	104	✔	✔	
SERVO LK LZM (LENZE® Standard)	105	✔	✔	
SERVO LK LZM-FD (LENZE® Standard)	106	✔	✔	
SERVO LK LZR (LENZE® Standard)	106	✔	✔	
SERVO LK LZR-FD (LENZE® Standard)	106	✔	✔	
SERVO LK LZE (LENZE® Standard)	106	✔	✔	
SERVO LK LZE-FD (LENZE® Standard)	106	✔	✔	
SERVO LK HDH (HEIDENHAIN® Standard)	106	✔	✔	
SERVO LK ELX (ELAU® Standard)	106	✔	✔	
SERVO LK KEB (KEB® Standard)	106	✔	✔	
SERVO LK BLX (BERGER LAHR Standard)	106	✔	✔	
SERVO LK BRX (B&R Standard)	106	✔	✔	
SERVO LK FNC (FANUC® Standard)	106	✔	✔	
ÖLFLEX® FD CLASSIC 810	118	✔	✔	
ÖLFLEX® FD CLASSIC 810 CP	119	✔	✔	

Certificate type				
Product	**Page***	**Gost R**	**Fire protection**	**EAC R**
ÖLFLEX® CHAIN 808 P	116	✔		
ÖLFLEX® CHAIN 808 CP	117	✔		
ÖLFLEX® FD CLASSIC 810 P	118	✔	✔	
ÖLFLEX® FD CLASSIC 810 CP	119	✔	✔	
ÖLFLEX® FD 855 P	120	✔	✔	
ÖLFLEX® FD 855 CP	121	✔	✔	
ÖLFLEX® PETRO FD 865 CP	122	✔	✔	
ÖLFLEX® FD ROBUST	123	✔		
ÖLFLEX® FD ROBUST C	124	✔		
ÖLFLEX® FD 90	111	✔	✔	
ÖLFLEX® FD 90 CY	109	✔	✔	
ÖLFLEX® CHAIN 809	112	✔	✔	
ÖLFLEX® CHAIN 809 CY	113	✔	✔	
ÖLFLEX® FD 891	114	✔	✔	
ÖLFLEX® FD 891 CY	115	✔	✔	
ÖLFLEX® FD 891 P	114	✔	✔	
ÖLFLEX® ROBOT 900 P	127	✔	✔	
ÖLFLEX® ROBOT 900 DP	128	✔	✔	
ÖLFLEX® ROBOT F1 + ROBOT F1 C	129	✔	✔	
LIFY	131	✔	✔	
X00V3-D	134	✔	✔	
ESUY	133	✔	✔	
ÖLFLEX® SOLAR XLR-R	138	✔	✔	
ÖLFLEX® SOLAR XLS-R	139	✔	✔	
ÖLFLEX® SOLAR XLSv	140	✔	✔	
ÖLFLEX® SOLAR XLS-R T	142	✔	✔	
ÖLFLEX® SOLAR V4A	143	✔	✔	
ÖLFLEX® TORSION	144	✔	✔	
ÖLFLEX® TORSION FRNC	145	✔	✔	
ÖLFLEX® TORSION D FRNC	145	✔	✔	

Certificate type				
Product	Page*	Gost R	Fire protection	EAC R
ÖLFLEX® CRANE NSHTÖU	152	✔	✔	
ÖLFLEX® CRANE VS (N)SHTÖU	153	✔	✔	
ÖLFLEX® CRANE PUR	154	✔	✔	
ÖLFLEX® CRANE	155	✔	✔	
ÖLFLEX® CRANE 2S	156	✔	✔	
ÖLFLEX® LIFT	157	✔	✔	
ÖLFLEX® LIFT T	158	✔	✔	
ÖLFLEX® LIFT S	159	✔	✔	
ÖLFLEX® CRANE CF	161	✔	✔	
ÖLFLEX® LIFT F	162	✔	✔	
ÖLFLEX® HEAT 105 MC	163	✔	✔	
ÖLFLEX® HEAT 145 MC	164	✔	✔	
ÖLFLEX® HEAT 145 C MC	165	✔	✔	
ÖLFLEX® HEAT 180 SiHF	166	✔	✔	
ÖLFLEX® HEAT 180 H05SS-F EWKF	167	✔	✔	
ÖLFLEX® HEAT 180 MS	168	✔	✔	
ÖLFLEX® HEAT 180 C MS	169	✔	✔	
ÖLFLEX® HEAT 180 EWKF	170	✔	✔	
ÖLFLEX® HEAT 180 EWKF C	171	✔	✔	
ÖLFLEX® HEAT 180 GLS	172	✔	✔	
ÖLFLEX® HEAT 205 MC	173		✔	
ÖLFLEX® HEAT 205 PTFE/FEP	173	✔	✔	
ÖLFLEX® HEAT 260 MC	174	✔	✔	
ÖLFLEX® HEAT 260 C MC	175	✔	✔	
ÖLFLEX® HEAT 260 GLS	176	✔	✔	
ÖLFLEX® HEAT 350 MC	177	✔	✔	
ÖLFLEX® HEAT 1565 MC	178	✔	✔	
ÖLFLEX® HEAT 180 SiF	180	✔	✔	
ÖLFLEX® HEAT 180 SiD	181	✔	✔	
ÖLFLEX® HEAT 180 SiF/GL	182	✔	✔	

Certificate type				
Product	Page*	Gost R	Fire protection	EAC R
ÖLFLEX® HEAT 180 SiZ	182	✔	✔	
ÖLFLEX® HEAT 180 FZLSi	182	✔	✔	
ÖLFLEX® HEAT 205 SC	183	✔	✔	
ÖLFLEX® HEAT 260 SC	184	✔	✔	
ÖLFLEX® HEAT 350 SC	185	✔	✔	
ÖLFLEX® HEAT 1565 SC	186	✔	✔	
LiY	187	✔	✔	
ÖLFLEX® CRANE F	160	✔	✔	
H05V-K	191	✔	✔	
X05V-K	189	✔	✔	
H07V-K	192	✔	✔	
X07V-K	194	✔	✔	
S07V-K	194	✔	✔	
Multi-Standard SC 1	197	✔	✔	
Multi-Standard SC 2.1	198	✔	✔	
Multi-Standard SC 2.2	201	✔	✔	
H05Z-K (90°)	203	✔	✔	
H07Z-K (90°)	204	✔	✔	
LiYCY	206	✔	✔	
Li2YCY	206	✔	✔	
ÖLFLEX® STATIC CY BLACK	207	✔	✔	
NYM-J	209	✔	✔	
NHXMH	210	✔	✔	
NYY-J	211	✔	✔	
NYY-O	211	✔	✔	
NYCY	213	✔	✔	
NYCWY	214	✔	✔	
SERVO KON. LK 6FX5002 (SIEMENS® Standard)	216	✔	✔	
SERVO KON. LK 6FX8002 (SIEMENS® Standard)	217	✔	✔	

Certificate type				
Product	**Page***	**Gost R**	**Fire protection**	**EAC R**
SERVO KON. LK IKG (INDRAMAT® Standard)	218	✔	✔	
SERVO KON. RKL (INDRAMAT® Standard)	218	✔	✔	
SERVO KON. LK IKS (INDRAMAT® Standard)	219	✔	✔	
SERVO KON. RKG (INDRAMAT® Standard)	219	✔	✔	
SERVO KON. EYL (LENZE® Standard)	220	✔	✔	
SERVO KON. EYP (LENZE® Standard)	220	✔	✔	
SERVO KON. EYF (LENZE® Standard)	220	✔	✔	
SERVO KON. LK-EWLM (LENZE® Standard)	220	✔	✔	
SERVO KON. LK-EWLR (LENZE® Standard)	220	✔	✔	
SERVO KON. LK-EWLL (LENZE® Standard)	220	✔	✔	
SERVO KON. LK-EWLE (LENZE® Standard)	220	✔	✔	
ÖLFLEX® SPIRAL 400 P	222	✔		
SPIRAL H07BQ-F BLACK	224	✔	✔	
ÖLFLEX® SPIRAL 540 P	225	✔	✔	
UNITRONIC® SPIRAL	227		✔	
ÖLFLEX® PLUG H05VV-F	229		✔	
ÖLFLEX® PLUG 540 P	230		✔	
ÖLFLEX® PLUG CEE	233		✔	
SIM. S7-300 (SIMATIC®)	233	✔	✔	
SIM. S7-400 (SIMATIC®)	233	✔	✔	
UNITRONIC® 100	244		✔	
UNITRONIC® 100 CY	244		✔	
UNITRONIC® LiYY	246		✔	
UNITRONIC® LiYCY	248		✔	
UNITRONIC® LiYY (TP)	250		✔	
UNITRONIC® LiYCY (TP)	251		✔	
UNITRONIC® EB CY (TP)	252		✔	

Certificate type				
Product	**Page***	**Gost R**	**Fire protection**	**EAC R**
UNITRONIC® LiYCY- CY	253		✔	
UNITRONIC® LIFYCY (TP)	254		✔	
UNITRONIC® CY PiDY (TP)	255		✔	
UNITRONIC® ST	256		✔	
UNITRONIC® PUR CP	258		✔	
UNITRONIC® PUR CP (TP)	259		✔	
UNITRONIC® LiYD11Y	257		✔	
UNITRONIC® LiHH	263		✔	
UNITRONIC® LiHCH	264		✔	
UNITRONIC® LiHCH (TP)	265		✔	
UNITRONIC® LiYY A	266		✔	
UNITRONIC® LiYCY A	267		✔	
UNITRONIC® LiYCY (TP) A	268		✔	
UNITRONIC® 300	269		✔	
UNITRONIC® 300 CY	269		✔	
UNITRONIC® FD	270		✔	
UNITRONIC® FD CY	271		✔	
UNITRONIC® FD P plus	272		✔	
UNITRONIC® FD CP plus	273		✔	
UNITRONIC® FD CP (TP) plus	274		✔	
UNITRONIC® Li2YCY (TP)	260		✔	
UNITRONIC® Li2YCYv (TP)	260		✔	
UNITRONIC® Li2YCY PiMF	262		✔	
RE-2Y(ST)Yv	276		✔	
RE-2Y(ST)Yv PiMF	277		✔	
RD-Y(ST)Y	278		✔	
JE-Y(ST)Y...BD	279		✔	
JE-LiYCY...BD	280		✔	
J-Y(ST)Y...LG	281		✔	
J-H(ST)H...BD	284		✔	

Certificate type				
Product	Page*	Gost R	Fire protection	EAC R
J-2Y(ST)Y...ST III BD	285		✔	
UNITRONIC® BUS ASI (PVC) A	286		✔	
UNITRONIC® BUS ASI FD	287		✔	
UNITRONIC® BUS ASI FD (TPE) A	287		✔	
UNITRONIC® BUS ASI FD P FRNC	287		✔	
UNITRONIC® BUS PB	288		✔	
UNITRONIC® BUS PB A	292		✔	
UNITRONIC® BUS PB 7-W A	294		✔	
UNITRONIC® BUS PB H 7-W	294		✔	
UNITRONIC® BUS PB FC	293		✔	
UNITRONIC® BUS PB 7-W FC	294		✔	
UNITRONIC® BUS PB-H FC	290		✔	
UNITRONIC® BUS PB P FC	297		✔	
UNITRONIC® BUS PB TORSION	300		✔	
UNITRONIC® BUS PB 105	290		✔	
UNITRONIC® BUS PB ROBUST	289		✔	
UNITRONIC® BUS PB FRNC FC	291		✔	
UNITRONIC® BUS PB ARM	292		✔	
UNITRONIC® BUS PB Yv	292		✔	
UNITRONIC® BUS PB YY	293		✔	
UNITRONIC® BUS PB Y 7-W FC BK	294		✔	
UNITRONIC® BUS PB FD P	295		✔	
UNITRONIC® BUS PB FD P A	296		✔	
UNITRONIC® BUS PB FD P FC	297		✔	
UNITRONIC® BUS PB FD FRNC FC	298		✔	
UNITRONIC® BUS PB FD P COMBI	299		✔	
UNITRONIC® BUS PB FD P HYBRID	299		✔	
UNITRONIC® BUS PB FD Y HYBRID	300		✔	
UNITRONIC® BUS PB FESTOON	301		✔	
UNITRONIC® BUS LD	310		✔	

Certificate type				
Product	Page*	Gost R	Fire protection	EAC R
UNITRONIC® BUS LD FD P	311		✔	
UNITRONIC® BUS LD FD P A	311		✔	
UNITRONIC® BUS PA	312		✔	
UNITRONIC® BUS PA FC	312		✔	
UNITRONIC® BUS PA (BK)	312		✔	
UNITRONIC® BUS PA FC (BK)	312		✔	
UNITRONIC® BUS DN THICK FRNC	313		✔	
UNITRONIC® BUS DN THIN FRNC	313		✔	
UNITRONIC® BUS DN THICK Y	313		✔	
UNITRONIC® BUS DN THIN Y	313		✔	
UNITRONIC® BUS DN THICK FD P	314		✔	
UNITRONIC® BUS DN THIN FD P	314		✔	
UNITRONIC® BUS DN THICK FD Y	314		✔	
UNITRONIC® BUS DN THIN FD Y	314		✔	
UNITRONIC® BUS CAN	315		✔	
UNITRONIC® BUS CAN FD P	315		✔	
UNITRONIC® BUS FF 2	320		✔	
UNITRONIC® BUS FF 3	320		✔	
UNITRONIC® BUS FF 3 ARM	320		✔	
UNITRONIC® BUS CC	321		✔	
UNITRONIC® BUS CC FD P FRNC	321		✔	
UNITRONIC® BUS SAFETY	322		✔	
UNITRONIC® BUS SAFETY FC	322		✔	
UNITRONIC® BUS SAFETY FD P	322		✔	
UNITRONIC® BUS IBS	323		✔	
UNITRONIC® BUS IBS P COMBI	324		✔	
UNITRONIC® BUS IBS A	323		✔	
UNITRONIC® BUS IBS Yv	325		✔	
UNITRONIC® BUS IBS Yv COMBI	325		✔	
UNITRONIC® BUS IBS FD P	324		✔	

Certificate type				
Product	**Page***	**Gost R**	**Fire protection**	**EAC R**
UNITRONIC® BUS IBS FD P COMBI	324		✔	
UNITRONIC® BUS IBS FD P COMBI A	324		✔	
UNITRONIC® BUS EIB	326		✔	
UNITRONIC® BUS EIB COMBI	326		✔	
UNITRONIC® BUS EIB-H	326		✔	
UNITRONIC® SENSOR	361		✔	
UNITRONIC® SENSOR FD	361		✔	
Coaxial RG	385		✔	
ETHERLINE® H Cat.5e	390		✔	
ETHERLINE® P Cat.5e	390		✔	
ETHERLINE® H Flex Cat.5e	391		✔	
ETHERLINE® P Flex Cat.5e	391		✔	
ETHERLINE® H-H Cat.5e			✔	
ETHERLINE® Cat.5 FRNC HYBRID	394		✔	
ETHERLINE® FD P FC Cat.5			✔	
ETHERLINE® PN Cat.5e Y	397		✔	
ETHERLINE® PN Cat.5e YY	397		✔	
ETHERLINE® Y FC Cat.5			✔	
ETHERLINE® PN Cat.5 Y FLEX FC	398		✔	
ETHERLINE® Y Cat.5e BK	400		✔	
ETHERLINE® TORSION Cat.5	401		✔	
ETHERLINE® Cat.6_A P	405		✔	
ETHERLINE® Cat.7 P	405		✔	
ETHERLINE® FD P Cat.6	407		✔	
ETHERLINE® Cat.6_A H	405		✔	
ETHERLINE® Cat.7 H	405		✔	
ETHERLINE® Cat.6_A Y	405		✔	
ETHERLINE® Cat.7 Y	405		✔	
UNITRONIC® LAN 200 U/UTP Cat.5e	426		✔	
UNITRONIC® LAN 200 F/UTP Cat.5e	426		✔	

Certificate type				
Product	**Page***	**Gost R**	**Fire protection**	**EAC R**
UNITRONIC® LAN 200 SF/UTP Cat.5e	426		✔	
UNITRONIC® LAN 200 U/ UTP Cat.5e LSZH	426		✔	
UNITRONIC® LAN 200 SF/ UTP Cat.5e LSZH	426		✔	
UNITRONIC® LAN 250 U/ UTP Cat.6	427		✔	
UNITRONIC® LAN 250 U/ UTP Cat.6 LSZH	427		✔	
UNITRONIC® LAN 250 F/ UTP Cat.6 LSZH	427		✔	
UNITRONIC® LAN 500 S/ FTP Cat.6_A	428		✔	
UNITRONIC® LAN 500 U/ FTP Cat.6_A LSZH	428		✔	
UNITRONIC® LAN 500 F/ FTP Cat.6_A LSZH	428		✔	
UNITRONIC® LAN 1000 S/ FTP Cat.7 LSZH	429		✔	
UNITRONIC® LAN 1000 S/ FTP Cat.7 DUPLEX	429		✔	
UNITRONIC® LAN 1200 S/ FTP Cat.7_A LSZH	430		✔	
UNITRONIC® LAN 1500 S/ FTP Cat.7_A LSZH	431		✔	
UNITRONIC® LAN 200 F/ UTP Cat.5e FLEX	426		✔	
UNITRONIC® LAN 200 SF/ UTP Cat.5e FLEX	426		✔	
UNITRONIC® LAN 600 S/ FTP Cat.7 Y FLEX			✔	
UNITRONIC® LAN 200 F/ UTP Cat.5e LSZH FLEX	426		✔	
UNITRONIC® LAN 200 SF/ UTP Cat.5e LSZH FLEX	426		✔	

* Refer page to the main catalogue 2014/15.

