Top Cable

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TOXFREE VFD EMC/MARINE ROZ1-K (AS) 0,6/1_1,8/3 kV

1. Object

This document defines the design and manufacturing characteristics of the cable type ROZ1-K (AS) 0,6/1 kV y ROZ1-K (AS) 1,8/3 kV EMC / Marine manufactured by Top Cable.

2. Design

This type of cable is basically designed, manufactured and tested according to IEC 60502-1 and IEC 60092-353 (for 3x + 3G cables).

Approvals: DNV (from 3x16+3G2,5 to 3x240+3G50 0,6/1kV)

3. Application

Flexible cable for fixed installations with three phase conductors and protective conductor. For fixed installations on ships and offshore units in all locations. Suitable for transporting and distributing of electric power in installations where it's required low smoke and halogen free emissions under fire conditions.

In the last years has increased the use of variation engines of speed by means of variation of frequency, so much in the new industries like in the already installed ones, where gradually they are replacing to the systems with traditional engines.

This new technology presents big advantages, but brings some disadvantages; one of these disadvantages is the emission of electromagnetic waves of high frequency. A part of the solution is obtained by choosing cable with an appropriate electromagnetic shield. Also, the solution is obtained with a symmetrical distribution of the protective conductor in the interstices of the cable (for small sections the symmetrical distribution is not necessary).

This cable type, that incorporate a special screen and have a symmetrical distribution of the protective conductor, are adequate for facilities where is necessary avoid the interferences of electromagnetic waves of high frequency of nearby circuits, as variation engines of speed.

4. Installation conditions

Being very performant cables there are, however, certain precautions that must be taken into account during installation:

- Always respect the bending radius of the cable. Radius below the minimums indicated can cause damage or breakage in the outer sheath.

- Precautions desing of the laying. It is necessary that the laying of the cable is done in a careful way, taking care not to damage the outer sheath in irregular areas, sharp edges, etc.

- Fixings / Fastenings. Adapt fastenings so that the cable adopts a natural position in the laying to avoid stress concentration in the outer sheath. Allow a certain degree of freedom of movement in order to absorb possible movements produced by temperature variations.

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5. Characteristics

Nominal voltage: 0,6/1 (1,2) kV

1,8/3 (3,6) kV

Maximum conductor temperature: 90 ºC

Minimum operating temperature: -40 °C (static, with protection)

Minimum installation and handling temperature: 0 °C

Maximum ambient temperature: 60 ºC

Maximum short-circuit temperature: 250 °C (maximum 5 s.)

