CONTENTS

1. OBJECTIVE 1
2. APPLICABILITY 1
3. BASIC CONCEPTS 1
4. DIMENSIONAL CHARACTERISTICS 2
5. MECHANICAL CHARACTERISTICS 2
6. ELECTRICAL CHARACTERISTICS 3
7. GENERAL CHARACTERISTICS 3
7.1 Porcelain 3
7.2 Marking 3
7.3 Cementation 3
7.4 Metal Fittings 4
7.5 Insulator Holes 4
7.6 Pin 4
8. INSPECTION AND TESTING 4
8.1 Acceptance Tests on Insulators 4
8.2 Tests on Metal Fittings 4
9. TEST REPORTS AND DIMENSIONAL DRAWINGS 5
10. PACKAGING 5
11. WARRANTY 5

---

1. OBJECTIVE

This specification establishes the technical characteristics, testing requirements, and conditions for the supply of cap-and-pin type insulators used in substation electrical installations of Companhia Paulista de Força and Luz e Companhia Piratininga de Força e Luz (CPFL).

This document is an English version of the original document in Portuguese, GED 5337.

2. APPLICABILITY

Directory for Engineering and Asset Management; Directory for Operations; Directory for Supplies; Suppliers.

3. BASIC CONCEPTS

The insulators shall be manufactured according to the Brazilian ABNT NBR 6882 Technical Standard (*Isolador suporte pedestal de porcelana – Padronização de dimensões e características*, that is, porcelain cap and pin insulator – standard dimensions and

characteristics), and according to NEMA (National Electrical Manufacturers Association) publication n° 146 (Wet-Process Porcelain Insulators – Apparatus, Cap and Pin Type) and ANSI C29.8 (American National Standards Institute) Technical Standards. The insulators emcompass reference numbers TR 10, 140, and 147 (Technical References, as per NEMA).

For supply purposes, the proponent shall select the use of the Brazilian (ABNT) or the American (NEMA, ANSI) Technical Standards, and all the characterisitics and parameters informed for each type of insulator (see ahead) shall coherently comply with all the requirements set for each assigned Technical Standard documents. It shall be allowed neither the superposition of values, nor the “blend” among different Technical Standards.

However, it is also allowed the adoption of equivalent definitions of other worldwide accepted Technical Standards, such as IEC (International Electrotechnical Commission) publications, provided the requirements of the previous paragraph and this Technical Specification be accomplished.

4. DIMENSIONAL CHARACTERISTICS

Insulator	**TR 10**		**TR 140**		**TR 147**	
Minimum distances:	ABNT (mm)	NEMA (inch)	ABNT (mm)	NEMA (inch)	ABNT (mm)	NEMA (inch)
creepage	710	28	840	33	660	26
dry arc	356	14	375	14¾	349	13¾

5. MECHANICAL CHARACTERISTICS

Insulator	**TR 10**		**TR 140**		**TR 147**	
Strengths:	ABNT	NEMA	ABNT	NEMA	ABNT	NEMA
Cantilever, upright (ABNT: daN; NEMA: lbf)	900	2,000	3,200	7,000	1,400	3,000
Cantilever, underhung (ABNT: daN; NEMA: lbf)	450	1,000	1,800	4,000	900	2,000
Tensile (NEMA: lbf)	—	7,000	—	20,000	—	12,000
Torsional (ABNT: daN.m; NEMA: lbf.pol)	110	10,000	460	40,000	170	15,000
Compression (NEMA: lbf)	—	15,000	—	60,000	—	25,000
Proof load* (NEMA: lbf)	—	1,750	—	2,000	—	2,000
* Proof load: mechanical tension along insulator symmetry axis during 3 seconds						

6. ELECTRICAL CHARACTERISTICS

Insulator		TR 10		TR 140		TR 147	
		ABNT	NEMA	ABNT	NEMA	ABNT	NEMA
Power frequency voltage (kV rms)	Dry flashover	—	145	—	160	—	140
	Wet flashover	—	100	—	95	—	85
	Dry withstanding (1 minute)	—	95	—	115	—	95
	Wet withstanding (1 minute)	70	80	70	75	70	70
	Low frequency puncture	195	195	215	215	195	195
Dry lightning impulse flashover voltage (1.2×50 µs; kV crest)	positive polarity	—	225	—	235	—	210
	negative polarity	—	290	—	290	—	260
	Basic Impulse Level (BIL)	200	200	200	210	170	190
Radio-influence voltage	Test voltage to ground (kV, at 1,000 kHz)	—	22	—	22	—	22
	Maximum value (µV)	—	100	—	100	—	100

7. GENERAL CHARACTERISTICS

7.1 Porcelain

The porcelain used shall comply with ASTM D116-63 Technical Standard, non-porous type, high dielectric and mechanical resistance, chemically inert, high melting point, and produced by a liquid process.

