

**Test requirements for low voltage aerial bundled cable accessories -  
Part 3: Tension and suspension clamps for neutral messenger system**

Prescriptions relatives aux essais  
des accessoires pour réseaux aériens  
basse tension torsadés -  
Partie 3: Matériels d'ancrage  
et de suspension pour réseaux aériens  
en conducteurs isolés torsadés  
avec neutre porteur

Prüfanforderungen für Bauteile für  
isolierte Niederspannungsfreileitungen -  
Teil 3: Abspann- und Tragklemmen  
für Systeme mit Nullleiter-Tragseil

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**CENELEC**

European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

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## Foreword

This European Standard was prepared by a sub-group of WG 11 of the Technical Committee CENELEC TC 20, Electric cables.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50483-3 on 2008-12-01.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2009-12-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2011-12-01

This is Part 3 of CENELEC standard EN 50483 “*Test requirements for low voltage aerial bundled cable accessories*”, which has six parts:

- Part 1: Generalities;
  - Part 2: Tension and suspension clamps for self supporting system;
  - Part 3: Tension and suspension clamps for neutral messenger system;
  - Part 4: Connectors;
  - Part 5: Electrical ageing test;
  - Part 6: Environmental testing.
-

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## 1 Scope

EN 50483 series applies to overhead line fittings for tensioning, supporting and connecting aerial bundled cables (ABC) of rated voltage  $U_0/U (U_m)$ : 0,6/1 (1,2) kV.

This Part 3 applies to tensioning devices consisting of tension and suspension clamps, and tension and suspension assemblies used for the installation of ABC with either insulated or bare neutral messenger.

The tension and suspension clamps are designed to be installed on neutral conductors of ABC defined in HD 626.

Tests described in this document are type tests.

NOTE This European standard does not invalidate existing approvals of products achieved on the basis of national standards and specifications and/or the demonstration of satisfactory service performance. However, products approved according to such national standards or specifications cannot directly claim approval to this European Standard. It may be possible, subject to agreement between supplier and purchaser, and/or the relevant conformity assessment body, to demonstrate that conformity to the earlier standard can be used to claim conformity to this standard, provided an assessment is made of any additional type testing that may need to be carried out. Any such additional testing that is part of a sequence of testing cannot be done separately.

## 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 50483 series, *Test requirements for low voltage aerial bundled cable accessories*

HD 626 S1:1996, *Overhead distribution cables of rated voltage  $U_0/U(U_m)$ : 0,6/1 (1,2) kV*

IEC 60050-461, *International Electrotechnical Vocabulary (IEV) – Part 461: Electric cables*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-461 and the following apply.

### 3.1

#### **aerial bundled cable (ABC)**

aerial cable consisting of a group of insulated conductors which are twisted together including, or not, a non insulated conductor  
[IEV 461-08-02, modified]

NOTE The terms bundled conductors, bundled cables, bundled cores, conductor bundles and bundle could be used as equivalent to the term aerial bundled cable (ABC).

### 3.2

#### **aerial-insulated-cable**

insulated cable designed to be suspended overhead and outdoors  
[IEV 461-08-01]

### 3.3

#### **angle of deviation**

complementary angle to the angle defined by the two parts of the cable on both sides of the suspension clamp

### 3.4

#### **clamp bolt**

bolt which tightens two parts of a clamp together

### 3.5

#### **conductor insulation**

insulation applied on a conductor  
[IEV 461-02-02, modified]

### 3.6

#### **conductor (of a cable)**

part of a cable which has the specific function of carrying current  
[IEV 461-01-01]

### 3.7

#### **core**

assembly comprising conductor and its own insulation  
[IEV 461-04-04, modified]

### 3.8

#### **fixture (or fitting)**

device for attaching ABC tension or/and suspension clamps to a pole or to a wall

### 3.9

#### **insulation (of a cable)**

insulating materials incorporated in a cable with the specific function of withstanding voltage  
[IEV 461-02-01]

### 3.10

#### **messenger**

wire or rope, the primary function of which is to support the cable in aerial installations, which may be separate from or integral with the cable it supports  
[IEV 461-08-03]

### 3.11

#### **minimum breaking load (MBL)**

minimum breaking load of the conductor given by HD 626 or the cable manufacturer if not defined in the standard or minimum breaking load of the clamp given by the clamp manufacturer

### 3.12

#### **mobile link**

device linking the suspension clamp to the fixture

### 3.13

#### **neutral messenger system**

aerial insulated system where only the neutral messenger supports the ABC

### 3.14

#### **sheath**

uniform and continuous tubular covering of metallic or non metallic material, generally extruded  
[IEV 461-05-03]

**3.15****suspension clamp**

device which attaches an aerial insulated cable to a fixture in order to carry its weight and any specified loading

[IEV 461-18-02, modified]

**3.16****suspension or tension assembly**

clamp with mobile link, or not, and associated fixture

**3.17****tension clamp**

device which firmly attaches an aerial insulated cable to a fixture and is designed to transmit the specified mechanical tension in the cable or messenger to the supporting structure

[IEV 461-18-01, modified]

**3.18****type test**

test required to be made before supplying a type of material covered by this standard on a general commercial basis, in order to demonstrate satisfactory performance characteristics to meet the intended application

NOTE These tests are of such a nature that, after they have been made, they need not be repeated unless changes are made to the accessory materials, design or type of manufacturing process which might change the performance characteristics.

