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LOW VOLTAGE AERIAL BUNDLED CABLES  
ADDENDUM FOR ENEL DISTRIBUIÇÃO SÃO PAULO

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Revision	Data	List of modifications
00	04/04/2019	First emission
01	13/06/2019	Common list updated.

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## 1 SCOPE

This addendum of the Global Standard GSCC009 rev. 1 specifies the requirements applicable to Enel Distribuição São Paulo (Brazil). They are specified in this document with reference to the same paragraph number of GSCC009 rev. 1.

## 5 DESIGN AND MANUFACTURING

### 5.1 Conductor

For **Type III** cables the conductors shall be stranded circular non-compacted (Class 2) made of aluminum with 99,5% purity degree.

For **Type I, Type II & Type IV** cables the phase conductors shall be stranded compacted circular (Class 2) made of aluminum with 99,5% purity degree.

Aluminum conductors shall comply all the features specified herein and in standard IEC 60228.

If required, the distance between welding points of the aluminum conductor shall not be less than:

- 15 m between two welding points of the whole conductor
- 200 m between two welding points of the external layer

On the other hand, for neutral supported cables (**Type II & Type IV**) aluminum alloy neutral conductor shall be stranded circular non-compacted, made with wires that shall comply all features specified in standard EN 50183, specifically for AL2 type.

Welding points are forbidden in the central wire. However, welding points in other layers are permitted as long as the distance between welding is not less than:


- 50 m between two welding points of the whole conductor.
- 200 m between two welding point in the external layer

In Table 2 and Table 3 aluminum and aluminum alloy conductor characteristics are shown.

Nominal cross-section [mm <sup>2</sup> ]	Minimum number of wires	Diameter of conductors [mm]		Maximum resistance of conductor at 20°C [Ω/km]
		Minimum	Maximum	
10	(7)*	3,7	4,1	3,08
16	6(7)*	4,6	5,2	1,91
25	6(7)*	5,6	6,5	1,20
35	6	6,6	7,5	0,868
50	6(7)	7,7	8,6	0,641
54,6**	7	9,2	9,8	0,630
70	12	9,3	10,2	0,443
80**	19	11,2	12	0,437
95	15	11,0	12,0	0,320
150	15	13,9	15,0	0,206

\* (7) For non-compacted conductors  
\*\* Aluminum alloy conductor used for neutral cores

**Table 1: Characteristics of aluminum and aluminum alloy conductors.**

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The lay direction of conductors external layer shall be right hand “Z” direction.

Messenger conductor (Type II & Type IV)			
Material	AL2 EN 50183		
Stranding Type	Non-compacted		
Tensile strength of the individual wires (See EN 50183)	$\geq(325) \text{ N/mm}^2$		
Cross-section	[mm <sup>2</sup> ]	54,6	80
Wire nominal diameter	[mm]	3,15 ±0,03 mm	2,32 ±0,03 mm
Coefficient of linear thermal expansion	[°C <sup>-1</sup> ]	23·10 <sup>-6</sup>	
Young modulus	[MPa]	62.000	

**Table 2 Neutral supporting conductor additional features.**

The Aluminum 1350 H19 and aluminum alloy conductors shall be according to the following table:

Material	Nominal cross-section [mm <sup>2</sup> ]	Formation		Min Breaking load [daN]
		Number of wires	Wire nominal diameter [mm]	
Al 1350 H19	10	7	1,36	195
Aluminum alloy	70	7	3,45	1991

**Table 4 Aluminum 1350 H19 and aluminum alloy features**

## 5.2 Insulation

The insulation shall be applied by a suitable extrusion process, and shall form a compact and homogenous body, it shall not penetrate beyond the external layer of the conductor. In addition, it shall be possible to remove without creating any damage to the conductor.

The insulating material shall be cross-linked polyethylene (XLPE), compliant with the characteristics required herein this document.

The insulation must allow maximum conductor temperatures of 90 °C in normal operation and 250 °C under short circuit condition by at least 5 seconds.