The table displays the state of available certifications at the time of catalogue printing. Please contact us regarding the current certification status of our products.

Our products – contained substances and legislation

The use of hazardous substances in products is subject to ever stricter international laws and restrictions. Applies at the time of catalogue production (07.2013): The products in the catalogue meet the following legal requirements (among others):

- REACH – Regulation No 1907/2006/EC
- RoHS – Directive 2011/65/EU, respectively 2002/95/EC
- Regulation No 1005/2009/EC on substances that deplete the ozone layer

REACH

Regulation No 1907/2006/EC represents the EU's standard system concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH). The purpose of the regulation is to ensure a high level of protection for human health and the environment.

REACH came into force on 1 June 2007 and replaced a number of former specifications relating to the material composition of products, as previously governed, for example, by directive 76/769/EEC, which included restrictions on the marketing and use of certain dangerous substances. Lapp Group sells products within the meaning of REACH. The following requirements of the REACH regulation are therefore particularly significant:

1. Information requirement for the manufacturers and importers of products containing a material on the "candidate list" at a concentration in excess of 0.1 % of the mass of the product.
2. Observance of substances requiring authorisation in accordance with REACH Annex XIV.
3. Observance of the manufacturing, marketing and use restrictions specified in REACH Annex XVII.

The Lapp Group has attributed great importance to the subject of safety and the environment from a very early stage. Our aim is to implement the REACH regulation by keeping our products free from substances of very high concern (SVHC) or to replace such substances with non-hazardous materials.

We therefore keep a very close eye on the Candidate List, in which the European Chemicals Agency lists these dangerous substances, continuously evaluate our products and implement any necessary measures. We observe all registration requirements for materials in accordance with REACH Annex XIV as well as the manufacturing, marketing and use restrictions specified in REACH Annex XVII.

To meet the periodic updates of the Candidate List of Substances of Very High Concern (SVHC), we offer the latest information on REACH on www.lappgroup.com/rohs-reach. Please contact our competent REACH experts regarding specific substances.

RoHS

Directive 2011/65/EU represents the updated version of the EU's directive on the restriction of the use of hazardous substances in electrical and electronic equipment and supersedes the previous directive 2002/95/EC. Directive 2011/65/EC was published on 1 July 2011, different transitional periods apply for the amendments introduced by the directive. This directive results in national laws (e. g. the German ElektroStoffV).

In addition to the extended scope of the directive, which now also comprises "other" electrical and electronic equipment (EEE), one significant new feature is the obligation to assure compliance with the requirements of the RoHS directive by means of a conformity assessment procedure.
Lapp certifies the "RoHS-conformity" of EEE covered by the directive with a product-specific EC declaration of conformity and the application of the CE mark.

Irrespective of the scope of the RoHS directive, all products in this catalogue meet the substance-specific requirements of the RoHS. The exceptions detailed in the RoHS directive notwithstanding, our products do not contain any of the restricted substances specified in the RoHS directive or exceed the maximum concentrations stipulated therein.

WEEE directive 2012/19/EU

The WEEE directive governs the disposal and recycling of electrical and electronic goods. A list of products from our range falling under the category of electrical and electronic tools and equipment is provided below, along with the relevant registration numbers:

Article number	Registration number
61801245	DE 39896667
83259601, 83259602, 83259598	DE 42488170
61813817	DE 38694244

The article/registration numbers are subject to change as a result of any modifications to the scope of the WEEE directive after printing of this catalogue.

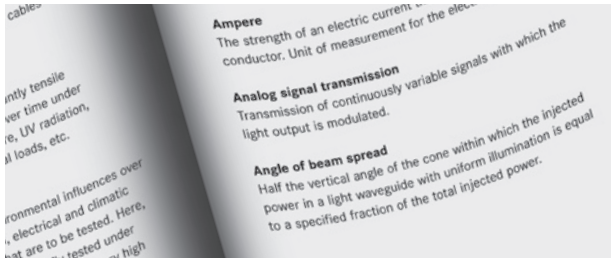
Directive 2006/66/EC on batteries and accumulators as well as waste batteries and accumulators

This directive and the resulting national laws (e. g. the German batteries Act – BattG) stipulate obligations for the registration and return of batteries.

The products listed in this catalogue do not constitute or contain batteries, nor are any batteries provided with these products.Therefore, the articles in this catalogue do not fall within the scope of this directive or its associated national laws.

Exception: EPIC® M23 Tool, article 11148001 EPIC® CIRCON CRIMPTOOL DIGITAL is supplied with a standard 3V lithium battery (button cell CR2025) which can be recycled at the designated collection points for waste batteries.

Glossary



- Specialist lexicon
- Key words

Absorption
Cause for attenuation of a fibre optic cable.

ACR
Abbreviation for Attenuation to Crosstalk Ratio. The ACR value indicates the relationship between the near-end crosstalk and the attenuation at a certain frequency.

Address bus
System of associated cables, to which address bits can be transferred.

Adhesion
Adhesive, cohesive and density property of the outer sheath of a cable. “Low adhesion” property important e. g. for drag chain use in order to avoid the cables from sticking to each other.

Aging
The change in the properties (predominantly tensile strength and expansion) of a material over time under specific conditions such as temperature, UV radiation, ozone influence, chemical and thermal loads, etc.

Aging resistance
As cables are often subject to environmental influences over decades (life cycle), i. e. chemical, electrical and climatic exposure, it is these properties that are to be tested. Here, all the materials found in cables are briefly tested under extreme conditions. All materials should have a very high aging resistance.

Alternating current
The alternating current is produced by linking three alternating currents with identical oscillation values and frequencies. Also known as multi-phase alternating current.

Aluminium sheath
The aluminium sheath is lighter than the lead sheath, has better conductivity and greater resistance, however must include a plastic sheath to protect against corrosion.

American wire gauge
Cables or cores according to American cross-sections/ dimensions. High AWG number → small cross-section, low AWG number → large cross-section (see Table T16).

Ampacity
Maximum permitted current that can be transmitted under defined conditions. VDE0298, Part 4.

Ampere
The strength of an electric current that flows through a conductor. Unit of measurement for the electric current (A).

Analog signal transmission
Transmission of continuously variable signals with which the light output is modulated.

Angle of beam spread
Half the vertical angle of the cone within which the injected power in a light waveguide with uniform illumination is equal to a specified fraction of the total injected power.

ANSI
Abbreviation for the American National Standards Institute. An American committee which, similar to the German DIN, develops and publishes standards.

Antenna cable
Antenna cables are coaxial high-frequency cables for receiver connections, domestic distribution grids and single antenna installations. They are mainly used in receiving and distribution stations for sound and television broadcasting. They must guarantee a low-reflection signal transmission.

Anti-kink cable glands
Mechanism that is part of a cable gland and provides additional protection if a flexible cable is frequently subjected to bending (e. g. SKINDICHT® SR-SV-M at Lapp).

Antioxidant, Oxidation inhibitor
As antioxidants may colour rubber compounds, they are generally only ever used for dark compounds. They prevent the compounds from becoming brittle too early.

Approved cables
Approved control and data network cables with certification, standards such as VDE, UL/CSA.

Armouring
Also known as reinforcement. Armouring is a mechanical protection for cables. It is produced in a variety of ways and using a wide range of materials, depending on the expected loads on the cable. It can be made of steel wire braiding, circular or flat steel wires, strip iron or combinations of these materials.

Armouring types
Commonly used are the flat steel wire, steel band, profile steel wire and round steel wire armouring with outer protective cover. There are also steel wire armourings with an anti-twist tape (steel band), however without an outer protective cover (for interior spaces).

Armouring, armour
A special electromechanical or mechanical protection against external stresses, for the improvement of the reduction factor and for the absorption of tensile forces. Plastic fibres are used instead of metallic armouring for fibre optic cables.

AS
Abbreviation for Australian Standard

ASI (Actor-Sensor-Interface)
Bus system for the lowest level of automation. Facilitates the simple connection of sensors, actuators and integrated systems to the first control level. See → Master-Slave principle. Up to 248 binary inputs and outputs per grid, one cable for information and energy, reversepolarity protected connection technology, 100 m cable length or up to 300 m with repeaters, open tree structure of grid, protection class up to IP 67, cycle time <5 ms, high immunity to interference and fault tolerance.

ASME
Abbreviation for the American Society of Mechanical Engineers (USA).

Assembly
A ready-to-install cable. It is cut to the appropriate length and fitted with connecting elements (plugs, cable lugs, etc.) at the ends.

ASTM
Abbreviation for the American Society of Testing and Materials.

ATEX approval
This approval is required for the intended use of devices and protection systems in areas at risk to explosions.

Attenuation
Attenuation is the reduction of the signal amplitude during transmission to a medium. It increases with the rising frequency and cable length. The signal level is impaired in the process.

Attenuation a
The reduction of the optical signal power between two cross-sectional surfaces of a fibre optic cable due to losses. The unit of measurement is decibels (dB).

Attenuation coefficient a
The attenuation relative to the length of a fibre optic cable. The standard unit of measurement is decibel/kilometre (dB/km).

Automotive cable
Vehicle cables are cores and cables used in passenger cars and trucks (e. g. ÖLFLEX® TRUCK at Lapp).

AWG
Abbreviation for American Wire Gauge. Standard expression for the wire diameter. The smaller the AWG value, the bigger the wire diameter. The actual values (mm) depend on the core resolution, regardless of whether a fixed conductor or a strand is used.

AWM
UL marking for Appliance Wiring Material.

Backbone
Backbone or secondary wiring is the connection between the building distributor and the individual floor distributors in a structured wiring system.

Backscatter
A small fraction of the light that is deflected from its course due to dispersion travels in a reverse direction, i. e. in the light waveguide back to the transmitter. By observing the chronological progression of the backscattered light using a beam splitter on the transmitter, it is possible to measure not only the length and damping of an installed light waveguide from one end but also local irregularities, e. g. light losses in splices.

Backtwist
The term relates to the stranding process. The technical design of the stranding machine twists the elements to be processed into a strand without torsion.

BALUN
Balun is a term combining “balanced” and “unbalanced”. Baluns are used for adjusting impedance and symmetry in the various transmission media in copper grids.

Banding
Wrapping a bundle of wires with relatively narrow paper, textile, plastic or metal strips.

Bandwidth
Frequency range of a fibre optic cable within which data can be transmitted within a particular time frame. The greater the bandwidth, the more data that can be transmitted. The transmission speed depends on the bandwidth of the entire network.

Bandwidth product
The bandwidth product is what results when the bandwidth of a glass fibre cable is multiplied with the length of the measured section.

Bandwidth-length product
Measurement for the frequency range that can be transmitted by a fibre optic cable one kilometre in length. It is a constant value.

BASEC
Abbreviation for the British Approvals Service for Cables. Certification body – Great Britain and Northern Ireland.

Basic raw materials
In addition to the basic raw material, synthetic materials contain a range of other components such as stabilisers, softeners, filler and colour.

Batteries Act
The Battery Act came into force in 2009 and also covers the registration and return of batteries.

Battery cables
Link between battery and generator in the engine. They are developed, manufactured and delivered in accordance with customer requirements/product specifications.

Baud
Unit for a modulation rate in the transmission of communications. One step per second. 1 bit/s = baud, 1 Mbit/s = 1 Mbaud → see Bit

Bel
1 Bel = 10 decibels. In highfrequency technology, the common unit of measurement for attenuation and, like decibel, a dimensionless ratio.

Bending capacity
The bending capacity indicates how far a product can bend without forfeiting function.

Bending cycle
Number of bends repeated in the drag chain (How often was a cable actively stressed during testing or during application?)

Bending radii
Permissible radius for occasional or constant bending of cables. The bending radius is defined as a multiple of the cable diameter. The construction of the cables determines the minimum permissible bending radius, which allows it to be increased or reduced. The permissible bending radii must be adhered to when laying power lines and cables. The standard values are between 15 x D and 30 x D, depending on construction type and regulation. D is the outer diameter of the cable. (At Lapp: ÖLFLEX® FD with 5 x D or 7.5 x D).

Bending test at low temperature
Cold flexibility test for cables. A cold cable is wrapped around a pin and no cracks may occur in the insulation.

Binary
Property restricted to just two values.

Bit
The smallest unit for representing binary data, significance either 0 or 1. It is the basic unit for transmission information in digital systems. A byte is a group of 8 bits.

Bit error rate, BER
Ratio of error bits to the overall number of bits received during a specific period.

Blue cable
Cable for intrinsically safe systems in hazardous locations. The compulsory colour code here is blue, RAL 5015. (For Lapp, ÖLFLEX® EB. These cable types are also available with shielding, e. g. ÖLFLEX® EB CY, UNITRONIC® EB CY).

Braid angle
Variation in degrees between the longitudinal axis and the wire routing within the braid.

Braiding
Arrangement of interlaced wires or threads forming part of the structure of a cable. Copper wire braiding is used for screening, while braiding made of textile, plastic thread or steel wire performs supporting or carrying, i. e. mechanical, functions. Braiding can be close or wide meshed (coverage density in percent) with different angles of twist.

Breakdown
This refers to electrical breakdown between two conductors or a conductor in water during the testing process, when the insulation can no longer withstand the constantly increasing voltage (breakdown voltage) or if a fault in the insulation results in a breakdown within a specified time at a constant voltage.

Breaking load, ultimate load
The product of nominal cross-section and tensile strength is the breaking load.