**4 Symbols**

$g_2$  slippage after 2 cycles

$g_{15}$  slippage after 15 cycles

$g_{250}$  slippage after 250 cycles

$g_{500}$  slippage after 500 cycles

$d$  diameter of core

$\alpha$  maximum angle (°) of deviation of a suspension clamp as recommended by the manufacturer or specified by the customer

**5 Characteristics**

These fittings shall be capable of supporting the tensile loads applied to the ABC for which they are designed, referring to the neutral messenger specified MBL, in accordance with the following tests.

Tension and suspension equipment shall be designed to avoid any direct or accidental contact between any phase conductor and metallic parts of the clamp.

**6 Marking**

See Clause 6 of EN 50483-1.

## 7 General test conditions

See Clause 9 of EN 50483-1.

### 7.1 Mechanical tests

See Clause 9 of EN 50483-1.

NOTE Where an assembly is to be tested, each bracket should be secured in accordance with the manufacturer's installation instructions.

### 7.2 Temperature

See Clause 9 of EN 50483-1.

## 8 Type tests

Each clamp shall be tested for the smallest and largest messenger size except for environmental tests where only the largest size is used.

### 8.1 Type tests for tension clamps

The following type tests shall be carried out.

Test	Applicability	Subclause
Tensile test at ambient temperature	insulated and bare neutral messenger	8.1.1
Tensile test at high temperature	insulated neutral messenger only	8.1.2
Tensile test at low temperature	insulated neutral messenger only	8.1.3
Environmental tests	insulated and bare neutral messenger	8.1.4
Clamp bolt tightening test	common for both suspension and tension clamps	8.2.1

If a cable breaks beyond any part of the tension clamp, the test result shall be declared void without discrediting the tension clamp. Tests shall be repeated using a new tension clamp and a new cable.

In order to find the possible cause of the failure, the test shall be repeated with a reference tension clamp as specified in HD 626 S1:1996, Part 2, 2.3.1.

NOTE When agreed between the manufacturer and the customer, the mechanical test loads may be defined by the smallest cable for the clamp but in this case the clamp may only be considered to conform to this standard for the smaller cable size.

### 8.1.1 Tensile test at ambient temperature (and breaking load test)

#### 8.1.1.1 Principle

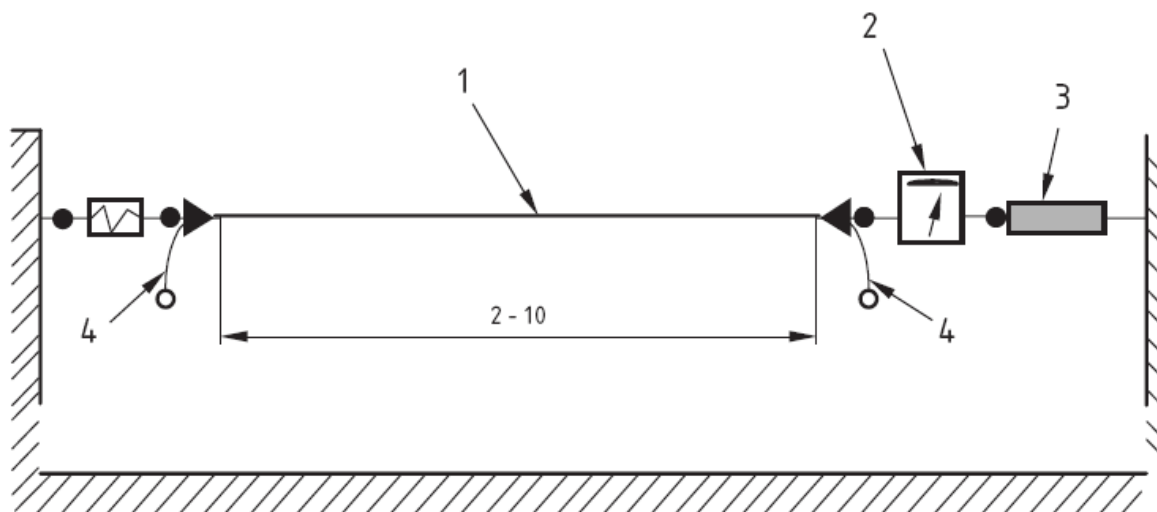
The tension clamps shall be subjected to high mechanical loads at ambient temperature in order to ensure that they are capable of sustaining loads likely to be encountered in service without being damaged or damaging the conductor.

The test shall be carried out for the maximum and minimum insulated neutral messenger cross-section, for which the clamp is designed.

#### 8.1.1.2 Test arrangement

Figure 1 shows a typical test arrangement. The test configuration can differ from this arrangement as long as it complies with the neutral messenger lengths.

