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POWER INDUSTRY STANDARD

OF THE PEOPLE'S REPUBLIC OF CHINA

ICS 27.100

K 47

Filing No.: 40019-2013

DL/T 763-2013

Replacing DL/T 763-2001

Technical requirements for overhead line helical fittings

架空线路用预绞式金具技术条件

Issued on: March 07, 2013

Implemented on: August 01, 2013

Issued by: National Energy Administration

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Technical requirements for overhead line helical fittings

1 Scope

This standard specifies the types and technical conditions of overhead line helical fittings.

This standard applies to helical fittings, such as suspension clamps, tension clamps, connecting fittings, protective fittings, which are installed on overhead lines in a pre-twisted manner.

2 Normative references

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) is applicable to this standard.

GB/T 528 Rubber, vulcanized or thermoplastic - Determination of tensile stress-strain properties

GB/T 1173 Casting aluminium alloys

GB/T 1179 Round wire concentric lay overhead electrical stranded conductors

GB/T 2314 General technical requirements for electric power fittings

GB/T 2317.1 Test method for electric power fittings - Part 1: Mechanical tests

GB/T 2317.2 Test method for electric power fittings - Part 2: Corona and RIV tests for electric power fittings

GB/T 2317.3 Test method for electric power fittings - Part 3: Heat cycle tests for electric power fittings

GB/T 2317.4 Test method for electric power fittings - Part 4: Acceptance inspection for electric power fittings

GB/T 2479 Conventional abrasive - White fused alumina

GB/T 10125 Corrosion tests in artificial atmospheres - Salt spray tests

GB/T 11352 Carbon steel castings for general engineering purpose

GB/T 15115 Die casting aluminum alloys

GB/T 17937 Aluminium-clad steel wires for electrical purposes

GB/T 23308 Aluminium-magnesium-silicon alloy wire for overhead line conductors

DL/T 683 Nomenclature for fitting model

DL/T 758 Splicing fittings

DL/T 766 Technical requirements and tests for helical fittings of OPGW

DL/T 767 Technical requirements and tests for helical fittings of ADSS

DL/T 768.4 Manufacture quality specification for electric power fittings spheroidal graphite iron castings

DL/T 768.7 Manufacture quality specification for electric power fittings hot dip galvanized coatings on fabricated iron and steel articles

DL/T 788 All dielectric self-supporting optical fiber cable

DL/T 832 Optical fiber composite overhead ground wires

DL/T 1069 Repair guideline of conductor and earth wire for overhead transmission line

DL/T 1098 Requirements and tests for overhead line spacers

DL/T 1099 Technical requirements and tests for damper

YB/T 4222 Coated steel wire for overhead line helical fittings

3 Terms and definitions

The following terms and definitions apply to this standard.

3.1

Helical fittings

Fittings consisting of pre-twisted helical wires or non-metallic wires and related accessories.

3.2

Valid length

Figure 2 -- Schematic diagram of the typical structure of commonly used helical fittings

6 Technical conditions

6.1 General requirements

6.1.1 The general technical conditions of helical fittings shall comply with the provisions of GB/T 2314. It shall be manufactured according to the drawings which are approved by the prescribed procedures.

6.1.2 Dimensions and tolerances:

- a) The size of the fittings shall meet the requirements of the design drawings.
- b) The effective length of the helical wire of the helical tension clamp should not be less than 5 pitches.
- c) The single wire diameter tolerance for manufacturing helical wires shall comply with the provisions of GB/T 17937, GB/T 23308, YB/T 4222.

6.1.3 Appearance of helical wire:

- a) The end of the helical wire is generally round or hemispherical. If there is an anti-corona requirement, the end of the helical wire should be duckbill-shaped.
- b) The surface of the helical wire shall be smooth and free from defects, such as cracks, folds, scars.

6.1.4 Helical direction of helical wire: The outer helical wire of the helical fittings shall be in the same direction as the outer layer of the twisted wire, generally right-handed. The rotation direction of the helical wire in the inner layer of the tension clamp, for OPGW, shall be opposite to that of the outer layer of OPGW.