British Standard Wire Gauge
Also known as NBS (New British Standard), SWG (Standard Wire Gauge), Legal Standard and Imperial Wire Gauge. A modified version of the Birmingham Wire Gauge, a standard from Great Britain valid for all wires.

Broadband
Transmissions in which the signals are transmitted by a high number of oscillations per second (glass fibre technology).

BS
Abbreviation for British Standard. Standards body for Great Britain, similar to VDE in Germany.

BSI
Abbreviation for British Standard Institution – Great Britain.

Bundle
Several cores or pairs that are stranded into a group and in turn make up one element of a strand assembly.

Bus system
The bus system is a system of cables that transmits information and data.

Cable
Combination of several cores with protective layers (sheath) or sheathing of a single core. The sheathing protects the cores against all kinds of harmful influences. Cables are used to transport electric current (power cables), transmit information using an electric current (data cables) or to transfer information using light waves (light waveguide cables). The term line is also commonly used, depending on the application. It is not possible to exactly delineate the two terms. In general, the term “cable” is used for installations outside buildings. In practice, however, the terms are used interchangeably. Combination of any number of cores under a sheath.

Cable carrier
An assembly of linked, hinged support elements for directional, dynamic routing of all types of flexible bending power cables.

Cable data
The cable type file is part of the CAE software from ePLAN®. The cable type file defines the number of cores, their colour code, the PE core and the screening for all cables. In the Lapp item master data for ePLAN®, the cable type is assigned to the relevant item. This means that when a Lapp item is selected, each core is automatically assigned the appropriate colour code in the ePLAN® circuit diagram.

Cable gland
The brand name is SKINTOP® at Lapp. A cable gland is a device that is designed to guide a cable or an insulated conductor into a sheath and provides a seal and a restraint mechanism. It can also have other functions, e. g. kink prevention, strain relief, potential equalisation, earthing, insulation or a combination of these.

Cable gland size
The following sizes are currently defined in EN 60562: M 12 x 1.5; M 16 x 1.5; M 20 x 1.5; M 25 x 1,5; M 32 x 1.5; M 40 x 1.5; M 50 x 1.5; M 63 x 1.5; M 75 x 1.5; M 90 x 2; M 110 x 2. M stands for metric.

Cable print
Coloured marking on the outer sheath of individual elements or cables using symbols, names and other markings.

Cable set-up
Describes (from inside to out) the materials used for cables, their design and properties and the position of the individual elements.

Cable tree
Combination of individual cores or cables tied together with nylon ties, spirals or hose sheathing. The form of the harness is created when joining the wires, as the various consumers in the device and system circuits are physically separated and the connection with the individual cables makes constant branches necessary.

Cable type letter code
Identification of cables according to their design, nominal cross-section and number of cores, nominal voltage and conductor shape, which results in specific combinations of predetermined letters and numbers. For rules and standards, each of the letters and numbers has a specific meaning.

Cables for hand-held machinery
Handheld device cables are connecting and extension cables for power tools used in the open air or in enclosed spaces (e. g. ÖLFLEX® 540 P/CP, ÖLFLEX® 550 P, ÖLFLEX® 400, ÖLFLEX® 500 P, ÖLFLEX® SF ... at Lapp).

Caloric load values
Caloric load is the energy that is released when cables and other building materials are burned.

Campus
The campus or primary wiring establishes the connection between the various buildings within a structured wiring system.

CAN
Controller Area Network. Result-controlled communication system. As a generator of information, this reports to all connected nodes.

Canadian Electrical Code
See → CEC

Capacity
Electrical unit of measure, measured in Farad, or electrical unit of measure V x A = Watts.

Carrier frequency
The frequency of the oscillation whose amplitude, phase or frequency is influenced by a signal.

Carrier frequency, hook-up wire
In carrier frequency systems, they are used to transmit signals. Up to 120 carrier frequency channels can be simultaneously transmitted in a cable.

CCC
Abbreviation for China Compulsory Certificate. Products requiring certification can only be imported to China, sold in China or used in Chinese business activities after the relevant CCC certification has been requested and granted.

CE
Abbreviation for Communauté Européenne (European Community).

CE marking
Comprises the “CE” symbol and indicates a product’s compliance with all applicable EU directives. CE indicates that the natural or legal entity which carries out or initiates the connection is satisfied that the product meets the requirements of all relevant harmonised standards and has been subjected to all mandatory conformity assessment procedures.

CEBEC
Abbreviation for Comité Electronique Belge – Belgian certification body.

CEC
Abbreviation for the Canadian version of the US National Electrical Code (NEC).

CEE
Mark for the European standards institution: International Commission on Rules of Electrical Equipment.

CEI
Abbreviation for Commission Electrotechnique Internationale – International.

CENELEC
Abbreviation for Comité Européen de Normalisation Electrotechniques (Europe).

Central element
See → Core.

Central filler
The core is a design element onto which the other design elements are attached.

Characteristic impedance
Apparent impedance of an electronic quadrupole; it is made up of the Ohmic resistance and the frequency-dependent resistances of inductances and capacitances. The impedance of a cable represents the ratio of the voltage waves advancing in a direction to the current wave moving in the same direction. Common values are 100, 120 and 150 Ohm. It is important that the impedance of the cable corresponds to the input/output impedance of the connected equipment.

Chromatic dispersion
Grouping of wavelength-dependent effects which lead to a bandwidth limitation, such as waveguide dispersion and sheath dispersion.

Circular Mil (CM)
Measurement for conductor cross-sections in 1/1000 inch (0.001") from circuit diameter.

Cladding
Cladding is the glass layer which surrounds the core of the fibre optic cable.

Clamping range
Cable diameter range for which the assured properties of a cable gland apply.

CNOMO
Abbreviation for Comité de Normalisation des Moyens de Production. Commission for the standardisation of machine tools and tools used in the French automotive industry. With fibre optic cables, the plastic layer on the surface of the sheath for preserving the original surface condition.

Coating
Coating is a form of mechanical surface protection.
It is a primary plastic layer which is applied directly to the sheath glass for fibre optic cables.

Coaxial cable
Concentric pair of conductors consisting of an inner conductor and an outer conductor, which completely

surrounds the inner conductor. Coaxial cables are suitable for low-attenuation and distortion free transmission of high bandwidth signals. Because of their self-screening construction, they are much less sensitive to external interference (e. g. RG coaxial cable at Lapp). Coaxial cables are used in high frequency telecommunications systems (cable TV, Ethernet applications) for transmission of high frequency signals.

Colour code
For uniform marking of metallic cables and waveguides, various institutions including the EIA, DIN and IEC, have developed a standardised colour coding system. The colour codes for metallic cores assign totally different colours to the insulation of the pairs of cores for the individual standards. In addition to these standards, which are not consistently applied by manufacturers, colour codes specific to the manufacturer are often used.

Colour print
Sheaths and insulation covers are usually printed with colour, using a metallic disc whose lettering is engraved inversely on its periphery. Using a scraper, the excess colour can be scraped away.

Communication
Interaction between two independent systems. Used for one-way or two-way exchange of messages in the form of voice, text, images or data.

Compensating cable
Compensating cables are used together with a thermal element for temperature measurements. (Thermal elements such as Fe/CuNi iron-constantan (blue); NiCr/Ni nickel-

chromium-nickel (green); PtRh/Pt platinum-rhodium-platinum (white). A thermal element consists of two conductors made from different materials, between which there is an electric potential depending on temperature. A compensating cable transmits this potential from the thermal element to a cold junction. There, based on the value of the potential, the temperature can be assigned at the point of measurement.

Composite layer, composite sheath
The combination of an aluminium foil with the plastic/polyethylene sheath of a cable. The foil covers the core of the cable lengthways and overlapping, while the plastic part is placed on the outside. The outer sheath extruded onto it forms a homogeneous connection with the foil due to the effect of temperature, resulting in an interconnected “laminated” aluminium foil sheath. Used in outdoor telecommunications cables.

Compound
A material compound of polymer plastics with filler. Polymers are often compounded with colours, processing aids, fibres and other fillers.

Concentric conductor
The concentric conductor (e. g. NYCWY) may be used as a PE or PEN wire and can also act as the screening.

Conditioning
Division of production length of cables into storage or delivery lengths. Standard forms include coils with lengths of 50, 100 and 250 m and drums with 250, 500 and 1,000 m, depending on weight.

Conductance
The electrical conductivity is the inverse of the electrical resistance.

Conductor
Single-conductor cables are single- or multi-wire cables, used mainly for fixed laying with rubber or plastic insulation (ground wire). A non-insulated wire of a material whose high number of free electrons makes it suitable for carrying electric current (particularly copper and aluminium). Component allowing a connection that is easy to break and reestablish between two light waveguides. The insertion loss from a connector is normally higher than that from a splice. In signal and power engineering, connectors are used for connecting cables with different numbers of poles and in a variety of different designs. Because of the associated ease of service compared to fixed cable connections, connectors are being used in an increasing number of applications. (e. g. EPIC® at Lapp). Plugs are components that enable electrical conductors to be connected and are designed to create detachable electrical connections with an appropriate counterpart. Plugs may not be inserted or removed during proper use (under electrical voltage). A distinction is made between free and fixed plugs according to the mounting. The plug is made up of the plug housing and the contact elements. (e. g. EPIC® brand from Contact at Lapp). Central component for star-shaped passive light waveguide networks. It connects numerous transmitters and receivers and distributes the signal light output supplied by a connected transmitter evenly to all connected receivers.

Contact voltage
Part of an error voltage which may be contacted by members of the general public.

Control cable
The Lapp ÖLFLEX® brand is synonymous with connecting and control cables. The key features of control cables are: Bare or tin plated fine copper wire conductors, PVC insulation, stranding of cores with back twist, special PVC compound outer sheath. Different ÖLFLEX® designs include:
a) Different coloured cores,
b) Numbered cables. ÖLFLEX® cables have the following properties: Flexible, largely resistant to all kinds of oils, alkalis and acids. ÖLFLEX® are used in the following areas: As control cables in machine tool manufacture and general engineering, plant construction, in all kinds of industrial plants, in measurement and control engineering, process engineering, data processing etc. ÖLFLEX® control cables are highly recommended for these applications due to their excellent flexibility, the good general chemical resistance, the clear core coding and the problem-free compatibility with multi-pole machine connectors.

Copolymere
Mixture which polymerises from two or three monomers to form a chain.

Copper
The best material for producing electrical conductors. Excellent conductivity of heat and electricity. In addition, copper (Cu) has very good ductility and good strength properties.

Copper base
The monetary value used to value the copper contained in cables in the price.

Copper weight
It expresses the mass of the copper contained in the cables.

Copper-clad aluminium wire
This wire is made up of an aluminium core and a copper sheath.

Core
The optical core in glass fibre cable technology.

Core check, response at increased temperature
In order to determine the influence of heat on the mechanical properties of, for example, insulating covers, a test item is placed in a device for heat pressure testing which has already reached the testing temperature. The wall thickness of the test item determines the test load. After a specific storage period in the heating cabinet and subsequent cooling, the impression depth is measured with the reading microscope.

Core check, response with thermal shock
The core insulating cover is checked for thermal shock by wrapping the cores or strips from the insulating cover around a defined mandrel and storing them in a heating cabinet for approx. 1 hour at 150 °C. After removing the cores/strips and cooling them to room temperature, these test items should not display any visible cracks.

Core diameter
The core diameter is the diameter of the central light-carrying section of a light waveguide.

Core group
For the transmission of signals or energy, two or more stranded cores are required. Using two cores, it is possible to form a circuit that can transmit energy or signals.

Core Ident Code
VDE-DIN-colour code for colour-coded low-voltage cables according to VDE 0293-308/HD 308 S2.

Core identification
Coloured or numbered identification of single cores.
A Lapp development: The internationally proven ÖLFLEX® colour code is based on the colour-coded identification of the single cores. Ten basic colours are combined with 2 mm wide colour spirals. This results in 102 colour variations. This colour marking is particularly advantageous compared to cores printed with numbers, as it means the cores can be assigned much more quickly in a device (saving time).

Core joint
Core joints combine synthetically insulated signal cable and telecommunication cores in a conductor diameter range of 0.35 – 0.9 mm. The cores are pressed together using a special core-joining pliers and thus placed solderless into the connection sleeve.

Core print
In the manufacture of cables, cores are principally identified by four methods:
1. Cores can be manufactured in one primary colour.
2. Marked with various colour codes.
3. Printed.

4. A combination of the different colour codes with printing. It must be noted that only earth conductors are to be green-yellow in colour and that these colours may not be used if there is any risk of confusion with other cables.

Core stranding
Without stranding, wires positioned parallel to one another would deform when bent. The outer wires would be overstretched and the inner wires compressed. The individual wires are twisted together in a spiral to maintain the flexibility and mobility of the conductor. The result is known as core stranding.

Core stranding with more than four cores
When constructing a cable, the best layer structure of the stranding elements is always selected, to obtain cables that are as circular as possible. Gaps in the layer structure are filled with insulated fillers or central cores (filling elements). In flat cables, the structural elements (groups or cores) are parallel to one another and can be stranded.

Core wrapping
Core wrappings are used to protect the insulating covers of rubber-insulated cables. They are mainly made from foil or fabric tape.

Core, conductor, insulated wire
Individually insulated conductor, e. g. made of single- or multi-wire copper or aluminium. Core = conductive component of cables with insulation coloured or marked numerically.

Corrosion
Degradation of minerals and materials due to mechanical and chemical environmental influences.

Coupler
Passive optical components for transmission of light between a light source and a light waveguide or between several light waveguides. Couplers that allow light waveguide networks for connecting multiple transmitters and receivers to be set up are of particular importance (see → T coupler).

Crane cables
Crane cables are supply cables for cranes in the open air or indoors (e. g. ÖLFLEX® CRANE at Lapp).

Crimp connection
Mechanical joining technology. When joining, for example, coaxial connectors with a coaxial cable using a crimping tool, a metal sleeve is pulled over the shielding and pressed together.

Cross-linked
The term refers to a manufacturing process for elastomers, thermoplastics and duroplastics. It describes the fact that particular chemicals are used to change the original linear alignment of the macromolecules from planar to solid structures. The materials used include sulphur compounds for rubber and peroxides for thermoplastics and duroplastics. Cross linking is carried out under the influence of heat and pressure, and high energy rays for thermoplastics. Cross linking is a permanent and irreversible process and plays a critical role in determining the actual material properties (it gives rubber its permanent elasticity and improves the thermal, mechanical and electrical properties of polyethylene).

Cross-linked polyethylene XLPE
Cross-linked polyethylene.

Cross-linking agent
Cross-linking agents or vulcanising materials in rubber compounds are either sulphur (for natural or synthetic rubber) or peroxide (for silicone, EPDM). Sulphur cross linking begins at room temperature and intensifies as the temperature is increased. With peroxide cross linking, oxygen is released for cross linking at a specific temperature.

Cross-section
Cross-sectional area of the conductor. A distinction is made between the geometrically defined nominal cross-section and the conductive cross-section, which is derived from the electrical → resistance. A certain maximum resistance is assigned to the nominal cross-section, within which the conductor structure is specified. The cross-section is normally specified in mm^2. However, for certain types of cables, which are always made up of single-core conductors (telecommunications cables), the conductor diameter is used for marking or description.

CSA
Abbreviation for “Canadian Standards Association”. Canadian standards and testing body. Similar to VDE in Germany.

Current
Electrical unit, measured in Amperes.
Current = Voltage/Resistance.

D.C.
Abbreviation for direct current.

Dark current
Current at the output of an optical receiver if no radiation is present.

