



Proximus's Reference ULLOffer

Annex Jc

Specifications of the Tie Cables

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1. Tie cable for Type 1 services.

1.1 General Characteristics

1.1.1 Conductors

1. mono-conductor tinned copper wires with a diameter as mentioned in the present technical specifications with a tolerance of minus 0.01 mm and plus 0.03 mm. In principle the conductors should be in one length.
2. The electrical resistance of the conductors. The specific electrical resistance of the conductor measured at 20°C shall be $< 1/55 \text{ ohm}$ or $0,01818 \text{ ohm/m/mm}^2$. The resistance per meter and per mm^2 increases with the temperature with $0,000068 \text{ ohm/}^\circ\text{C}$.
3. The specific electrical resistance of the conductor measured at 20°C shall be $< 1/55 \text{ ohm}$ or $0,01818 \text{ ohm/m/mm}^2$. The resistance per meter and per mm^2 increases with the temperature with $0,000068 \text{ ohm/}^\circ\text{C}$.
4. The conductors should be tinned completely smooth over the entire surface with minimum 2 g/m^2 .

1.1.2 Insulation of the conductors

5. Insulation material :
 - a. Cables up to 10 pairs : polyethylene (PE)

The conductor should be centred completely in its insulation. The thickness should be even and free from blisters, holes, cracks, porous spots or any other defects. The insulation should not adhere to the conductors. The surface should be smooth and the colour stable. The colours should comply with the colours published in the International Electromechanical Committee, Publication 304 – latest edition.

- b. Cables as from 20 pairs on : insulation material of flame retardant polyethylene copolymer (FRPE)

Characteristics as per 2.1.a.

6. The PE and FRPE sheaths have a thickness of minimum 0,15 mm. This requirement is valid at any place of the sheath. The diameter of the insulated conductor should not exceed the diameter for this conductor, measured on the tinned copper with 0.6 mm.

1.1.3 Outersheath

7. The cable core is covered with an outersheath of polyethylene copolymer (FRPE).
8. He should be well centred and free from blasts, holes, and cracks, porous spots or any other defects. The surface should be smooth and equal over the whole length.

up to 10 pairs (F1) : light grey RAL 7032

20 pairs and more (F2) : dark grey RAL 7001

9. The FRPE-sheaths should have following minimum thickness

<u>Number of conductors</u>				<u>Minimum thickness</u>
up to	21			0,8 mm
from	22	to	55	1,0 mm
from	56	to	101	1,2 mm
from	102	to	175	1,4 mm
from	176	to	250	1,6 mm
from	251	to	350	1,8 mm
from	351	to	450	2,0 mm
from	451	to	808	2,2 mm

1.2 Cable assembly description

10. The cables consist of tinned copper conductors with a diameter of 0,6 mm for the cable with 2 pairs and 0,5 mm for the cables with more than 2 pairs, insulated with PE for cables up to 10 pairs and FRPE for cables as from 20 pairs on.
The conductors are twisted together with a lay of maximum 75 mm.
In order to avoid cross talk the lay of adjacent pairs should slightly deviate from each other.
The pairs will be stranded in concentric layers.
The wires are either mono- or bi-coloured.
The cable core is wrapped in a spiral way with an Alu-PET foil having an overlay of min. 20 %.
The thickness of the Alu will be 25 micron. For cable with two pairs the Alu-PET foil can be placed in a longitudinal way.

11. The colours of the wires are as follows:

<u>Pair</u>	<u>a-wire</u>	<u>b-wire</u>
1	white	blue
2	white	orange
3	white	green
4	white	brown
5	white	grey
6	red	blue
7	red	orange
8	red	green
9	red	brown
10	red	grey
11	black	blue
12	black	orange
13	black	green
14	black	brown
15	black	grey
16	yellow	blue
17	yellow	orange
18	yellow	green
19	yellow	brown
20	yellow	grey
21	white-blue	blue
22	white-blue	orange
23	white-blue	green
24	white-blue	brown
25	white-blue	grey

26	red-blue	blue
27	red-blue	orange
28	red-blue	green
29	red-blue	brown
30	red-blue	grey
31	blue-black	blue
32	blue-black	orange
33	blue-black	green
34	blue-black	brown
35	blue-black	grey
36	yellow-blue	blue
37	yellow-blue	orange
38	yellow-blue	green
39	yellow-blue	brown
40	yellow-blue	grey
41	white-orange	blue
42	white-orange	orange
43	white-orange	green
44	white-orange	brown
45	white-orange	grey
46	orange-red	blue
47	orange-red	orange
48	orange-red	green
49	orange-red	brown
50	orange-red	grey
51	orange-black	blue
52	orange-black	orange
53	orange-black	green