The minimum thickness of insulation measured and accepted at any point of the cable shall not be less than 90% of the nominal value minus 0,1 mm. In addition, the average of all these measures should not be less than the nominal thickness.

$$t_{min} \geq 0,9 t_n - 0,1$$

Where:

$t_{min}$ : minimum insulation thickness in millimeters

$t_n$ : nominal thickness in millimeters

If there is any separator between the conductor and insulation it shall not be considered when the insulation thickness measurement is performed.


Cross-section [mm <sup>2</sup> ]	Type I and Type II		Type III and Type IV	
	Insulation nominal thickness [mm]	Insulation minimum thickness [mm]	Insulation nominal thickness [mm]	Insulation minimum thickness [mm]
10	1,2	0,98	-	-
16	1,2	0,98	1,3	1,07
25	1,4	1,16	1,3	1,07
35	1,6	1,34	1,6	1,34
50	1,6	1,34	1,6	1,34
70	1,8	1,52	1,6	1,34
95	1,8	1,52	1,8	1,52
150	1,8	1,52	1,8	1,52
54,6*	1,6	1,34	1,6	1,34
80*	1,8	1,52	1,8	1,52

\*Aluminum alloy conductor used for neutral cores

**Table 3 XLPE insulation thickness**

The insulation color shall be **black**.

For **Type IV** cables the insulation color of the neutral core shall be grey RAL 7001

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## 6 TEST CLASSIFICATION

### 6.3 Tests list for Type I and Type II cables

N°	Test	Requirements	Test Method	R	S	T
3	Mechanical breaking load verification of: Phase conductors					
	10 mm <sup>2</sup>	≥190 daN	HD 626 Part 2 sub-clause 2.1.2	-	-	X
	16 mm <sup>2</sup>	≥190 daN				
	25 mm <sup>2</sup>	≥300 daN				
	35 mm <sup>2</sup>	≥420 daN				
	50 mm <sup>2</sup>	≥600 daN				
	70 mm <sup>2</sup>	≥840 daN				
	95 mm <sup>2</sup>	≥1140 daN				
	150 mm <sup>2</sup>	≥1800 daN				
Neutral conductors						
54,6 mm <sup>2</sup>	≥1660 daN					
80 mm <sup>2</sup>	≥2100 daN					

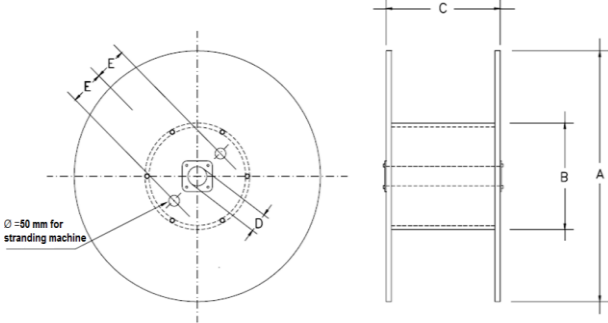
### LOCAL SECTION G – ENEL DISTRIBUIÇÃO São Paulo

ITEM	TITLE	DESCRIPTION
3.3	Replaced local standards	<ul style="list-style-type: none"> <li>• E-BT-002</li> <li>• PM-R 1796 R-05</li> <li>• PM-R 208.01.2</li> <li>• PM-R 208.10.0</li> <li>• NTC-27 – Review 2</li> <li>• NTE-M-056 Condutores Elétricos - Distribuição Aérea</li> <li>• NBR – 8182 Cabos de Potência Multiplexados auto sustentados com isolamento extrudada de PE ou XLPE, para tensões até 0,6/1kV.</li> <li>• NBR – 11137 – Carretel de madeira para acondicionamento de fios e cabos elétricos – Dimensões e extruturas.</li> </ul>