Dimensions in metres



#### Key

1	neutral messenger	◄	tension clamp
2	mechanical load measurement device	●	mechanical junction allowing rotation
3	tensioning device	○	current source connection
4	minimum 1 m	⏏	mechanical tension adjustment

Figure 1 – Test arrangement

#### 8.1.1.3 Procedure

For the maximum and minimum neutral messenger cross-sections, for which the clamp is designed, a tension clamp shall be installed at a minimum of 1 m from the end of the cable sample. The tension clamp shall be secured to a device similar to the one used for its attachment to the support. At the other end, which is not stripped for insulated messenger, an appropriate tensioning device shall be attached to the neutral messenger by means of a tension clamp or other appropriate device.



NOTE A different distance between the clamps (from 2 m to 10 m), may be agreed between the manufacturer and the customer.

A load shall be applied and increased until it reaches 80 % of MBL of the messenger. The load shall then be reduced to 20 % of MBL of the messenger.

The neutral messenger shall then be marked where it leaves the clamp so that any slippage can be seen with respect to the clamp.

The load shall then be increased to 90 % of MBL of the messenger for both insulated and bare neutral messenger. This load shall be maintained for 60 s.

The speed of load application is defined in EN 50483-1, 9.1.4.

#### **8.1.1.4 Requirements**

The clamp shall not slip by more than 10 mm with respect to the mark on the neutral messenger.

No damage shall occur which could affect the correct function of the tension clamp.

NOTE When agreed between the customer and the manufacturer, an additional test may be carried out as follows. The previous test arrangement should be used again with a new tension clamp and the messenger should be replaced with a steel wire of cross section equivalent to the neutral messenger. The assembly should be subjected to an increasing load until the clamp breaks or the load reaches 110 % of the MBL of the messenger. When a breaking occurs, the load at which the breaking occurs should be recorded. For practical reason, to avoid any slippage between steel wire and clamp, fixed stops may be used.

### **8.1.2 Tensile test at high temperature**

#### **8.1.2.1 Principle**

The purpose of this test is to ensure that the tension clamp does not slip excessively on the insulated neutral messenger during service and that any movement does not damage the insulation. It combines heat cycles with mechanical load.

#### **8.1.2.2 Test arrangement**

Figure 1 shows a typical test arrangement. The test configuration may differ from this arrangement as long as it complies with the neutral messenger lengths.

The test shall be carried out for the maximum and minimum insulated neutral messenger cross-section, for which the clamp is designed.

#### **8.1.2.3 Procedure**

Tension clamps and the neutral messenger shall be subjected to this test, which comprises of 500 cycles, of 90 min each in which a heat cycle is combined with mechanical loads.

A tension clamp shall be fitted 1 m from both ends of the section of neutral messenger. The distance between the clamps shall be at least 2 m.

NOTE 1 A different distance between the clamps (from 2 m to 10 m) may be agreed between the manufacturer and the customer.

Before starting the first cycle the neutral messenger shall be subjected to 10 % of its MBL and the sheath shall be marked so that any slippage can be measured with respect to the clamp.

An alternating current shall be passed through the neutral messenger until its temperature rises to  $(60 \pm 3) ^\circ\text{C}$ . The temperature rise shall be achieved within 15 min and then maintained at this temperature for the next 30 min or until the total time is 45 min if the temperature is achieved more quickly.

The temperature of the neutral messenger shall be measured underneath the insulation with a thermocouple.

NOTE 2 For further information on thermocouple application, see EN 50483-5, 5.4.1.

