

AMENDMENT NO. 2
SPECIFICATION NO. L-500 kV (REVISION 1)
CONSTRUCTION OF 500 kV TRANSMISSION LINE
APRIL 2001

The following amendment shall be made with the entitled specifications.

1. **Section B. Conductor**, revise as follows:

- a) On page B1, **Article B-1. General**, delete this article in its entirety and replace with the following :

"B-1. General

This Specification covers the detail requirements for the design, fabrication, test and shipping of aluminum conductor, concentric-lay-stranded, coated steel-reinforced for use as subconductors of a four bundled conductor system. All requirements for the ASTM or TIS Specifications shall be applicable unless superseded or modified by this Specification.

It is intended that the conductor covered by this Specification shall be suitable for both tension and slack stringing. Any conductor which, when properly threaded, exhibits "bird caging" or popped strands during stringing may be rejected."

- b) On page B1, **Article B-2. Standard**, delete this article in its entirety and replace with the following :

"B-2. Standards

The materials covered under this Specification shall conform to the following standards and latest applicable standards referenced therein, except as specified herein.

ASTM B230 Specification for Aluminum Wire, EC-H19 for Electrical Purposes.

ASTM B232 Specification for Aluminum Conductors, Concentric-Lay-Stranded Coated Steel-Reinforced.

ASTM B549 Specification for Concentric-Lay-Stranded Aluminum Conductors, Aluminum-Clad Steel-Reinforced.

ASTM B498 Specification for Zinc-Coated (Galvanized) Steel Core Wire for Aluminum Conductors, Steel Reinforced.

ASTM B502 Specification for Aluminum-Clad Steel Core Wire for Aluminum Conductors, Aluminum-Clad Steel Reinforced.

ASTM B354 Standard Definitions of Terms Relating to Uninsulated Metallic Electrical Conductors.

NEMA Pub. 107 Methods of Measurement of Radio Influence Voltage (RIV)

IEEE Std. 524 Guide to the Installation of Overhead Transmission Line Conductors.

TIS 85 Specification for Round Wire Concentric Lay Overhead Electrical Stranded Conductors

TIS 2222 Specification for Hard-Draw Aluminum Wires for Overhead Line Conductors

TIS 2221 Specification for Zinc-Coated Steel Wires for Stranded Conductors ”

- c) On pages B1 and B2, **Article B-3. Conductor Characteristics**, delete this article in its entirety and replace with the following:

“B-3. Conductor Characteristics

- a) Aluminum Conductor, Steel Reinforced (ACSR/GA). The conductor to be furnished shall be aluminum conductor, concentric-lay-stranded, reinforced with Class A zinc coated steel wire and shall conform to the general characteristics shown in Table 1B.1.
- b) Aluminum Conductor, Aluminum-Clad, Steel Reinforced (ACSR/AW). The conductor to be furnished shall be aluminum conductor, concentric-lay-stranded, reinforced with aluminum-clad steel wire and shall conform to the general characteristics shown in Table 1B.1.

TABLE 1B.1
CONDUCTOR CHARACTERISTICS

Description		795 kcmil	795 kcmil	1272 MCM	1272 MCM	1272 MCM	1272 MCM
		ACSR/GA	ACSR/AW	ACSR/GA	ACSR/GA	ACSR/AW	ACSR/AW
Complete Conductor :							
Code name		CONDOR	CONDOR	-	PHEASANT	-	PHEASANT
Nominal aluminum area	cmil	795,000	795,000	1,272,000	1,272,000	1,272,000	1,272,000
Outside diameter	mm	27.73	27.73	33.91	35.10	33.91	35.10
Cross-section area	mm ²	455.0	455.0	677.8	726.2	677.8	726.2
Stranding :							
Aluminum							
- Number		54	54	42	54	42	54
- Diameter	mm	3.08	3.08	4.42	3.90	4.42	3.90
Steel							
- Number		7	7	7	19	7	19
- Diameter	mm	3.08	3.08	2.46	2.34	2.46	2.34
Minimum breaking strength	kg	12,800	13,290	14,050	19,770	13,820	19,232
Approximate weight	kg/m	1.523	1.459	2.040	2.433	2.006	2.336
Nominal length :							
returnable metal reel	m	3,500	3,500	2,400	2,400	2,400	2,400
non-returnable wooden reel	m	1,750	1,750	1,200	-	1,200	-
Length of lay (Aluminum wire layers) :							
First (Outside)		10 - 13	10 - 13	10 - 13	10 - 13	10 - 13	10 - 13
Second		10 - 16	10 - 16	10 - 16	10 - 16	10 - 16	10 - 16
Third (Inside)		10 - 17	10 - 17	10 - 17	10 - 17	10 - 17	10 - 17
Steel wire layer		18 - 30	18 - 30	18 - 30	18-30 (6strand) 16-24 (12strand)	18 - 30	18-30 (6strand) 16-24 (12strand)
Component Aluminum Wire :							
Number		54	54	42	54	42	54
Diameter	mm	3.08	3.08	4.42	3.90	4.42	3.90
Minimum elongation in 254 mm (average)	%	1.8	1.8	2.0	2.0	2.0	2.0
Minimum tensile strength (average)	kg/mm ²	17.58	17.58	16.87	16.83	16.87	16.83
Component Steel Wire :							
Number		7	7	7	19	7	19
Diameter	mm	3.08	3.08	2.46	2.34	2.46	2.34
Minimum elongation in 254 mm (average)	%	4.0	1.5	3.5	3.5	1.5	1.5
Minimum stress at 1 per cent extension	kg/mm ²	127	123	130	130	123	123
Minimum tensile strength	kg/mm ²	144	137	144	144	137	137
Minimum weight of zinc coating	g/m ²	259	-	229	230	-	-
Minimum weight of aluminum coating	g/m ²	-	439	-	-	349	349
			(or Aluminum thickness ≥ 10% of wire radius)			(or Aluminum thickness ≥ 10% of wire radius)	(or Aluminum thickness ≥ 10% of wire radius)

