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## Basic design elements of insulated wires and cables

### Conductor

Consists of one or more metal wires and is used for transporting electric current.



#### Round, solid (RE)

For small and medium diameters or cross-sections, made of copper (bare or tinned) up to 16 mm<sup>2</sup> and of aluminium up to 35 mm<sup>2</sup>. For use in single and multi core cables and wires for fixed installation.



#### Round, stranded (RM)

For medium and large cross-sections, made of copper conductors from 6 mm<sup>2</sup> and aluminium conductors from 25 mm<sup>2</sup>. For use in single and multi core cables and wires for fixed installation.



#### Round, stranded, compressed (RM)

For particularly compact conductors of medium and large cross-section, made of copper from 6 mm<sup>2</sup> and aluminium from 25 mm<sup>2</sup>. For use in single and multi core cables and wires for fixed installation.



#### Fine or superfine-wire (F)

For all cross-sections of copper conductors (bare or tinned). For use in flexible cables.



#### Sector-shaped, solid (SE)

For medium and large cross-sections of aluminium conductors from 50 mm<sup>2</sup> up to 240 mm<sup>2</sup>. For use in 3-, 4- and 5-core cables.



#### Sector-shaped, stranded (SM)

For medium and large cross-sections of copper and aluminium conductors from 35 mm<sup>2</sup> up to 300 mm<sup>2</sup>. For use in 3-, 4- and 5-core cables.

### Conductor classes in accordance with IEC 60228

Class	Construction	Type codes for	
		power cables DIN VDE 0271/0276	harmonised cables
1	solid e.g. round solid or sector-shaped solid	RE, SE	-U, -W
2	stranded e.g. round stranded or sector-shaped stranded	RM, SM	-R, -S
5	fine wire flexible	(F)	-K, -F, -D
6	superfine wire highly flexible	(FF)	-H, -E

**Core insulation**

Covers the conductor and is used for electrical separation from the surroundings. Mainly made of extruded polymers but also of paper, glass or minerals, varnish etc. or a combination of several of these materials. The conductor and insulation together form the core.

**Inner covering, taping**

Covers the stranded core consisting of several or many cores and is used for filling the interstices between the stranding elements. The inner covering has no electrical function and consists usually either of extruded polymers, of one or more layers of tape or a combination of these elements.

**Screen**

Conductive layer which prevents electrical influences (electric fields) from reaching elements within the screen or electric fields generated by these elements from penetrating outside. Consists of metallic tapes (e.g. copper or aluminium), laminated metallic tapes, wires, wire braids or a combination of these elements.

**Armouring**

Usually arranged over the inner sheath, the armouring provides mechanical reinforcement of the cable. The armouring protects the interior of the cable from damage which may arise from radial forces (e.g. running over by vehicles or pressure of stones in the cable bed etc.). Under certain circumstances, the armouring can take over or assist the electrical function of the screen. Tapes as well as round or flat wires made of galvanized steel or aluminium are usually used as armouring material. Thin, bare steel tapes are commonly used for protection against damage by rodents. Non-metallic designs as protection against damage by rodents or termites are provided by HDPE and PP reinforcement.

**Inner sheath**

Similar to the sheath, the inner sheath covers the inner part of the cable (stranded core), ensures that it remains compact and protects it from mechanical damage caused by other cable layers, e.g. the armouring. It is made of extruded polymers.

**Sheath, protective covering (oversheath)**

Functions as the outermost cover of a cable or insulated wire and protects the cable against mechanical damage, water penetration and chemical influences. Mostly made of extruded polymers, but also of metal (lead, aluminium), impregnated fabric tapes etc.

## Common insulation and sheathing materials (overview)

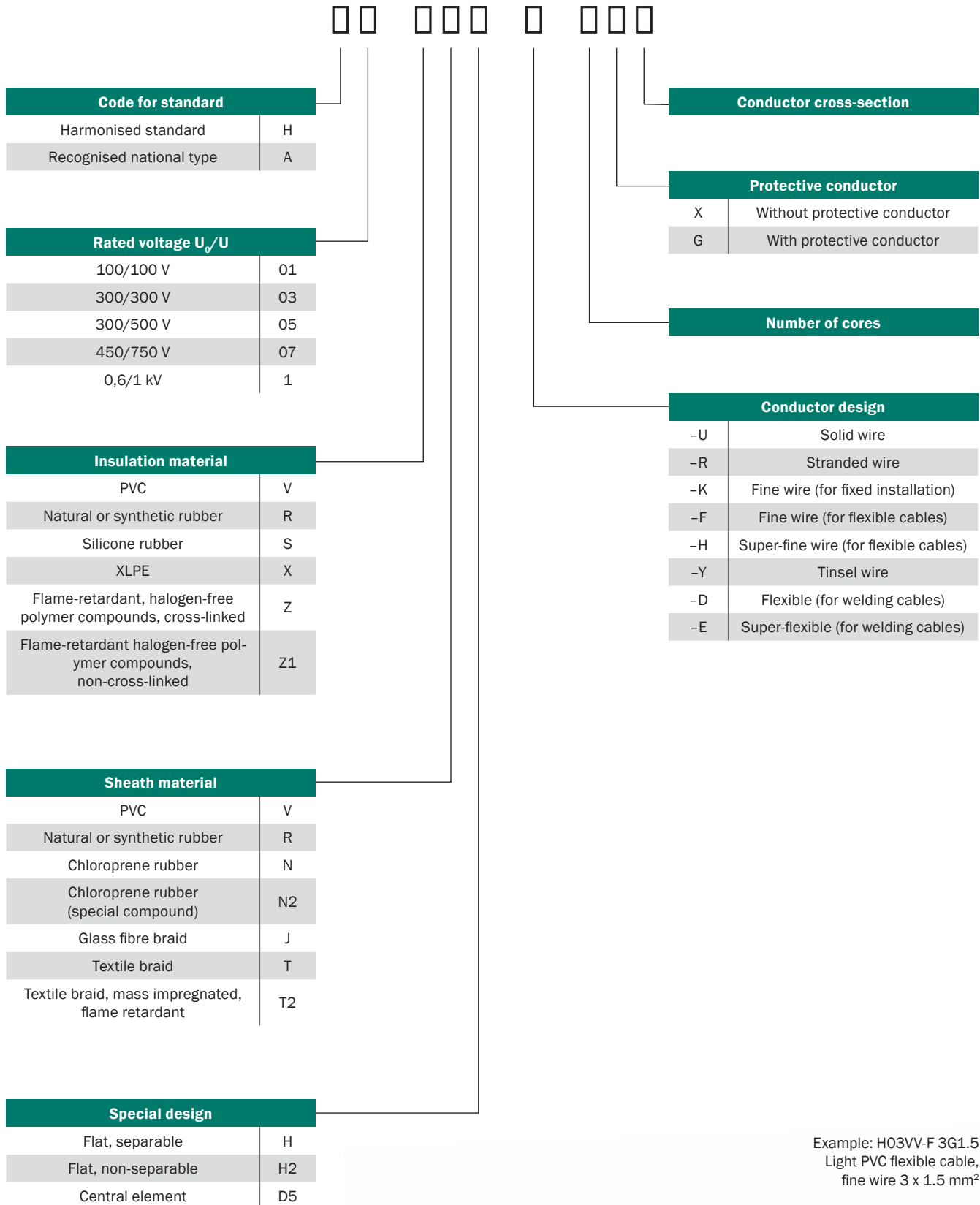
Polymers	Designs	Application examples
<b>Thermoplastics</b> Non-cross-linked plastics which undergo reversible plastic deformation at higher temperatures, i.e. which do not harden after cooling and remelting.	Polyvinyl chloride <b>PVC</b> Low cost, excellent ageing properties, service life > 30 years	Insulation and sheathing material for cables and insulated wires for fixed installation (e.g. low-voltage cables for utility networks) and flexible cables
	Thermoplastic polyethylene <b>PE</b> Low water absorption, good mechanical and electrical properties	Sheathing material for low-voltage cables in utility networks subject to higher mechanical stress, insulated overhead lines
	Polypropylene <b>PP</b> Good fatigue resistance, e.g. for repetitive drag chain movement, high strength	Insulation material for heavy duty industrial cables with lower wall thickness and for higher operating temperatures
<b>Thermosets</b> Cross-linked plastics which do not change their structure at higher temperatures and thus maintain their elastic properties.	Cross-linked polyethylene <b>XLPE</b> Low water absorption, high chemical resistance, applicable at higher temperatures and voltages	Insulation material for medium and high-voltage cables, motor supply cables, insulated overhead lines
<b>Thermoplastic elastomers</b> Blends of polyolefins or rubber having amorphous and crystalline regions which undergo reversible plastic deformation at higher temperatures and exhibit rubber-elastic properties without cross-linking at service temperatures.	Thermoplastic polyurethane elastomer <b>TPE-U</b> (TPU, PUR) High-performance material with a unique combination of resistances to abrasion, mechanical and chemical stress, cold	Sheathing material for control and drag chain cables for a range of industrial applications, spiral cables, EVC cables; sheathing material for cables used under adverse ambient conditions
	Thermoplastic polyester elastomer <b>TPE-E</b> Good impact resistance even at low temperatures, high heat resistance (<150 °C)	Insulation material for drag chain cables subject to high thermal stress
	Thermoplastic polyolefin elastomer <b>TPE-O</b> Higher mechanical resistance	Conductors subject to high thermal and mechanical stress
<b>Elastomers</b> Cross-linked rubber-like polymers which exhibit rubber-elastic properties at service temperatures and maintain their structure even at higher temperature.	Silicone rubber <b>SIR</b> Media resistant, high elasticity, cold and heat resistant	Heat-resistant insulated wires for temperatures up to 180°C (up to 250°C for short periods of time)
	Ethylene propylene rubber <b>EPR</b> Good thermal and chemical resistance	Flexible insulated wires and cables for low- and medium voltage, filling compound for inner sheaths
	Polychloroprene <b>CR</b> Elastic even at low temperatures, self-extinguishing	Sheathing material, e.g. for flexible insulated wires
<b>Special compounds</b>	Flame-retardant, halogen-free polymer compounds, <b>non-cross-linked HFFR/FRNC</b> No emission of corrosive fumes, low fire propagation and smoke development	Insulation, filling and sheathing material for flame-retardant, halogen-free safety cables for protecting high concentrations of people and material goods
	Flame-retardant, halogen-free polymer compounds, <b>cross-linked HFFR/FRNC</b> No emission of corrosive fumes, low fire propagation and very low smoke development	Insulation and sheathing material for flame-retardant, halogen-free safety cables for protecting high concentrations of people and material goods