54	orange-black	brown
55	orange-black	grey
56	yellow-orange	blue
57	yellow-orange	orange
58	yellow-orange	green
59	yellow-orange	brown
60	yellow-orange	grey
61	white-green	blue
62	white-green	orange
63	white-green	green
64	white-green	brown
65	white-green	grey
66	red-green	blue
67	red-green	orange
68	red-green	green
69	red-green	brown
70	red-green	grey
71	green-black	blue
72	green-black	orange
73	green-black	green
74	green-black	brown
75	green-black	grey
76	yellow-green	blue
77	yellow-green	orange
78	yellow-green	green
79	yellow-green	brown
80	yellow-green	grey
81	white-brown	blue

82	white-brown	orange
83	white-brown	green
84	white-brown	brown
85	white-brown	grey
86	red-brown	blue
87	red-brown	orange
88	red-brown	green
89	red-brown	brown
90	red-brown	grey
91	black-brown	blue
92	black-brown	orange
93	black-brown	green
94	black-brown	brown
95	black-brown	grey
96	yellow-brown	blue
97	yellow-brown	orange
98	yellow-brown	green
99	yellow-brown	brown
100	yellow-brown	grey
101	white-grey	blue

12. The cables with 8 conductors and more should also have a tinned conductor insulated with PE/FRPE of the same diameter as the other conductors and placed in parallel with the cable direction (drainwire).

13. The insulation of this drainwire is white with double black ringmarking :
 - distance between two colourings : 5 mm
 - distance between two double colourings : 17 mm

14. Cables with four conductors are twisted into starquads.

15. The four conductors have following colours :
pair one : white and blue

pair two : turquoise and violet
16. In this cable the drainwire is replaced by an enamelled copperwire of 0,4 mm measured on the copper and 0,42 mm measured on the lacquer.
17. This wire is put in the centre of the starquad.

1.3 Particular characteristics

1.3.1 Insulation resistance

18. The insulation resistance is measured with 500 volt direct current at a temperature of 20 ° C. The results are read after one minute.

1.3.1.1 Tests on finished cables

19. The conductors not being measured as well as the eventual metallic screenings are connected to earth.
20. The insulation resistance measured at 20 ° C, under these circumstances should not be less than 5000 megohm.kilometer.

1.3.1.2 Tests on individual wires

21. The insulation resistance is measured with 500 volt direct current.
22. Take a few meters of the cable as testing sample. Take the wires separately and put them in water, first at a temperature of 20°C and then 40°C.
The insulation resistance between each conductor and the water is being measured after one hour in water for both temperatures. The insulation resistance should be at least 100 megohm.kilometer at 20°C and 10 megohm.kilometer at 40°C.

1.3.2 Diaphony between 2 pairs

23. The para- and tele-diaphony measured between 2 pairs, at their characteristic impedance, should be equal or above 48 dB at a signal of 1000 kHz.

2. Tie cable for Type 2 services.

2.1 Description of the cable

The cable is respectively made of:

24. 24 symmetrical pairs, each of them having the following characteristics:
 - a) Conductor : a mono-conductor wire of 0.5 mm (± 0.01 mm) diameter made of annealed copper, single strand, circular in section.
 - b) Insulation : a full polyvinyl chloride insulating or PE coat of 0.20 mm thickness (0.17 mm minimum) and with a nominal external diameter of 0.90 [+0.05 mm, -0.03 mm]. The insulation shall fit closely to the conductor, without adhering to it. The colours shall correspond with IEC 189-2 App. A and IEC 304.
 - c) The cabling element is a pair of two insulated conductors designated wire A and wire B. Twisting pitch of the pair: 50mm maximum.
25. The 24 cabling elements shall be stranded in concentric layers. A binding tape (preferably consisting of non-hygroscopic material) shall be placed between successive layers. The sequence of elements is from the centre to the outside layer; the counting direction is clockwise and the same in each layer.
26. The core of the cable must be wrapped with a protective layer of non-hygroscopic material, wound helical or longitudinal lapping and consists of 1 or 2 tapes with overlap.
27. A tinned copper wire with the same dimensions as the conductor wires shall be included in the cable in continuous contact with the surface of the screening foil.
28. A screening foil consisting of a sandwich foil aluminium-insulated tape-aluminium with an aluminium thickness of 25 microns on both sides. The tape shall be applied longitudinally round the wrapped core with an overlap of 6 mm minimum.
29. A braid shield of tinned copper wires, forming a screen with a minimum coverage ratio of 50 %, placed around the elements from 1.1. to 1.5. The diameter of the single wires shall be between 0.10 mm and 0.20 mm. The woven shield shall comply with the electrical requirements for the transfer impedance and the mechanical strength.
30. A thread of non-hygroscopic material denoting company of manufacture, laid underneath the sheath.