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ITEM	TITLE	DESCRIPTION
8	CONDITIONS OF SUPPLY	<p><b>Packaging and Labelling</b></p> <p>Cables shall be delivered on spools made of wood or metal, such spool will not be returned. Characteristics are indicated in Figure A, dimensions are depicted in Table A.</p> <p>The total length of the supplied cable shall not be less than that requested in the purchase order and shall not be longer by any more than 5%.</p> <p>The maximum gross weight of the packaged spool must not exceed 3500 kg.</p> <p>The ends of the cables on each spool must be protected with caps or hoods that prevent the entry of moisture. These ends internally secured to the spools, must be mechanically protected against possible damages resulting from handling and transportation of each spool, leaving both ends accessible through the use of an internal helix or reel on each spool.</p> <p>When distance between manufacturing facilities and distribution company storage center is less than 200 km and is necessary only one mean of transportation,</p> <p>It is mandatory to use internal helix for cables cross-section greater of equal to 120 mm<sup>2</sup>. However, moisture protection on both visible ends of the cables, mechanical protection, and careful handling shall be applied.</p> <p>Some Purchase orders could request 2,000 m of maximum length per spool and/or pre-joined cables.</p> <p>Spools made of wood shall be treated according to the international requirements for the control of plant disease, avoiding the compounds "Pentachlorophenol" and "Creosote". The treatment must include, at least: highly toxic to xylophagous organisms, high penetration and holding power, chemical stability, non-corrosive substances to metals that could affect the physical characteristics of wood.</p>

LOCAL SECTION G – ENEL DISTRIBUIÇÃO (BRASIL)

ITEM	TITLE	DESCRIPTION															
8	CONDITIONS OF SUPPLY	<div style="text-align: center;">  <p>Figure A</p> </div> <p><u>Dimensions:</u></p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;">A<sup>(1)</sup></th> <th style="text-align: center;">B</th> <th style="text-align: center;">C<sup>(1)</sup></th> <th style="text-align: center;">D<sup>(2)</sup></th> <th style="text-align: center;">E</th> </tr> <tr> <th style="text-align: center;">mm</th> <th style="text-align: center;">mm</th> <th style="text-align: center;">mm</th> <th style="text-align: center;">mm</th> <th style="text-align: center;">mm</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">2000</td> <td style="text-align: center;">(3)</td> <td style="text-align: center;">1120</td> <td style="text-align: center;">80</td> <td style="text-align: center;">(4)</td> </tr> </tbody> </table> <p style="text-align: center;">Table A</p> <p>Notes:</p> <p>(1) Maximum value.  (2) Minimum value.  (3) Two times the minimum bending radius indicated by the supplier.  (4) 300 or 180 mm according to spool type (large or small, respectively)</p> <p>The spools must contain:</p> <ul style="list-style-type: none"> <li>• An external protection built with wooden flanges fixed on the wooden spools or some equivalent for metal spools, being secured with tapes or straps.</li> <li>• Indication with an arrow of the rolling direction.</li> <li>• A stainless steel plate for identification purposes. Such plate shall be applied in both flanges and shall have the following information (in Portuguese): <ol style="list-style-type: none"> <li>1) Manufacturer name</li> <li>2) Country of origin</li> <li>3) ENEL RIO/ENEL CEARÁ/ENEL GOIÁS/ ENEL SÃO PAULO (according to purchase)</li> <li>4) Purchase order N°</li> <li>5) Rated Voltage U<sub>o</sub>/U (U<sub>max</sub>)</li> <li>6) Insulation material</li> <li>7) Cable cross-section [mm<sup>2</sup>]</li> <li>8) Spool number of the corresponding delivered batch</li> <li>9) Net and gross weight [kg]</li> <li>10) Configuration type (unipolar, triplex, quadruplex).</li> <li>11) Cable length [m]</li> </ol> </li> </ul>	A <sup>(1)</sup>	B	C <sup>(1)</sup>	D <sup>(2)</sup>	E	mm	mm	mm	mm	mm	2000	(3)	1120	80	(4)
A <sup>(1)</sup>	B	C <sup>(1)</sup>	D <sup>(2)</sup>	E													
mm	mm	mm	mm	mm													
2000	(3)	1120	80	(4)													



