



201383  
DSTU ISO/IEC 17025

Атестат акредитації  
№ 201383  
Дійсний до  
16 червня 2021 року

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Accreditation certificate  
№ 201383  
Expiry date:  
16 June, 2021

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APPROVED BY  
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"15" "06" 2021

**Protocol № 12/21**  
***Tests of earthing electrodes***

**Requirements:** clauses 5.3.2 5.3.5, 5.3.6, 5.3.7, 5.3.8 of IEC 62561-2.

**Test methods:** clauses 5.3.2, 5.3.5, 5.3.6, 5.3.7, 5.3.8 of IEC 62561-2

**Product name:** Earthing electrodes

**Producer:** LLC "FS LIGHTNING PROTECTION"  
80383, Lviv region, Zhovkivsky r-n,  
Malekhiv 9/37, Vokzalna str.

**Ordering company:** LLC "FS LIGHTNING PROTECTION"  
80383, Lviv region, Zhovkivsky r-n,  
Malekhiv 9/37, Vokzalna str.

**Reason:** Agreement № 14-04-21 of 20.04.2021

**Test results:** *Earthing electrodes meet the requirements of  
p. 5.3.2, p. 5.3.5, p. 5.3.6, p. 5.3.7, p. 5.3.8 of  
DSTU ISO 62561-1*

The test results apply to the tested samples.

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LVIV - 2021

<u>Date of samples receipt:</u>	<u>03.05.2021</u>
<u>Number of samples and ID numbers of the samples :</u>	<u>3 samples, №1...3</u>
<u>Period of testing:</u>	<u>04.05 - 14.06.2021</u>
<u>Site of testing:</u>	<u>Testing laboratory "LIZO Ltd."</u> <u>Lviv, Pymonenka str. 3</u>
<u>Environmental conditions:</u>	temperature: 21,8-22,8°C atmospheric pressure: 97,1-97,6 kPa humidity: 79-80%

## **1 Testing of the coating thickness on the earthing electrodes:**

1.1 3 samples coated with hot zinc were provided for testing.

### **1.2 Testing procedure**

1.2.1 The tests are carried out in accordance with paragraph 5.3.2 of IEC 62561-2. Measurements were performed in three places along the electrode: one measurement at a distance of 50 mm from the top of the electrode, one at a distance of 50 mm from the base of the electrode, and another one in the middle of the electrode.

In each of the location described in detail above, two additional measurements must be performed on the circumference of the rod, divided by approximately 120 °.

1.2.2 Samples are considered to have passed the test if they meet the requirement of table 3 of IEC 62561-2 on coating (1 µm) and minimum weight (350 g/m<sup>2</sup>).

The coating should be smooth, continuous and free of colored spots.

### **1.3 Testing results:**

The zinc coating of the earthing electrodes exceeds 8.0 µm in all measuring points, the minimum weight is 368 g / m<sup>2</sup>. The coating is smooth, continuous and free of colored spots.

## **2 Climatic tests of earthing electrodes**

2.1 3 samples of earthing electrodes were provided for testing.

### **2.2 Testing procedure**

Climatic tests of the earthing electrodes are carried out in accordance with p. 5.3.5 in a salt spray chamber in accordance with A.1, followed by a test in humid sulfuric atmosphere, as specified in A.2 of IEC 62561-2.

Samples of the earthing electrodes with zinc coating that meet the requirements of p. 5.3.2 of IEC 62561-2.

2.2.1 Samples of parts are tested in a salt spray chamber for 2 h, then in a humidity chamber for 22 h at a temperature of (40±2)°C and relative humidity of (93±2)%. There are 3 of such cycles.

The parts were placed in a salt chamber on a rack so they did not touch each other; the parts did not get drops of the saline solution from the ceiling and other parts.



### 2.2.2. Salt spray test chamber

The testing equipment meets the requirement of IEC 60068-2-52.

The parameters of the salt mist are controlled during tests by two accumulating collectors with an area of 80 cm<sup>2</sup> each. Mist collects in each collector at a rate of 1-2 ml/h, with an average spraying time of at least 16 hours. About 80 ml/h of saline solution is used in the test chamber for the area of the chamber pallet of 550x550 mm.

The saline solution used for the tests has a concentration by mass of (5±1)%. The pH value of the saline solution is within the normal range of 6.5 to 7.2. As the salt for testing, we use high-quality sodium chloride (NaCl) which contains in dry form no more than 0.03% of all impurities (permissible 0.3%).