- d) On page B4, **Article B-5. Tests and Reports**, item a. **Component Wires**, delete this item in its entirety and replace with the following:

"a. Component Wires

- (1) Aluminum wire, before stranding, shall be tested in accordance with the requirements of ASTM B230 or TIS 2222.
- (2) Zinc-coated steel wire, before stranding, shall be tested in accordance with the requirements of ASTM B498 or TIS 2221.
- (3) Aluminum-clad steel wire, before stranding, shall be tested in accordance with the requirements of ASTM B502."

2. Section D. Insulators and Hardware, revise as follows:

- a) On pages D2 and D3, Article D-3. Detail Requirements for Insulators, item b. Suspension Type Insulators, sub-item (1). Dimensions and Characteristics, delete this sub-item in its entirety and replace with the following:

- "(1) Dimensions and Characteristics. Dimensions and characteristics of each type of insulator shall be in accordance with the following:

<u>Particular</u>		<u>Standard Type</u>			<u>Fog Type</u>	
ANSI Class		52-4	52-8	52-11	-	-
Dimensions:						
Maximum disc diameter	mm	273	298	311	298	330
Unit spacing	mm	146	146	156	146	178
Minimum leakage distance	mm	292	305	381	432	545
Mechanical Values:						
Combined mechanical and electrical strength	kg	6,800	16,300	22,600	16,300	22,600
Mechanical impact strength	m-kg	0.63	1.04	1.04	1.04	1.04
Tension proof	kg	3,400	8,150	11,300	8,150	11,300
Time load	kg	4,500	10,880	13,600	10,880	13,600
Electrical Values:						
Low-frequency dry flashover	kV	80	80	80	80	80
Low-frequency wet flashover	kV	50	50	50	50	50
Critical impulse flashover,						
Positive	kV	125	125	140	125	140
Negative	kV	130	130	140	130	140
Low-frequency puncture	kV	110	110	125	110	125

<u>Particular</u>		<u>Standard Type</u>			<u>Fog Type</u>	
		52-4	52-8	52-11	-	-
ANSI Class						
Radio-Influence Voltage Data:						
Low-frequency test voltage, rms to ground	kV	10	10	10	10	10
Maximum RIV at 1000 kHz	V	50	50	50	50	50
Coupling Type:		-	K	K	K	K
Glaze Color:		brown	grey or brown	grey or brown	K	K
(In case porcelain insulators are supplied)						
<u>Note</u> : Specific glaze color shall be as specified in the Contract "						

b) Article D-7. Tests, revise as follows:

(1) Article a. Complete Conductor Insulator and Hardware Assemblies, revise as follows:

(i) On page D8, item (1) Corona and RIV Tests. Sub-item (c)(5) for Test Arrangement, delete this item in its entirety and replace with the following:

"(5) The test arrangement shall consist of a four conductor bundle configuration. The length of the conductor to be used shall be approved by EGAT. The conductor to be used for the tests shall be provided by the Contractor at his own expense and shall be in clean and good conditions."

(ii) On page D10, item (2) Lightning Impulse, Switching Surge and Power Frequency Flashover Tests. Sub-item (c). Test Arrangement, delete this item in its entirety and replace with the following:

"(c) Test Arrangement. Simulation arrangement for these tests shall be as follows:

(1) Assembly 3 shall be tested on a full-scale mock-up of a DL(3°) tower. This assembly shall be fixed at a swing angle which results in a conductor to tower clearance of 4 meters for these tests.

(2) Assemblies 14 or 14A and 17 shall be tested on a full-scale mock-up of the DT40 tower."