All the exposed porcelain surfaces shall be vitrified. Materials used in the porcelain production shall be rigorously selected, controlled and analyzed by the manufacturer. Pieces with paint retouched defects on the glaze will be rejected. The colour for the finishing shall be brown Munsell 5 YR 3/3 or light gray Munsell 5 BG 7.0/0.4.

7.2 Marking

On each insulator shall be legibly and indelibly marked, without producing any surface irregularity, the manufacturer trade mark and year of manufacturing.

7.3 Cementation

Cement used for joining porcelain parts and metal fittings with porcelain shall be of the best quality and high mechanical resistance.

7.4 Metal Fittings

Metallic parts shall be made of malleable cast iron of good commercial standard and galvanized according to Brazilian ABNT MB 25 Technical Standard or ASTM A153 – Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

The cap shall be fixed so as to assure the perfect parallelism between the insulator upper surface and base, and the bores with bolts shall be perfectly aligned.

7.5 Insulator Holes

The insulator hole axis shall not present an appreciable deviation from the insulator symmetry axis.

7.6 Pin

The insulator pin shall be made of malleable iron or forged steel, galvanized.

8. INSPECTION AND TESTING

The insulators shall be subjected to inspection and testing by the manufacturer, witnessed by CPFL's Inspector, according to this Technical specification and the Technical Standards herein indicated.

CPFL reserves the right to attend the tests and perform inspections in the material encompassed by this Specification, either during manufacturing, or at embarkation, or at any moment deemed necessary. The Supplier shall then provide free access to laboratories, manufacturing sites, packaging processes, etc., as well as qualified personnel to furnish information and perform the tests. It is the Supplier's sole responsibility the costs of materials and personnel for inspection and tests.

8.1 Acceptance Tests on Insulators

The following tests shall be performed on a sample:

- Lightning impulse withstand voltage;
- Dry power-frequency withstand voltage;
- Wet power-frequency withstand voltage;
- Thermal supportability;
- Visual and dimensional checkings;
- Tensile strength mechanical rupture test;
- Torsional strength mechanical test;
- Puncture test;
- Porosity test;
- Cantilever strength mechanical test;
- Compression strength mechanical test.

8.2 Tests on Metal Fittings

- Steel quality test (ASTM A-7 Technical Standard);
- Steel resistance test after galvanization;
- Visual inspection;

- Dimensional checking;
- Galvanization test (*Preece*), on the base (in a sample) with 6 immersions, and on the bolts (thread) with 4 immersions.

9. TEST REPORTS AND DIMENSIONAL DRAWINGS

It shall be presented the drawings and 5 copies of the complete inspection and testing report with the necessary indications for their perfect understanding (methods, instruments and physical constants employed). Three copies will accompany the lot of insulators and the remaining 2 shall be sent to CPFL's Engineering Department.

This report shall bear the names "CPFL" and that of the manufacturer, the manufacturing order and Purchase Order numbers, and the characteristics and quantities subjected to the tests and their results.

All the copies of the above mentioned report shall be signed by the responsible for their performance, by the manufacturer's supervisor and by CPFL's Inspector. Should CPFL does not accompany the tests, the manufacturer will furnish, in addition to the referred report, a statement of authenticity of results. Such a warranty may apply to a certain item in the report, or by means of a certificate due signed by an authorized person. Anyway, the manufacturer shall present a certificate attesting the inspected material is in full compliance with this Technical Specification requirements.

Inspection or its omission as well as acceptance by CPFL will not exempt the Supplier from its responsibility to furnish the insulator in thorough accordance with the Purchase Order and this Technical Specification, nor will invalidate or hinder any CPFL's further claims based in existence of inadequate or defective material.

10. PACKAGING

Any packing and embark preparation will be subject to CPFL's Inspector approval.

Conditioning of all the material shall be done according to packing drawing EMB 505, in order to guarantee a safe transportation under any condition or limitation that may be found. Packing system shall be so done as to protect all the material against breakage, damage or loss due to packing rupture, from factory until reception at destination.

Each volume shall bear a tag indicating the amount of pieces contained, type number and manufacturer name so as to ease material checking.

11. WARRANTY

The manufacturer shall be responsible for any eventual failure or defect that may occur within 18 months from the date of acceptance of the material at destination, and shall be obliged to repair or even substitute the material at its own cost.

/