To create a mist, compressed air without dust and oil with a maintained pressure of 120 kPa±50 kPa is used. Before supplying to the sprayer, the air is heated and humidified by passing through water heated to at least 350 C.

The temperature in the test chamber is maintained at (35 ± 2)°C.

2.2.3 Tests in a chamber with a humid sulfuric atmosphere are carried out in accordance with ISO 6988 in 7 cycles with a sulfur dioxide concentration of  $667 \cdot 10^{-6}$  (volume) ±  $25 \cdot 10^{-6}$ .

Each cycle lasts 24 hours and consists of a heating period of 8 hours at a temperature of (40 ± 3)°C in a saturated humid atmosphere, followed by a rest period of 16 hours. After that, the humid sulfur atmosphere is changed.

2.2.4. After the tests, the samples must have good appearance and have no uneven edges or burrs along the entire length. No corrosion damage should be visually observed on the base metal.  
*Note: White rust is not considered corrosion damage.*

## 2.3 Testing results:

The samples have good appearance. Uneven edges and burrs are absent. No corrosion damage. All samples have white rust.

## 3. Tensile strength test and yield strength during the tensile of earthing electrodes.

3.1 The tests are carried out on 4 pieces of proportional cylindrical specimens of type four, number 8 in accordance with Annex 2 of ISO 6893 with an initial diameter of 4 mm, initial design length  $l_0 = 40$  mm, which are made of the same material as the earthing electrodes.

### 3.2 Testing procedure:

3.2.1 Samples with nuts that are screwed on the end of the sample are installed in the bursting machine, Fig.1.

The bursting machine with a speed not exceeding 10N/mm<sup>2</sup> creates a force.

(Initial cross section is 12,5 mm<sup>2</sup>, force is 125 N/s ).

The force increases until the rupture of the sample, the dynamometer fixes the yield strength and strength of the samples.

3.2.2 Samples are considered to have passed the test if they meet the requirements of table 4 of IEC 62561-2, namely tensile strength  $R_m = (350 \div 770)$  N/mm<sup>2</sup> and the ratio of the yield strength and tensile  $R_{cn} = 0,80 \div 0,95$ .

### 3.3 Testing results:

The test results are given in tab. 1.

No.	Tensile strength, N	Yield strength, N	Tensile strength according to tab.4 of IEC 62561-2, N	Ratio of the yield strength and tensile acc. To tab.4 of IEC 62561-2	Resulting ratio	Conclusion
1	10470	8950	4375 ÷ 11800	0,80 ÷ 0,95	0,85	Corresponds
2	9720	8980			0,92	Corresponds
3	9270	8320			0,89	Corresponds
4	9980	9150			0,90	Corresponds

The tested proportional samples are made of the same material as the earthing electrodes and meet the requirements of IEC 62561-2 on tensile strength and the ratio of yield strength and tensile.

### 4. Electrical resistivity test of the earthing electrodes

4.1 Test of electrical resistivity of earthing electrodes is carried out in accordance with clause 5.2.6, Annex D of IEC 62561-2.

#### 4.2 Testing procedure:

4.2.1 For tests we use a sample with a length of 1,2 m, with the diameter of 18 mm, the measurement of electrical resistance is carried out at a length of 1 m (± 1 mm) and readings should be adjusted to a temperature of 20 ° C by using correcting factors.

The resistivity of the sample of the specified length can be found by the formula:

$$\rho = R \frac{A}{\ell}, \quad \text{Om} \cdot \text{m}$$

where: R is active resistance of the sample,

A is a cross-sectional area of the sample, m<sup>2</sup>,

L is the length of the sample, which is 1m.

4.2.2 The sample is considered to have passed the test if it meets the requirements of table 4 of IEC 62561-2, namely:

– maximum electrical resistivity of 0,25 μΩ·m

#### 4.3 Testing results:

Resistivity of the tested electrode is 0,218 μΩ·m.

