



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

**TRANSMISSION NEW PROJECTS DEPARTMENT**

**TRANSMISSION LINES TOWER DESIGN  
AND SPECIFICATIONS SECTION**

**SPECIFICATION TR - 3**

**SHIELD WIRE**

**Revision February 2015  
ATHENS - GREECE**



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**Specification TR – 3**

**1. SCOPE**

This specification covers the design, manufacturing and testing of steel conductors which shall be used as overhead shield wires at 150 kV and 400 kV Transmission Lines.

**2. GENERAL REQUIREMENTS**

Manufacturing and characteristics of shield wire and corresponding wires shall meet the requirements of International Standards ASTM A 363–03, ASTM B 415–98 and ASTM B 416–98, when applied and don't conflict with the requirements of this specification. The quality of shield wire during the manufacturing process will be verified by standard EN ISO 9001.

**2.1 Technical characteristics**

**2.1.1** Shield wires are made of concentric lay stranded zinc coated steel wires. The zinc coating is Class A.

**2.1.2** Reinforced shield wire is made of concentric lay stranded zinc coated steel wires of type R and tensile strength 160 kg/mm. The zinc coating is Class A.

**2.1.3** Alumoweld type shield wire is made of concentric lay stranded aluminum clad steel core wires. The aluminium clad steel wires have conductivity 20.3%

**2.1.4** The manufacture of standard conductor length shall be continuous.

**2.1.5** Technical characteristics of shield wire shall meet the requirements of Annexes A, B or C.

**2.2 Material**

All the wires should have, before stranding, characteristics that meet the requirements of par.5 of International Standard ASTM A 363–03 and par.4 of International Standard ASTM B 415–98.

**2.3 Stranding – Joints**

Stranding and joints of steel wires shall meet the requirements of par.13 of International Standard ASTM A 363–03 and par.11 of International Standard ASTM B 415–98. The specified direction of lay of the external layer of shield wire shall be "left – hand".

**2.4 Length of each section**

The specified "standard reel length" is approximate. The accepted tolerance is  $\pm 5\%$ . No more than 5% of the total weight of conductor may be furnished in random lengths, none of which shall be less than 65% of the standard reel length. It is not allowed a random length to be wound on the same reel with a standard length.

The specified standard reel length may be changed by approval or commission of the Company.

**2.5 Reels**

**2.5.1** The shield wire will be packed in wooden reels, designed in such a way so the shield wire is properly protected from damages during transportation (sea, rail, road, air), moving or storing it outdoors.

**2.5.2** Reels shall be made from dry pine or fir wood. The wood humidity before reels manufacturing has to vary between 15-25%. Wood quality and its humidity will be proved either by measurements using special electronic devices or by the relevant reports and wood Supplier's shipping invoices. The reels will be brand-new, they must not be used and their surfaces have to be frictionless, without any



flakes or holes or generally any inkling of insects presence.

**2.5.3** 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 wood lagging, so that the outer layer of the conductor to be protected. In addition the reels shall have a layer of water proof paper around the drum and around the conductor lies inside the lagging and also on the inner surface of the reel heads. Special attention shall be taken during the winding of the conductor to the reel, so that the conductor is properly placed in order to avoid friction between the lays of the conductor during transportation.

The connection of the wooden parts of the reel shall be done in such a manner so that the conductor won't be scratched or afflicted, such as staples, while the use of nails shall be avoided. The outer surface of the reels shall be properly painted in order to protect the reel from humidity and to characterize each type of conductor.

**2.5.3** The winding of the conductor on the reel has to be uniform and in accordance with the rules of art, the conductor layers have to be distinguished, the layer level must keep order and the phenomenon of "straddled" conductors must not appear. For this reason Manufacturer has to pay high attention to the winding during conductor fabrication from the very first layer, which is of highest importance, so that the conductor spires are strictly the one beside the other, without leaving any spaces for all along the reel length and continue in the same way for all layers.

**2.5.5** The correspondence between drum's colour and conductor's type is:

| <b>Shield wire type</b>                      | <b>Colour</b> |
|--|---------------|
| - Shield wire for 150 kV T.L.                | Red           |
| - Shield wire for 400 kV T.L.                | Blue          |
| - Alumoweld type shield wire for 150 kV T.L. | Yellow        |
| - Reinforced shield wire for 150 kV T.L.     | White         |
| - Reinforced shield wire for 400 kV T.L.     | Green         |

The drawing of the reel shall meet the requirements of drawing TR – 3/1 of IPTO S.A.