Minimum bending radius (static): 10 x cable Ø

Optical coverage of braid screen: minimum 80%

No flame propagation: according to EN 60332-1/ IEC 60332-1

No fire propagation: according to EN 60332-3/ IEC 60332-3/ EN 50399

Reaction to fire CPR: Cca-s1a,d1,a1 according to EN 50575

Halogen free: according to EN 60754/ IEC 60754

HCl content < 0,5

pH > 4,3

conductivity < 10 µS/mm

Smoke density: according to EN 61034/ IEC 61034

light transmittance > 60 %

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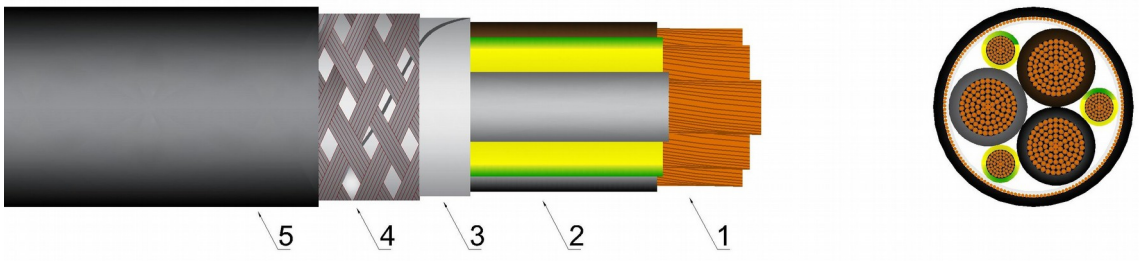
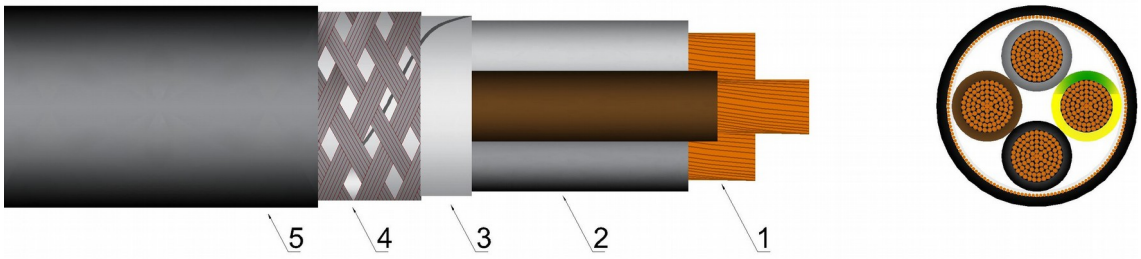
6. General make-up of the cable



3x + 3G cables



4G cables

6.1 Conductor (1)

Electrolytic annealed copper conductor, class 5 in accordance with IEC 60228.

6.2 Protective conductor

Electrolytic annealed copper conductor, class 5 in accordance with IEC 60228. For 3x+3G cables, the ground conductor is divided into three conductors; the equivalent section of the three protective conductors together is over 50% of the section of the phase conductor. For 4G cables, grounding conductor is of the same section as the phase conductors.

6.3 Insulation (2)

Cross-linked polyethylene insulation, type XLPE according to IEC 60502-1 and type HF XLPE-90 ºC according to IEC 60092-360. The standard identification is the following:

- 3x + 3G..... grey + brown + black + Yellow/Green (3G)
- 4 G..... grey + brown + black + Yellow/Green

6.4 Assembly of cores

For 3x+3G cables, the three phase conductors are cabled helically with the three protective conductors distributed in the interstices. For 4G cables, the three phase conductors and protection conductor are cabled helically.

6.5 Separator / Screen

Aluminium-polyester tape (3), helically over the set of insulated conductor. The polyester is in contact with the insulated conductors and serves as the separator, while the aluminium is in contact with the braid of tinned copper wire (4) that is placed directly above the aluminium-polyester tape, doing all a screen function.

Screen has a lining of 100% and its total section is about 10% of the section of the phase conductor in each cases.

6.6 Outer sheath (5)

Polyolefin outer sheath with low smoke and halogen free, black colour, type ST_8 according to IEC 60502-1 and type SHF1 according to IEC 60092-360.

7. Current-carrying capacities

7.1 Nominal current-carrying capacities

Table 1 shows the current-carrying capacities and voltage drop detailed for every cable.

Current-carrying capacities, in amperes, are calculated according to IEC 60364-5-523 and for the following conditions:

- Open air installation: one cable with adequate ventilation and ambient temperature of 30 °C, supported by cleats and hangers or on perforated tray (reference method E).
- Buried installation: one cable in a duct buried at depth of 0,7 m, with soil thermal resistivity of 2,5 °K·m/W, and 20 °C of ground temperature (reference method D).
- It is supposed a three-phase circuit.

For conditions other than this apply the adequate correction factors (point 6.3).

The electrical resistance of conductor is indicated according to IEC 60228 for copper conductor class 5.

Voltage drop is the maximum that may occur. It is calculated for the maximum service temperature and for cos φ= 1, supposed a three-phase circuit.