Data bus
A system of associated cables, to which data bits are transferred.

Data transmission cable
Cables whose structure make them suitable for transmitting electric data processing pulses with minimum errors. Simple (pair) or more complex (screening) constructions are required depending on the susceptibility of the data pulses to faults (brand: UNITRONIC® at Lapp). Computer cables (Li2YCY-PIMF) or other, at least twisted in pairs, normally screened and often individually screened cables, e. g. UNITRONIC® LIYCY (TP), UNITRONIC® BUS; UNITRONIC® LAN, telephone cable, also light waveguide cables.
TP = Twisted pair.

Data transmission rate
Unit of measure for the transmission speed of a data transmission. It is measured in bit/s or byte/s.

Data transmission, data transfer
Optical data transmission is always serial. Before data transmission, pending parallel data is always prepared for serial transfer and is post-processed to a parallel form after the transmission. We also refer to bit serial data transmission, as all of this data is always transferred as digital signals.

Decibel
A decibel is the logarithmic ratio of two levels (e. g. input level to output level). The unit of measure has no dimension and is specified in dB.

Degrees of protection
Protection of electrical equipment by housing, covers etc. Protection of equipment against the ingress of foreign bodies and water.

DEL
Abbreviation for Deutsches Elektrolytkupfer für Leitzwecke (German electrolyte copper for conduction) DEL is the stock market code for 99.5% pure copper in Euro/100 kg (see T17).

DEMKO
Abbreviation for Danmarks Elektriska Materialkontroll – Danish standards and testing body, testing and certification body, tasks similar to VDE/UL.

Density
Ratio of the mass to the volume of a body. If the mass is M and the volume is V, the radio is the density d = M/V.

Density unit
Result of the density of a body relative to the density of water (= 1). Corresponds to the specific weight.

Designation label
Fixing elements with which single wires, bundles, cables and cables on machine parts or walls can be permanently fixed in place. They are transparent or coloured, usually made from nylon and can display indelible information about their content.

DESINA®
The Verein Deutscher Werkzeugmaschinenfabriken e. V. (VDW) [German Machine Tool Manufacturing Federation] developed DESINA® (DEcentralised and Standardised

INstAllation technology), a comprehensive overall concept for standardisation of electrical installation of equipment and machinery. Colour codes of cables:

- Servo cable, screened: Sheath colour orange RAL 2003
- Cable for measuring systems, screened: Sheath colour green RAL 6018
- Power cable, unscreened: Sheath colour black RAL 9005
- 24 Volt control cable, unscreened: Sheath colour grey RAL 7040 (similar to 7001)
- Field bus hybrid cable, Cu and light waveguide: Sheath colour violet RAL 4001
- Sensor/actuator cable, unscreened: Sheath colour yellow RAL 1021

DeviceNet™
Simple CAN-based communication system for networking of industrial automation equipment (limit transmitters, photo sensors, motor starters, frequency controlled drives, control terminals and similar) with master control equipment. Two screened twisted pairs of conductors within a cable are used as the transmission medium. One is used for communication (with transmission rates of 125, 250 or 500 kBit/s for cable lengths of 500 m, 250 m or 100 m) and the other to supply power to the connected equipment (max. 8 A for 24 V DC voltage).

Dielectric
Dielectric refers to the characteristic of certain substances to be electrically non-conductive – therefore insulating. Any electrically insulating material in which an external electrical field (e. g. between the plates in a capacitor) builds up an opposing field is referred to as dielectric. A dielectric causes a static electrical field to be retained even without a continuous supply of electric charge.

Dielectric constant (DC)
A material constant for a dielectric. The dielectric constant specifies how many times greater the capacitance of the capacitor will be if the insulating material is used as the dielectric instead of air. Multiplying the DC of the empty space by the dielectric constant gives the DC of the dielectric.

Diffusion
The primary cause of attenuation in a light waveguide. It is the result of microscopic fluctuations in the density of the glass, which deflect part of the guided light sufficiently from its course that it actually leaves the light waveguide. With light wavelengths above 1600 nm, this effect is very weak, however it increases at short wavelengths by the wavelength to the power of four (Rayleigh dispersion).

Digital signal transmission
Transmission of a signal using binary light pulses in a period time pattern.

Dimension
A term for the geometric size of a wire or strand, expressed as a diameter or cross-section. Often used in conjunction with the number of cores, e. g. 18 x 1.5 mm^2.

DIN
Abbreviation for Deutsches Institute für Normung [German Standardisation Institution]. It is based in Berlin, Germany.

DIN EN
European standard added to the German body of standards.

Direct line, connecting cable
A connecting cable is a cable that has a coupling connector through which the network connection is established. The fixed connection is found inside the device. The device is portable. The coupling connector contains earthed contacts and is thermoplastically moulded to the cable. Connecting cables are, for example, used to connect portable telephones.

Dispersion
Dispersion of the signal running time in a light waveguide. It is made up of various components: mode dispersion, material dispersion and waveguide dispersion. As a result of its dispersion, a light waveguide acts as a low-pass filter for the signals to be transmitted (see → Transmission function).

DKE
Abbreviation for Deutsche Kommission Elektrotechnik und Elektronik Informationstechnik [German Electrical Engineering, Electronics and Information Technology] in DIN und VDE. It is a branch of the DIN and its agency the VDE (Electrical Engineering, Electronics and Information Technology Federation). As a national organisation for formulating standards in electrical engineering and information technology, the DKE deals with important interdisciplinary issues such as safety, EMC, components and performance of conventional electric circuits, mobile wireless communication, software and Internet protocols. DKE is the German member of the European and global standardisation organisations. The DKE implements and publishes the results of standardisation work by the → IEC, → CELENEC and → ETSI in national standards.

Drag chain cables
Drag chain cables are cables used in power chains (e. g. ÖLFLEX® FD, ÖLFLEX® SERVO FD, UNITRONIC® FD plus at Lapp).

Drain wire
Single- or multi-wire non-insulated conductor that is run in close metallic contact under a screening.

Ductility, flexibility
As all cables and cores are liable to mechanical stress, they are also checked for flexibility, i. e. bent several times around various bending radii. There may be no visible damage to the cables, sheaths, inner or outer protective covers after testing. All stranded elements, braidings and wrappings must also remain correctly in place. In addition to the diameter of the strand assembly and the number of elements to be stranded, the length of lay plays a significant role in the flexibility of a cable. Based on the following principle: The shorter the length of lay, the more flexible the strand assembly.

Dummy
If there are “openings” detected in the cable, dummy elements or dummy cores are inserted and stranded together with the cable assembly. Dummy elements are generally made from cheap, inferior materials such as polyethylene twine, spun rayon and cotton. They are usually the same size as the real stranding elements.

Duplex operation
Transmission of two independent signals over a particular distance.

Duroplastic
In contrast to thermoplastics, after heating duroplastics cannot be deformed by heating them again. Duroplastics are required in the cable industry, e. g. as cable fittings or connectors.

Earth connection
Earthing of a point of the circuit, such as the neutral point, neutral conductor, midpoint or outer conductor.

Earth electrocode, ground system
Conductor that provides a conductive connection to earth. For example, it can be embedded in the ground or have a large area in contact with the ground.

Earthing
Earthing guarantees a clear reference potential for screening the active and passive components of a network.

ECAD
The ECAD component standard is a manufacturer-independent standard for describing item and engineering data in electrical engineering, specifically for machine and equipment manufacture.

EIA
Abbreviation for Electronic Industries Associations.

Elastomere
Elastomers are widely used for sheathing and insulating cables because of their excellent electrical and mechanical properties. Elastomers are high-molecular materials, whose elasticity depends on the degree of cross-linking. The biggest difference between elastic and plastic materials lies in

loading and relief. After relief, an elastic material reverts to its original shape.

Electric circuits
In a cable, circuits with different voltages can be operated if they are insulated for the maximum voltage that occurs – VDE 0113 Part 1 and VDE 0100 Part 520.

Electric diameter of conductors
Determined on cables by electrical resistance measurements.

Electric Field
When voltages are applied to cables, electrical fields are formed, which can take on different shapes depending on the cable construction. In the low voltage range, up to approx. 1 kV, electrical fields have only a negligible influence on the dimensions of the insulating walls. To guarantee operational safety, there are high demands on the materials and dimensions in the high voltage range. An electrical field is represented by field lines. The density of these field lines indicates the force that exists between the two points on a field line (voltage).

Electric resistance
Resistance with which an electric circuit opposes the passage of the current. Resistance is specified and measured in Ohms.

Electricity
Form of energy based on the flow of free electrons. Electricity is produced in generators.

Electromagnetic protection
Protection against faults that could affect the cable from outside (immisions). Protection against faults caused by the cable (emissions). Braid, e. g. copper (tin plated) → flexible → coverage. Protection against external influences: mechanical, e. g. cables over edges; stepping on; pulling of cables; chemical: e. g. oils; thermal: heat, cold.

Element
Individual component of cables, a collective term for cores, pairs, bundles and carrier organs.

Elongation at break, ultimate elongation
Elongation at break is the ratio of the elongation to the initial length when a break occurs.

Elongation, extension, stretch
Extension of a body by mechanical forces. In the cable industry, it is tested using a mechanical testing method to determine the tensile strength of all components.

ELOT
Hellenic Organization for Standardization. Certification body for Greece.

EMC
Abbreviation for Electromagnetic Compatibility. The ability of a system, machine or item of equipment to work satisfactorily in the electromagnetic environment without itself causing any electromagnetic interference that would be unacceptable for all systems, machines or equipment in that environment.

EMK
Abbreviation for electromotive force.

EMS
Abbreviation for Electromagnetic Susceptibility. This is the functional resistance of a specific object to electromagnetic interference factors.

EN
Abbreviation for European Standards.

EPDM
Abbreviation for Ethylene Propylene Dien Monomer rubber. Chemically cross-linked elastomer with good electrical insulating properties and outstanding flexibility at low and high temperatures.

EPIC®
Abbreviation for Environmental Protected Industrial Connector. Registered trademark, a robust industrial connector from Contact.

ePLAN®
ePLAN® is the leading CAE software for planning electrical designs and documentation in machine and plant construction. The Lapp item data and the cable type file enable the individual cores in the ePLAN® circuit diagram to be assigned automatically. ePLAN® is produced by ePLAN® Software & Service GmbH & Co.KG. See www.eplan.de

EPR
Abbreviation for Ethylene Propylene Rubber.

Ethylene-Propylene- Rubber
See → EPDM

ETSI
Abbreviation for European Telecommunication Standards Institute. Its duties include developing harmonised standards for an integrated European communication system.

Explosive atmospheres
See VDE 0165 Part 1. Cables with a thermoplastic, duroplastic or mineral insulated metal sheath can be used for fixed routing. There may not be any cavities in the core bundle (not hose cable). The extruded embedding material and the fillers, if used (press extruded), must be “non-hygroscopic”. Flame retardant in compliance with IEC 60332-1. Cables for mobile and transportable equipment must have connecting cables with an outer sheath made of heavyduty polychloroprene or an equivalent synthetic elastomer or a heavy-duty rubber insulated cable or connecting cables with a comparably robust construction.

Extension cord
A mobile cable assembled with a coupling connector and socket. The couplings are integrally moulded onto the cable using thermoplastics and contain protective contacts.

Extrusion line
It is powered by a motor and coils through a cylinder in a spiral. The filler is made up of thermoplastic prepared in the form of granules. Granules, i. e. a free-flowing mixture of grains of equal size, are the delivery form of various plastics for cable manufacture; in other words, an extruder is a system in which a continuous supply of granules is heated, compressed, mixed and homogenised.

Farad
Unit of measurement for electrical capacitance.

FDDI
Abbreviation for Fibre Distributed Data Interface. Network type made up of a double ring with a 100 Mbit/s transmission rate and using waveguides as the transmission medium.

Fibre cover
Made up of one or more materials and is used to mechanically insulate the fibres and to protect them against damage.

Fieldbus technology
Sensors and actuators are conventionally connected to a controller or evaluation unit using an analogue 4 – 20 mA signal. With this technology, a 2-core cable is necessary for each connection between the sensor or actuator and the controller. In addition, an input/output circuit (I/O) must be provided for each sensor and actuator in the controller (normally a PLC or PC). The picture looks very different when using a field bus system. In this case, all devices are connected to a bus cable (2, 4 or 5 cores depending on the field bus system). An interface card is used instead of the input/output circuits. This saves on I/O cards, reduces the space required in the control cabinet and permanently cuts the wiring costs. In conventional systems, information (e. g. measured values or a fault signal) can only be transmitted in one direction and in very limited amounts. This can be from the sensor to the controller or from the controller to the actuator. By contrast, in a field bus system information can be exchanged bidirectionally via the digital bus. As well as the actual process data such as measured values (e. g. temperature) and control variables (e. g. speed), parameters such as the measuring range, measuring point codes (TAG),

filter properties, maintenance or fault signals etc. can be transmitted. The advantages that this brings are obvious. Commissioning and maintenance are simplified and the flexibility of the system (e. g. with central measuring range selection) is improved. This normally also enables cost benefits to be achieved compared to conventional solutions.

Filler
Used as a component of insulating and sheathing compounds. The fillers in rubber compounds, for example, mesh directly into the rubber molecules and give them good mechanical abrasion resistance. Important fillers include siliceous chalk, soot and aluminium oxide.

Filler wire
Usually a tin-coated copper wire which should have contact with the aluminium layer of the screen along the entire cable length. In order to ensure the filler wire doesn't break when the cable bends, it must lie very loosely (undulating) on the cable core. The filler wire should be able to pass over any possible breaks in the screen.

Filler, valley sealer
Filler or support element in individual stranding layers in cables.

Fire behavior
Property which describes the behaviour of the cable when on fire (in particular, fire propagation).

Fire resistant
Property of materials used for insulation and sheathing that are slow to catch fire when exposed to heat and are

self-extinguishing when the heat source is removed (→ hard to inflame).

Flame retardant
Thermoplastic and elastomer compounds for insulation and sheathing are influenced by additives so that they are slow to catch fire when heat acts on them.

Flat cable
Ribbon cable in which the individual strands are welded together to form a ribbon (often with multiple colours) and normally with small cross-sections (0.08, 0.14 or 0.25). The individual cores can normally be separated. Application: In electronics, for connecting circuit boards.

Flat type cable
Several individually insulated conductors in parallel with a sheath for mechanical protection, produced in such a way as to give a rectangular cable cross-section. Used in crane systems (ÖLFLEX® – Crane F).

Flexibility
A product (relating to cables in this case) is flexible if it can be moved around without impairing its functionality (e. g. lift cable or robot cable).

Fluorethylenpropylen (FEP)
Product from the TEFLON® series. A plastic for high temperatures, with excellent chemical resistance and excellent electrical properties but not economical. TEFLON® is a registered trademark of the company Du Pont de Nemours.

Foil
Plastic foil, metal foil and metal clad plastic foil are used for different purposes. Plastic foil provides mechanical protection, e. g. as padding under a screening braid or around the cores below when stripping to protect against incisions. Metal foil is used for electrical screening.

Frequency
Number of changes of polarity in an alternating current per second; the unit of measure is Hertz (Hz).

FTP
Abbreviation for Foil Shielded Twisted Pairs; in these cables the twisted pairs of cores are screened by a common plastic clad aluminium foil.

Full duplex
Full duplex transmission allows simultaneous transmission and reception of signals.

GAEB
Abbreviation for “Gemeinsamer Ausschuss Elektronik im Bauwesen” [Joint Committee for Electronics in Construction] and describes the data format in which engineering and planning offices create specifications and tenders for industry, infrastructure and building services projects. Lapp tender texts in the common formats GAEB 90 (*.d81) and GAEB 2000 (*.p81) are available for download from www.lappkabel.de.

