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**INDEPENDENT POWER TRANSMISSION OPERATOR S.A.**

**TRANSMISSION NEW PROJECTS DEPARTMENT**

**TRANSMISSION LINES TOWER DESIGN  
AND SPECIFICATIONS SECTION**

**TECHNICAL SPECIFICATION  
FOR OPTICAL GROUND WIRE  
(OPGW)  
ON TRANSMISSION LINES  
150 kV & 400 kV**

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**ATHENS - GREECE**



# **INDEPENDENT POWER TRANSMISSION OPERATOR S.A.**

## **TRANSMISSION NEW PROJECTS DEPARTMENT**

### **TRANSMISSION LINES TOWER DESIGN AND SPECIFICATIONS SECTION**

#### **OPTICAL GROUND WIRE ON 150 kV AND 400 kV TRANSMISSION LINES**

#### **1. SCOPE**

This technical description covers the requirements for design, construction and testing of:

- OPGW (Optical Ground Wire) on 150kV and 400kV transmission lines.

#### **2. KEY – WORDS : OPGW**

#### **3. TECHNOLOGY**

All supplied material and equipment must be of the latest technology and a relative declaration-certificate must be provided by the manufacturers.

The manufacturers of the supplied materials and equipment must have previous experience on the production of similar products for at least four-year time.

Similar products must have been supplied to other large electricity companies.

The contractor must guarantee the quality of the installation for at least three years.

#### **4. SPECIFICATIONS FOR OPGW**

##### **4.1 Specifications**

4.1.1 This specification covers the manufacturing and testing of Optical Ground Wire (OPGW), composed of aluminum clad steel concentric-lay stranded wires, which shall be used as overhead shield wire at electric power transmission lines and for the telecommunication between substations.

4.1.2 The technical data of OPGW are specified in Annex A for 400 kV T.L. and Annex B for 150 kV T.L. and have to be confirmed by the manufacturer.

4.1.3 In order to determine the physical characteristics of OPGW, as well as, the cable installation and the cable behavior in operation, bidders have to submit with their offer all tests, which have already carried out and to propose any



other test necessary for the quality acceptance of the product.

Bids must include, but not by way of limitation, following type tests in accordance and in full compliance with the requirements of the IEC 60794 and IEEE Std.1138/2009.

- Stress – strain test
- Breaking tensile load test
- Tensile performance test
- Short time current test. ( $40.5\text{kA}^2\text{s}$ )
- Sheave test
- Aeolian vibration test (as per IEEE Std.1138/2009 recommendations)
- Galloping test
- Temperature cycling test (-40-80°C- 3 cycles)
- Water penetration test
- Lightning test (class 2) (as per IEC 60794-1-24-2014)
- Salt spray corrosion test

4.1.4 The OPGW shall be in accordance with the requirements of the IEC 60794-1-24-2014. The selection of samples for the testing of OPGW as well as, all other type, routine & acceptance tests where applicable will be made according to the corresponding specifications EN 187200, IEC 61089, IEC 60794-1-24-2014, IEEE Std.1138/2009.

The following routine and sample tests shall be performed on samples from **each delivery lot**:

- Tensile test
- Elongation at failure
- Diameter
- Resistance
- Thickness of aluminum or zinc or combination of both (applicable to aluminum-clad steel and galvanized steel wire)
- Twist test (applicable to aluminum-clad steel and galvanized steel wire)
- Bending test (applicable to aluminum-alloy 6201-T81 wire)
- Water penetration test (on fiber optic tubes)
- Lay length measurements

Above tests shall be performed on samples after stranding. Should the manufacturer claim that mechanical and electrical properties are significantly affected by the stranding process (i.e. rendering them non-conforming to the relevant standards), this should be stated in the offer along with new acceptance criteria for the said properties after stranding.

The following specifications apply for the acceptance tests of OPGW component elements (as applicable):



Item	Item
Aluminum-clad steel wire	<b>IEC 61232</b> or ASTM B 415, ASTM B 502
Aluminum alloy 6201-T81 wire	<b>IEC 60104</b> or ASTM B 398/B 398M
Aluminum alloy 1350	<b>IEC 60889</b> or ASTM B 230
Galvanized steel wire	<b>IEC 60888</b> or ASTM B 498

Mechanical and Electrical tests on tubes and spacers:

- Tensile strength
- Resistance
- Elongation (mechanical and electrical tests will be based on standards as agreed upon by the supplier and the purchaser prior to time of order and they should comply with the properties of the samples successfully submitted to type tests.)