nº x Section (mm^2)	Open Air Inst. (A)	Buried Inst. (A)	Conductor Resistant (Ω/Km)	Voltage drop (V/A·km)
3 x 10 + 3 G 1,5	75	61	1,91	4,22
3 x 16 + 3 G 2,5	100	79	1,21	2,67
3 x 25 + 3 G 4	127	101	0,780	1,72
3 x 35 + 3 G 6	158	122	0,554	1,22
3 x 50 + 3 G 10	192	144	0,386	0,852
3 x 70 + 3 G 10	246	178	0,272	0,601
3 x 95 + 3 G 16	298	211	0,206	0,455
3 x 120 + 3 G 16	346	240	0,161	0,356
3 x 150 + 3 G 25	399	271	0,129	0,285
3 x 185 + 3 G 35	456	304	0,106	0,234
3 x 240 + 3 G 50	538	351	0,0801	0,177
3 x 300 + 3 G 50	621	396	0,0641	0,142
4 G 1,5	23	22	13,3	29,4
4 G 2,5	32	29	7,98	17,6
4 G 4	42	37	4,95	10,9
4 G 6	54	46	3,30	7,29
4 G 10	75	61	1,91	4,22

Table 1

7.2 Short-circuit current-carrying capacities

The maximum short-circuit current that a cable can withstand depend on the time of reaction of the protection elements installed in the line. The maximum current-carrying capacity in a short-circuit accident, for a specific type of cable, is the result of multiplying the cross section of the cable for the values shown in table 2. These values are taken from IEC 949 with initial temperature 90ºC and end temperature 250ºC.

Time (s)	0,1	0,2	0,3	0,5	1	1,5	2	2,5	3
A/mm^2	449	318	259	201	142	116	100	90	82

Table 2

7.3 Correction factors

The current-carrying capacities must be multiplied with the adequate correction factor when the installation conditions differs from point 6.1

Correction factors for air temperature other than 30°C.

Air T. (ºC)	20	25	30	35	40	45	50	55	60
Factor	1,08	1,04	1	0,96	0,91	0,87	0,82	0,76	0,71

Table 3

Correction factors for ground temperature other than 20°C.

Ground T. (ºC)	10	15	20	25	30	35	40	45	50
Factor	1,07	1,04	1	0,96	0,93	0,89	0,85	0,80	0,76

Table 4

Correction factors for soil thermal resistivity, other than 2,5 °K·m/W.

Moisture degree of soil	Damp	Slightly Damp	Slightly dry	Dry	Very dry
Thermal Resist, (º K ·m / W)	1	1,5	2,0	2,5	3,0
Factor	1,18	1,1	1,05	1	0,96

Table 5

8. Dimensions

Tables 6 and 7 shows diameter and weight detailed for every cable.

0,6/1 kV cables

nº x Section (mm²)	Diameter under the braid (mm)	Overall diameter (mm)	Weight (Kg/Km)
3 x 10 + 3 G 1,5	11,1	15,6	510
3 x 16 + 3 G 2,5	14,0	19,2	795
3 x 25 + 3 G 4	16,9	22,3	1.145
3 x 35 + 3 G 6	19,5	24,9	1.505
3 x 50 + 3 G 10	22,7	28,1	2.055
3 x 70 + 3 G 10	26,2	31,6	2.660
3 x 95 + 3 G 16	30,1	35,5	3.465
3 x 120 + 3 G 16	33,3	39,4	4.340

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nº x Section (mm²)	Diameter under the braid (mm)	Overall diameter (mm)	Weight (Kg/Km)
3 x 150 + 3 G 25	39,1	45,4	5.490
3 x 185 + 3 G 35	42,3	49,0	6.730
3 x 240 + 3 G 50	49,4	56,5	8.815
3 x 300 + 3 G 50	55,0	62,5	10.715
4 G 1,5	6,9	11,4	185
4 G 2,5	7,7	12,2	230
4 G 4	9,2	13,7	300
4 G 6	10,6	15,1	385
4 G 10	12,7	17,2	560

Table 6

1,8/3 kV cables

nº x Section (mm²)	Diameter under the braid (mm)	Overall diameter (mm)	Weight (Kg/Km)
3 x 50 + 3 G 10	27,0	32,4	2.240
3 x 70 + 3 G 10	30,1	35,5	2.840
3 x 95 + 3 G 16	34,0	40,2	3.795
3 x 120 + 3 G 16	36,7	43,1	4.560
3 x 150 + 3 G 25	41,6	48,2	5.670
3 x 185 + 3 G 35	45,3	52,2	6.895
3 x 240 + 3 G 50	50,7	58,0	8.955
3 x 300 + 3 G 50	55,8	63,6	10.820

Table 7