Designation			Basic data		Properties (guiding values)								
Material	Abbreviation	Abbreviation acc. to VDE	Ambient temperature		Electrical		Mechanical			Chemical		Thermal	
			Permanent (°C)	Short-term (°C)	Dielectric constant 50 Hz / 20 °C	Specific insulation resistance ( $\Omega \times \text{cm}$ ) / 20C°	Tensile strength N/mm <sup>2</sup> MPa	Elongation at break %	Shore hardness	Water absorption % / 20C°	Weather resistance	Oil resistance	Flammability
<b>Thermoplastics</b>													
Polyvinyl chloride	PVC	Y	-30 +70	+100	3,6-6,0	10 <sup>13</sup> -10 <sup>15</sup>	10-25	130-350	70-95 (A)	0,4	moderate	good	self-extinguishing
Low density polyethylene	LDPE	2Y	-50 +70	+100	2,3	10 <sup>17</sup>	10-20	400-600	43-50 (D)	0,1	good	moderate	flammable
High density polyethylene	HDPE	2Y	-50 +90	+100	2,6	10 <sup>18</sup>	15-28	400-600	60-63 (D)	0,1	good	moderate	flammable
Polypropylene	PP	9Y	-30 +90	+140	2,3-2,4	10 <sup>16</sup>	20-35	300-400	55-60 (D)	0,1	moderate	moderate	flammable
<b>Thermosets</b>													
Cross-linked polyethylene	XLPE	2X	-35 +90	+100	4,0-6,0	10 <sup>12</sup> -10 <sup>16</sup>	12,5-20	300-400	40-45 (D)	0,1	good	moderate	flammable
<b>Thermoplastic elastomers</b>													
Thermoplastic polyurethane elastomer	TPE-U	11Y	-50 +90	+100	2,7-3,6	5 x 10 <sup>14</sup>	≥ 6	≥ 400	60-75 (A)	1,5	very good	moderate	flammable
Thermoplastic polyester elastomer	TPE-E	12Y	-50 +90	+110	3,7-5,1	>10 <sup>10</sup>	30-40	300-400	55-75 (D)	1,5	very good	very good	flammable
Thermoplastic polyolefin elastomer	TPE-O	18Y	-40 +90	+110	2,7-3,6	>10 <sup>12</sup>	15-25	320-600	36-50 (D)	1,5	very good	moderate	flammable
<b>Elastomers</b>													
Silicone rubber	SIR	2G	-60 +180	+250	2,8-3,2	10 <sup>15</sup>	5-10	200-350	60-70 (A)	1,0	very good	good	flame-retardant
Ethylene propylene rubber	EPR	3G	-25 +70	+100	3,2	10 <sup>14</sup>	2-25	200-450	55-75 (A)	0,02	good	low	flammable
Polychloroprene	CR	5G	-40 +100	+100	6,0-8,0	10 <sup>13</sup>	25	450	50-70 (A)	0,0	very good	good	self-extinguishing
<b>Special compounds</b>													
Polymer compound, halogen-free	FRNC	H	-30 +70	+100	3,4-5,0	10 <sup>12</sup> -10 <sup>14</sup>	8-13	150-250	65-95 (A)	0,20-1,50	moderate	moderate/medium	self-extinguishing
Polymer compound, halogen-free, cross-linked	HX	HX	-30 +90	+120	3,4-5,0	10 <sup>13</sup> -10 <sup>14</sup>	8-13	150-250	65-95 (A)	0,20-1,50	medium	medium	self-extinguishing

## Properties of cable insulation and sheathing materials



# Type codes for harmonised insulated wires



Example: H03VV-F 3G1.5  
Light PVC flexible cable,  
fine wire 3 x 1.5 mm<sup>2</sup>

## Type codes for power cables

Design / code element	Cables according to DIN VDE and ÖVE	
Type	DIN VDE 0266, 0276, -603, -604, -620, -627	ÖVE/ÖNORM E 8200-603, -604, -620, -626, -627
Standard type	N	-
Power cable	-	E-
Special design	-	X
<b>Rated voltage <math>U_0/U</math></b>		
300/500 V	-	-
0.6/1 kV	-	-
<b>Conductor</b>		
Cu	no code	no code
Al	A (only 0276)	A
Tinned conductor		
Conductor covered (taping)	no code	F
<b>Insulation</b>		
PVC	Y	Y
PE	2Y	2Y
XLPE	2X	2X
Halogen-free polymer compounds, non-cross-linked	-	NY
Halogen-free polymer compounds, cross-linked	HX	NG, 3G
<b>Special structural features</b>		
Cable, unscreened	-	-
Cable, flat with web	-	-
Cable, aluminium tape screened	-	-
Cable, flexible	-	-
Cable, flexible screened	-	-
<b>Screen, concentric conductor</b>		
Concentric conductor (Cu, conventionally stranded)	C	C
Concentric conductor (Cu, wave-form)	CW	C
Cu screen	S	C
Cu screen (longitudinally water-proof)	S(F)	CJ
Individual Cu screen over each core	SE	CE
<b>Sheath, inner covering</b>		
Pb	K	M
PVC	Y	Y
PE	2Y	2Y
Halogen-free polymer compounds, non-cross-linked	H	NY
Halogen-free polymer compounds, cross-linked	HX	NG
<b>Armouring/cable structure</b>		
Steel tape	B	B
Steel flat wire	F	F
Steel round wire	R	R
Steel tape (counter helix)	G	G
Cable, flat	-	-
Cable, self-supporting	-	-
<b>Outer covering</b>		
PVC	Y	Y
PE	2Y	2Y
Halogen-free polymer compounds, non-cross-linked	H	-
<b>Protective conductor</b>		
With protective conductor	-J	-J
Without protective conductor	-O	-O
<b>Insulation / Circuit Integrity</b>		
Halogen-free, without insulation/circuit integrity	-	FRH
Halogen-free, with insulation integrity ...minutes	FE ...	FE ...
Halogen-free, with circuit integrity ...minutes	E ..	E ..