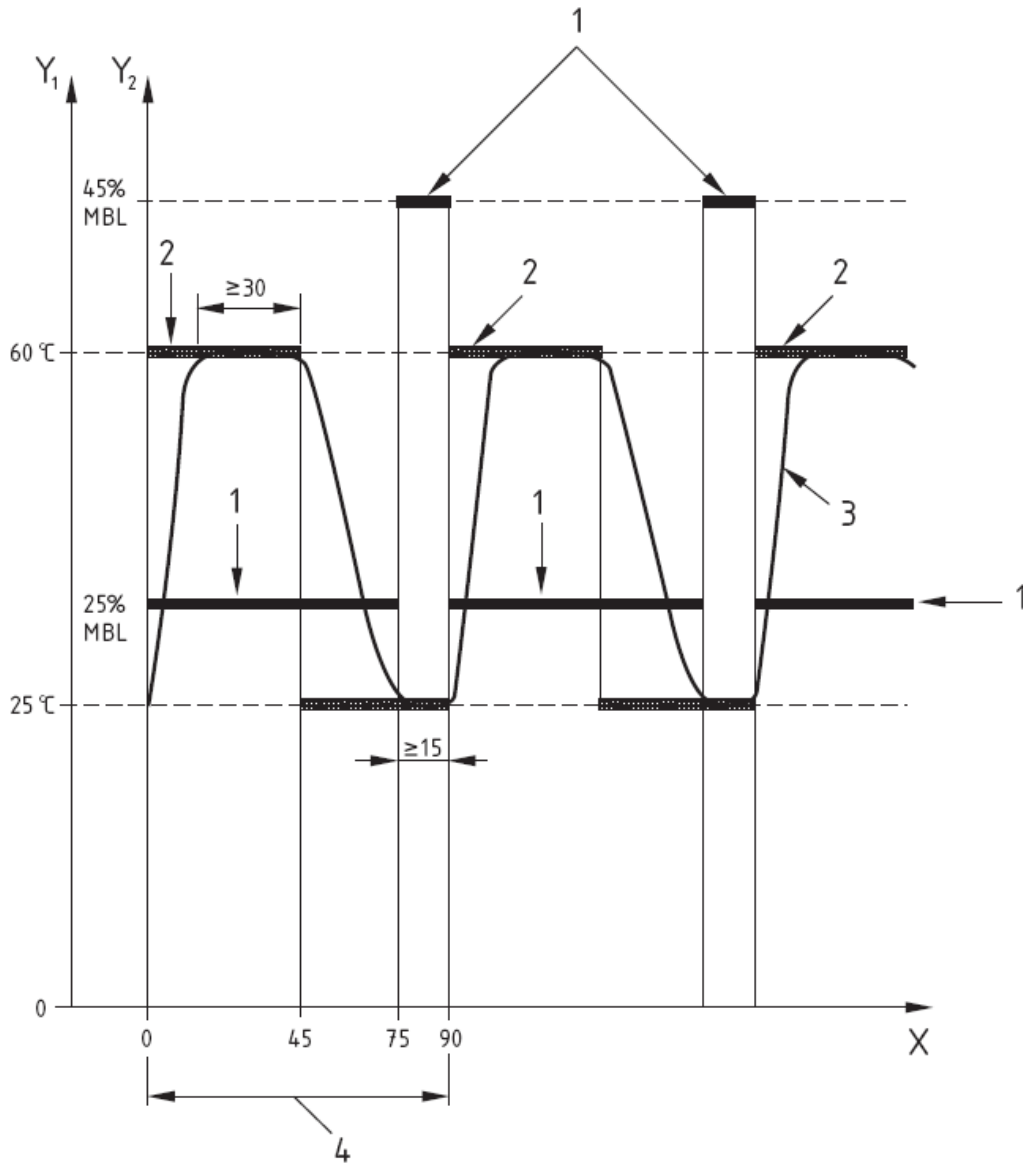
The temperature can be measured at a position that is not under mechanical tension. The measuring position shall be at least 1 m from the clamp and the end of the neutral messenger. It shall also be at the same horizontal level as the clamp in order to avoid any difference in air temperature.

The neutral messenger shall be allowed to cool to  $(25 \pm 3) ^\circ\text{C}$  during the next 30 min. This temperature shall be maintained for the next 15 min until the end of the cycle.

A mechanical load of 25 % of the MBL of the neutral messenger shall be applied, and maintained, for the first 75 min of the cycle. During the last 15 min once the neutral messenger has cooled to  $25 ^\circ\text{C}$ , the load shall be increased to 45 % of the MBL of the neutral messenger. This increase in load shall be gradually applied in not less than 5 s and not more than 60 s.

If accelerated cooling is used, it shall act on the whole of the loop, and use air within ambient temperature limits.

The cycle and the theoretical temperature profile are shown diagrammatically in Figure 2.



**Key**

- |   |                                   |       |  |
|---|-----------------------------------|-------|--|
| 1 | selected value of mechanical load | $X$   | time in minutes                                      |
| 2 | selected value of temperature     | $Y_1$ | temperature in °C                                    |
| 3 | temperature profile               | $Y_2$ | mechanical load in % of MBL of the neutral messenger |
| 4 | one cycle                         |       |  |

**Figure 2 – Cycle and temperature profile**

**8.1.2.4 Requirements**

**8.1.2.4.1 Slippage checking**

The neutral messenger sheath slippage with regard to the clamp shall comply with the following conditions:

- slippage after 2 cycles:  $g_2 \leq 4$  mm;
- slippage after 500 cycles:  $g_{500} \leq 5$  mm.

#### 8.1.2.4.2 Dielectrical voltage test

The clamp and conductors shall meet the requirements of the dielectrical voltage test as detailed in 8.1.5.3.

### 8.1.3 Tensile test at low temperature

#### 8.1.3.1 Principle

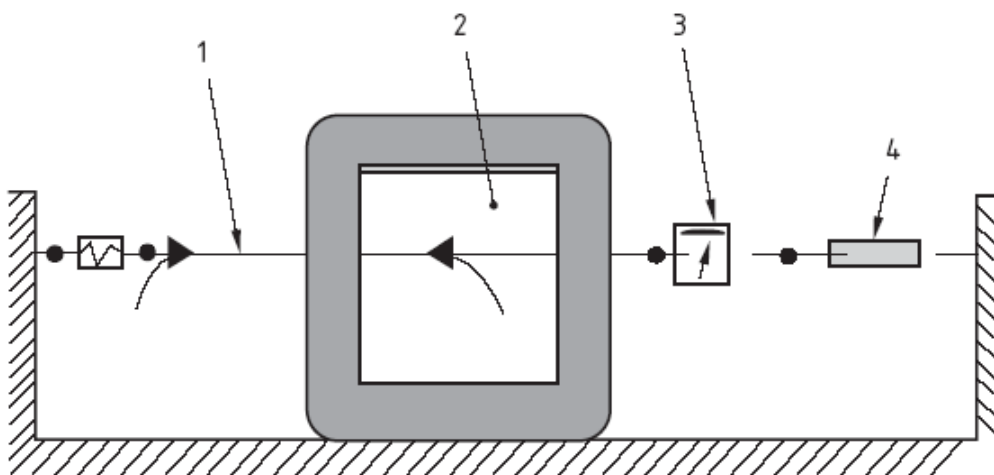
The purpose of this test is to ensure that the tension clamp is suitable for use at  $-10\text{ °C}$ .