## **2.6 Marking**

**2.6.1** On a tablet or label, properly attached at the edge of the shield wire, the following data will be marked:

- shield wire type,
  - mixed and net weight,
  - length,
  - size,
  - lay characteristics,
- and every other characteristic that the manufacturer consider necessary.

**2.6.2** The data of the marking described in par.2.6.1 of present specification, the ordering number, the series number of the manufacturer (if there is any) and the shipment data shall be marked on the outer surface of the wooden drum (reel).

## **3. TESTS**

The tests shall meet the requirements of International Standards ASTM A 363–03 and ASTM B 415–98, where applicable and don't conflict with the requirements of present specification.

All required type tests should be preformed in proper independent laboratories accredited according to International Standard ISO/IEC 17025. Test reports have to be written in Greek or English language, clear-sighted and certified by the laboratory where the tests have taken place.

Especially sample and routine tests can be performed to manufacturer's laboratory if it's certified by ISO 9001.

### **3.1 Test samples**

The size and length of the samples shall be according to par.16 of International Standards ASTM A 363–03.

Samples of wires shall be taken after stranding, will be cut in presence of the Company's representative and will be hand over to him for the prosecuting of the tests.



### **3.2 Type tests**

- 3.2.1** For common shield wire type tests shall meet the requirements of par.6, 7, 8, 9, 10, 11 and 12 of International Standard ASTM A 363–03.
- 3.2.2** For ALUMOWELD type shield wire shall meet the requirements of par.5, 6, 7, 8, 9, 10 and 11 of International Standard ASTM B 415–98.
- 3.2.3** For reinforced shield wire type tests shall meet the requirements of par.3.2.1, but tensile strength shall be equal to specified value in par.2.1.2 and Annex C of present specification.

### **3.3 Sample tests**

Sample tests shall meet the requirements of par.3.2 of present specification.

## **4. INSPECTION**

- 4.1** The shield wires shall be subjected to inspection and shall not be released for shipping without the approval of the Company's representative. The approval for shipping shall neither relieve the Manufacturer from responsibility of furnishing material conforming to all requirements of the Company nor invalidate any claim which the Company may make because of defective or unsatisfactory material.
- 4.2** The Manufacturer shall submit to the Company copies of the control and test reports of the material. Company reserves the right to demand all the routine test reports from the manufacturer.
- 4.3** In each delivery quantity, sample tests shall be performed in accordance with the requirements of par.3.3 of present specification.
- 4.4** For type test reports that haven't been submitted or that aren't adequate according to the requirements of par.3 of present specification, IPTO S.A. reserves the right to request the performance of any or all type tests specified in par.3.2 of present specification on samples which shall be taken from the production of the offered items. The Company reserves the right to select test laboratory and witness any or all tests.
- 4.5** Purchaser has the right, with his own expenses, to pick up a proper length of any part which is delivered from the manufacturer, according to present specification, and give them to a proper independent accredited laboratory of his choice (Purchaser), for the certification of tests or characteristics or for additional research and tests which will be judged necessary from the purchaser.
- 4.6** IPTO S.A. reserves the right, if deems it is necessary, to request to check the correct conductor winding during inspection by performing the "Test for ability of a conductor to be erected using tension stringing", which is referred to Annex E of EN 50182:2001 "Conductors for overheads lines – Round wire concentric lay stranded conductors". Test sampling will be according to ISO 2859-1, General Inspection Level I, AQL 4.0 – Normal inspection.  
In case of failure during this test, the batch will be rejected and manufacturer has to rewind all the batch reels and test will be repeated. In this case Company reserves the right to retest with sampling according to ISO 2859-1, General Inspection Level I, AQL 4.0 – Tightened inspection. If this test is not possible to be performed in Manufacturer's plant, he will be obliged to rewind all reels which IPTO S.A.' s inspector considers that don't meet the requirements of par.2.5.4 of present specification.
- 4.7** All Bidders shall have to state the manufacturers of the material, as well as all related sub-contractors, if any.  
They shall also have to submit along with their offer a Quality Assurance Plan (Q.A.P), for the manufacturing procedure of the stated manufacturer and all potential sub-contractors, by which it shall be evident in a detailed way the entire manufacturing procedure, the quality control equipment as well as all quality control stages, including all of the related printed material and referring to the specific international standards and regulations applied.  
During the Technical Evaluation procedure, IPTO S.A. shall reserve itself the right to monitor the production procedure so as to ascertain the application of the Q.A.P. and, in general, to conclude on the production procedure, in a way that shall deem the offer technically acceptable or not.



**4.8** Manufacturer is responsible for the shield wire behaviour during installation at the T.L.

**5. DATA TO BE SUBMITTED WITH OFFER**

In the offers must be included the following data in a clear and unique way. In any case that the following data are missing or don't comply with the following the offers will be rejected.