The complete cable code consists of (composition and structure vary depending on standard):

- |   |   |                                   |
|---|---|-----------------------------------|
| - Code for cable type                               | - Code(s) for core identification   | conductor                         |
| - Code(s) for cable design                          | - Code for conductor design   | - Code for core identification    |
| - Number of cores x nominal conductor cross-section | - If necessary after a slash: nominal cross-section of screen or concentric | - Code for rated voltage          |
|   |   | - Code for additional information |

Example: NHXCH-O 4x2,5 RE/2,5 FE180/E90



# Type codes for telecommunication cables

Design / code element	Cables according to ÖVE	Cables according to TA specification	Cables according to DIN VDE
<b>Type</b>			
Telecommunication cable	F-	F-	-
Outdoor cable	-	-	A-
Outdoor cable with protection against interference	-	-	AJ-
Installation cable	-	FI-	J-
Installation cable for industrial electronics	-	-	JE-
Switchboard cable	-	-	S-
Special design	X	-	-
<b>Conductor</b>			
Cu	no code	no code	no code
Tinned conductor	V	V	-
Al	A	-	-
<b>Insulation</b>			
Paper	P	P	P
PVC	Y	Y	Y
PE	2Y	2Y	2Y
XLPE	-	-	-
Foam PE	-	02Y	02Y
Foam PE with skin of solid PE	-	02YH	02YS
Halogen-free polymer compounds, non-cross-linked	NY	-	H
Design of core	-	-	-
No filling of cable cavities	-	-	-
Jelly filling of cable cavities	J	J	F
<b>Screen</b>			
Static screen, laminated Al tape	A	A	(St)
Cu screen	C	C	C, K
Individual screen	E	E	-
<b>Sheath, inner covering</b>			
Pb	M	M	M
Al tape, taped	L	L	-
Al laminated sheath, longitudinally applied	-	A2Y	(L)2Y
PVC	Y	Y	Y
PE	2Y	2Y	-
Halogen-free polymer compounds, non-cross-linked	NY	-	H
<b>Armouring</b>			
Steel tape	B	B	b
Steel flat wire	F	F	-
Steel round wire	R	R	-
Steel tape (counter helix)	G	G	-
Steel wire braid	-	-	Q
Al round wire	-	-	-
<b>Outer covering</b>			
Mass-impregnated jute	U	U	c
PVC	Y	Y	Y
PE	2Y	2Y	2Y
<b>Strain-bearing element</b>			
Strain-bearing element, supporting element	-	T	T
<b>Stranding elements</b>			
Pairs	P	P	P
Pairs, individually screened with metal tape	-	-	PiMF
Star-quads	ST	ST	St
Star-quads in long distance cables	-	-	St I
Star-quads in local cables	-	-	St III
Multiple-twin quad cables	DM	DM	DM
Stranded in layers	-	-	Lg
Stranded in groups	-	BD	Bd
<b>Insulation / circuit integrity</b>			
Halogen-free, without insulation/circuit integrity	FRH	-	FRH
Halogen-free, with insulation integrity ...minutes	FE ...	-	FE ...
Circuit integrity ... minutes	E ...	-	E ...

The complete cable code consists of (composition and structure vary depending on standard):

- Code for cable type
- Code(s) for cable design
- Number of elements × number of cores per element × conductor diameter
- Codes for stranding elements and kind of stranding
- Codes for additional information

Example: JE-H(St)H 2x2x0,8 Bd FE180/E30, F-2YA2Y 10x2x0,8


































## Core identification

Cores in cables and insulated wires (except insulated overhead lines) are identified by the colour of the insulation and/or printed colours (numbers, rings, etc.) or longitudinal colour stripes. The following colour abbreviations are used:

Colour	Abbreviation	Colour	Abbreviation	Colour	Abbreviation
blue	bu	orange	og	turquoise	tq
brown	bn	pink	pk	green/yellow	gnye
yellow	ye	red	rd		
grey	gy	black	bk		
green	gn	violet	vt		
natural	nat	white	wh		

In insulated overhead lines, the cores are identified by longitudinal ribs on the insulation surface.

### Core codes for insulated wires and power cables according to HD 308 S2

Number of cores	Acc. to ÖVE	Acc. to HD	With green-yellow core	Acc. to ÖVE	Acc. to HD	Without green-yellow core
1	-J	1G		-0	1X	 and other colours
2				-0	2X	 
3	-J	3G	  	-0	3X	  
4	-J	4G	   	-0	4X	   
5	-J	5G	    	-0	5X	    
6 or more	-J	nG	 other cores with printed numbers 	-0	nX	 with printed numbers

These rules are not valid for cables which are exclusively used for internal wiring of electrical devices and control cabinets.



**Core identification for electronic control cables LiYY and LiYCY according to DIN 47100**

Cores are counted from outside to inside through all layers.

The first colour is the basic colour of the core insulation, while the second colour indicates the colour of the printed ring (core colour). Slight blurring of the core colour at the edges and a small offset of the two half-rings is permissible.

Twisted cores					
Number of cores	Colour	Abbreviation	Number of cores	Colour	Abbreviation
1	white	wh	24	brown-red	bnrd
2	brown	bn	25	white-black	whbk
3	green	gn	26	brown-black	bnbk
4 <sup>1)</sup>	yellow	ye	27	grey-green	gygn
5	grey	gy	28	yellow-grey	yegy
6	pink	pk	29	pink-green	pkgn
7	blue	bu	30	yellow-pink	yepk
8	red	rd	31	green-blue	gnbu
9	black	bk	32	yellow-blue	yebu
10	violet	vt	33	green-red	gnrd
11	grey-pink	gypk	34	yellow-red	yerd
12	red-blue	rdbu	35	green-black	gnbk
13	white-green	whgn	36	yellow-black	yebk
14	brown-green	bngn	37	grey-blue	gybu
15	white-yellow	whye	38	pink-blue	pkbu
16	yellow-brown	yebn	39	grey-red	gyrd
17	white-grey	whgy	40	pink-red	pkrd
18	grey-brown	gybn	41	grey-black	gybk
19	white-pink	whpk	42	pink-black	pkbk
20	pink-brown	rdbn	43	blue-black	bubk
21	white-blue	whbu	44	red-black	rdbk
22	brown-blue	brbu	45 <sup>2)</sup>	white etc.	wh
23	white-red	whrd			

<sup>1)</sup> Colour sequence for four-core cables: white, yellow, brown, green.









<sup>2)</sup> For stranded cores the colours are repeated from the 45<sup>th</sup> core.

Twisted pairs				
Pair No.			Colour	
			a-core	b-core
1	23	45	white	brown
2	24	46	green	yellow
3	25	47	grey	pink
4	26	48	blue	red
5	27	49	black	violet
6	28	50	grey-pink	red-blue
7	29	51	white-green	brown-green
8	30	52	white-yellow	yellow-brown
9	31	53	white-grey	grey-brown
10	32	54	white-pink	pink-brown
11	33	55	white-blue	brown-blue
12	34	56	white-red	brown-red
13	35	57	white-black	brown-black
14	36	58	grey-green	yellow-grey
15	37	59	pink-green	yellow-pink
16	38	60	green-blue	yellow-blue
17	39	61	green-red	yellow-red
18	40	62	green-black	yellow-black
19	41	63	grey-blue	pink-blue
20	42	64	grey-red	pink-red
21	43	65	grey-black	pink-black
22 <sup>1)</sup>	44	66	blue-black	red-black

<sup>1)</sup> If there are more than 22 pairs, the colours are repeated.

### Colour codes for installation cables for industrial electronics JE-LiYCY...Bd, JE-Y(St)Y ... Bd, JE-H(St)H ... Bd according to DIN VDE 0815

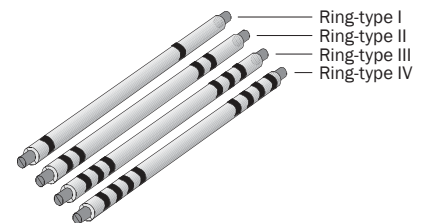
Basic colours

Core	Pair 1	Pair 2	Pair 3	Pair 4
a				
b				

The pairs within a group are identified by the basic colours of the insulation. These colours are repeated in each unit in the same order. In cables with 2 pairs (stranded as star-quad), the a-core (physical circuit 1) is blue, the b-core (physical circuit 1) is red, the a-core (physical circuit 2) is grey and the b-core (physical circuit 2) is yellow.








#### Group identification by printed helical tapes ("BdZ")

Groups are identified by helical plastic tapes which carry the printed group number.







#### Group identification by colour rings ("BdSi")

For the identification of groups, the cores contained therein are marked with colour rings. In cables with more than 12 groups, the additional groups are identified with coloured helical plastic tapes.

