B05: Cable protection and sheathing

SHEATHING MATERIALS

MDPE, BLACK

This is the standard sheathing material for cables for outdoor use. The material is UV stabilised with using 2.5 ± 0.5 % carbon black. It has excellent weathering resistance.

The MDPE has very good physical properties such as: Excellent abrasion resistance, high hardness, low dielectric constant and outstanding oxidation resistance.

Compared with HDPE the MDPE has better resistance to stress cracking. Compared to LDPE the MDPE has a higher strength.
The MDPE meets the requirements of a number of national and international standards:

- ISO 1872-PE, KGC, 40 - G200, C
- ASTM D1248-84: Type II, Class C, Cat 5
- BS 6234 3C
- The MDPE fulfils the requirements of IEC 708-1 (test according to IEC 811)

LDPE, BLACK

This is the alternative PE material for cables for outdoor use. The material is UV stabilised using 2.5 ± 0.5 % carbon black and have excellent weathering resistance.

The LDPE material is used for UNI tube cables and when specified according to customer request.

The LDPE meets the requirements of a number of national and international standards:

- ISO 1872-PE, KCHL, 18 - D003
- ANSI C 8.35
- ASTM D1248-84: Type I, Class C, Cat 5, grade J3, E5
- BS 6234 03C, TS1
- DIN VDE 0207 type 2YM2
- NF C 32-060
- The LDPE fulfils the requirements of IEC 708-1 (test according to IEC 811)

MDPE, COLOURED

The coloured MDPE is used for outdoor cables where the customer requires a cable sheath of other colours than black. The material is UV stabilised for good weathering stability.

Standard sheath colours are: Orange, red, green, blue and violet. Other colours according to IEC 304 or sample are possible.

The natural base material meets the requirements of a number of national and international standards:

- ISO 1872-PE, KNH, 27-D003
- ASTM D 1248 Type II, Class A, Cat 5, Grade E4, E5
- DIN VDE 0207 2YI1, 2YI3.
- NF C 32-060
- BS 6234: type 03

STANDARD MULTIPURPOSE LSZH

Our standard LSZH (Low Smoke Zero Halogen) material is produced from polyolefin's and is filled with flame-retardants in the form of aluminium or magnesium hydroxide.

This sheathing compound is used for indoor as well as multipurpose cables.
Other colours according to colour standards or a sample are possible.

The LSZH material meets the requirements of a number of national and international standards:

- EN 50290-2-27:2002

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Important properties of the material are given in Table 1 below.

FireBur®

The FireBur® Low Smoke Zero Halogen material is produced from PE-copolymers and silicon elastomer with chalk as fire retardant filler.

This sheathing compound is used for cables that are installed as indoor/outdoor cables, due to its very low water absorption.

The cables made with this compound can be used outdoor installation in ducts (also flooded with water) as well as for direct burial.

The FireBur® sheathing material is UV stabilized using a selected type of hindered amine light stabilizer (HALS). Thus a long lifetime even in the open air is assured.

Cables made with this material is self-extinguishing and fulfils IEC 60332-1.

The material fulfils the requirements of:

- EN 50290-2-27:2002
- VDE0207 Teil 24 (HM5).

Important properties of the material are given in Table 2 below.

FireRes®

The FireRes® sheathing material is a high performance state-of-the-art LSZH (Low Smoke Zero Halogen) material.

The FireRes® material is primary used where a very high resistance towards fire is needed.

While the FireRes® material implement improvements of Draka Comteq's well known multi purpose concept regarding performance in case of fire, the resistance towards the outdoor environment is retained: The FireRes® material is UV resistant, and water resistant.

The UV resistance is achieved using a selected type of hindered amine light stabilizer (HALS). Thus a long lifetime even in open air is assured.

The FireRes® material is non- toxic, non-corrosive and do not contain any halogens that could cause damage to equipment or the environments.

Further in case of fire it generates only extremely low amount of smoke.

The FireRes® material fulfils all relevant international and national standards for this class of sheathing material, among them:

- EN 50290-2-27:2002
- VDE 0207 part 24, type HM2
- BS 7655 6.1 type LTS1 and LTS2

Cables made with our FireRes® sheathing material is self-extinguishing and generally fulfils IEC 60332-3C.
The FireRes® material is used as part of the A.F.R. Technology® to achieve fire resistance for Firetuf® FO cables.

Important properties of the material are given in Table 3 below.

PA 12

A PA12 outer jacket is used optionally on top of a black MDPE sheath. This jacket gives the cable a hard, smooth surface. The hardness is >71 (Shore D according to DIN 53505 and ISO R868).

The PA12 jacket adds a number of features to the cable: The cable gets improved rodent protection properties. The friction between cable and a PE duct is reduced with approximately 50%.