Measurements on optical fibers:

- Optical attenuation/ continuity (on each fiber and on each drum)
- Other properties may be verified by measurements and/or OEM certificates.

Routine and sample tests shall be performed on samples representing 10% of the delivery drums.

4.1.5 All material shall be subject to inspection and shall not be released for shipping without the approval of Company's representative. The approval for shipping of material shall not relieve manufacturer from responsibility, for furnishing material conforming to the specified requirements, nor invalidate any claim, which the Company may make because of defective or unsatisfactory material. The manufacturer shall provide adequate facilities to the Company's representative to test and inspect the manufacture and packing of all materials.

The manufacturer shall inform the Company on the progress of the work and shall give advance notice of the expected dates of completion, so that the progress of work shall be clearly indicated, and the inspection of the material and the witnessing of the tests may be scheduled without delay.

**The manufacturer shall be also responsible for the behavior of the conductor during its installation on the line.**

Copies of manufacturer's test reports shall be submitted to the Company as requested. These reports shall be certified as correct by a responsible representative of the manufacturer.

4.1.6 Cable shall be shipped on substantial wooden reels. Reel heads shall be firmly bolted to the drum and shall be equipped with a cast iron hub bushing with a



hole at the center of the head. Reels shall be lagged with wooden lagging, so that the outer layer of the conductor will be protected.

In addition the reels shall have a layer of waterproof paper around the drum and around the cable inside the lagging and also on the inner surface of the reel heads. Manufacturer shall furnish a drawing of the reels showing essential details and dimensions.

Special care shall be taken during the conductor's wrapping on the drum, such as to limit any movement of the conductor which may cause friction during conductor's transportation. Also the use of nails which may wound the conductor shall be avoided.

Reels must be designed, according to the minimum acceptable bending radius of the conductors.

4.1.7 On each reel has to be attached a tag in which shall be marked the name of material, the length, the size the stranding, the number of the order, the manufacturer's serial number (if any) the type of fiber and shipping marks. All the previous data shall appear on the outside of the package.

#### 4.2. Colour scheme

The Fibers and yarns have to be coloured in a clearly distinguishable way with the colours given in the following tables respectively:

##### FIBRES COLOURS

FIBER TUBE	FIBER N	FIBER COLOURS
	1	RED
	2	YELLOW
	3	GREEN
	4	BLUE
	5	VIOLET
	6	BROWN
	7	BLACK
	8	ORANGE
	9	PINK
	10	GREY
	11	LIGHT GREEN
	12	NATURAL



## YARN COLOUR CODING

GROUP	COLOUR
1	BLUE
2	ORANGE
3	GREEN
4	BROWN

### 4.3 Specification for fiber optics

Fiber optics should conform to the attached specification "TECHNICAL DESCRIPTION OF OPTICAL FIBRES".



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**ANNEX A**

**O P G W DATA  
For 400 kV T.L.**

Overall diameter approx.	(mm)	13
Short time Current 0,5 sec	(kA)	9
Maximum Temperature after short time current according to IEC 865 (Temp 20 °C)	(° C)	200
Temperature during operation	(° C)	-40÷80
Minimum Breaking Load	(kN)	110
Modulus of Elasticity	(kN/mm <sup>2</sup> )	160
Approx. weight of wire (max.)	(kgr/m)	~0.75
Number/type of fibers	36/G-652.B and 12/G-655.B	
Type of fibers according to	ITU-T	G-652.B/G-655.B



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**ANNEX B**

**O P G W DATA  
For 150 kV T.L.**

Overall diameter approx.	(mm)	max 11
Short time Current 0,5 sec	(kA)	7
Maximum Temperature after short time current according to IEC 865 (Temp 20 °C)	(° C)	200
Temperature during operation	(° C)	-40÷80
Minimum Breaking Load	(kN)	65
Modulus of Elasticity	(kN/mm <sup>2</sup> )	160
Approx. weight of wire (max.)	(kgr/m)	~0.45
Number/type of fibers	36/G-652.B and 12/G-655.B	
Type of fibers according to	ITU-T	G-652.B/G-655.B