Number of group		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ring colour																					
Ring group in group unit	4 cores	I	I	II	II																
	8 cores or 4 pairs	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
	Helix																				

**Colour code for telecommunications cables J-Y(St)Y...Lg, JB-Y(St)Y according to DIN VDE 0815**

Core	Pair 1	Pair 2	Pair 3	Pair 4
a	<input type="text" value="1)"/>	<input type="text" value="1)"/>	<input type="text" value="1)"/>	<input type="text" value="1)"/>
b				

<sup>1)</sup> The colour of the a-core of the first pair in each layer (counting pair) is red, in all the other pairs it is white.



For more than 5 pairs the colour code is repeated in the same sequence. In cables with 2 pairs (stranded as star-quad), the a-core (physical circuit 1) is red, the b-core (physical circuit 1) is black, the a-core (physical circuit 2) is white and the b-core (physical circuit 2) is yellow.

Number of pairs	Number of pairs per layer					
	1	2	3	4	5	6
2	2 <sup>1)</sup>					
3	3					
4	4					
5	5					
6	6					
10	2	8				
12	3	9				
16	5	11				
20	1	6	13			
30	4	10	16			
40	1	7	13	19		
50	4	10	15	21		
60	1	6	12	18	23	
100	2	8	14	20	25	31

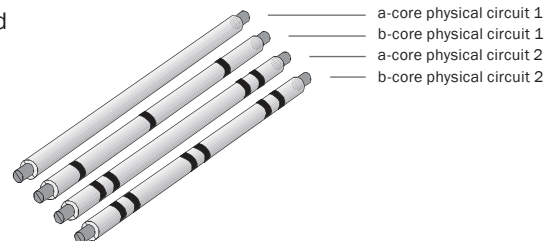
<sup>1)</sup> In star quad stranding.

**Core code for outdoor telecommunication cables A-2Y(L)2Y, A-2YF(L)2Y and installation cables J-H(St)H according to DIN VDE 0816 and 0815**

In order to identify the group, a group (tracer group) is identified with a helix of red plastic tape in each layer. The quads in each group are identified by the basic colour of the core insulation. The colours are repeated in each group in the same sequence.

Quad 1	Quad 2	Quad 3	Quad 4	Quad 5
				<input type="text" value=""/>

To distinguish the individual cores of each quad these are identified by black colour rings.



## Colour codes for YR and YYSch cables

### Colour code for YR cables

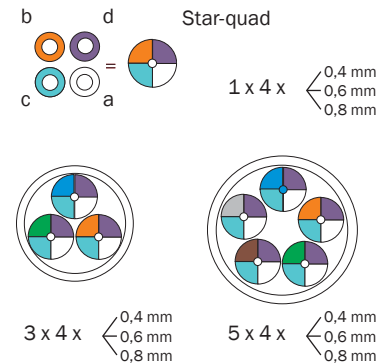
Number of cores x cross-section	Colours
2 x 0,8	bk, bu
3 x 0,8	bk, bu, bn
4 x 0,8	bk, bu, bn, ye
5 x 0,8	bk, bu, bn, ye, gn
6 x 0,8	bk, bu, bn, ye, gn, vt
8 x 0,8	bk, bu, bn, ye, gn, vt, wh, or,
10 x 0,8	bk, bu, bn, ye, gn, vt, wth or, tq, gy
12 x 0,8	bk, bu, bn, ye, gn, vt, wh, or, tq, gy, rd, lbu
14 x 0,8	bk, bu, bn, ye, gn, vt, wh, or, tq, gy, rd, lbu, cog, lgn
16 x 0,8	bk, bu, bn, ye, gn, vt, wh, or, tq, gy, rd, lbu, cog, lgn, lrd, lgy

### Colour code for YYSch cables

Number of cores x cross-section	Colours
2 x 0,6	ye, bn
3 x 0,6	ge, gn, bn
4 x 0,6	ge, gn, bn, bk
5 x 0,6	ge, gn, bn, bk, bu
6 x 0,6	ge, gn, bn, bk, gy, pk, wh
10 x 0,6	wh, bk, hbu, bn, gn, ye, gy, pk, bu, rd
16 x 0,6	1 <sup>st</sup> layer: wh, bk, hbu, bn, gn
	2 <sup>nd</sup> layer: ye, lgy, pk, bu, rd, tq, gy, vt, lgn, or, ivory
26 x 0,6	Core: wh, bk + 2 fillers
	1 <sup>st</sup> layer: hbu, bn, gn, ye, lgy, pk, bu, rd, tq
	2 <sup>nd</sup> layer: gy, vt, lgn, or, ivory, whbu, whye, whgn, whbn, whbk, rdbu, rdye, rdgn, rdbn, rdbk

Colour code for telecommunication cables according to EN 60708

Colour code for cores in basic groups				
Quad number (XN)	Core insulation colour			
	a-core	b-core	c-core	d-core
1	white	blue	turquoise	violet
2	white	orange	turquoise	violet
3	white	green	turquoise	violet
4	white	brown	turquoise	violet
5	white	grey	turquoise	violet
Spare quad	white	blue	turquoise	violet

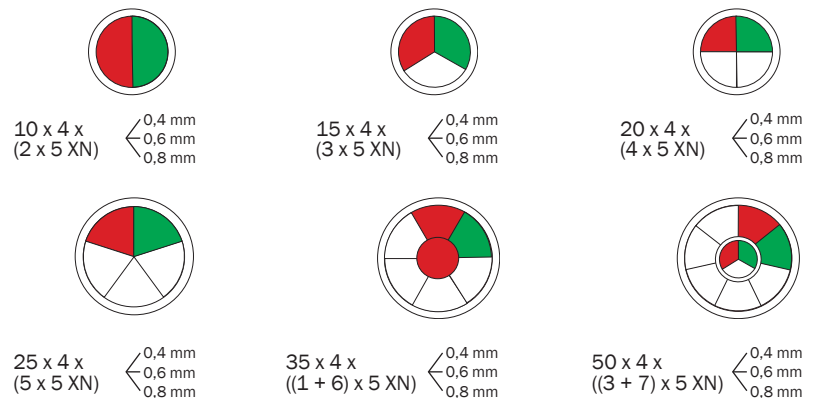
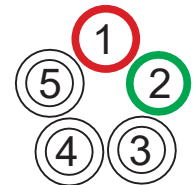


Star-quad 5 XN	
Number of basic group in each layer	Colour of marking tape
1 - Counting group	red
2 - Guiding group	green
Other + cable core	white

Note: The centre of a 35 XN cable core has a red marking tape.

(view of the cable beginning, from the centre of the drum)

Example:  
25 x 4 x 0.4  
is equivalent to  
5 x 5 XN x 0.4

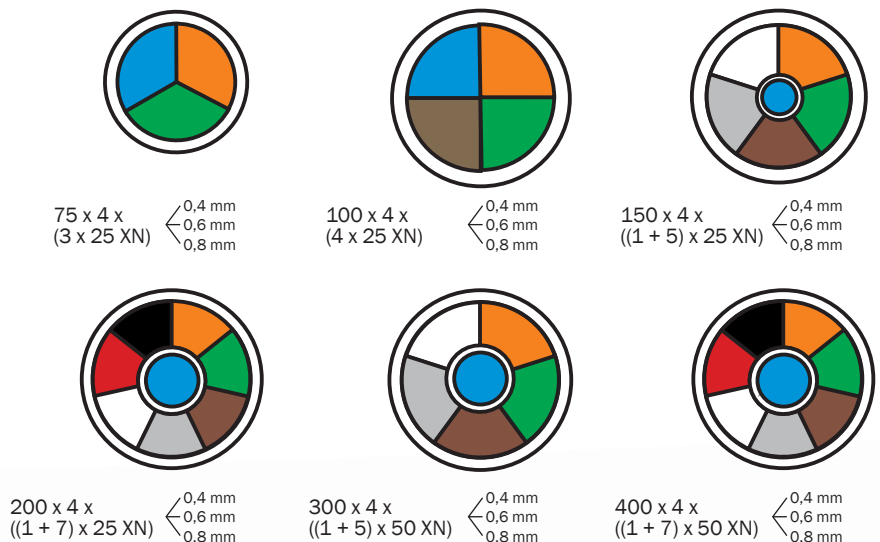


Star quad can be marked by the symbol XN

Colour code for main groups 25 XN and super groups 50 XN	
Number of main or super group	Colour of marking tape
1	blue
2	orange
3	green
4	brown
5	grey
6	white
7	red
8	black
Cable core	white

Note: Control wire in non-filled cables:  
a-core: red, b-core: white.