General cable tie
General cable ties are coloured or transparent fixing elements (normally made of nylon) that can be used to secure individual wires or cables in a bundle. The teeth on the inside provide a permanent connection.

Glass fibre cable
Used to transmit data. They use light as the transmission medium rather than electric current. Dielectric waveguide, used to transmit signals using light waves. Also known as a fibre.

GOST
Standards institute in Russia (comparable with the VDE in Germany, British Standards in the UK, IMQ in Italy and UTE in France)

Gradient fibre
Light waveguide with a gradient profile, i. e. with a → refraction index profile that constantly changes across the cross-sectional area of the light waveguide. The profile of standard gradient fibres can be approximated as $1 < g < 3$ by an exponent profile.

Grid
The exact spacing between the conductors in a ribbon cable.

Gusset
Cavities that inevitably occur between the cores twisted into a strand due to their circular cross-section. When using sector-shaped conductors, practically no gussets occur.

Halogen free
Refers to materials that do not contain any halogens such as chlorine (Cl), bromine (Br), iodine (I) or fluorine (F).

HAR
Quality mark for a harmonised cable complying with CENELEC HD standards, issued only by HAR testing bodies, e. g. VDE, USE, BASEC, USE, SEV.

Hardness
See → Shore

Harmonizing key
→ See Table T6.

HD
Abbreviation for harmonisation document. In the EU, HDs have the status of a harmonised European standard (like ENs).

Heat of combustion
The temperature or heat released when a cable is burned (see → Thermal load).

Hertz
Unit of measure for the frequency of an alternating current (in Germany 50 Hz for mains cables).

Hood
The upper section of the housing can have a straight or lateral cable outlet. The hood can be freely combined with an externally mounted, surface mounted or coupling housing.

Hood termination
The insides of the end plates are coated with a thermoplastic adhesive. The end plates are used for sealing pressure monitored, moisture-resistant cables and tubes with a diameter of 5 to 10 mm.

Hybrid cable
Cable with different transmission media, such as light waveguide, copper conductor, HF conductor.

ICEA
Abbreviation for Insulated Cable Engineers' Association. A sub-committee of NEMA – USA.

IEC
Abbreviation for International Electrotechnical Commission. Standards committee for international standardisation of electrical materials and international commission for standardisation in the electrical engineering and electronics sector.

Imprinting
Marking of cables using a relief imprint (no colour). This technique is only possible when the sheath is warm as the marking is impressed into the material positively or negatively.

Industrial machinery for USA
The following general rules apply to construction and operation of machinery in the USA: The machinery must comply with federal safety laws issued by the Occupational Safety and Health Administration (O.S.H.A.: www.osha.gov) and the applicable national codes (statutory regulations) at the installation location. Machinery is only classed as safe if it has been designed and manufactured in compliance with applicable standards (NFPA 70, NFPA 79....) and its safety has been tested and declared safe by a Nationally Recognized Testing Laboratory (N.R.T.L., www.osha.gov/dts/otpca/nrtl/).

Insertion loss, insertion attenuation
Attenuation caused by inserting an optical component into an optical transmission system. The attenuation that is caused in an optical transmission system by inserting an optical component, e. g. a plug or a → coupler.

Insulation
Preventing the passage of electrical currents using non-conductive materials. Materials are non-conductive (suitable for use as insulators) if they do not contain conduction electrons or only isolated electrons. These materials include various plastics, rubber, ceramic, porcelain, glass, paper, resin. (Insulation in capacitors and radio frequency cables is referred to as → dielectric).

Insulation resistance
The electrical resistance of a non-metallic material between two electrodes, measured using a DC voltage.

Intensity
Power density at a surface through which radiation penetrates, e. g. at the radiating surface of a light source or at the cross-sectional area of a light waveguide (standard unit W/cm^2).

Interactive
Property of two systems to influence one another in order to exchange messages.

Interbus
At the lowest level of the automation hierarchy model, there are particular requirements for a communication system. Connection costs, real time capability and short cycle times are of crucial importance. The data to be transmitted, normally measured and control values, are typically only a few bits in length. INTERBUS-S, standardised in DIN E 19258, has a summation frame protocol and is designed specifically to meet these requirements. With a clock speed of 500 Kbit/s and a net data rate of approx. 50 %,

even time-critical controllers can be implemented using a bus system. With around 1,000,000 INTERBUS-S nodes in use worldwide, the system is one of the leading field bus systems. In some areas, e. g. networking of frequency converters and drive technology, it is actually the market leader.

Interface
Connecting point in a technical system that has particular properties enabling connection to another technical system.

Internet
Worldwide virtual data network.

Intrinsically safe
Electrical installation that is, in its own right, safe from the point of view of risk of explosion, i. e. no ignitable sparks can occur in the installation. All parts, including the cables, should be blue (RAL 5015) – e. g. at Lapp ÖLFLEX® EB, ÖLFLEX® EB CY, UNITRONIC® EB CY).

IP Code
A system of designations used to indicate the degree of protection provided by a housing against access to hazardous components, ingress of solid foreign bodies and/or water and to provide additional information relating to this protection (e. g. EN 602529).

ISDN
Abbreviation for Integrated Services Digital Network. Integrated service digital telecommunications network. Suitable for transmission of voice, text, images and data.

ISO
Abbreviation for International Organisation for Standardisation. Committee that develops internationally recognised standards.

Joint
Interconnection point between (data) transmission paths.

Kink
The cable has been forcefully bend over a sharp edge, causing plastic deformation of the individual strands and wires. This results in grooves that promote breakages on the individual wires.

kV
Abbreviation for Kilovolts. 1 kilovolt equals 1,000 Volts.

LAN
Abbreviation for Local Area Network. Physically limited network used for communication within a building or company.

Laser-printer, ink-jet printer
With this method, small production batches can be printed at low cost as there is no need for a print wheel to be made. The downside, however, is that it produces a print result of lesser quality.

Laying temperature
When installed, the cable temperature should not be below +3 °C. Cables with sheathing and insulation are sensitive to bending and impacts when exposed to cold.

Leading protective ground
The PE contact in a plug establishes the first contact and is the last to disconnect, and is marked as the protective earth symbol.

Leakage current
Leakage current is the current that flows via the functional insulation of a consumable to earth or an external conductive part. It can appear as a pure active current or as an active current with a capacitive value. In VDE 0700-1 “Household and Similar Electrical Appliances – Safety”, the following leakage currents are specified:

- For devices of protection class 0 and 0I 0.5 mA
- For portable devices of protection class I 0.75 mA
- For non-portable motorised equipment of protection class I 3.5 mA
- For non-portable heating equipment of protection class I 0.75 mA or 0.75 mA/kW, max. 5 mA
- For devices of protection class II 0.25 mA
- For devices of protection class III 0.5 mA

When taking leakage currents for an entire system (also important for residual current protective equipment) into consideration, both the leakage current (residual current) of the cables and the leakage current of the consumable must be accounted for.

Length of lay, length of twist
The twist length is the distance (measured in the direction of the longitudinal axis) covered by the elements of a layer after being twisted by 360°, e. g. 40 mm. It is usual to specify the number of twists per metre, e. g. 40 mm = 25 twists.

Lever series
To lock the EPIC® rectangular connector, there are single or central levers available for the one-handed locking of upper and lower housing sections, the double levers are used for the two-hand locking.

Li2YCY
Polyethylene screened individual cores.

Li5YCY
TEFLON® PTFE screened individual cores. TEFLON® is a brand name of the company DuPont de Nemours.

Lift cable
Lift cables are control cables with strain relief used for lifts, gantry cranes, teach pads, etc. (e. g. ÖLFLEX® LIFT, ÖLFLEX® CRANE at Lapp).

Link
A link represents a complete section of cabling from the floor distribution board to the data terminal input. It includes all connecting sockets and plugs, installation cables and patch cables. The quality of a link is defined using classes, the quality of the individual components using categories.

LiY
Individual cores (strand) predominantly 0.14 and 0.25 mm^2
LiYv: Tin plated individual cores (strand).

LiYCY
Individual cores with copper screening (C stands for copper).

LiYY
Multi-core stranded cable (ÖLFLEX®, UNITRONIC®).

Longitudinal water tightness
Achieved by filling the gaps between the core arrangements with various kinds of filler (e. g. petroleum jelly filling).

Loss factor
The loss factor depends on frequency, temperature and capacitance. This factor is the ratio of effective power to idle power with a sinusoid voltage.

Machine set-up for core insulation – Extrusion
The following single units have mainly conventional extrusion lines for core and insulating covers: Overend take-off, wire straightener, wire pre-heater, capacitance bridge, extruder, embossing or marking device, cooling section, eccentricity measuring device, diameter scanner, high-voltage testing device, double roller haul-off machine, accumulator and double bobbin winder.

Master
Central bus subscriber that controls bus access. All other subscribers operate as slaves (see → ASI).

Master-Slave principle
The master element issues instructions and the slave elements follow them. With decentralised bus control, for example, an automation device acts as the master element and issues access rights for the other components (slave elements – see → ASI).

Material dispersion
With a non-monochromatic light source, the dispersion that results from the dependency of a material's refraction index n on the wavelength and from the light velocity in that material.

Mica powder
Natural mineral product that is pulverised and used as a separating agent and lubricant either on its own or mixed with talcum. In the form of foils and strips, mica is also used for insulating conductors exposed to high thermal loads.

Microbending
Bending of fibres that have local axial deviations of a few micrometers and physical wavelengths of a few millimetres, for example. Microbending causes light losses and thus increases the → attenuation of the fibres.

Mode
Discrete light wave forms that can propagate in a light waveguide.

Mode dispersion
The signal distortion in a light waveguide caused by overlapping modes with different running times.

Modem
Device for adapting digitally operating data stations for analogue telecommunications channels.

Modulation
A network signal to be transmitted is modified by a carrier signal.

Monomode fibre
Light waveguide with small → core diameter in which only one mode, the basic mode, can be propagated. This fibre type is particularly suitable for broadband transmission over long distances as its → transmission bandwidth is only limited by → chromatic dispersion.

Motor cable
Motor cables are supply cables for electric motors (e.g. ÖLFLEX® SERVO FD at Lapp).

Multimode fibre
Light waveguide whose core diameter is large compared to the light wavelength and in which a large number of modes can therefore be propagated. A gradient profile (→ gradient fibre) allows the → mode dispersion to be kept low, allowing large transmission bandwidths to be achieved, although these can be exceeded using → monomode fibres.

Mutual capacity, operating capacity
For four, pair or phantom cable circuits: the capacity between the cores a and b of these cable circuits. With one core: the capacity between a conductor and all remaining interconnected conductors of a cable.

Nanosecond
Billionth of a second. Time unit for the internal switching speed of computers.

Near-end crosstalk, far end crosstalk
In multi-pair data cables, the field effect of the signal transmission for one pair induces an interference signal in adjacent pairs. Crosstalk does not depend on the length and is greater as the frequency increases. The difference between the effective signal and the interference signal measurable at the adjacent pair is referred to as crosstalk attenuation and is specified in dB. We differentiate between: NEXT (Near End Crosstalk) and FEXT (Far End Crosstalk).

NEC
Abbreviation for National Electrical Code. Group of standards for the safety of electrical equipment, e.g. electrical equipment installations in the low voltage range up to 600 V – USA.

NEMA
Abbreviation for National Electrical Manufacturers' Association. The NEMA works in conjunction with the IECA to produce and promote standards for cables – Washington D.C., USA.

NEMCO
Norwegian testing body, similar to the VDE in Germany.

Neoprene®
Trade name of the company DuPont de Nemours for synthetic chloroprene rubber.

Network
Cable network used to create connections between data stations.

Neutral conductor
Neutral conductors, where used, may not have a smaller cross-section than the outer conductor, see VDE 0100 Part 520, Section 524.2.

NFPA
Abbreviation for National Fire Protection Association. Issuer of NFPA standards and NEC – USA.

NFPA 79
NFPA 79 is the section of the National Electric Code (NEC®) which includes the requirements for electrical wiring of industrial machinery. NFPA 79 generally applies to electrical

components used in individual machines and machine configurations operating together (machine groups). The National Fire Protection Association (www.nfpa.org) is the issuer of this important standard. NFPA 79 applies to all electrical and electronic components in machinery with a maximum nominal voltage of 600 V. NFPA 79 was revised in 2006. The aim of this revision was to harmonise NFPA 79 with its European counterpart IEC/EN 60204.

Nominal voltage
The nominal voltage is the voltage to which the structure of the cable relates in terms of its electrical properties. The nominal voltage is expressed by specifying two AC voltages U_0/U in V : U_0 = Effective value between an outer conductor and earth (non-insulating environment). U = Effective value between two outer conductors in a multi-core cable or a system of single-core cables.

Norms
The German Federal Supreme Court gave the following statement on engineering rules on 14.05.1998: Recognised engineering rules are those that are recognised as correct by the theory and have demonstrated their effectiveness in practice. By contrast, according to the BGH DIN standards are only private engineering regulations with the nature of recommendations, which do reflect the recognised engineering rules but lag behind them or could actually be incorrect.

Numeral identification
See → Colour codes/Numerical identification

Numerical aperture
Sine of the maximum possible launch angle of a light waveguide.

NYM
These cables (standard cable for fixed installation) are designed for installation above, on and below ground, in dry, damp and wet areas and within walls and concrete, except for direct embedding in shaken, vibrated or compressed concrete.

Ohmic resistance
The resistance per unit length records the losses in the metallic conductors. The conductor dimensions, material and the temperature determine the DC resistance Ro'. Because of skin effect, the conductor resistance increases as the frequency rises. It also shows a linear increase as the cable length increases.

ÖNORM-Format
Austrian format for invitations to tender.

Operating supplies
All objects needed when using electrical energy, e. g. switch, motors and cables.

Operating temperature range
The range between the lower (lowest permissible temperature) and upper (highest permissible temperature) limit temperature that may be utilised by the operator.

Operating voltage
The actual voltage in a grid. This can fluctuate by up to 5 %, caused by the alternating use of consumers.

Opposite direction of lay
See → Stranding

Order length
The length of cable ordered by the customer.

OTDR
Measuring method for testing glass fibres for faults or transmission quality. OTDR stands for Optical Time Domain Reflectometer.

Outdoor cable
Cables suitable for outdoor laying in the ground, in pipes, in the air, in rivers and lakes, in mines, on ships, for interior spaces or the most varied of industrial plants, etc. The design of the cable depends on the electrical, thermal, mechanical and chemical laying and operating conditions.

Outer conductor
Conductors that connect current sources with consumables. For example, C1, C2 or C3 in a three-phase system but not conductors come from the midpoint or neutral point. The conductor is arranged concentrically around the inner conductor of a coaxial pair.

Outer diameter
Diameter of the smallest circle that will enclose the surface of the sheath.

Outer sheath
Enclosed cover for protection of the elements underneath.

Outer sheath
On the one hand, refers to the outer covering of a cable. On the other hand, it is the entire optically transparent material in a light waveguide, excluding the core.

Overcurrent
If the permitted ampacity is exceeded, this is referred to as overcurrent.

Overcurrent protection devices
Overcurrent protection devices break the current supply in case of overcurrent. They include overcurrent protective switches and safety fuses.

Oxygen index
Percentage oxygen content in the ambient air that is necessary to maintain combustion after removal of a flame. As the natural oxygen content in the air is approx. 23 %, materials with an oxygen index of greater than 24 are generally self-extinguishing when the flame is removed. This term comes up primarily in connection with halogen free cables.