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The PA12 jacket has a good chemical resistance towards certain chemicals:

At moderate temperatures the material is resistant without appriciable swelling to water, dilute and concentrated alkalis, edible, lubricating and diesel oils, aliphatic hydrocarbons, esters, ketones and ethers.
At room temperature, the material is resistant to dilute organic acids and to very dilute mineral acids.

Standard colour for the PA12 jacket is orange and black.

PP

A PP outer jacket is used optionally on top of a black MDPE sheath. This jacket gives the cable a hard surface.

The PP jacket adds a number of features to the cable: The cable gets improved rodent protection properties. The friction between cable and a PE duct is somewhat reduced. The outer PP jacket is 0,5 mm thick.

Standard colour for the PP jacket is orange.

METALLIC PROTECTION OF THE CABLES

ALUMINIUM TAPE MOISTURE BARRIER

Aluminium moisture barrier in the form of a folded tape is mainly used for telecom trunk lines. The aluminium tape is adhesively bonded to the outer jacket, which is made of LDPE or MDPE. This type of jacket is often called a 'LAP' sheath and in German a 'Schichtenmantel'.

The aluminium moisture barrier fulfils the requirements of:

- IEC 708-1
- IEC 794-3
- EN 187 100
- DIN/VDE 888-3 (DIN/VDE 816-1) (together with a black LDPE jacket.)

The nominal thickness of the aluminium tape is 0.20 mm. There is a polymer film on both sides of the aluminium tape.

The nominal thickness of the polymer film is 0.05 mm. The adhesion between aluminium tape and the polyethylene sheath is fulfilling the requirements of IEC 708-1.

The tape is folded with an overlap.
As standard the aluminium tape is surrounded by a 1.8 mm thick LDPE or a MDPE jacket.

The combined thickness of the aluminium tape and the jacket is thus >2.0 mm.

CORRUGATED STEEL TAPE ARMOURING

Corrugated steel tape armouring is used as rodent protection and as additional mechanical protection for outdoor cables for direct burial and for installation along railways and into sewers where the risk for rodent attack is high.
Cables with corrugated steel tape and LDPE or HDPE jacket fulfils the requirements of:

- REA PE 90 (USA)

As well as the requirements of several Railway administrations: Among them Banestyrelsen (Denmark), SNCF and RATP (France), BR (Great Britain).

The steel tape is corrosion protected with a layer of chromium on both sides.
The steel tape fulfils the requirements of:

- EN 10 202: 1989
- ASTM A 657 - 87

The standard thickness of the steel tape is 0.155 mm ± 0.015 mm.

Upon request tapes with a thickness of 0.250 mm may be supplied.

There is a polymer film on both sides of the steel tape.

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The nominal thickness of the polymer film is 0.055 mm. The purpose of the polymer film is to ensure good adhesion between tape and outer (LDPE or MDPE) jacket and make the bonding of the overlap possible.

The adhesion between steel tape and a polyethylene sheath is fulfilling the requirements of REA PE-90.

A common trade name for this material is Zetabon™.

The steel tape is corrugated and folded over the cable core or an inner jacket. On top of the steel tape is extruded an outer polymer heath.

NON-METELLIC PROTECTION AND REINFORCEMENT OF THE CABLES

ARAMID YARNS

Aramid yarns are used as strength member for cables with tightly buffered fibres, some cables with semi tight fibres and for UNI tube cable.

Aramid yarns are also used in loose tube cables with central strength member as additional tensile reinforcement.

There are no international or national standards for Aramid yarns. The most common trade names for Aramid yarns are Twaron™ and Kevlar™.

The tensile strength requirement for the cable determines the amount of Aramid yarn to be used.

GLASS YARNS

Glass yarns in the form of rovings are used as alternative strength member for UNI tube cables. Glass yarns are also used in loose tube cables with central strength member as additional tensile reinforcement.

Thick layers of glaziers have appeared to be a good rodent protection scheme, however not as effective as steel armouring.

FRP ELEMENTS

Flat FRP elements are excellent means of making non-metallic armour of optical cable.
The FRP elements are glass fibre – polymer composites having high tensile strength and great hardness.
The flat FRP elements, used as an armouring provides cables with high tensile strength, and an effective rodent protection.
Tests have shown that FRP elements are the only means of providing a secure non-metallic rodent protection of optical cables.