6.1.5 Material of helical wire:

- a) The material of the helical wire shall meet the design requirements.
- b) The tensile strength of aluminum alloy wire shall not be lower than 340 MPa; the tensile strength of aluminum-clad steel wire shall not be lower than 1100 MPa.
- c) The mechanical properties and galvanizing quality of the galvanized steel wire, which is used for helical wire, shall comply with the provisions of YB/T 4222.
- d) The helical wire material, which is used for helical tension clamps for insulated cables, shall be made of metal wires, whose strength is higher than that of the insulated cable core.

6.1.6 The white corundum, which is used in manufacturing, shall comply with the provisions of GB/T 2479.

6.1.7 Components and accessories, which are made of ferrous metals, are generally treated with hot-dip galvanizing for anti-corrosion treatment.

6.1.8 If there are other special requirements, they shall be determined, through negotiation between the supplier and the purchaser.

6.2 Suspension clamps

6.2.1 The sum (α) of the double-sided hanging angles of single-hanger clamp shall not be less than 30° ; the sum (α) of double-sided hanging angles of double-hanger clamps shall not be less than 60° .

6.2.2 The cast aluminum alloy, which is used for the main body of the suspension clamp, shall meet the requirements of GB/T 1173 or GB/T 15115.

6.2.3 The synthetic rubber parts, in the suspension clamps, shall have good anti-aging properties, anti-ozone, anti-ultraviolet, anti-air pollution capabilities. The performance of the rubber components shall meet the requirements in 7.8 of DL/T 1098.

6.2.4 Suspension clamps shall meet the requirements of vertical load and grip. The clamping force of the suspension wire shall meet the requirements of GB/T 2314, which shall not be less than 14% ~ 28% of the rated breaking force of the cable.

6.2.5 When the horizontal unbalanced load exceeds the design value, the clamp shall slide.

6.3 Tension clamp

6.3.1 When steel strands are connected to ground rods through helical tension clamps, it shall be considered to set up the length adjustment device of the pull wires and the anti-theft measures of helical wires.

6.3.2 Grip of tension clamps:

- a) The grip of helical tension clamps, which are used for conductors and ground wires, optical fiber composite overhead ground wires, optical fiber composite phase wires, etc., shall not be less than 95% of the rated breaking force of the cables.
- b) The grip of the helical tension clamps, which are used for insulated wires, shall not be less than 65% of the rated breaking force of the cables.
- c) The grip of the helical tension clamps, which are used for distribution lines, shall not be less than 65% of the rated breaking force of the cable.

- c) If the cable is damaged, but the location of the damage is more than 25 mm from the ends of the suspension clamp, the test shall be repeated.

7.2.1.3 Grip test of helical fittings for other clamps

- a) The layout of the helical anti-vibration hammer clamp for the cable grip test is as shown in Figure 4; the grip value shall meet the requirements of DL/T 1099.
- b) The test layout of helical spacer bar clamp's grip force test is as shown in Figure 4; the grip force value shall meet the requirements of DL/T 1098.

7.2.2 Mechanical damage load test of tension clamps and connecting fittings

7.2.2.1 Test arrangement and test procedure

- a) The test arrangement for the mechanical breaking load test is the same as for the grip test.
- b) Install the tested fitting on the tensile machine. Apply the load to the nominal failure load of the fitting, at a steady speed. Keep it for 60 s. Then increase the load, until the fitting or the cable is mechanically damaged. Record test results, sliding conditions, failure modes. If the load reaches 1.2 times the nominal failure load, BUT the fitting are not damaged, the test can be stopped at this time, unless otherwise agreed by both parties.

7.2.2.2 Judgment criteria

When the nominal failure load is reached, if the fitting does not fail, the mechanical failure load test is passed.

7.2.3 Tension test under optical measurement

- a) Helical tension clamps for optical cables shall be subjected to tension tests, under optical measurement.
- b) Carry out test, according to the method specified in DL/T 766 or DL/T 767.

7.2.4 Vertical load test of suspension clamp

7.2.4.1 Test arrangement

- a) Vertical load test and steering angle test shall be arranged, according to Figure 5 or other equivalent schemes.
- b) This test can also be carried out, according to the requirements of GB/T 2317.1.

See Appendix A for the layout, test conditions, test criteria of the breeze vibration fatigue test.

7.4 Waving fatigue test

Please refer to Appendix B for the arrangement, test conditions, test criteria of waving fatigue test.