Pad
Non-conductive element made of insulating material (PVC) or textile, used to fill up gaps in a strand group. Also known as a dummy core.

Pair
Two stranded → cores within a larger strand group (see → Element). The inductive coupling of two parallel conductors is reduced by twisting the two cores together as tightly as possible (→ twist length).

Panel mount base
Panel mount bases are designed for the feeding through of cables from below. The panel mount base is mounted to control cabinet walls for connecting control or power cables.

Patch cable
Patch cable complying with EN 50173/ISO IEC 11801 is used to provide a flexible connection between ports in patch fields and the connection to telecommunication sockets.

Patch field
A patch field is the switching device that is used to set up, establish and route connections.

PE
Abbreviation for polyethylene.

Photodiode
Semiconductor diode that absorbs light and feeds the charged particles released to an external circuit as a photoelectric current. A distinction is made between PIN photodiodes and avalanche photodiodes.

Photovoltaic
Photovoltaics refers to the direct conversion of solar energy into electrical energy using solar cells. Photovoltaics is a branch of solar technology, which includes other technical uses of solar energy.

Pigtail
Short part of a fibre optic cable on a laser diode or connector. The pigtail is the coupling link between a component and transmission fibre and is permanently fixed to the component.

PiMF
Abbreviation for pairs in metal foil.

Pollution level
Numerical value specifying the anticipated pollution of the micro-environment. Pollution levels 1, 2 and 3 are used. The pollution level is used to assign air gaps and creep distances. In industrial environments, the pollution level is typically 3.

Polyamide
Polyamide is a polymer. Polyamide is cold resistant with impact loads, impact resistant and abrasion resistant.

Polycarbonate
The prerequisite for resistance is that no aggressive components such as emollients (PVC) or solvents attach the polycarbonate. The material swells up, which can lead to stress cracks.

Polychloroprene-rubber
Synthetic rubber is resistant to solvents, has very good strength properties and is flame resistant, however very expensive (high-quality rubber cables, Pattex glue).

Polyethylene
Polyethylene is a halogen-free plastic, but is highly flammable. By adding additional materials, PE can be made flame retardant and smokeless.

Polyuretane
Extremely impact resistant, difficult to strip, strong reset forces. (PUR, 11Y, Q).

Polyvinylchloride
Polyvinylchloride is a halogenated plastic. The halogens are chlorine, bromine, fluorine, iodine and astatine. Chlorine and

fluorine are used to make plastics flame retardant and more resistant to external influences. Cables with PVC sheathing are flame retardant. Halogenated plastics produce highly toxic gases when they burn, which form aggressive acids when they mix with extinguishing water and can, in turn, cause extremely severe corrosion damage.

Power dissipation factor
Power that is converted into heat or other energy losses.

Preform
Glass rod from which the glass fibres for light waveguides are drawn. When drawing the glass fibres, the ratio of core glass to shell glass is maintained.

Print wheel
This procedure is generally only a cost-effective option for average or large batches as a new print wheel is required for every change made to the print. Print wheels can, however, be used for geometrical logos and inverse printing. Print wheel results are also relatively easy to remove and wipe away.

PROFIBUS
The PROFIBUS network is based on the principle of master-slave communication. A central controller – the field bus master – cyclically reads the information from the field devices – the field bus slaves – and writes their output values. In a PROFIBUS DP network, a high-speed transmission rate of up to 12 Mbit/s is possible. It is based on the European standard EN 50170.

Protective conductor
(Symbol PE) A conductor that is necessary for certain protective measures against shock currents to create the electrical connection to subsequent parts. The protective conductor is marked in green/yellow (GNYE) in cables.

PTFE
Abbreviation for polytetrafluoroethylene, TEFLON® plastic (PTFE); a trade name of the company Du Pont de Nemours.

PUR
Abbreviation for polyurethane; a ductile, abrasion resistant thermoplastic alternative to rubber, e. g. in ÖLFLEX® 400P, ÖLFLEX® 540P.

PVC
Abbreviation for polyvinylchloride.

PVC-powder additive
Additives are added to PVC mixtures as matting agents, lubricants, colour pigments, wax for smooth surfaces.

Quad
Stranding type in which the four individual cores are twisted into a quad (telecommunications cables).

RAL
The RAL colours with four-digit numbers have been a yardstick in colouring for more than 70 years. The collection of colours currently includes more than 200 colours. The basic collection for mat shades is the RAL 840-HR register. The collection for gloss shades is the RAL 841-GL register. The basic collections

are continuously updated in line with the requirements of industry. These collections cover a wide range of applications. The registers provide a colour template for designs, but also include safety and signal colours and comply with the colour specifications in DIN standards.

Rated current
Current determined by the manufacturer, primarily at an ambient temperature of 40°C, which the connector can carry on a permanent basis and which simultaneously flows though all contacts which are connected to the largest possible conductor. In the process, not exceeding the upper limit temperature.

Rated voltage
Value of a voltage, measured according to the connector assembly and referring to specific operating conditions.

REACH
REACH directive (EC) No, 1907/2006 on registration, evaluation, authorisation and restriction of chemical substances With the REACH directive, the EU created a harmonised system for the registration, evaluation, authorisation and restriction of chemicals – referred to as REACH for short. The purpose of the directive is to ensure a high level of protection for human health and the environment.

Receiver sensitivity
The light output required by the receiver for low interference signal transmission. For digital signal transmission, the average light output (in W or dBm) required to achieve a bit error rate of 10 – 9 is normally specified.

Receiver, optical
Assembly for converting optical signals into electrical signals. It consists of a photodiode with a connecting fibre and plug and a low-noise amplifier and electronic signal processing circuits. Where possible, the main components of the receiver are normally combined into a compact sub-unit known as the reception module.

Reel
To keep setup times and transport costs down, the cable industry tries to supply large cables and long cable lengths on reels. In addition, this saves on connecting points and the associated fittings with longer cable lengths. The length supplied is limited by various factors, including the tensile strength and flexibility of the cable and the mass or cable volume. There are a large number of different reel sizes in the cable industry.

Reel size choice
Most winding systems in the cable industry now have tables showing the capacity and the product lengths and bending radii that can be wound, ensuring that the correct choice of reel can be made.

Reel structure
Reels consist of a circular core, which is bounded on both sides by flanges of larger diameter. The flange diameter is also the nominal size of the reel. Steel sockets are fitted in the centre of the reel flanges to hold the drive axes or barrels. These prevent damage to the reel flanges when winding and unwinding. On one reel flange (up to 1800 mm nominal size) there is a through hole for inserting one end of the cable;

on larger reels, an inlet spiral is fitted to hold the end of the cable. This means that both ends of the wound length of cable are accessible and final inspection of the cable length can be carried out. Shipping reels are normally made of pine or spruce wood.

Reeling
This refers to the ability of cables to withstand constant winding and unwinding over a long period of time without sustaining damage. For mobile consumers (e. g. a crane), the cable length required for the different working positions is carried on a reel. Constant winding and unwinding makes high demands on the cable construction, which means that only special cables are suitable.

Reference earth
Part of earth considered as conductive that lies outside the zone of influence of any earthing arrangement.

Reflexion
Signal reflections occur at coupling points between components such as plugs and cables and, in copper networks, can be attributed to different characteristic impedances: In cases of extreme differences in characteristic impedance, this leads to signal distortion.

Refractive index
The factor n, by which the light velocity in an optically dense medium (e. g. glass) is smaller than in free space. More accurate term: Phase refraction index.

Refractive index distribution, index profile
Progression of the refractive index n across the cross-sectional area of a fibre optic cable.

Resistance
Resistance = Voltage/Current: “Obstruction” of the current flow, expressed in Ohm. The lower the cross-section, the greater the resistance. The more Ohms, the weaker the current flow. See also → Corrosion resistance, ozone resistance, radiation-resistant cables.

Resistant
The cable has a resistance to certain substances, i. e. they do not destroy it.

Retention of cable glands
The ability of a cable gland to limit the movement of a secured cable under static load.

RFID
RFID stands for Radio Frequency Identification and means that data can be transmitted with no contact or line of sight.

RJ45
An RJ45 connection is an eight-pin miniature connector system, e. g. for patch cables. The connector is standardised to comply with the ISO/IEC 11801 cabling standard.

RoHS
The EC directive 2011/65/EU for limiting the use of certain hazardous substances in electrical and electronic equipment governs the use of hazardous substances in equipment and

components. Along with the applicable implementation in national law are referred to by the abbreviation RoHS (Restriction of (the use of certain) hazardous substances).

Route warning tape
In excavations, the greatest damage occurs on cables already laid in the ground. For this reason, route warning tapes are laid around 40 cm above the laid cables, which draws the attention of excavator drivers to the cable route when excavating.

Rubber insulated cable
Cable with rubber sheathing. For example, H05 RR/RN, H07 RR/RN at Lapp (previously: NMHöu/NSHöu).

S-FTP
The structure of shielded foil and braid twisted pair (S-FTP) cables is made up of a foil screen over all pairs, over which an additional screen of tin plated copper braiding is placed.

Same direction of lay
See → Stranding

Sample test, screening
Testing of production lengths or production parts in relation to production quantity.

Screened cable
Cables with screen in outer layer, over the cores or in double sheath. The screen can be made from braiding, foil or solid metal. With the foil version, a drain wire from the filler strand is used. Identified with a “C”, and with “CY” for additional PVC sheathing if copper braiding used.

Self-extinguishing
Property of a (synthetic) material to extinguish itself when a flame is removed from the material.

SEMCO
Swedish testing body, similar to the VDE.

Semi-conductor
Materials whose electrical conductivity depends on various influences, e. g. current direction, temperature, incidence of light. By mixing with conductive materials (carbon, graphite), insulating materials (PVC) can be modified to give semiconductor properties.

Semiconductor bandgap
Energetic distance between the valence band and the conduction band of a semiconductor.

Separating layer
Foils positioned between the individual layers on the cable core to prevent harmful influences.

Separator
Polyethylene terephthalate foils are used in the cable industry as insulating foils. They have excellent dielectric and mechanical properties. They are used as separating foils in PVC insulated cables.

SEV
Abbreviation for Schweizerischer Elektrotechnischer Verein [Swiss Electrical Engineering Association], testing body similar to the VDE.

Sheath print
The customer receives information about the printing of cable sheaths regarding design, testing- and operation-related markings, colour codes, customer-specific markings and manufacturer markings. The prints are created using laser and ink-jet printers or print wheels. They are, however, of inferior quality to the embossed letters as they wear away relatively quickly or can be rubbed off.

Sheathed cable
Designation for NYM and other sheathed cables.

Shielding
A cover made of conductive material that is placed over an individual core, a group of cores or all cores in a cable. Screening is used to protect the cable against penetration by electrical and/or magnetic fields and to prevent electrical interference from escaping from a cable. Screening takes various forms: a copper wire braid or → covering, copper or aluminium foil wrapping or enclosed tubular copper or aluminium bodies. For the screening, the covering density is defined in percent, relative to the area located below the braiding.

Shipping reels
The correct choice of shipping reel is a crucial factor in the quality of a cable from winding to installation. The reel size and thus the winding volume is determined by the diameter and length of the material to be wound and the mass of the cable. The delivery agreement between the manufacturer and the customer is determined by the diameter and mass from the production design and the product length. It is critical that the bending radius of the cable, which determines the size of the reel core, is maintained.

Shore
Hardness of the cable sheath. The definition is: The resistance to penetration by another body, which is measured without exception before the occurrence of damage. Shore A test is used for soft plastics, Shore D test for harder plastics.

SIA
Swiss format for invitations to tender.

Signal cable
Signal cables are used to control the accuracy and precision of electric motors. (For example, ÖLFLEX® connecting and control cables, ÖLFLEX® SERVO, UNITRONIC® data cables at Lapp).

Single conductor
Conductor which, unlike a strand, consists of just a single wire. A rigid wire is suitable for fixed installation.

Single wire
See → Cable, single-wire.

Single-mode fibre
Waveguide in which only a single mode can be propagated at the operating wavelength.

Single–wired conductor
A single-wire conductor consists of just one wire.

Skin effect
The higher the frequency of the effective or interference signal, the more the high frequency current is pushed towards the surface. The skin effect is the property of an alternating or high frequency current in a conductor to move towards the

surface due to field line induction processes. This limits the penetration depth of an external electromagnetic field into the object and thus its effectiveness inside.

Slave
Subscriber in a network that can only communicate in data exchange when addressed by the master (see → ASI).

SNA
Abbreviation for System Network Architecture. Network architecture concept that enables data to be transmitted between different types of computer.

Specific volume resistance
The specific volume resistance [Ohm m] results from the measured volume resistance [Ohm] multiplied by the measuring area [m^2] divided by the sample length [m]. VDE 0207, Part 4 and VDE 0303, Part 30.

Speed of signal propagation
Signals propagate in all cables at a speed that is always lower than the speed of light. The NVP value specifies the ratio of this speed to the propagation speed of light.

Spiral cable
Flexible cables that are formed into a “spiral spring”. The cable is wound onto a mandrel. The addition of heat (tempering) reduces the tensions in the plastic caused by the winding process, which means that the cable retains the spiral shape in a stress free condition after cooling. When expanded, the spiral extends and, when the force is no longer acting upon it, returns to its original condition.

Splice
Connection of two light waveguides created by melting their ends. Fixed connection between two light waveguides. A distinction is made between bonded and welded splices (→ Welded light waveguide connection).

Stabiliser
a) A component used in some plastics to obtain certain physical and chemical properties during processing and the usage time.
b) Additives (e. g. lead, tin or cadmium salts) for plastics. They delay or counteract the decomposition and aging process that occurs when exposed to thermal loads.

Step index fibre
Light waveguide with a stepped profile, i. e. with a refraction index profile that is characterised by a constant refraction index within the core and a sharp decline in the refraction index at the boundary of the core and the sheath.

STP
In twisted pair cables with foil screening of the individual pairs and an overall braided screening (STP = Individually Screened Foil and Braid Twisted Pair), the cores are twisted in pairs and individually screened with a metallic foil, to achieve exceptionally low near end crosstalk. An additional overall screen is then added.

Strain relief of cable glands
The ability of a cable gland to limit the movement of a secured cable under a dynamic and torsional load.

Strand
The individual wires in a conductor combined into a bundle; the number and individual wire thickness varies according to the desired cross-section. The individual wires are either bundled by stranding or by twisting. Individual cores, e. g. LiY, H05V-K, H07V-K

Stranding
The individual elements of cables are wound parallel around a central element. The elements can be the individual wires in a conductor or the cores or groups of cores themselves. Depending on requirements, the elements are twisted or stranded with different twist lengths. This is done in concentric layers, one on top of another, according to the number of elements. If the subsequent layer of the element is stranded in the same direction as the preceding layer, this is known as parallel lay stranding, as opposed to cross lay (reversed lay) stranding, where each subsequent layer is stranded in the opposite direction to the previous one. The stranding has an “S” lay if the stranding direction runs to the left as an observer looks at it, or a “Z” lay if the stranding runs to the right: A distinction is also made between stranding techniques with and without back twist.

Stranding machine, twister
Stranding machines are used to strand the components of a cable. Different types of stranding machines include single twist, double twist, multiple twist, high-speed, basket, SZ and universal stranding machines.

Strip line
Strip lines are used as fixed signal transmission cables in control and steering technology, measurement and data processing technology. They can contain up to 40 cores

which lie parallel to each as a result of the welded insulating cover. Single cores can be separated from the strip line, without causing any damage to the insulating cover. Their flat arrangement means they can be guided through narrow slots or openings. They are fixed in place using brackets or adhesive.