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ITEM	TITLE	DESCRIPTION																																				
8	CONDITIONS OF SUPPLY	<p>The Drums and the length are indicated in the following table:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Formation</th> <th style="text-align: center;">Spool max dimension</th> <th style="text-align: center;">Nominal length per spool [m]</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">2X1X10+ 10MM<sup>2</sup></td> <td style="text-align: center;">Cable roll</td> <td style="text-align: center;">100</td> </tr> <tr> <td style="text-align: center;">3X1X10+ 10MM<sup>2</sup></td> <td style="text-align: center;">Cable roll</td> <td style="text-align: center;">100</td> </tr> <tr> <td style="text-align: center;">2X1X10MM<sup>2</sup></td> <td style="text-align: center;">ABNT 11137 100/60</td> <td style="text-align: center;">1500</td> </tr> <tr> <td style="text-align: center;">3x1x25 MM<sup>2</sup></td> <td style="text-align: center;">ABNT 11137 100/60</td> <td style="text-align: center;">1000</td> </tr> <tr> <td style="text-align: center;">4x25 MM<sup>2</sup></td> <td style="text-align: center;">ABNT 11137 125/70</td> <td style="text-align: center;">1000</td> </tr> <tr> <td style="text-align: center;">2x25 MM<sup>2</sup></td> <td style="text-align: center;">ABNT 11137 125/70</td> <td style="text-align: center;">1500</td> </tr> <tr> <td style="text-align: center;">2x50+54,6 MM<sup>2</sup></td> <td style="text-align: center;">ABNT 11137 125/70</td> <td style="text-align: center;">1000</td> </tr> <tr> <td style="text-align: center;">3x50+54,6 MM<sup>2</sup></td> <td style="text-align: center;">ABNT 11137 150/80</td> <td style="text-align: center;">1200</td> </tr> <tr> <td style="text-align: center;">2x70+70 MM<sup>2</sup></td> <td style="text-align: center;">ABNT 11137 125/70</td> <td style="text-align: center;">900</td> </tr> <tr> <td style="text-align: center;">3x95+54,6 MM<sup>2</sup></td> <td style="text-align: center;">ABNT 11137 125/70</td> <td style="text-align: center;">500</td> </tr> <tr> <td style="text-align: center;">3x150+80 MM<sup>2</sup></td> <td style="text-align: center;">ABNT 11137 150/80</td> <td style="text-align: center;">500</td> </tr> </tbody> </table>	Formation	Spool max dimension	Nominal length per spool [m]	2X1X10+ 10MM <sup>2</sup>	Cable roll	100	3X1X10+ 10MM <sup>2</sup>	Cable roll	100	2X1X10MM <sup>2</sup>	ABNT 11137 100/60	1500	3x1x25 MM <sup>2</sup>	ABNT 11137 100/60	1000	4x25 MM <sup>2</sup>	ABNT 11137 125/70	1000	2x25 MM <sup>2</sup>	ABNT 11137 125/70	1500	2x50+54,6 MM <sup>2</sup>	ABNT 11137 125/70	1000	3x50+54,6 MM <sup>2</sup>	ABNT 11137 150/80	1200	2x70+70 MM <sup>2</sup>	ABNT 11137 125/70	900	3x95+54,6 MM <sup>2</sup>	ABNT 11137 125/70	500	3x150+80 MM <sup>2</sup>	ABNT 11137 150/80	500
Formation	Spool max dimension	Nominal length per spool [m]																																				
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Common list