(view of the cable beginning, from the centre of the drum)



## Core identification of telecommunication cables according to ÖVE and TA specifications

### F-VYAY, F-YAY

The individual pairs are identified by the basic colour and colour rings for the a-core and by the basic colour for the b-core. In cables with 2 pairs (stranded as star-quad), the a-core (physical circuit 1) is blue, the b-core (physical circuit 1) is yellow, the a-core (physical circuit 2) is green and the b-core (physical circuit 2) is brown.

Colour of a-core	Colour of b-core				
	bl	ge	gn	br	sw
wsbl	Pair no. 1	Pair no. 2	Pair no. 3	Pair no. 4	Pair no. 5
wsge	Pair no. 6	Pair no. 7	Pair no. 8	Pair no. 9	Pair no. 10
wsgn	Pair no. 11	Pair no. 12	Pair no. 13	Pair no. 14	Pair no. 15
wsbr	Pair no. 16	Pair no. 17	Pair no. 18	Pair no. 19	Pair no. 20
wssw	Pair no. 21	Pair no. 22	Pair no. 23	Pair no. 24	Pair no. 25
rtbl	Pair no. 26	Pair no. 27	Pair no. 28	Pair no. 29	Pair no. 30
rtge	Pair no. 31	Pair no. 32	Pair no. 33	Pair no. 34	Pair no. 35
rtgn	Pair no. 36	Pair no. 37	Pair no. 38	Pair no. 39	Pair no. 40
rtbr	Pair no. 41	Pair no. 42	Pair no. 43	Pair no. 44	Pair no. 45
rtsw	Pair no. 46	Pair no. 47	Pair no. 48	Pair no. 49	Pair no. 50

The colour code is repeated in the same sequence from pair no. 51.

### F-2YA2Y, F-2YC2Y, FI-02YHAY, F-2YJA2Y, F-02YHJA2Y, F-02YHJA2YR

The individual pairs are identified by the basic colour and colour rings for the a-core and by the basic colour for the b-core. In cables with 2 pairs (stranded as star-quad), the a-core (physical circuit 1) is blue, the b-core (physical circuit 1) is yellow, the a-core (physical circuit 2) is green and the b-core (physical circuit 2) is brown.

a-core physical circuit 1	b-core physical circuit 1	a-core physical circuit 2	b-core physical circuit 2
1)			

<sup>1)</sup> The colour of the a-core of the first star-quad in each layer (counting quad) is black, in all the other quads it is natural.



## Parameters for drag chain applications

Type	Minimum bending radius	Traverse length	Acceleration	Traverse speed	Bending cycles up to
FLEXICS® CHAIN	10 × D	5m	3m/s <sup>2</sup>	3m/s	3 Million
FLEXICS® CHAIN C	10 × D	5m	3m/s <sup>2</sup>	3m/s	3 Million
FLEXICS® CHAIN 11	10 × D	5m	3m/s <sup>2</sup>	3m/s	5 Million
FLEXICS® CHAIN 11C	10 × D	5m	3m/s <sup>2</sup>	3m/s	5 Million
FLEXICS® CHAIN 911	7,5 × D	5m	3m/s <sup>2</sup>	3m/s	5 Million
FLEXICS® CHAIN 99111C	7,5 × D	5m	3m/s <sup>2</sup>	3m/s	5 Million
FLEXICS® CHAIN UL / c(UL)	10 × D	5m	3m/s <sup>2</sup>	3m/s	3 Million
FLEXICS® CHAIN C UL / c(UL)	10 × D	5m	3m/s <sup>2</sup>	3m/s	3 Million
FLEXICS® CHAIN 11 UL / c(UL)	7,5 × D	5m	3m/s <sup>2</sup>	3m/s	5 Million
FLEXICS® CHAIN 11C UL / c(UL)	10 × D	5m	3m/s <sup>2</sup>	3m/s	5 Million
FLEXICS® CHAIN SERVO 911	7,5 × D	5m	3m/s <sup>2</sup>	3m/s	5 Million
FLEXICS® CHAIN SERVO 911C	7,5 × D	5m	3m/s <sup>2</sup>	3m/s	5 Million
FLEXICS® CHAIN SERVO 911 UL / c(UL)	7,5 × D	5m	3m/s <sup>2</sup>	3m/s	5 Million
FLEXICS® CHAIN SERVO 911C UL / c(UL)	7,5 × D	5m	3m/s <sup>2</sup>	3m/s	5 Million

The number of cycles was determined by testing the cables using programmable drag chain test systems with adjustable traverse ranges, traverse speeds, acceleration and bending radius under standardised conditions and in continuous operation at constant temperature.



## Construction Products Regulation (CPR)

The Construction Products Regulation entered into force on 1 July 2017 and applies to the entire territory of the European Union. Pursuant to the Regulation, manufacturers and suppliers are not allowed to place cables for “fixed installation” in buildings on the European market without “CE marking” and “Declaration of Performance”.

### The CE marking

The CE marking is a statutory requirement confirming that the product is in conformity with all relevant guidelines and provisions. The CPR additionally requires the provision of accompanying information on the product, its testing or certification and its performance. The CE marking must be affixed to the product, and where this is not possible, it must be affixed to the drum, coil or packaging and to the accompanying documents.

### What is a construction product?

A construction product means any product which is placed on the market for permanent incorporation in construction works or parts thereof.

Cables fall under the basic requirement “Safety in case of fire” of the CPR and must therefore be classified according to EN 13501. Important notice: For cables and insulated wires, reference is made to EN 50575, which contains only requirements for compliance with fire safety standards but no requirements for the structure or use of such products.

The standard does not apply to cables and insulated wires which provide circuit integrity, but are certified.

### What are the duties of the market participants?

#### ● Authorities

- Specify where the CPR-classified cables are to be used
- Examine the market for correct application of the Regulation

#### ● Testing laboratories

- Specify the required reaction to fire based on the CPR classification
- Assess potential specific risks

#### ● Manufacturers

- Produce all products in compliance with the CPR
- Have the products tested according to the CPR

#### ● Wholesaler

- Ensure that all cables placed on the market meet the specified requirements
- Ensure that the product bears the CE marking and that the documents required by the CPR are available

#### ● Installers

- Observe the relevant national provisions
- Install only cables which are in compliance with the CPR

### CPR classification

The following criteria are assessed in tests according to EN 50399:

- Heat of combustion
- Heat release
- Vertical flame propagation
- Smoke development
- Flaming droplets / dripping plastic material which may contribute to flame propagation
- Acidity (acid concentration in the substance)

**The CPR cable classes:**

EN 50575 defines the following fire classes for cables:

- A<sub>ca</sub> non-flammable, no contribution to fire
- B1<sub>ca</sub> low flammability, very limited contribution to fire
- B2<sub>ca</sub>, C<sub>ca</sub> very limited contribution to fire, limited fire development and heat release
- D<sub>ca</sub> small contribution to fire, continuous flame propagation; moderate heat release
- E<sub>ca</sub> normally flammable
- F<sub>ca</sub> highly flammable

Additional sub-classes need to be specified for classes B1<sub>ca</sub> – D<sub>ca</sub>.

Class	Smoke	Droplets	Acidity
A <sub>ca</sub>			
B1 <sub>ca</sub>	s1a/s1b		
B2 <sub>ca</sub>	s1	d0	a1
C <sub>ca</sub>	s2	d1	a2
D <sub>ca</sub>	s3	d2	a3
E <sub>ca</sub>			
F <sub>ca</sub>			

Example: B2<sub>ca</sub> – s1a, d0, a1

The fire classes must be indicated either on the label or on the accompanying documentation.

**The Declaration of Performance (DoP)**

By signing this declaration, the manufacturer confirms the performance of the product. The manufacturer must make the DoP available in easily understandable language or in the language required by the relevant Member State.

**Which information is mandatory on the DoP and what does it look like?**

1. DoP reference number
2. Unique identification code of the product type
3. Intended use
4. Manufacturer
5. Authorised representative
6. System(s) of AVCP (Assessment and Verification of Constancy of Performance)
7. Harmonised standard and notified body
8. Declared performance(s)
9. Declaration of responsibility

**LOGO**  
Manufacturer

**1 Declaration of Performance**  
456789-FR2H

Date: 12.02.19  
Product name:  
**H07RN-F10G1.5 MBH GL1000**

Unique identification code: 10056883 **2**

**3** Intended use of the product  
Cable for general applications in construction works subject to

**6** AVCP (Assessment and Verification of Constancy of Performance) System 3  
Notified body: NB 1812

**8** Declared performance Harmonized Standard

Essential Characteristic	Performance	Harmonized Standard
		<b>7</b>

**9** Declared performance Faciae cone pliquaecece velero il moles silat occulto magistro et quam reperit ceteris, si alius fugit quam quarenet nisi pro dolo: nisi venem ad repensam equorite qua vel diti anufligite qua delictis, conatit pstat mod m, et a districum libentem ceteris mo volupta enevol utem. Nam aut laud ea quam reperita pa evenit vorell no nactum utem ventura hanc, quae dispartit in saae quam, qui case an magis hanc accure net ad ea et act mo deliquam mae et, ceteris que came.