Styrol
Is used as an insulating material for telecommunication cables (→ Dielectric). It has a good strength value, however is not resistant to solvents.

Super conduction
The property of metals and oxides to lose their electrical resistance due to cooling when a so-called transition temperature is reached.

Supporting cable
Because of their small dimensions, they are used for installation in small and miniature equipment.

Supporting core
Strands of hemp, steel or plastic are incorporated into the construction as supporting elements or to absorb tensile forces. In most cases, the carrier organ is positioned next to the core, i. e. in the middle of cables. However, there are also constructions in which one or two steel strands are positioned outside the bunch of cores but below a shared outer sheath.

Surface mount base
Lower housing sections with an enclosed base are referred to as surface-mounted. Surface mounted bases are available

with a cable outlet on the right-hand side or on both sides of the housing.

Synthetic india rubber
Butyl synthetic rubber has a high resistance to ageing and lower gas permeability. It is highly resistant to chemicals.

T-Coupler
Optical component for combining the light from two light waveguides (see also → Coupler). Conversely, it can also be used to split the light output in one light waveguide into two outgoing light waveguides.

Take-up system
Sheathed cables are generally wrapped around wooden or process drums. The most common types of winding devices are bottom roller winders, axial winders and barrel winders. Depending on their flexural loading, tensile strain, torsional strain, design, storage, mechanical load and transport, cables are individually wrapped and delivered on drums, bobbins, in coils or barrels.

Talcum
Talcum is a mineral, slightly fatty natural product. It is used in powder form as a separating agent or lubricant. It is also used when mixed with mica. When sheathing a strand of cores, to prevent the sheathing material that is applied when hot from sticking to the core insulation, the strand is dusted with talcum first. As well as the separating effect, this greatly reduces the friction between the individual elements of the cable and thus promotes flexibility and stripping.

Tape
The stranded assembly, comprising several cores, is surrounded by the tape. Generally, the tape is made from one or several synthetic or paper band layers.

Tape wrapping
Cables can be wrapped in a variety of different insulating materials. The tape is always helically wrapped around the cable as the taping machine operates in a rotary motion and the pull-off movement is always in a longitudinal direction. Several layers of paper or plastic tape are wrapped around the cable stranding or the cable core.

TDR
The Time Domain Reflectometry measuring method is used to locate faults in copper cables. The running time and shape of a reflected pulse enables the possible location of the fault to be determined relatively accurately. For PVC insulated cores, this value is approx. 0.541.

Telephone cord
Cables to or in telecommunication devices which have a high flexural loading or flexibility.

Temperature range
If the specified minimum temperature range is not reached, no mechanical forces may act on the cable as otherwise the insulation will break (rigidity of polymer chains). If the maximum temperature is exceeded, the insulation begins to melt (decomposition of polymer chains). Important! With every change of temperature, the resistance of the conductor also changes.

Tensile load
The maximum force with which a cable can be loaded under defined conditions.

Test voltage
The voltage applied to a test specimen to demonstrate a particular electrical strength.

Tex
The fineness of fibres is determined using the “fineness in Tex” system. This is a physical variable. 1 Tex = a fibre that has a mass of 1g at a length of 1000 m. Example: Polyester silk has a rating of 7 Tex = 1000 m of silk weighs 7 g.

Thermal splice
A thermal splice is a connection between light waveguides created by fusing the ends of the conductors.

Thermoplastics, thermoplastic materials
Thermoplastics are non-cross linked macromolecular compounds. By heating, it is possible to transfer them repeatedly to a plastic condition. They are primarily used for sheathing and insulation of cables.

Thomson measuring bridge for resistance measurement
Primarily used to measure very low resistances. The measuring range is between 10-6 and one Ohm. It is independent of voltage changes. The measured result is not falsified by the resistance of the measuring lead and other transition resistances (see also → Electrical resistance).

Tight buffer tube
Fibre type used in light waveguides, with a solid plastic layer attached directly to the outer glass.

Tin
Tin is used for tin plating copper wires.

Torsion
Twisting of the cable about the longitudinal axis. VDE0298, Part 300, Section 5.4.4: Flexible cables are not generally intended for torsional loads. In cases where this kind of torsional load cannot be avoided, the construction of the cable and the type of installation must be agreed between the user and the cable manufacturer.

Tracer thread
A thread whose structure, colour or colour combination is registered and protected as a trademark by a cable manufacturer. It provides information about the manufacturer of the relevant cables (at Lapp, the colour is ochre yellow).

Train signal cable
Designed for voltages up to 600 V. Depending on their purpose, the cores are twisted in fours or layers. They are PE insulated. Because of the strong electromagnetic fields on railways, an effective copper screen and steel tape armouring must be fitted under the outer sheath.

Transceiver
This is the active component of an Ethernet LAN for connection of terminals to the electrical bus cable with collision detection and signal adaptation functions. Transceiver is a combination of the words transmitter and receiver. The transceiver performs transmitting, monitoring, reception and interference functions.

Transfer impedance
Measure for the quality of the screening, defined as the ratio of the voltage along the screening in the system subject

to interference to the current of the system causing the interference. The transfer impedance (coupling resistance) is the key variable for the quality of the screen and depends on the frequency. It is the ratio of the voltage drop along a screen on the side with interference (outside) to the interference current on the other side (inside) of the screen. The coupling resistance is determined by the construction of the screen, the skin effect and the capacitive coupling.

Transfer rate
The frequency at which the level of the transmission function of a light waveguide has reduced to half of its value at a frequency of zero, i. e. at which the signal attenuation has increased by 3 dB. As the transmission bandwidth of a light waveguide is approximately the reciprocal of its length (mode mixing), the bandwidth/length product is often specified as a quality feature.

Transmission function
A light waveguide acts as a low-pass filter for the signals to be transmitted. While only continuous wave attenuation is important for low signal frequencies (see also → Attenuation), higher signal frequencies are also attenuated as a result of the dispersion in the light waveguide. The transmission function of a light waveguide makes this a complex issue; however the phase distortion is normally so low that it is sufficient to specify the figure for the function.

Transmitter, optical
Assembly for converting electrical signals into optical signals. It consists of a transmission diode with connecting fibre, plug and driver amplifier and other electronic circuits. Particularly in laser diodes, a photodiode with control amplifier is required for monitoring and stabilising the radiated power.

In many cases, a temperature sensor and a Peltier cooler are also required to stabilise the operating temperature. Where possible, the main components of the transmitter are normally combined into a compact sub-unit known as the transmission module.

Triaxial cable
Three-conductor cable that is made up of three connected axes. It consists of one conductor in the centre, the second conductor concentric around the first and the third conductor is isolated from the first two, normally by insulation, a braid and an outer sheath.

Trimming
Cables are reeled at standard lengths of, for example, 50 m, 100 m and 500 m on cable drums or coils (single cores) and placed in storage. Should a customer require a length shorter than the standard length, the cable is cut to size. The customer is then charged for this adjustment.

TTP
Time Triggered Protocol systems in data technology communicate continuously at predefined time intervals. The bandwidth is 5 Mbit/s asynchronous and 25 Mbit/s synchronous (see also CAN bus system).

Tube cable
Coaxial carrier frequency cable with copper inner conductor, PE discs as spacers, a tube-shaped bend copper tape as the outer conductor and a lead or aluminium sheath. They are used as long-distance cables for transmission of TV signals and communications.

Twist protection
Protection of light waveguide connectors against twisting. Without this protection, the end faces of the light waveguide would be next to one another and become scratched, significantly increasing attenuation.

Type test
Test to be performed periodically that includes all parameters that can influence the result. This test must be performed again if advancements or new developments have been made or the material, technology or design has been changed. The frequency of type tests is set out in legislation, contracts or operationally.

UL
Abbreviation for Underwriters Laboratories. American testing body, similar to the VDE in Germany.

UL Approbation for cable glands
Approval is particularly required if the machinery or system in which the cable gland has been used is to be exported to the USA. Approval is granted after a test complying with UL 514B and is confirmed by a certificate. The number of this certificate is known as the "file number" (e. g. E 79903).

UL listing mark for listed cables & wires
Cables intended for use as fixed wiring in buildings used for residential, commercial or industrial purposes. Listed cables not only have to meet individual UL product standards, but must also comply with the relevant articles of the National Electrical Code (NEC). Listed cables and wires can be used both for factory wiring of electrical equipment, devices, appliances and machines as well as for field wiring of industrial machinery and systems in accordance with NFPA 79. Approval marking on the product: (UL) = UL Listing mark.

UL recognition mark for AWM cables and wires
Appliance wiring material or "AWM" comprises cables intended solely for use in factory-wired electrical equipment, devices, appliances, control cabinets and industrial machinery as part of a "listed assembly". AWM is not intended for field wiring purposes. Cables with UL AWM style labelling must be used for the applications stipulated by the individual style designation.

Ultraviolet radiation
This invisible radiation is the section of the electromagnetic spectrum that is next to the visible range (UV radiation).

Underground cable
Cables are often designated according to their usage conditions. Underground telecommunication cables include outdoor cables designed to be routed underground.

Unit conductor of power cables
Unit conductors are solely used as large conductors, from approx. 400 square millimetres. In order to reduce the large amount of heat required during welding, the bundles are separated into subconductors during assembly and rejoined again in a new stranding procedure.

Unit cores of fiberoptic cables
Several coated fibre optic cables lightly undulating and loose in small plastic pipes which are filled with Vaseline or swelling powder.

Unit of wires
Bare wire bundles are the initial product for copper strands. They are also used as copper strands in wire screens (non-insulated product).

UTE
Abbreviation for Union Technique de l'Electricité (France).

Vagrancy currents
Currents that do not flow through the electrical mains (L1, L2, L3, N) are referred to as vagrancy currents.

VDE
Abbreviation for Verband Deutscher Elektrotechniker e.V., [German Electrical Engineering Federation], VDE testing and certification institute – VDE testing body.

VDE Approbation for cable glands
Approval is granted after a test complying with DIN/EN 50262 and is confirmed by an approval certificate,

VDEW
Abbreviation for Vereinigung Deutscher Elektrizitätswerke [Association of German Electricity Plants].

Velocity of propagation
Transmission speed of the electrical energy in a length of the cable compared to the light speed in free space. Usually expressed as a percentage.

Volt
Electrical unit of measure for voltage. 1 Volt is the voltage produced by a current of 1 A with a resistance of 1 Ohm. Voltage = Resistance x Current

Volt meter
Instrument for measuring voltage.

Voltage-level classes
We refer to four voltage levels. Everything that is < 1000 Volt (< 1 kV) belongs to the low voltage class. Voltages > 1 kV are classed as high voltage. In practice (no statutory specification), the high voltage class is divided into: Medium voltage 1 kV – 30 kV, high voltage 50 kV – 150 kV, extremely high voltage 150 kV – 400 kV. There are several different voltage levels within these classes.

Voltage, tension
Electrical unit of measure, measured in Volts, i. e. Voltage = Resistance x Current.

VSWR (Voltage Standing Wave Ratio)
Ratio of the transmitted signal voltage to the reflecting signal voltage measured along the transmission path.

Vulcanising
Technological process in which temperature, pressure and the use of sulphur compounds, for example, cause the molecules in rubber to form cross linkages. It is this process that gives rubber its permanent elasticity and makes it suitable for industrial use (see → Cross linking).

Wall thickness
The thickness of the insulation or sheath.

WAN
WAN is the abbreviation for Wide Area Network. This is a large network, which can extend worldwide. WANs normally connect LANs (Local Area Networks) via telephone cables.

Routers and gateways connect the LANs using different technologies. WAN is a wide area transmission network for connecting distance users to a central network using public cables.

Watt
Electrical unit of measure for power V x A = Watts (VA).

Wave lengths
Length of a full wave oscillation (period). In optical signal technology, three wavelength ranges are normally used – 850 nm, 1300 nm and 1550 nm.

Waveguide dispersion
The dispersion that occurs with non-monochromatic light sources because the a/l relationship and, as a result, field distribution and group speeds of the modes in a light waveguide are wave dependent (a is the core radius, l is the light wavelength). In practice, waveguide dispersion always acts in conjunction with material dispersion; its overall effect is referred to as chromatic dispersion.

Wear resistance
The characteristic of a cable, wire or material to withstand surface wear.

WEEE directive
Under electrical and electronic equipment legislation (ElektroG in Germany), the WEEE directive governs the withdrawal of electrical and electronic products.

Wire drawing
Cold forming process, in which a sequence of increasingly small drawing dies (carbide cores or diamonds) gradually reduce the cross-section of pressed wire or wire rod.

Wire termination technique
Depending on the application, different wire termination methods can be chosen. Where ease of service and maintenance is required, a screw fitting is used. If large numbers of plug connectors with a reliable connection method are required, crimping is the best choice. A cage clamp combines ease of service with reliable wire termination, although the space required per contact for the wire termination is the highest of all the methods described here.

Wire–wrap connection
This is an electrical connection made without soldering. The contact is made by wrapping a bare copper wire around a square rod made of bronze, brass or silver under high tension (also known as cold welding).

Wiring cable
Cable for wiring equipment, control cabinets etc.

Wiring system
Wiring systems are made up of a variety of individual elements, such as cable sheathing, contact plugs, connector shells, seals, fixing elements, etc. In a car, the wiring system connects the electromechanical and electrical components and guarantees the transmission of information from and between the control units, as well as for the supply of energy to the consumers (engine, relay, lighting, etc.).

Working current, service current
The maximum permissible current that may be transmitted.

Woven cable
Several conductors running parallel which are held together using a thin sheath. See also → Flat cable.

Zinc
In the cable industry, galvanised steel tape or steel wire are used as the armouring material (→ Armouring) to protect against corrosion.

ZVEH
Abbreviation for Zentralverband der Deutschen Elektrohandwerke e.V. [Central Association of German Electrical Trades] (Germany).

ZVEI
Abbreviation for Zentralverband der Elektrotechnik- und Elektronik Industrie e.V. [Central Electrical Engineering and Electronics Industry Association] (Germany).