NOTE See EN 50483-1, 9.1, for information on the use of a lower temperature.

#### 8.1.3.2 Test arrangement

Figure 3 shows a typical test arrangement.

The test shall be carried out for the maximum and minimum insulated neutral messenger cross-section, for which the clamp is designed.



#### Key

1	neutral messenger		tension clamp tested
2	cold enclosure		mechanical junction allowing rotation
3	mechanical load measurement device		mechanical tension adjustment
4	tensioning device		

**Figure 3 – Arrangement of the fitting for mechanical test at low temperature**

#### 8.1.3.3 Procedure

The tension clamp shall be installed at a distance of a minimum 1 m from the end of a minimum 4 m long neutral messenger sample. The tension clamp shall be secured to a device similar to the one used for its fixing on the support. At the other end, which is not stripped, an appropriate tensioning device shall be set up.

During the tensile test, the clamp shall be located in an enclosure with a temperature of  $(-10 \pm 3)\text{ °C}$ .

A time period of 12 h is suggested which will allow the clamp to cool to -10 °C. However if the temperature of the clamp can be measured the time period can be less, but shall not be less than 2 h as long as the temperature of the clamp reaches -10 °C.

Under these conditions the tension clamp shall be gradually subjected to 25 % of the MBL of the neutral messenger, within  $\pm 5$  % of the applied load, which shall be maintained at this value for 60 s. The conductor shall then be marked where it leaves the clamp, and the load released. A load of 45 % of the MBL of the neutral messenger shall be applied in less than 2 s and then released.

NOTE See EN 50483-1, 9.1, for information on the use of a lower temperature.

#### **8.1.3.4 Requirements**

There shall be

- no damage that could affect the correct function of the tension clamp,
- no slippage by more than 10 mm with respect to the mark on the insulated neutral messenger.

The clamp and conductor shall meet the requirements of the dielectrical voltage test as detailed in 8.1.5.3.

#### **8.1.4 Environmental tests**

In order to meet the requirements of the type tests at least one of the three corrosion tests (detailed in 8.1.4.1) and one of the two climatic test methods (detailed in 8.1.4.4) shall be carried out. When a clamp that consists only of metallic parts is designed for use on a bare messenger then, there is no requirement to carry out the climatic tests. The choice of the test shall be agreed between the manufacturer and the customer.

##### **8.1.4.1 Corrosion ageing test**

See EN 50483-6, 8.4, modified in accordance with 8.1.4.2 or 8.1.4.3 below.

##### **8.1.4.2 Salt mist test**

See EN 50483-6, 8.4.1.

###### **8.1.4.2.1 Test criteria**

The following criteria shall be used during this test.

Number of tension clamps shall be 2.

Number of cycles shall be 4 (4 weeks).

The cross section of the neutral messenger shall be the largest for which the clamp is designed.

#### **8.1.4.2.2 Procedure**

A tension clamp shall be installed at both ends of a neutral messenger section. The free length between tension clamps shall be approximately 0,5 m.

NOTE The tension clamp and its attached fittings may be tested together if requested by the customer.

A load of 25 % of the MBL of the neutral messenger shall be smoothly applied to the device and maintained for 10 min.

The samples shall be placed in a horizontal position in a corrosion chamber with the tension clamps longitudinal opening turned towards the ground.

#### **8.1.4.2.3 Requirements**

Visual inspection shall be carried out and there shall be no significant trace of red rust.

NOTE Significant rusting would constitute more than 10 % of the exposed surface area.

The sample's identification marking shall be legible when examined with normal or corrected vision, without magnification.

No damage shall occur which could affect the correct function of the tension clamp.

For tension clamps for insulated messenger the requirements of 8.1.1 shall be met except that the length of the neutral messenger can be reduced to approximately 0,5 m. If the test in 8.1.1. is carried out before the corrosion test, a reduced value of 75 % of MBL of the neutral messenger shall be applied when the test is repeated after the corrosion test.

If necessary, for tension clamps for bare messenger, the clamps shall be removed from the bare messenger and re-installed onto a new bare messenger in accordance with the test arrangement of 8.1.1.2. The clamps shall meet the requirements of 8.1.1.4. The bare messenger that has been exposed to the corrosion test shall be examined to ensure that the conductor has not deteriorated in the area where the clamp has been installed.