31. A monochrome grey (RAL 7032, colored in the block) sheath in LSZH material enveloping the previous assembly. The sheath shall be applied to fit closely to the core of the cable without adhering to the screen or to the insulated conductors or to the wrapping tape. It shall be perfectly continuous and having a thickness as uniform as possible. Sheath thickness: 0.80 mm nominal, 0.60 mm minimum. The diameter of the finished cable shall not exceed 11.5 mm.

2.2 Conductors

32. Composition of the conductors: the conductors have to be made of a copper wire drawn in one piece for the whole manufacturing length. No soldered joint is tolerated.
33. Eccentricity: the eccentricity shall be maximum 1.8 at any cross section.
34. Conductor insulation: The insulation (polyvinyl chloride or PE) of the conductor shall have adequate mechanical strength and elasticity which remains sufficiently constant during normal use; it shall be continuous and of uniform thickness.
35. Sheath insulation: The insulation (LSZH) of the conductor shall have adequate mechanical strength and elasticity which remains sufficiently constant during normal use; it shall be continuous and of uniform thickness.

2.3 Electrical characteristics

36. The measurements to carry out in order to check the electrical features should always be carried out on cable sections of a nominal length of 250 meters, at a temperature comprised in between 15 and 25 degrees centigrade.

2.3.1 Electrical requirements of the conductor

37. The loop resistance shall be maximum 196.5 ohm/km at 20°C and the conductivity shall be minimum 57 m/ohm.mm² at 20°C.

2.3.2 Insulating resistance

38. The measurements will be taken after a minute of electrification. The insulating resistance between the two wires of the pair or between each wire and the screen won't be inferior to 500 Megohm x kilometer.

2.3.3 Dielectric strength

39. The dielectric strength shall be minimum 1500 Vac when measured during 1 minute.

2.3.4 Cable impedance

40. The typical cable impedance has to be in the range $100\ \text{ohms} \pm 10\ \text{ohms}$ at 1 MHz. With any price offer for this cable, the supplier has to provide a document containing the variation curves of the real and imaginary parts of the typical characteristic of a section of 250 meters, in function of the frequency, in a transmission band opening the range of 0.3 to 10000 kHz. Indications on the manufacturing tolerances have to be added to the curves which will be of average values.

2.3.5 Attenuation

41. With every price offer for this cable, the supplier will communicate the kilometric attenuation value at $(20 \pm 2)^\circ\text{C}$ for the frequencies between 0.3 and 10000 kHz.

42. At 1 Mhz, the attenuation may not exceed 32 dB/km.

2.3.6 Crosstalk between 2 pairs

43. The supplier has to communicate the near end and far end crosstalk values at 100, 500, 1000 and 10000 kHz between two symmetrical pairs under the screen placed side by side on a length of 250 meters, each terminated on their cable impedance. This value has to be greater than 55 dB at 1 MHz and 40 dB at 10 MHz.

2.3.7 Mutual capacitance

44. The mutual capacitance shall be maximum 100 nF/km measured between 500 and 2000 Hz.

2.3.8 Capacitance unbalance

45. Between any pair and the earth the capacitance unbalance shall not exceed 750 pF/500m with the exception of 1 value of the values up to 1500 pF/500m at 1 kHz.

3. Tie cabling - Labelling

46. To guarantee an efficient operational work, each tie cable will be labelled as follows:

3.1 Raw Copper

3.1.1 Cable 24 pairs, OLO & PROXIMUS side

RC/A - C00xx - 23/0/00 to 23/0/23 (xx) : OLO code

(numbering = column/bed/position)

3.1.2 Cable 100p, OLO & PROXIMUS side

RC - C00xx - 23/5/00 to 23/5/99 (xx) : OLO code

(numbering = column/bed/position)

3.2 Shared Pair

3.2.1 PROXIMUS side

side "LINE" : SPL 0098/0001 to 0098/0024

side "POTS" : SPL 0098/0051 to 0098/0074
(numbering = upright/position)

3.2.2 OLO & PROXIMUS side

side "DATA" : C00xx 61/01 SPL DATA 1-3 P (P for PSTN)

C00xx 61/01 SPL DATA 1-3 I (I for ISDN)

(numbering = rack/subrack)