**4** Manufacturer  
Cable Corporation  
Rue Marie de Bourgogne 58  
1000 Bruxelles, Belgium

**5** Signed from The Manufacturer by  
David King

Declaration of performance



**What information is provided on the CPR label?**

1. The CE marking
2. Year of initial affixing of the CE marking (2 digits min)
3. Manufacturer
4. The unique identification code of product type
5. The reference number of Declaration of Performance
6. The class of the performance declared
7. The dated reference to the harmonised technical specification applied
8. The identification number of the notified body
9. The intended use as laid down according to applied harmonised technical specification

**Choosing the right cable for a specific building:**

Each EU Member State can define independently for itself which performance requirements it imposes to ensure that an adequate level of fire protection is achieved, depending on the building type and the typical local construction technologies. Economic agents throughout the supply chain, as well as planners, are therefore obliged to familiarise themselves with the requirements that apply in their country.

Some EU countries have regulated by law which specific fire class is to be applied to which particular building or part of a building, while others only have recommendations of individual stakeholders. ÖVE (Austrian Association for Electrical Engineering), for example, issued such recommendations in Austria.

No.	Building description	Installation standard	Fire class Minimum requirement b		
		ÖVE/ÖNORM (series)	Building (except escape route)	Escape route	
1	Free-standing buildings, for example detached and semi-detached houses (buildings of building class 1 according to OIB guideline)	Free-standing buildings with access for firefighting on at least three sides, either on private or public land. Max. 3 floors above ground level, max. 2 residential units or 1 business unit, escape level ≤ 7 m, ≤ 400 m² gross floor space on the above-ground floors.	E 8001	E <sub>ca</sub>	-
2	Single and two-family terraced houses and non-detached buildings (buildings of building class 2 according to OIB guideline)	a) Buildings with max. 3 floors above ground level, escape level ≤ 7 m, ≤ 400 m² gross floor space on the above-ground floors. b) Terraced houses with max. 3 floors above ground level, escape level ≤ 7 m, consisting of apartments or business units with ≤ 400 m² gross floor space each on the above-ground floors. c) Free-standing buildings for exclusive residential use, with access for firefighting on at least three sides, either on private or public land, max. 3 floors above ground level, escape level ≤ 7 m, ≤ 800 m² gross floor space on the above-ground floors.	E 8001		-
3	Other buildings (buildings of building class 3 according to OIB guideline)	Buildings with max. 3 floors above ground level, escape level ≤ 7 m, which are not covered by lines 1 and 2 of this table.	E 8001	E <sub>ca</sub>	B2 <sub>ca</sub> s1a d1 a1
4	Other buildings (buildings of building class 4 according to OIB guideline)	a) Buildings with max. 4 floors above ground level, escape level ≤ 11 m, several residential or business units with max. 400 m² gross floor space each on the above-ground floors. b) Buildings with max. 4 floors above ground level, escape level ≤ 11m, one residential or business unit with unlimited gross floor space on the above-ground floors.	E 8001	E <sub>ca</sub>	B2 <sub>ca</sub> s1a d1 a1



No.	Building description		Installation standard	Fire class Minimum requirement b	
			ÖVE/ÖNORM (series)	Building (except escape route)	Escape route
5	Buildings with a maximum escape level of 22 m according to OIB guideline, section 5.4 (Buildings of building class 5 according to OIB guideline)	Buildings with an escape level ≤ 22 m, which are not covered by the buildings described in lines 1 to 4.	E 8001	C <sub>ca</sub> s1b d2 a1	B2 <sub>ca</sub> s1a d1 a1
<b>Special buildings and facilities</b>					
6	- School and preschool buildings as well as other buildings with similar use such as universities, universities of applied sciences, adult education centres, other educational establishments	With a gross floor space exceeding 3,200 m <sup>2</sup> (if the gross floor space is smaller, assignment according to line 4 of this table)	E 8002-9	C <sub>ca</sub> s1b d2 a1	B2 <sub>ca</sub> s1a d1 a1
7	- Accommodation facilities, including student residences and other buildings with similar use.	With more than 100 beds (if there are fewer beds, assignment according to line 4 of this table)	E 8002-5	C <sub>ca</sub> s1b d2 a1	B2 <sub>ca</sub> s1a d1 a1
8	- Sales outlets	With a sales area greater than 3,000 m <sup>2</sup> (if the sales area is smaller, assignment according to line 4 of this table)	E 8002-3	C <sub>ca</sub> s1b d2 a1	B2 <sub>ca</sub> s1a d1 a1
9	- Garages + parking decks	With a usable floor space greater than 1600 m <sup>2</sup> (if the usable floor space is smaller, assignment according to line 4 of this table) Garages with a defined group of users on the first underground floor with a usable floor space greater than 10,000 m <sup>2</sup> (if the usable floor space is smaller, assignment according to line 4 of this table)	E 8002-6	C <sub>ca</sub> s1b d2 a1	B2 <sub>ca</sub> s1a d1 a1
10	- Buildings with escape level above 22 m	Buildings with an escape level above 22 m	E 8002-4	C <sub>ca</sub> s1b d2 a1	B2 <sub>ca</sub> s1a d1 a1
11	- Exhibition sites	Exhibition sites in which the exhibition rooms – either individually or in total – have a usable floor space greater than 3,000 m <sup>2</sup> (if the usable floor space is smaller, assignment according to line 4 of this table)	E 8002-3	C <sub>ca</sub> s1b d2 a1	B2 <sub>ca</sub> s1a d1 a1
12	- Places of assembly	a) Places of assembly and associated stages in buildings with assembly rooms, if the assembly rooms have a capacity of more than 120 persons – either individually or in total. b) Places of assembly and associated stages in buildings with assembly rooms, if the assembly rooms have a capacity of more than 240 persons – either individually or in total – and if the escape routes lead directly to public illuminated transit routes via exit doors on both sides. c) Outdoor places of assembly with performance areas and associated stages for more than 1,000 persons d) Outdoor places of assembly and associated stages for more than 5,000 persons (a) to d): if the capacity is smaller, assignment according to line 4 of this table)	E 8002-2	C <sub>ca</sub> s1b d2 a1	B2 <sub>ca</sub> s1a d1 a1
13	- Medical areas according to ÖVE/ÖNORM E 8007	Medical areas according to the scope of application of ÖVE/ÖNORM E 8007 Bed wing: see accommodation facilities	E 8007	C <sub>ca</sub> s1b d2 a1	B2 <sub>ca</sub> s1a d1 a1
14	- Public houses	Pubs and restaurants with a capacity of more than 400 guests (if the guest capacity is smaller, assignment according to line 4 of this table) Discotheques and clubs with dance floor with a capacity of more than 120 persons (if the guest capacity is smaller, assignment according to line 4 of this table)	E 8002	C <sub>ca</sub> s1b d2 a1	B2 <sub>ca</sub> s1a d1 a1
15	- Transport infrastructure facilities, such as airports, railway stations, etc.	Publicly accessible areas with a floor space greater than 1,600 m <sup>2</sup> in transport infrastructure facilities, such as airports or railway stations (if the usable floor space is smaller, assignment according to line 4 of this table)	E 8002	C <sub>ca</sub> s1b d2 a1	B2 <sub>ca</sub> s1a d1 a1
16	- Nursing homes, care homes	Areas used for medical purposes in accordance with the scope of ÖVE/ÖNORM E 8007 Bed wing or residential wing: see accommodation facilities	E 8007	C <sub>ca</sub> s1b d2 a1	B2 <sub>ca</sub> s1a d1 a1

No.	Building description		Installation standard	Fire class Minimum requirement b	
			ÖVE/ÖNORM (series)	Building (except escape route)	Escape route
18	- Service buildings according to OIB	Areas with special hazards <sup>a</sup>	E 8001	C <sub>ca</sub> s1b d2 a1	B2 <sub>ca</sub> s1a d1 a1
19	-Workplaces according to ASchG	If used according to lines 6 to 18	E 8001	as indicated in rows 6 to 18	as indicated in rows 6 to 18
20	- Other rooms/facilities of a special kind (special purpose buildings)		-	determination by the authority	determination by the authority

a Workplaces with special hazards include, for example:

- Laboratories, if employees need to stop or interrupt a running test in order to prevent an acute hazard to employees and third parties. Such acute hazards may be explosions or fires and the release of pathogens or toxic or radioactive substances in hazardous quantities.
- Areas in the immediate vicinity of work equipment whose moving parts continue to move for some time even after the stop button has been pressed, and which could be a potential source of accidents because of the lack of a protective cover or guard – for example facing lathes.
- Control devices for installations that require constant monitoring – e.g. switch rooms and control rooms for power stations, traffic installations, chemical and metallurgical plants as well as workplaces where shut-off and control devices need to be activated during operation or in case of malfunctions in order to avoid accidents and hazards, and to interrupt or stop production processes without danger.
- Workplaces near hot or hazardous baths or casting pits where protection by means of railings or barriers is impossible for production reasons.
- Areas where production processes represent a risk.
- Areas in kitchens where hot liquids become a source of danger if the lighting fails.

b If the cables and insulated wires are routed inside a qualified fire protection duct or structure which is adequately sealed off from the specified area of use, it is possible to use cables and insulated wires within this fire protection duct or structure that do not fulfil the minimum fire class requirement that would otherwise apply to them (see also ÖVE/ÖNORM E 8002-1, Annex B).

# Properties of electric cables in case of fire

## Reaction to fire

This group of test standards is used to assign cables to fire reaction classes in accordance with the following criteria: heat release, smoke, corrosive gases, flame propagation, and dripping of burning parts.

### Testing of vertical fire propagation

EN 60332-1-2:

#### Self-extinguishing

The purpose of the test is to determine whether flame propagation occurs across the surface of individual conductors or cables.



Test of vertical flame propagation, self-extinguishing

### Testing of fire propagation in cable bundles

EN 60332-3-22 und 24:

#### minor fire propagation

Similar to the vertical fire propagation test, this test considers the extent of flame propagation across the surface of the cables. However, in this case we are looking at cable bundles.



Flame propagation test in bundles

### Corrosiveness of the combustion gases

EN 60754-1 and 2: **halogen-free, no corrosive combustion gases**

One of the most important parameters of cables in the event of fire is corrosiveness, i.e. the ability of the gases to create conditions that are aggressive and cause corrosion. This is particularly important because the corrosive atmosphere can potentially also cause damage to equipment that is not directly affected by the fire.



Measurement of the corrosiveness of the combustion gases

### Smoke density

EN 61034-2: **minimal smoke emission**

Another important parameter of cables in case of a fire is the smoke density and the resulting restriction of light propagation. Dense smoke interferes with orientation and thus makes it more difficult to evacuate people.

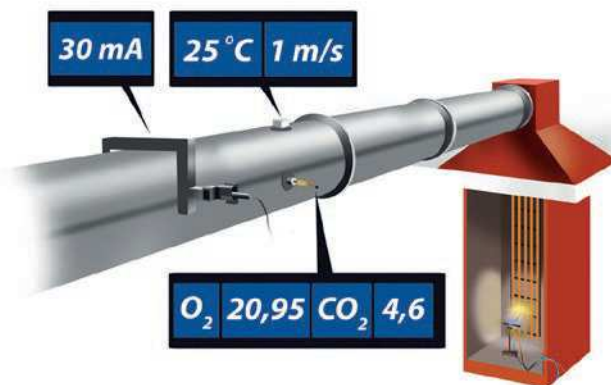


Measurement of smoke density

## Measurement of heat and smoke release in flame propagation tests

EN 50399

It is equally important to determine how much heat cables release in the event of a fire and how this contributes to fire development. This property is evaluated in a complex test. Its purpose is to assign the cables to so-called fire reaction classes within the framework of the Construction Products Regulation (CPR). These classes are defined in the European Commission Regulation No. 2006/751/EC.



Testing of the fire reaction of electrical cables to fire

## Resistance to fire

In the event of a fire, cables must continue to supply electricity and information to the equipment they feed. This requirement led to the development of cables that are able to keep functioning for a specified period of time in the event of fire.

### Insulation integrity FE180

EN 60331-21, DIN VDE 0472-814: **Insulation integrity V180 / FE180**

The first procedure, which examines the functionality of the cables, is described in the test standard EN 60331 'Testing of insulation integrity at temperatures >830° C'. During the test, the cables are connected to the nominal voltage and exposed directly to flames. The period of time during which the cable maintains its functional integrity is measured. As a rule, cables are designed to survive exposure to flames for a period of 180 minutes.

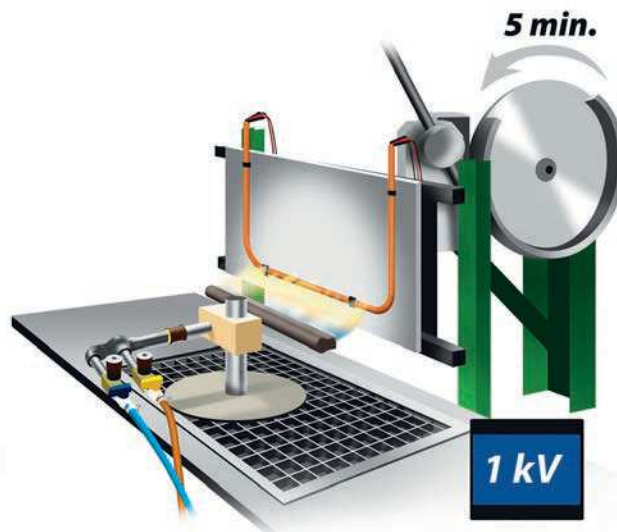


Testing according to EN 60331 (850°C 1 kV)

### Insulation integrity for emergency circuits

EN 50200, EN 50362

Additional test methods are described in the following standards: EN 50200 discusses the method for testing the insulation integrity of small-diameter cables exposed to fire (<20 mm), while EN 50362 discusses the method for testing cables with large diameters (>20 mm) laid in protected conduits for use in emergency circuits. During this test, the cable is exposed to high temperatures and voltages and is also subjected to mechanical stress. At five-minute intervals, a metal rod strikes the test plate to which the cable is attached to simulate mechanical vibrations.



Test according to EN 50200 and EN 50362 (approx. 842°C 1 kV)

## Functional integrity of cable installations and support systems in the event of fire

Fire protection systems ensure the safe and efficient evacuation of people and the successful subsequent deployment of rescue teams, especially in buildings and facilities where there is an increased risk of fire and where large concentrations of people occur (hospitals, stadiums, shopping malls, airports, tunnels, subways, etc.). Such systems must therefore retain their functional integrity even if there is a fire. Consequently, we need to ensure a continuous power supply or, if applicable, continuous signal and data transmission, and this is only possible with a functioning cable system.

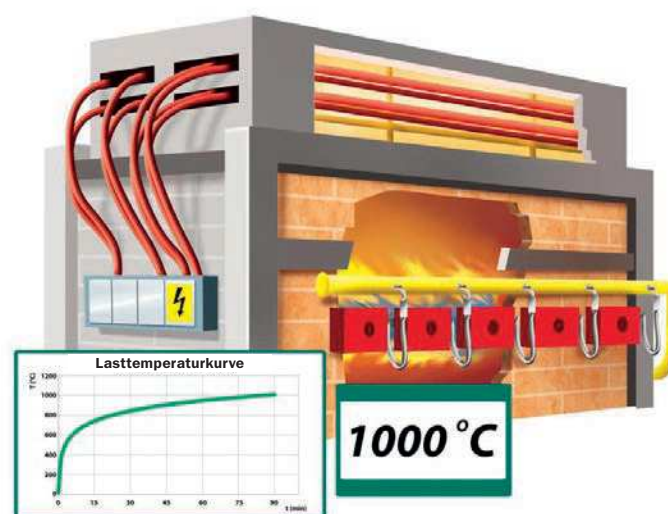
Such a cable system with integrated functional integrity is subjected to the most demanding cable function test procedure in a fire situation. In these cases, it is not only the individual cable that is tested, but also the complete cable system. This includes the cable, the support systems and their connecting elements (such as cable trays, cable ladders, fixing accessories, etc.), which are installed in a fire room and tested under real fire conditions. Since there is no European test procedure for this test, national test procedures are applied instead – standard ČSN 73 0895 in the Czech Republic, standard STN 92 0205 in Slovakia, and DIN 4102-12 in Austria, Germany and Switzerland. Based on these tests, the cables are assigned to classes according to the time in minutes during which they retain their functional integrity. Standard ČSN 73 0895 subdivides functional integrity into four classes (P15-R to P90-R or PH15-R to PH120-R), DIN 4102-12 subdivides it into three classes

(E30, E60 and E90). The cable only passes the test if its function is maintained for at least the specified period of time.