GS Type Code	Country	Country Code	Formation [mm <sup>2</sup> ]	Cable Type	Conductor material	Minimum number of wires in the conductor	Minimum Conductor diameter [mm]	Maximum Conductor diameter [mm]	Insulation material	Insulation nominal thickness [mm]	Insulation minimum thickness [mm]	Insulation color	Sheath Material	Sheath nominal thickness [mm]	Sheath minimum thickness [mm]	Sheath color	Messenger material	Minimum number of wires in the messenger	Minimum messenger diameter [mm]	Maximum messenger diameter [mm]	Messenger nominal insulation thickness [mm]	Messenger minimum insulation thickness [mm]	Manufacturing features
GSCC009/004	SP-Brazil	324066	4x25	I	Aluminum	6	5,6	6,5	XLPE	1,4	1,16	Black, Red grey and blue messenger	-	-	-	-	-	-	-	-	-	-	Self-supporting
GSCC009/007	SP-Brazil	324067	2x50+54,6	II	Aluminum	6	7,7	8,6	XLPE	1,6	1,34	Black, grey and blue messenger	-	-	-	-	AL2	7	9,2	9,8	1,6	1,34	Neutral supported
GSCC009/010	SP-Brazil	324068	3x50+54,6	II	Aluminum	6	7,7	8,6	XLPE	1,6	1,34	Black, Red grey and blue messenger	-	-	-	-	AL2	7	9,2	9,8	1,6	1,34	Neutral supported
GSCC009/012	SP-Brazil	324065	3x95+54,6	II	Aluminum	15	11	12	XLPE	1,8	1,52	Black, Red grey and blue messenger	-	-	-	-	AL2	7	9,2	9,8	1,6	1,34	Neutral supported
GSCC009/013	SP-Brazil	324064	3x150+80	II	Aluminum	15	13,9	15	XLPE	1,8	1,52	Black, Red grey and blue messenger	-	-	-	-	AL2	19	11,2	12	1,8	1,52	Neutral supported
GSCC009/020	SP-Brazil	324062	2X1X10+10MM <sup>2</sup>	II	Aluminum	1	3,7	4,1	XLPE	1,2	0,98	Black, grey and blue messenger	-	-	-	-	Aluminum 1350 H19	7	4,1	4,6	1,2	0,98	Neutral supported
GSCC009/021	SP-Brazil	324070	3X1X10+10MM <sup>2</sup>	II	Aluminum	1	3,7	4,1	XLPE	1,2	0,98	Black, Red grey and blue messenger	-	-	-	-	Aluminum 1350 H19	7	4,1	4,6	1,2	0,98	Neutral supported
GSCC009/022	SP-Brazil	324056	2X1X10MM <sup>2</sup>	I	Aluminum	1	3,7	4,1	XLPE	1,2	0,98	Black or Grey	-	-	-	-	-	-	-	-	-	-	Self-supporting

GS Type Code	Country	Country Code	Formation [mm <sup>2</sup> ]	Cable Type	Conductor material	Minimum number of wires in the conductor	Minimum Conductor diameter [mm]	Maximum Conductor diameter [mm]	Insulation material	Insulation nominal thickness [mm]	Insulation minimum thickness [mm]	Insulation color	Sheath Material	Sheath nominal thickness [mm]	Sheath minimum thickness [mm]	Sheath color	Messenger material	Minimum number of wires in the messenger	Minimum messenger diameter [mm]	Maximum messenger diameter [mm]	Messenger nominal insulation thickness [mm]	Messenger minimum insulation thickness [mm]	Manufacturing features
GSCC009/023	SP-Brazil	324069	3x1x25	I	Aluminum	6	5,6	6,5	XLPE	1,4	1,16	Black, grey and blue messenger	-	-	-	-	-	-	-	-	-	-	Self-supporting
GSCC009/024	SP-Brazil	324053	2x25	I	Aluminum	6	5,6	6,5	XLPE	1,4	1,16	Black or Grey	-	-	-	-	-	-	-	-	-	-	Self-supporting
GSCC009/025	SP-Brazil	324071	2x70+70	II	Aluminum	12	9,3	10,2	XLPE	1,8	1,52	Black, grey and blue messenger					Alluminum alloy	7	10,35	10,9	1,6	1,34	Neutral supported