(2) On page D11, Article b. Complete Shield Wire Insulator and Hardware Assemblies, item (1) Type of Test Assemblies, delete this item in its entirety and replace with the following:

"(1) Type of Test Assemblies. A complete set of each of the following assemblies shall be subject to test.

<u>Type of Assembly</u>	<u>Reference Assembly</u>
Shield wire (insulated) suspension assembly	1 or 1A
Shield wire (insulated) deadend assembly	11 or 11A "

- c) On pages D13 and D14, Article c. Insulators, revise item (4) Power Arc Test, item (5) Thermal – Mechanical Performance Test, and item (6) Steep Wave Front Impulse Test, as well as add item (7) Pollution Test, to read as follows:

- “(4) Power Arc Test. Three strings of insulators, each containing six units randomly selected from the first lot brought forth for acceptance, shall be assembled in a vertical configuration without conductors for each 52-8, 52-11, and fog type of insulator. The strings shall be energized at the bottom and grounded at the top. The insulator strings shall be subject to a 50 hertz power arc of 20,000 amps rms sustained for five cycles. The insulators shall be tensioned to 40 per cent of their rated strength prior to initiation of the arc and this tension shall be maintained for the duration of the arc and for five minutes following its extinction. There shall be no separation of cap and pin during this portion of the test.

After arcing, each string of insulators shall be mechanically tested in accordance with paragraph 5.1 of ANSI C29.1, except that the load may be increased rapidly to only 45 per cent of the rated strength of the insulator. The rate of increase of load from 45 per cent to failure shall be as given in Table 1 of ANSI C29.1. If any insulator fails at less than 60 per cent of its rated strength, the insulator design fails to meet these specifications.

- (5) Thermal – Mechanical Performance Test. Ten insulator units of ANSI Class 52-8, ANSI Class 52-11, and Fog Type shall be selected for testing at random from the first lot brought forth for acceptance. The test shall be performed in accordance with all requirements of Clause 3 of IEC Publication 575: Thermal – Mechanical Performance Test and Mechanical Performance Test on String Insulator Units except that the concluding stage of the test shall be the combined mechanical and electrical strength test of ANSI C29.1 and the criteria of judgement for acceptance shall be as follows:

$$3 \leq Q = (R - R_s)/S$$

Where

Q = Criteria of judgement for acceptance

R = Mean value obtained on the sample of ten insulator units tested

R_s = Rated mechanical and electrical strength value of the insulator

S = Standard deviation for the ten insulator units tested

Each value measured shall not be lower than the specified mechanical and electrical strength. In addition, electrical puncture shall not occur before reaching ultimate failure. The results of the Thermal-Mechanical Performance Test shall match the results of the ordinary combined mechanical and electrical strength test of paragraph D-7.c(2), and the fracture pattern shall not change.

- (6) Steep Wave Front Impulse Test. Ten (10) insulator units of each suspension type insulator of ANSI Class 52-8, ANSI Class 52-11, and Fog Type shall be selected by EGAT at random from the first lot brought forth for acceptance. These units shall be tested as follows:

- (a) The insulator units shall be subjected to five successive positive impulse flashovers followed by five successive negative impulse flashovers. Each wave impulse shall have an effective rate of rise of 2,500 kV per microsecond. These insulators shall be tested singly.

- (b) Each unit shall then be subjected to three flashovers of the low frequency dry flashover test of ANSI C29.1 and shall have a flashover value not less than 95% of the rated value.
 - (c) Upon failure of any one unit to pass either the steep wave front of the dry flashover test, and additional quantity of twenty (20) randomly selected units shall be tested in accordance with (a) and (b) above.
 - (d) Failure of any one unit of the second group of samples to pass either test shall constitute failure of the insulator design and evidence that the requirements of this specification are not met.
- (7) Pollution Test. Three (3) strings of insulators, each containing nine (9) units randomly selected from the first lot brought to be tested for acceptance, shall be assembled in a vertical configuration without conductors for each ANSI Class 52-8, 52-11, and fog type of insulator. The test shall be performed on the salt fog method or the solid layer method in accordance with all requirements of IEC Standard 60507 (Artificial Pollution Tests on High-Voltage Insulators to be used on A.C. Systems) and the leakage current shall be measured during this pollution test. The test method for insulator discs on transmission line shall be determined by EGAT. The criteria of judgment for acceptance shall be as follows:

For withstand test of all methods :

- (a) No flashover occurs during three (3) consecutive tests performed on three (3) strings of insulators at specified test voltage
where $\text{Specified test voltage} = 9 * \text{Withstand voltage for each unit}$
(value specified in proposal data)
the degree of pollution test (ESDD) shall be determined by EGAT.
- (b) If only one flashover occurs, the fourth test shall be performed and the insulator then passes the test if no flashover occurs.
- (c) The highest leakage current pulse amplitudes occurring on a polluted insulator throughout the duration of all individual withstand tests in withstand conditions shall be not more than those specified in Appendix A of IEC Standard 60507.