Tested earthing electrodes meet the requirements of p. 5.2.6 of IEC 62561-2 on the parameter of electrical resistivity



**5. Figures:**

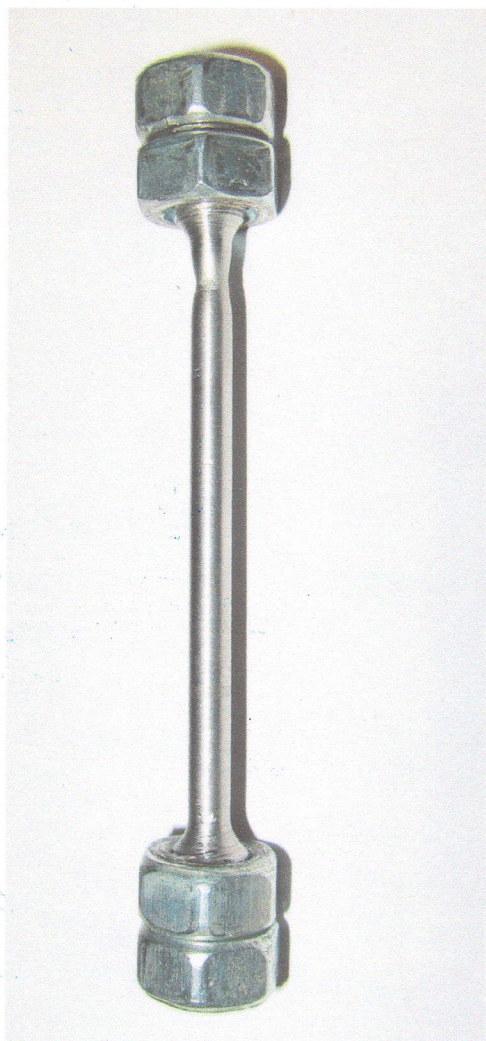


Fig.1 Sample during the test

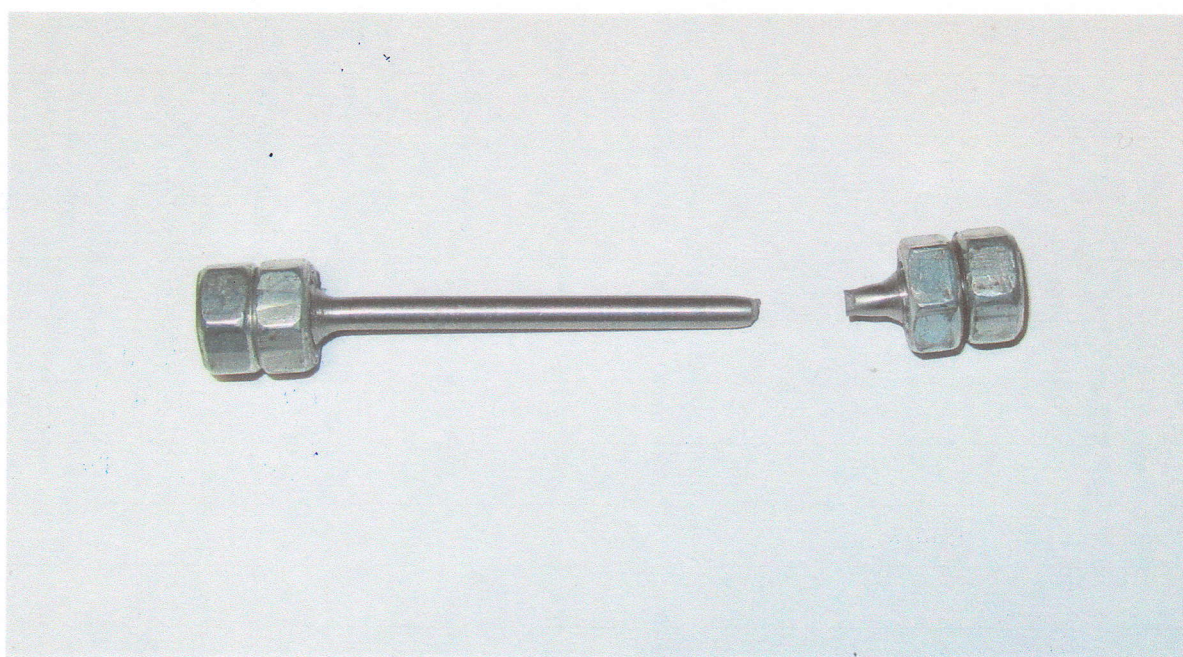


Fig.2 Sample after the test



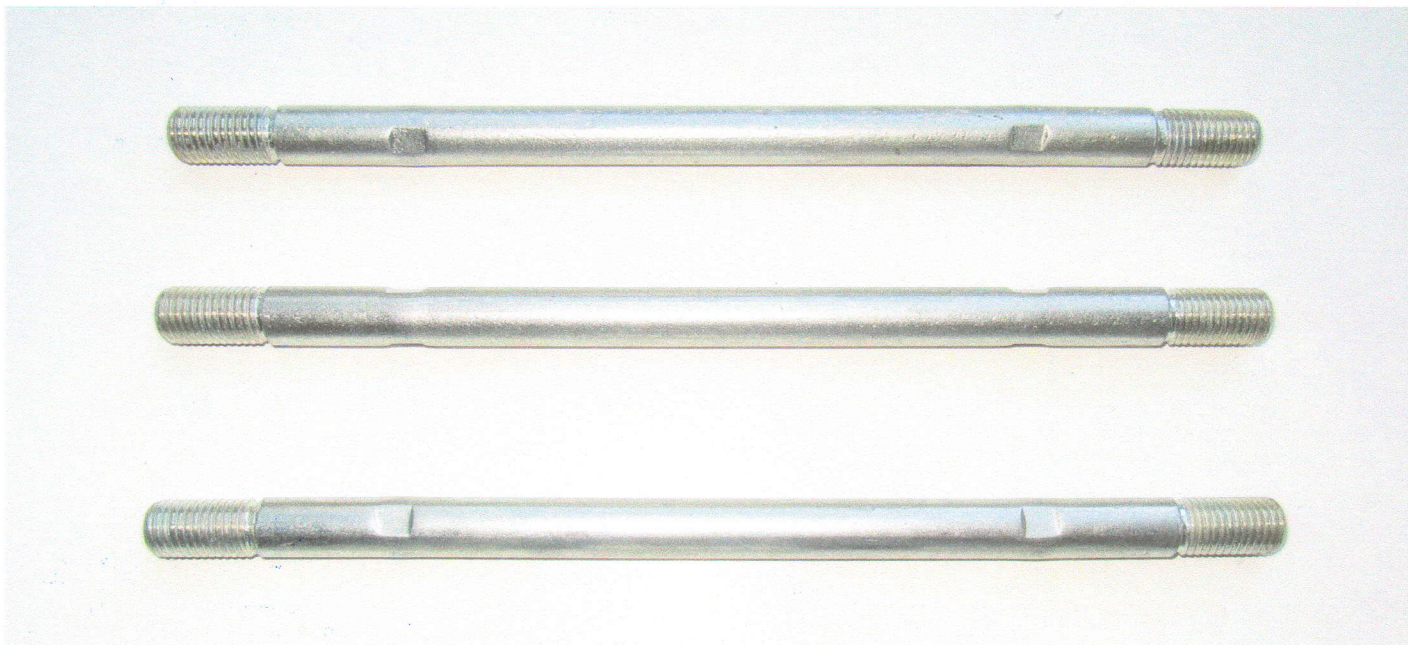


Fig.3 Samples before climatic tests



Fig.4 Samples after climatic tests



**6. Means of measurement and tests:**

No.	Name	Model	Calibration date
1	Salt spray chamber	LIZO №001	No calibration
2	Chamber of high humidity with the impact of sulfur dioxide	LIZO №001	No calibration
3	Meter regulator	RT 0102 №14-557	08.04.2021
4	Resistive temperature transducer	TSP-1388 №15-202	08.04.2021
5	Meter regulator	RT 0102 №14-558	08.04.2021
6	Resistive temperature transducer	TSP-1388 №15-201	08.04.2021
7	Thickness gauge	TP-44 № 00132	07.04.2021
8	Ruler 1 m	VaGo-Tools №003	08.04.2021.
9	Bursting machine №001	LIZO №001	No calibration
10	Dynamometer 50 kH	FB 50K №0032	07.04.2021.
11	DC source 3 B x 40 A	LIZO №001	No calibration
12	Shunt	75SHSM3 №405781	04.12.2020
13	Millivoltmeter M2016	№ 7824	08.04.2021
14	Voltmeter M2007	№ 1854	08.04.2021


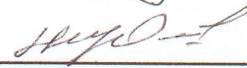

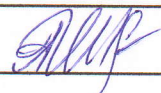
**The tests were performed by:**

Deputy Head of the laboratory:

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