#### **8.1.4.3 Gas atmosphere test**

##### **8.1.4.3.1 Test criteria – Method 1 – Combined test**

See EN 50483-6, 8.4.1 and EN 50483-6, 8.4.2.1.

The following criteria shall be used during this test.

Number of tension clamps shall be 2.

There shall be 4 cycles of 14 days. This 14-day cycle consists of 7 days of salt mist and 7 days in SO<sub>2</sub> atmosphere as defined in EN 50483-6, 8.4.1 and EN 50483-6, 8.4.2.1.

A tension clamp shall be installed at both ends of a neutral messenger section. The free length between tension clamps shall be approximately 0,5 m.

NOTE The tension clamp and its attached fittings may be tested together if requested by the customer.

A load of 25 % of the MBL of the neutral messenger shall be smoothly applied to the device and maintained for 10 min.

The samples shall be placed in a horizontal position in a corrosion chamber with the tension clamps longitudinal opening turned towards the ground.

#### **8.1.4.3.2 Test criteria – Method 2**

See EN 50483-6, 8.4.2.2.

The following criteria shall be used during this test.

Number of tension clamps shall be 2.

There shall be 500 cycles of 2 h (approximately 6 weeks).

A tension clamp shall be installed at both ends of a neutral messenger section. The free length between tension clamps shall be approximately 0,5 m.

NOTE The tension clamp and its attached fittings may be tested together if requested by the customer.

A load of 25 % of the MBL of the neutral messenger shall be smoothly applied to the device and maintained for 10 min.

The samples shall be placed in a horizontal position in a corrosion chamber with the tension clamps longitudinal opening turned towards the ground.

#### **8.1.4.3.3 Requirements (Method 1 and Method 2)**

Visual inspection shall be carried out and there shall be no significant trace of red rust.

NOTE Significant rusting would constitute more than 10 % of the exposed surface area.

The sample's identification marking shall be legible when examined with normal or corrected vision, without magnification.

No damage shall occur which would affect the correct function of the tension clamp.

Tension clamps shall meet the requirements of the mechanical test, 8.1.1. If the test in 8.1.1 is carried out before the corrosion test, a reduced value of 75 % of the MBL shall be applied when the test is repeated after the corrosion test.

#### **8.1.4.4 Climatic ageing test**

See EN 50483-6, 8.5.

NOTE The climatic test is not necessary on bare messenger when the clamp has only metallic parts.

##### **8.1.4.4.1 Test criteria – Method 1**

See EN 50483-6, 8.5.1.

The following criteria shall be used during this test.

Number of tension clamps shall be 2.

There shall be 6 cycles of 1 week.

The temperature during periods A and C shall be 70 °C.

NOTE The temperature may be varied if agreed between the customer and the manufacturer.

The tension clamps shall be installed on the largest cross section of neutral messenger, for which the clamp is designed, in such a way that the longitudinal opening of the samples shall be facing the light source.

#### **8.1.4.4.2 Test criteria – Method 2**

See EN 50483-6, 8.5.2.

The following criteria shall be used during this test:

Number of tension clamps shall be 2.

There shall be 56 cycles of 1 day (8 weeks).

The longitudinal opening of the samples shall be installed facing the light source.

#### **8.1.4.4.3 Requirements (Method 1 and Method 2)**

This test shall be carried out after 24 h and within 72 h of completion of the climatic ageing test.

The sample's identification marking shall be legible when examined with normal or corrected vision, without magnification.

No damage shall occur which could affect the correct function of the tension clamp.

The clamps shall meet the requirements of the dielectrical voltage test given in 8.1.5.2.

Tension clamps shall meet the requirements of the mechanical test given in 8.1.1. If the test in 8.1.1 is carried out before the climatic ageing test, a reduced value of 75 % of MBL of the neutral messenger shall be applied when the test is repeated after the climatic ageing test.

### **8.1.5 Dielectrical voltage test**

#### **8.1.5.1 Dielectrical voltage test in air – Tension clamp only**

##### **8.1.5.1.1 Principle**

This test is designed to prove that the withstand voltage of the clamp body and other parts is acceptable.

##### **8.1.5.1.2 Test arrangement**

An uninsulated conductive rod or suitable conductor shall be used to replace the neutral messenger in the tension clamp. The diameter of the rod or conductor shall be determined by the average diameter, over the insulation, of all the insulated neutral messengers for which the clamp is designed.

The rod or conductor shall protrude by a minimum of 5 cm from either side of the clamp. If necessary those parts of the rod that protrude from the clamp can be insulated in order to prevent flash over to earthed parts. The test shall be carried out without any mechanical tension.



The test arrangement is shown in Figure 4.

All conductive parts of the tension clamps shall be earthed.