**5.1** Detailed drawing of the reels from the Manufacturer, with all details and basic dimensions in scale, for each type of shield wire. The drawing will be submitted from the Manufacturer for approval.

**5.2** Technical characteristics of shield wires according to the data given in Annex A, B or C which shall be confirmed by the Manufacturer at the corresponding columns.

**5.3** Description of the manufacturing process shall be given. A quality assurance program (EN ISO 9001) for the factory, in order to verify the quality of shield wire during the manufacturing process. Also the Manufacturer/ Supplier must submit the place that each shield wire will be manufactured.

**5.4** A reference list of at least three (3) Electrical Companies for quantity equal at least with the quantity of inquiry for offered shield wire, which has been installed and is in satisfactory operation, with no problems, for the last five (5) years.

The installation and satisfactory operation of offered shield wire shall be accompanied by corresponding certificates of the Users (Electrical Companies), in which there shall be cited the type of shield wire, date of selling, installation date, as well as the exactly quantity.

Certificates shall be original or validated copies and distinct regarding the Electrical Company that edit and guarantee the excellent operation of corresponding material.

IPTO S.A. reserves the right to accept offers with reference list less than three (3) Electrical Companies, as long as the quantities and the purchaser are taken into account.

Bidders that have supplied in the last decade, PPC S.A. or IPTO S.A. with the requested material, have no obligation of submitting the prerequisites of par.5.3 and 5.4, provided that it does not change the factory of manufacture.



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**ANNEX A**

**SHIELD WIRE DATA**

| <b>DESCRIPTION</b>               |                   | <b>150 kV<br/>T.L.</b> | <b>Manufacturer<br/>data</b> | <b>400 kV<br/>T.L.</b> | <b>Manufacturer<br/>data</b> |
|----------------------------------|-------------------|------------------------|------------------------------|------------------------|------------------------------|
| Overall Diameter                 | mm                | 9.53                   |                              | 12.60                  |                              |
| Steel wires                      | mm                | 7×3.17                 |                              | 7×4.19                 |                              |
| Minimum breaking strength        | kN                | 63.77                  |                              | 117.72                 |                              |
| Nominal weight                   | kg/km             | 440                    |                              | 770                    |                              |
| Minimum elongation               | %                 | 4                      |                              | 4                      |                              |
| Zinc coating weight              | gr/m <sup>2</sup> | ≥ 260                  |                              | ≥ 270                  |                              |
| Maximum D.C. Resistance at 20° C | Ω/km              | 3.4617                 |                              | 2.0276                 |                              |
| Standard reel length             | m                 | 3000                   |                              | 2600                   |                              |
| Lengths per reel                 |                   | 1                      |                              | 1                      |                              |



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**ANNEX B**

**ALUMOWELD TYPE SHIELD WIRE DATA**

| <b>DESCRIPTION</b>               |       | <b>150 kV<br/>T.L.</b> | <b>Manufacturer data</b> |
|----------------------------------|-------|------------------------|--------------------------|
| Overall Diameter                 | mm    | 9.53                   |                          |
| Steel wires                      | mm    | 7×3.17                 |                          |
| Minimum breaking strength        | kN    | 68.67                  |                          |
| Nominal weight                   | kg/km | 364                    |                          |
| Maximum D.C. Resistance at 20° C | Ω/km  | 1.533                  |                          |
| Standard reel length             | m     | 3000                   |                          |
| Lengths per reel                 |       | 1                      |                          |



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**ANNEX C**

**REINFORCED SHIELD WIRE DATA**

| <b>DESCRIPTION</b>        |                   | <b>150 kV<br/>T.L.</b> | <b>Manufacturer data</b> | <b>400 kV<br/>T.L.</b> | <b>Manufacturer data</b> |
|---------------------------|-------------------|------------------------|--------------------------|------------------------|--------------------------|
| Overall Diameter          | mm                | 9.53                   |                          | 20.30                  |                          |
| Steel wires               | mm                | 7×3.17                 |                          | 37×2.91                |                          |
| Minimum breaking strength | kN                | 84.86                  |                          | 328                    |                          |
| Nominal weight            | kg/km             | 440                    |                          | 1960                   |                          |
| Minimum elongation        | %                 | 4                      |                          | 4                      |                          |
| Zinc coating weight       | gr/m <sup>2</sup> | ≥ 260                  |                          | ≥ 250                  |                          |
| Standard reel length      | m                 | 3000                   |                          | 2600                   |                          |
| Lengths per reel          |                   | 1                      |                          | 1                      |                          |