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Table 1: Typical properties of standard multipurpose LSZH

Property	Test reference	Result
Density	ASTM D792	≈1.6 kg/m^3
Tensile strength and elongation at break	IEC 60811-1-1 EN 60811-1-1	Tensile strength: 11 MPa Elongation: 180 %
Tensile strength and elongation at break after ageing 7 days at 100 °C	IEC 60811-1-2 EN 60811-1-2	Tensile strength: 14 MPa Elongation: 120 %
Change in tensile strength and elongation at break after 7 days at 23 °C in ASTM oil no. 2	IEC 60811-1-1-9	Tensile strength: <1 % Elongation: -22 %
Change in tensile strength and elongation at break after 4 hours at 70 °C in ASTM oil no. 2	IEC 60811--11-9	Tensile strength: -5 % Elongation: -5 %
Hot pressure at 80 °C	IEC 60811-3-1	33 %
Oxygen Index	ISO 4589-2	40 %
Smoke density	IEC 61034	Pass
Smoke corrosivity	IEC 60754-2	Pass: Conductivity 42 µS/cm (requirement < 100 µS/cm); PH = 4,5 (requirement pH > 3.5)
Toxicity index	NES 713	1.6

Table 2: Typical properties of FireBur®

Property	Test reference	Result
Density	ASTM D792	≈1.2 kg/m^3
Tensile strength and elongation at break	IEC 60811-1-1 EN 60811-1-1	Tensile strength: 11 MPa Elongation: >400 %
Water absorption after 10 days at 70 °C	IEC 60811-1-3	0.11 mg/cm^3
Flexural modulus	ISO 178	205 MPa
Change in tensile strength and elongation at break after ageing 10 days at 100 °C	IEC 60811-1-2 EN 60811-1-2	≤ 20 %
UV and humility aging 240 days (20 hours UV light at 60 °C and 4 hours damp heath at 50 °C each day)	Draka	Change in tensile strength: -9 % Change in elongation: -16 %
Acid and base resistance (28 days at 23 °C) HCL (37 %) $NaCO_3$ (pH 8) NH3 (10 %; PH 10 – 11) Acetic acid (20 %)		% Change: Tensile strength/Elongation at break -6/-7 -4/-6 -9/-3 -6/-4
Change in tensile strength and elongation at break after 4 hours at 70 °C in ASTM oil no. 2	IEC 60811--11-9	Tensile strength: -20 % Elongation: -3 %
Fluid resistance 24h at 49 °C Diesel Hydraulic oil Mil 5606		% Change: Tensile strength/Elongation at break -73/-43 -49/-41
Fluid resistance 14 days as 23 °C Petrol Acetone		% Change: Tensile strength/Elongation at break -41/-29 -18-7
Solvent resistance 14 days at 23 °C		% Weight Change

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Iso Octane Kerosene, paraffin Ethanol Acetone		Small 10.5 1.0 3.0
Hot pressure at 80 °C	IEC 60811-3-1	25 %
LOI	BS 2782: Method 141:1986	32 %
Smoke density	IEC 61034	Pass
Smoke corrosivity	IEC 60754-2	Pass: Conductivity 1.5 μS/cm (requirement < 100 μS/cm); pH = 5.3 (requirement pH > 3.5)
Heath of combustion	-	28 MJ/dm^3
Toxicity index	NES 713	1.5

Table 3: Typical properties of FireRes®

Property	**Test reference**	**Result**
Density	ASTM D792	≈1.6 kg/m^3
Tensile strength and elongation at break	IEC 60811-1-1 EN 60811-1-1	Tensile strength: 11 MPa Elongation: 170 %
Tensile strength and elongation at break after ageing 7 days at 100 °C	IEC 60811-1-2 EN 60811-1-2	Tensile strength: 13 MPa Elongation: 120 %
Change in tensile strength and elongation at break after 7 days at 23 °C in ASTM oil no. 2	IEC 60811-1-1-9	Tensile strength: none Elongation: none
Change in tensile strength and elongation at break after 4 hours at 70 °C in ASTM oil no. 2	IEC 60811-1-1-9	Tensile strength: -20 % Elongation: +10 %
Change in tensile strength and elongation at break after 4 hours at 70 °C in SAE 20 Oil	IEC 60811-1-1-9	Tensile strength: -25 % Elongation: +15 %
Change in tensile strength and elongation at break after 7 days at 23 °C in Diesel	IEC 60811-1-1-9	Tensile strength: -35 % Elongation: -20 %
Hot pressure at 80 °C	IEC 60811-3-1	35 %
Oxygen Index	ISO 4589-2	45 %
Flammability temperature index	ISO 4589-3	330 ºC
Smoke density	IEC 61034	Pass
Halogen acid gas evolution	IEC 60754-1	None
Corrosivity of gases	IEC 60754-2	Pass: Conductivity 7.5 μS/cm (requirement < 100 μS/cm); PH = 5,5 (requirement pH > 3.5)
Toxicity index	NES 713	0.4