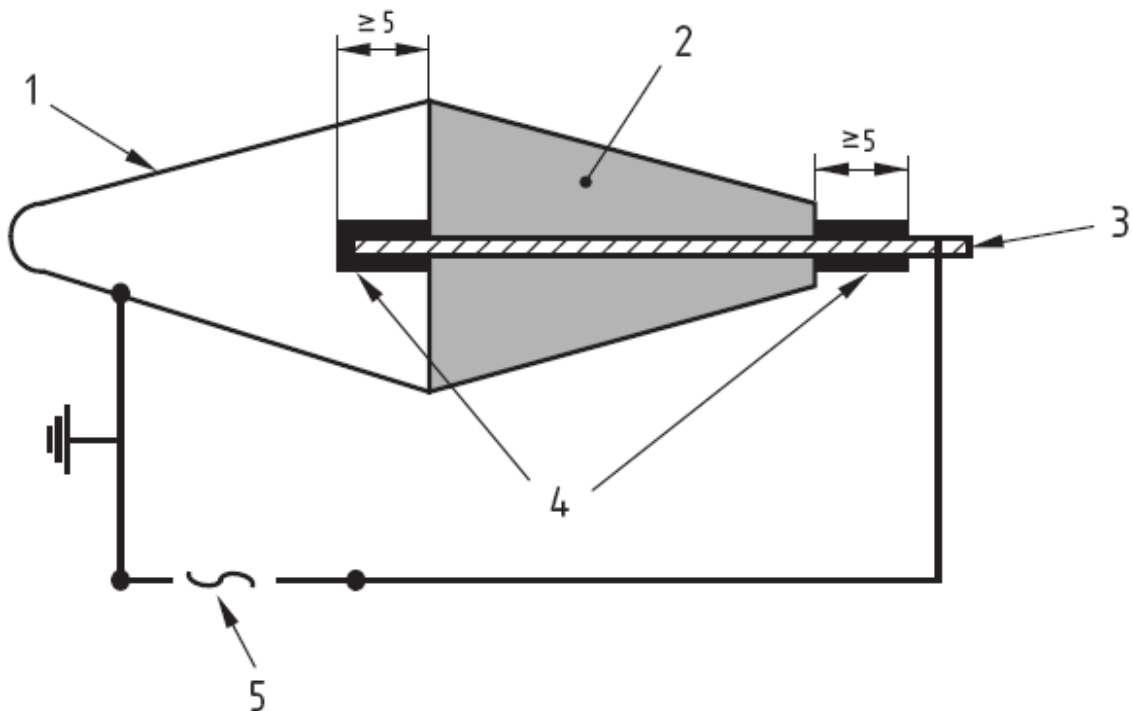
**8.1.5.1.3 Procedure**

An a.c. voltage of 4 kV shall be applied between the rod or conductor and the conductive parts of the clamp at a rate of approximately 1 kV/s.

NOTE A voltage of 6 kV may be used when this is agreed, between customer and manufacturer.

This voltage shall be maintained for 60 s.

Dimensions in centimetres



**Key**

- |   |                                |   |                  |
|---|--------------------------------|---|------------------|
| 1 | conductive part                | 4 | added insulation |
| 2 | clamp body                     | 5 | test voltage     |
| 3 | bare metallic rod or conductor |   |                  |

**Figure 4 – Voltage test arrangement on tension clamp only**

**8.1.5.1.4 Requirements**

No failure or flashover shall occur. The maximum leakage current is defined in EN 50483-1, 9.1.5.

**8.1.5.2 Dielectrical voltage test in air – Tension clamp and conductor**

**8.1.5.2.1 Principle**

The purpose of this test is to ensure that the tension clamp has not suffered damage that would adversely affect its dielectrical properties.

### 8.1.5.2.2 Test arrangement

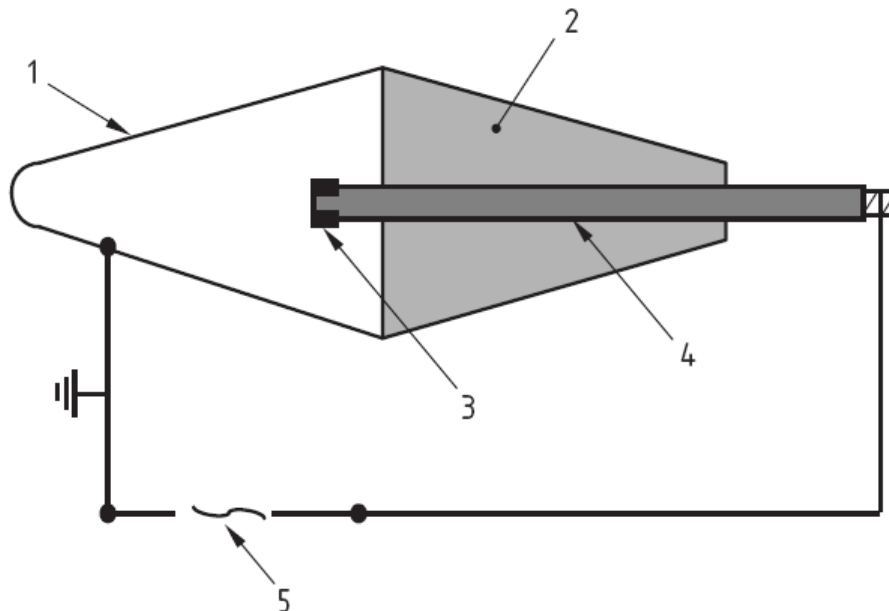
The end of the neutral insulated messenger, on which the tension clamp is fitted, shall be capped in order to avoid any flashover. All conductive parts shall be earthed.