Absorption	See Glossary
ACR	See Glossary
Actor Sensor Interface	ASI
Address bus	Adressbus
Adhesion	Adhäsion
Aging	Alterung
Aging resistance	Alterungsbeständigkeit
Alternating current	Drehstrom
Aluminium sheath	Aluminiummantel
American wire gauge	AWG, AWG-Leitungen, AWG-Adern
Ampacity	Strombelastbarkeit
Ampere	See Glossary
Analog signal transmission	Analogsignalübertragung
Angle of beam spread	Öffnungswinkel
ANSI	See Glossary
Antenna cable	Antennenkabel
Anti-kink cable glands	Knickschutz von Kabelverschraubungen
Antioxidant	Alterungsschutzmittel
Approved cables	Approbierte Leitungen
Armour	Bewehrung
Armouring	Armierung, Panzerung, Bewehrung
Armouring types	Bewehrungsarten
AS	AS
ASME	See Glossary

Assembly	Konfektionierte Leitung
ASTM	See Glossary
ATEX approval	ATEX-Zulassung
Attenuation	Dämpfung
Attenuation a	Dämpfung A
Attenuation coefficient a	Dämpfungskoeffizient a
Automative cable	Fahrzeugleitungen
AWM	See Glossary
Backbone	See Glossary
Backscatter	Rückstreuung
Backtwist	Rückdrehung
BALUN	See Glossary
Banding	Bandierung
Bandwidth	Bandbreite
Bandwidth product	Bandbreitprodukt
Bandwidth-length product	Bandbreiten-Längenprodukt
BASEC	See Glossary
Basic raw materials	Basisrohstoffe
Batteries Act	Batteriegesetz – BattG
Battery cables	Batterieleitungen
Baud	See Glossary
Bel	See Glossary
Bending capacity	Biegefähigkeit
Bending cycle	Biegezyklen
Bending radii	Biegeradien
Bending test at low temperature	Kältewickelprüfung

Binary	Binär
Bit	See Glossary
Bit error rate, BER	Bitfehlerrate
Blue cable	Blaue Leitung
Braid angle	Flechtwinkel
Braiding	Geflecht
Breakdown	Durchschlag
Breaking load	Bruchlast
British Standard Wire Gauge	See Glossary
Broadband	Breitband
BS	See Glossary
BSI	See Glossary
Bundle	Bündel
Bus-system	Bus-System
Cable	Kabel, Leitung
Cable carrier	Energieführungskette
Cable data	Kabeltypendatei
Cable gland	Kabelverschraubung
Cable gland sizes	Kabelverschraubungsgrößen
Cable print	Aufdruck
Cable set-up	Kabelaufbau
Cable tree	Kabelbaum
Cable type letter code	Leitungskurzbezeichnung
Cables for hand-held machinery	Handgeräteleitungen
Caloric load values	Brandlast
Campus	See Glossary

CAN	See Glossary
Canadian Electrical Code	See Glossary
Capacity	Kapazität, Leistung
Carrier frequency	Trägerfrequenz, Trägerfrequenzschaltung
CCC	See Glossary
CE	See Glossary
CE marking	CE-Kennzeichnung
CEBEC	See Glossary
CEC	See Glossary
CEE	See Glossary
CEI	See Glossary
CENELEC	See Glossary
Central element	Seele
Central filler	Kern
Characteristic Impedance	Impedanz, Wellenwiderstand
Chopper	Zerhacker
Chromatic dispersion	Chromatische Dispersion
Circular Mil (CM)	See Glossary
Cladding	See Glossary
Clamping range	Klemmbereich der Kabelverschraubung
CNOMO	See Glossary
Coating	Beschichtung
Coaxial cable	Koaxial-Kabel
Colour code	Farbcode
Colour print	Bedrucken mit Farbe

Communication	Kommunikation
Compensating cable	Ausgleichsleitung, Kompensationsleitung
Composite layer	Schichtenmantel
Composite sheath	Schichtenmantel
Compound	See Glossary
Concentric conductor	Konzentrischer Leiter
Conditioning	Aufmachung
Conductance	Konduktanz
Conductor	Aderleitung, Leiter, Ader
Connecting cable	Anschlussleitung
Connector	Stecker, Steckverbinder, Sternkoppler
Contact voltage	Berührungsspannung
Control cables	Steuerleitungen
Copolymere	Copolymer
Copper	Kupfer
Copper base	Kupferbasis
Copper weight	Kupferzahl
Copper-clad aluminium wire	Verbunddraht – Aluminium/Kupfer
Core	Ader, Blindader
Core check, response at increased temperature	Aderprüfung, Verhalten bei erhöhter Temperatur
Core check, response with thermal shock	Aderprüfung, Verhalten bei Wärmeschock
Core diameter	Kerndurchmesser
Core group	Adergruppe

Core Ident Code	Ader-Ident-Code
Core identification	Aderidentifizierung
Core joint	Aderverbinder
Core print	Bedruckung – Adern
Core stranding	Verseilverband, Verseilverbund
Core stranding with more than four cores	Verseilverband aus mehr als vier Adern
Core wrapping	Aderumhüllungen
Corrosion	Korrosion
Coupler	Koppler
Crane cables	Kranleitungen
Crimp connection	Crimpen
Cross-linked	Vernetzung
Cross-linked polyethylene XLPE	VPE
Cross-linking agent	Vernetzer
Cross-section	Querschnitt
CSA	See Glossary
Current	Stromstärke
D.C.	See Glossary
Dark current	Dunkelstrom
Data bus	Datenbus
Data transfer	Datenübertragung
Data transmission	Datenübertragung
Data transmission cable	Datenübertragungskabel, Datenkabel
Data transmission rate	Datenübertragungsrate

Decibel	Dezibel
Degrees of protection	Schutzarten
DEL	See Glossary
DEMKO	See Glossary
Density	Dichte
Density unit	Dichtezahl
Designation label	Beschriftungsbinder
DESINA®	See Glossary
DeviceNet™	See Glossary
Dielectric	Dielektrikum
Dielectric constant (DC)	Dielektrizitätskonstante (DK)
Diffusion	Streuung
Digital signal transmission	Digitalsignalübertragung
Dimension	Abmessung
DIN	See Glossary
DIN EN	See Glossary
Direct line	Anschlussleitung
Dispersion	See Glossary
DKE	See Glossary
Drag chain cables	Schleppkettenleitungen
Drain wire	Beidraht
Ductility	Biegbarkeit
Dummy	Blindelement
Duplex operation	Duplexbetrieb
Duroplastic	Duroplaste
Earth connection	Betriebserdung
Earth electrocode	Erder

Earthing	Erdung
ECAD-Bauteilenorm	See Glossary
EIA	See Glossary
Elastomere	Elastomer
Electric circuits	Stromkreise
Electric diameter of conductors	Elektrischer Leiterquerschnitt
Electric Field	Elektrisches Feld
Electric resistance	Elektrischer Widerstand
Electricity	Elektrizität
Electromagnetic protection	Elektromagnetischer Schutz
Element	See Glossary
Elongation	Dehnung
Elongation at break	Bruchdehnung
ELOT	See Glossary
EMC	EMV
EMK	See Glossary
EMS	See Glossary
EN	See Glossary
EPDM	See Glossary
EPIC®	See Glossary
ePLAN®	See Glossary
Ethylene-Propylene-Rubber	Ethylen-Propylen-Kautschuk
Explosive atmospheres	Explosionsfähige Atmosphäre
Extension	Dehnung
Extension cord	Verlängerungsleitung

Extrusion line	Extruder
Fibre cover	Faserhülle
Fieldbus technology	Feldbustechnik
Filler	Füllstoff, Blindader, Beilauf
Filler wire	Beilaufdraht
Fire behavior	Brennverhalten
Fire resistant	Flammwidrigkeit
Flame retardant	Schwer entflammbar
Flat cable	Flachbandleitung
Flat type cable	Flachkabel
Flexibility	Flexibilität, Biegbarkeit
Foil	Folie
Frequency	Frequenz
Full duplex	Vollduplex
General cable tie	Universalkabelbinder
Glass fibre cable	Lichtwellenleiter (LWL), Lichtleiter-Kabel
Gradient fibre	Gradientenfaser
Grid	Raster
Ground system	Erder
Gusset	Zwickel
Halogen free	Halogenfrei
Hardness	Härte
Harmonizing key	Harmonisierungsschlüssel
Heat of combustion	Verbrennungswärme
Hood	Tüllengehäuse
Hood termination	Endkappen

Hook-up wire	Trägerfrequenzschaltung
Hybrid cable	Hybridkabel
Imprinting	Prägung
Index profile	Brechzahlprofil
Industrial machinery for USA	Industrielle Maschinen in den USA
Ink-jet printer	Bedruckung – Kabelmäntel und Leitungen – Laser- und Tintenstrahldrucker
Insertion attenuation	Einfügungsdämpfung
Insertion loss	Einfügungsdämpfung
Insulated wire	Ader
Insulation	Isolation
Insulation resistance	Isolationswiderstand
Intensity	Intensität
Interactive	Interaktiv
Interface	Schnittstelle
Intrinsically safe	Eigensicher
Joint	Knoten
Kink	Knick
Laser-printer	Bedruckung – Kabelmäntel und Leitungen – Laser- und Tintenstrahldrucker
Laying temperature	Verlegetemperaturen
Leading protective ground	Schutzkontakt, voreilend
Leakage current	Ableitstrom
Length of lay	Schlaglänge
Length of twist	Schlaglänge

Lever series	Bügelarten
Lift cable	Hängekabel
Longitudinal water tightness	Längswasserdichtigkeit
Loss factor	Verlustfaktor
Machine set-up for conductor insulation – Extrusion	Anlagenaufbau für Isolierhüllen – Extrusion
Master-Slave principle	Master-Slave-Prinzip
Material dispersion	Materialdispersion
Mica powder	Glimmer
Microbending	Mikrokrümmungen
Mode	Moden
Mode dispersion	Modendispersion
Monomode fibre	Monomodefaser
Motor cable	Motorenkabel
Multimode fibre	Multimodefaser
Mutual capacity	Betriebskapazität
Nanosecond	Nanosekunde
Near-end crosstalk, far end crosstalk	Next, Fext (Nebensprechdämpfung)
Neoprene®	Neopren®
Network	Netzwerk
Neutral conductor	Erdleiter, Neutralleiter
Nominal voltage	Nennspannung
Norms	Normen
Numeral identification	Ziffernbedruckung
Numerical aperture	Numerische Apertur

Ohmic resistance	Leiterwiderstand
Operating capacity	Betriebskapazität
Operating supplies	Betriebsmittel
Operating temperature range	Betriebstemperatur
Operating voltage	Betriebsspannung
Opposite direction of lay	Gegenschlag
Order length	Bestelllänge
Outdoor cable	Außenkabel
Outer conductor	Außenleiter
Outer diameter	Manteldurchmesser
Outer sheath	Außenmantel, Mantel
Overcurrent	Überstrom
Overcurrent protection devices	Überstromschutzorgane
Oxidation inhibitor	Alterungsschutzmittel
Oxygen index	Sauerstoffindex
Pad	Füller
Pair	Paar
Panel mount base	Anbaugehäuse
Patch cable	Patchkabel
Patch field	Patchfeld
Photovoltaic	Photovoltaik
Pigtail	Anschlussfaser
Pollution level	Verschmutzungsgrad
Polyamide	Polyamid
Polycarbonate	Polycarbonat

Polychloroprene-rubber	Chloropren-Polymerisate, Kunstkautschuk
Polyethylene	Polyethylen (PE)
Polyuretane	Polyurethan
Polyvinylchloride	Polyvinylchlorid
Power dissipation factor	Verlustleistung
Preform	Vorform
Print wheel	Bedruckung – Kabelmäntel und Leitungen – Druckrad
Protective conductor	Schutzleiter
PVC-powder additive	PVC-Pulver-Additive
Quad	Vierer
Rated current	Bemessungsstrom
Rated voltage	Bemessungsspannung
Receiver sensitivity	Empfängerempfindlichkeit
Receiver, optical	Empfänger, optischer
Reel	Trommel
Reel size choice	Trommelauswahl
Reel structure	Trommelaufbau
Reeling	Trommelbar
Reference earth	Bezugserde
Refraction index	Brechungsindex, Brechzahl
Refractive index distribution	Brechzahlprofil
Resistance	Beständigkeit, Widerstand
Resistant	Resistent
Retention of cable glands	Rückhaltevermögen von Kabelverschraubungen

Route warning tape	Trassenwarnband
Rubber insulated cable	Gummischlauchleitung
Same direction of lay	Gleichschlag
Sample test	Auswahlprüfung
Screened cable	Abgeschirmte Leitungen
Screening	Auswahlprüfung
Self-extinguishing	Selbstverlöschend
Semiconductor	Halbleiter
Semiconductor bandgap	Bandabstand
Separating layer	Trennschicht
Separator	Trennfolien, PETP-Folien
Service current	Betriebsstrom
Sheath print	Bedruckung – Kabelmäntel und Leitungen
Sheathed cable	Mantelleitung
Shielding	Abschirmung
Shipping reels	Versandtrommeln
Signal cable	Geberleitungen
Single conductor	Massivleiter
Single wire	Eindrähtig
Single-mode fibre	Einmodenfaser
Single–wired conductor	Leiter, eindrähtig
Skin effect	Skin-Effekt
Specific volume resistance	Spezifischer Durchgangswiderstand
Speed of signal propagation	Signalausbreitungs-geschwindigkeit (NVP)

Spiral cable	Spiralkabel
Splice	LWL-Schweißverbindung, Spleiß
Stabiliser	Stabilisator
Step index fibre	Stufenfaser
Strain relief of cable glands	Zugentlastung von Kabelverschraubungen
Strand	Litze
Stranding	Verseilung
Stranding machine	Verseilmaschine
Stretch	Dehnung
Strip line	Bandleitung
Styrol	Butadien-Styrol-Kunstkautschuk
Super conduction	Supraleitung
Supporting cable	Tragarmleitung
Supporting core	Tragorgan
Surface mount base	Sockelgehäuse
Synthetic india rubber	Butyl Kunstkautschuk
T-Coupler	T-Koppler
Take-up system	Aufwickelanlagen, allgemein
Talcum	Talkum
Tape	Bebänderung
Tape wrapping	Bewickeln mit Bändern
Taped wrapping	Bewicklung, Lapping, Taping
Telephone cord	Apparateleitung
Temperature range	Temperaturbereich

Tensile load	Zugbelastung
Tension	Spannung
Test voltage	Prüfspannung
Thermal splice	Thermospleiß
Thermoplastic materials	Thermoplaste
Thermoplastics	Thermoplaste
Thomson measuring bridge for resistance measurement	Thomson-Messbrücke zur Widerstandsmessung
Tight buffer tube	Vollader
Tin	Zinn
Tracer thread	Kennfaden
Train signal cable	Eisenbahn-Signalkabel
Transfer impedance	Transferimpedanz, Kopplungswiderstand
Transfer rate	Übertragungsbandbreite
Transmission function	Übertragungsfunktion
Transmitter, optical	Sender, optischer
Triaxial cable	Triaxial Kabel
Trimming	Ablängen
Tube cable	Tubenkabel
Twist protection	Verdrehschutz
Twister	Verseilmaschine
Type test	Typprüfung
UL listing mark for listed cables & wires	UL Listing Mark für “listed cables & wires”
UL recognition mark for AWM cables and wires	UL Recognition Mark für “AWM cables and wires”

UL-Approbation for cable glands	UL-Zulassung für Kabelverschraubungen
Ultimate elongation	Bruchdehnung
Ultimate load	Bruchlast
Ultraviolet radiation	Ultraviolette Strahlung
Underground cable	Erdkabel
Unit conductor of power cables	Bündelleiter von Starkstromkabeln
Unit cores of fiberoptic cables	Bündeladern von Lichtwellenleitern
Unit of wires	Drahtbündel
Vagrancy currents	Vagabundierende Ströme
Valley sealer	Beilauf
VDE Approbation for cable glands	VDE-Zulassung für Kabelverschraubungen
Velocity of propagation	Ausbreitungsgeschwindigkeit
Volt meter	Voltmeter
Voltage	Spannung
Voltage Standing Wave Ratio	VSWR
Voltage-level classes	Spannungsebenen
Vulcanising	Vulkanisation
Wall thickness	Wanddicke
Wave lengths	Wellenlänge
Waveguide dispersion	Wellenleiterdispersion
Wear resistance	Abriebbeständigkeit
WEEE directive	WEEE-Richtlinie
Wide Area Network	WAN

Wire drawing	Drahtziehen
Wire termination technique	Leiteranschlusstechnik
Wire-wrap connection	Wickelverbindung
Wiring cable	Verdrahtungsleitung
Wiring system	Bordnetze
Working current	Betriebsstrom
Woven cable	Bandkabel
Zinc	Zink

Imprint
Responsibility:
Bülent Kulay
Marketing Communications

Design and layout:
AVS Werbe- und
Veranstaltungsagentur GmbH

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Edition: 20.000

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