7.5 Vibration elimination test of anti-vibration fittings

The vibration elimination test shall be carried out, according to the method of DL/T 1099.

7.6 Electrical test

7.6.1 Resistance test

The helical fittings used for electrical connection shall be subjected to the resistance test, according to the provisions of GB/T 2317.3. The length of the cables -- between the test pieces -- shall not be less than 50 times the outer diameter of the cables.

7.6.2 Thermal cycle test

Helical fittings subjected to electrical loads shall be subject to thermal cycle tests, in accordance with the provisions of GB/T 2317.3.

7.6.3 Corona and radio interference test

The helical fittings, which are used for 330 kV and above voltage lines, shall be subjected to corona and radio interference tests, in accordance with the provisions of GB/T 2317.2.

7.6.4 Short-circuit current test

7.6.4.1 Test arrangement and test procedure

The fittings for grounding wire shall be subjected to short-circuit current test, according to the provisions of DL/T 832.

7.6.4.2 Judgment criteria

After the test, if there is no mechanical damage or decline in mechanical properties of the fittings, the test is passed.

7.6.5 High voltage test of helical insulation tension clamp

7.6.5.1 Test arrangement and test procedure

- a) The helical insulation tension clamp shall be subject to high voltage test.

- b) Before the high-voltage test, the grip test at room temperature shall be carried out according to 7.2.1.1.
- c) After the grip test is passed, apply a 3.5 kV working voltage between the test piece and the fixed conductor; keep it for 5 minutes; check the test piece and the insulation layer.

7.6.5.2 Judgment criteria

If the insulation performance is not damaged after the test, the test is passed.

7.7 Anti-ultraviolet performance test

7.7.1 Test arrangement and test procedure

- a) The polymer material parts, which are used in the helical fittings, shall be subjected to the UV resistance performance test.
- b) The test method shall be implemented according to DL/T 788; the test duration shall be 1000 h.

7.7.2 Judgment criteria

After the test, if the test piece has no visible cracks and obvious discoloration, the test is passed.

7.8 Thermal aging test

7.8.1 Test arrangement and test procedure

- a) The polymer material parts, which are used in the helical fittings, shall be subjected to the UV resistance performance test.
- b) Place the test piece in an environment which has a temperature of $85\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$; the test duration is 120 h. The test method shall be implemented according to DL/T 788.

7.8.2 Judgment criteria

After the test, if the test piece has no visible cracks and obvious discoloration, the test is passed.

7.9 Elongation at break test

7.9.1 Test arrangement and test procedure

- a) The elongation at break test is applicable to various polymer material parts, which are involved in helical fittings.

- b) The test shall be carried out, according to the test method of GB/T 528.

7.9.2 Judgment criteria

If the elongation at break meets the requirements of DL/T 1098, the test is passed.

7.10 High temperature grip test of tension clamps for insulated cables

7.10.1 Test arrangement

- a) All tension clamps, which are used for insulated cables, shall be subject to high-temperature grip test.
- b) Assemble according to the method recommended by the manufacturer; the length of the conductor -- between the test piece and the tensile machine fixture -- shall not be less than 100 times the outer diameter of the conductor; the test temperature shall be kept at 60 °C ~ 75 °C.

7.10.2 Test procedure

- a) Apply a load to 50% of the breaking force of the conductor.
- b) Apply current to raise the temperature of the conductor to 60 °C ~ 75 °C; keep the temperature constant for 1 h.
- c) Carry out the grip test, according to 7.2.1.1.

7.10.3 Judgment criteria

During the test, if the test piece does not appear any sliding movement, meanwhile the test piece and insulation performance are not damaged after the high voltage test, THEN the test is passed.

7.11 Galvanized coating test

- a) The galvanized layer test of parts and accessories, which are made of ferrous metals, shall be carried out according to DL/T 768.7.
- b) Galvanized steel wires used for helical tension clamps for steel strands shall undergo a quality test of the zinc layer; the test method shall be carried out, in accordance with YB/T 4222.

7.12 Salt spray test

7.12.1 Test arrangement and test procedure

The fittings are placed horizontally in a standard salt spray box. The test is carried out continuously for 1000 hours. The test method shall be implemented, according to GB/T

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