**ČSN 73 0895, STN 92 0205 and DIN 4102-12 define four standardised support systems with integrated functional integrity:**

- Cable installations on cable ladders
- Cable installations on cable trays
- Cable installations on single clamps
- Cable installations on bracket clamps with long troughs

Since standardised support systems have precisely defined parameters and dimensions, they offer the advantage that the results of the performed tests are transferable. Certified cables for standardised constructions of one support system manufacturer can therefore be installed in another manufacturer's standardised construction without the need to carry out another system test. However, due to the diversity of projects, manufacturers of cable support systems also produce so-called non-standardised support systems. Their advantage is a greater degree of flexibility during installation, and they are usually also easier to assemble. On the other hand, the disadvantage is that the test results are not transferable, meaning that it is necessary to use the same manufacturers of cables and support systems that were previously tested.



Testing according to DIN 4102-12 - Functional integrity of cable systems in case of fire



# Packing

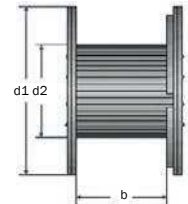
- R ..... Ring (coil)
- Sp ..... Plywood reel (non-returnable)
- D..... Wooden or steel drum

## Drum capacity

Cable Ø	Length in m per standard supply drum and cable diameter												Cable Ø	
	DA 06	DA 07	DA 08	DA 10	DA 12	DA 14	DA 16	DA 18	DA 20	DA 22	DA 24	DA 25		
6	1451	2277	3560											6
7	1054	1617	2622											7
8	811	1288	1993	4213										8
9	618	1020	1515	3244										9
10	523	806	1309	2668										10
11	396	667	1048	2149										11
12	356	560	877	1872										12
13	297	479	768	1615	2287									13
14	243	404	645	1278	1973	2891								14
15	232	336	552	1217	1721	2556								15
16	185	322	466	1039	1487	2195								16
17	175	261	448	901	1304	1950								17
18	143	249	371	772	1132	1817								18
19	135	207	315	726	1069	1595	2488							19
20	127	196	301	632	915	1387	2375	3389						20
21		159	287	590	858	1312	2111	3054						21
22		149	238	506	746	1159	1862	2736						22
23		149	226	487	720	1091	1764	2608	2913					23
24			213	468	618	951	1583	2316	2777					24
25			183	393	595	920	1538	2256	2516					25
26			172	377	572	859	1327	1985	2390					26
27				360	480	736	1286	1781	2148	2488				27
28				295	460	709	1131	1679	2032	2426				28
29				281	440	682	1093	1629	1809	2302				29
30				281	420	597	1056	1446	1756	2053	2477			30
31				267	343	573	916	1400	1548	1996	2408			31
32				253	343	549	882	1230	1500	1762	2144	2507		32
33				211	326	525	848	1188	1451	1711	2081	2435		33
34				199	326	450	754	1145	1403	1659	2018	2167		34
35				199	309	429	724	1145	1219	1607	1777	2101		35
36				187	257	409	694	992	1176	1400	1720	2035		36
37					243	409	664	954	1176	1353	1663	1850		37
38					243	389	581	954	1006	1306	1445	1791		38
39					229	389	554	814	968	1161	1445	1731		39
40					229	307	554	780	968	1120	1393	1671		40
41					214	307	528	780	929	1078	1342	1504		41
42					214	290	528	746	890	1078	1193	1450		42
43					172	290	430	746	779	1037	1147	1397		43
44					160	290	430	623	745	907	1147	1397		44
45					160	273	407	623	745	871	1101	1194		45
46					160	273	407	594	711	835	1055	1194		46
47						256	407	594	711	835	923	1146		47
48						205	385	564	677	798	883	1098		48
49						205	385	564	581	798	883	1098		49
50						205	385	564	581	798	883	1098		50
51						191	302	458	552	653	843	919		51
52						191	302	458	552	653	843	919		52
53						191	302	433	523	622	803	877		53
54						177	283	433	523	622	688	877		54
55						177	283	433	523	622	688	836		55
56						177	283	407	493	591	654	836		56
57							264	407	411	591	654	836		57
58							264	407	411	560	619	680		58
59							264	339	387	467	619	680		59
60							264	318	387	467	619	680		60
61								318	387	467	619	645		61
62								318	387	441	585	645		62

For flat cables: thickness of flat cable is cable diameter  
 Cable length: length according to table x cable thickness/cable width

Standard delivery drums



Wooden drums						
New drum designation	Size	Flange diameter d1 mm	Max. winding diameter mm *	Barrel diameter d2 mm *	Winding width mm "b" *	Weight kg *
DA06 without helix	6	600	540	300	330	12
DA07 without helix	7	700	640	350	370	20
DA08 without helix	8	800	740	400	430	33
EA08 with helix	8	800	740	400	405	36
DA10 without helix	10	1000	940	550	600	65
EA10 with helix	10	1000	940	550	580	68
DA12 without helix	12	1200	1120	700	650	105
EA12 with helix	12	1200	1120	700	620	110
DA14 without helix	14	1400	1320	850	750	170
EA14 with helix	14	1400	1320	850	720	175
DA16 without helix	16	1600	1500	900	850	230
EA16 with helix	16	1600	1500	900	800	240
DA18 without helix	18	1800	1700	1000	950	320
EA18 with helix	18	1800	1700	1000	900	330
DA20 without helix	20	2000	1880	1250	1000	400
EA20 with helix	20	2000	1880	1250	920	415
DA22 without helix	22	2200	2000	1300	1100	450
EA22 with helix	22	2200	2000	1300	1020	465
DA24 without helix	24	2400	2200	1450	1100	620
EA24 with helix	24	2400	2200	1450	1020	635
DA25 without helix	25	2500	2300	1500	1150	800
EA25 with helix	25	2500	2300	1500	1070	820

Steel drums						
New drum designation	Size	Flange diameter d1 mm	Max. winding diameter mm *	Barrel diameter d2 mm *	Winding width mm "b" *	Weight kg *
10MC	100(3k)	1000	940	600	575	56
12MC	120(4k)	1200	1120	600	660	82
15MC	150(5k)	1500	1400	750	940	150
18MC	180(6k)	1800	1700	1150	895	280
20MC	200(7k)	2000	1800	1200	895	380
22MC	220(8k)	2200	2000	1450	965	475
25MC	250(ZF)	2500	2300	1600	1250	780

\* guide values

## Drum allocation

Smallest permissible barrel diameter for cable types.

Types	Smallest barrel diameter
<b>Cables for fixed installation</b>	
Single-core cables	$20 \times D_A$
Sheathed cables, single-core	$20 \times D_A$
Sheathed cables, multi-core	$15 \times D_A$
Flexible cables	$12 \times D_A$
<b>Plastic insulated cables</b>	
Single-core $\leq 6$ kV	$20 \times D_A$
Single-core $\geq 10$ kV	$25 \times D_A$
Multi-core, including $95 \text{ mm}^2 \leq 1$ kV	$15 \times D_A$
Multi-core, including $95 \text{ mm}^2 \geq 6$ kV	$20 \times D_A$
Multi-core, including $95 \text{ mm}^2 \geq 20$ kV	$25 \times D_A$
Multi-core, larger than $95 \text{ mm}^2 \leq 10$ kV	$20 \times D_A$
Multi-core, larger than $95 \text{ mm}^2 \geq 20$ kV	$25 \times D_A$
Multi-core $\leq 1$ kV	$15 \times D_A$
<b>Telecommunication cables and installation cables for telecommunication facilities</b>	
Plastic cables	$20 \times D_A$
Installation cables	$20 \times D_A$
<b>Paper insulated cables with lead sheath</b>	
Single-core $\leq 10$ kV	$25 \times D_A$
Single-core $\geq 10$ kV	$30 \times D_A$
Multi-core, non-armoured $\geq 6$ kV	$25 \times D_A$
Multi-core, armoured $\geq 6$ kV	$20 \times D_A$
3-core lead sheathed cable, armoured $\geq 10$ kV	$20 \times D_A$

$D_A$  = conductor / cable diameter