The test arrangement is shown in Figure 5.

### 8.1.5.2.3 Procedure

An a.c. voltage shall be applied between the conductive parts of the clamp and the insulated neutral messenger conductor, the test connection to the conductor being made at the remote end of the cable. The voltage shall then be increased to 4 kV at a rate of approximately 1 kV/s. The voltage shall be maintained for 30 min.

NOTE A higher voltage up to a maximum of 10 kV may be used when agreed between customer and manufacturer.



#### Key

1	conductive part	4	neutral messenger
2	clamp body	5	test voltage
3	insulated cap		

**Figure 5 – Dielectrical voltage test arrangement on tension clamp and conductor in air**

### 8.1.5.2.4 Requirements

No failure or flashover shall occur. The maximum leakage current is defined in EN 50483-1, 9.1.5.

### 8.1.5.3 Dielectrical voltage test in water – Tension clamp and conductor

This test shall be carried out shortly after the tensile test at high temperature defined in 8.1.2 and the tensile test at low temperature defined in 8.1.3.

#### **8.1.5.3.1 Principle**

This test shall be carried out to ensure that the insulation properties of the tension clamps have not been damaged during testing.

#### **8.1.5.3.2 Test arrangement**

The insulated neutral messenger core and its tension clamps shall be immersed to a depth of at least 30 cm of water.

The neutral messenger may be cut on both sides of the tension clamps before immersion.

The resistivity of the water shall be less than 200  $\Omega$ .m.

NOTE Normally tap water will meet this requirement.

The water shall be at ambient temperature.

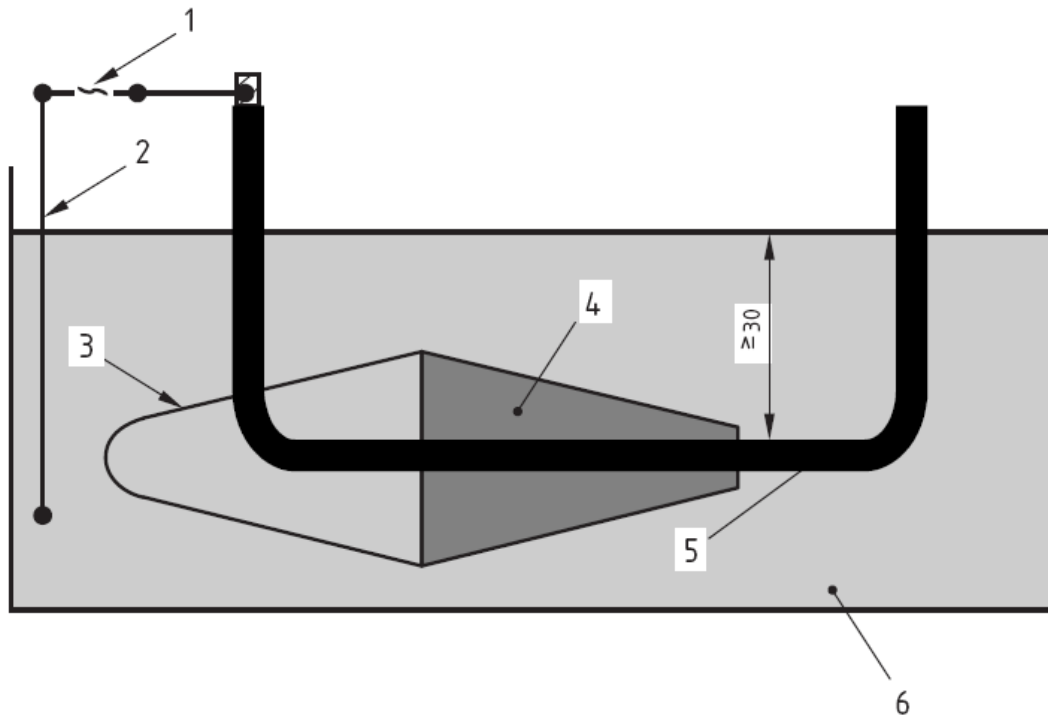
The test arrangement is shown in Figure 6.

#### **8.1.5.3.3 Procedure**

After a minimum of 30 min immersion, an a.c. voltage of 4 kV shall be applied to the sample for 60 s. The a.c. voltage shall be applied at a rate of approximately 1 kV/s.

NOTE A voltage up to a maximum of 10 kV may be used when this is agreed between customer and manufacturer.

Dimensions in centimetres

**Key**

1	test voltage	4	clamp body
2	electrode	5	neutral messenger
3	conductive part	6	water

**Figure 6 – Dielectrical voltage test arrangement on tension clamp in water**

#### 8.1.5.3.4 Requirements

No failure or flashover shall occur. The maximum leakage current is defined in EN 50483-1, 9.1.5.

#### 8.1.5.4 Clamp bolt tightening test

See 8.2.1.

## 8.2 Type tests for suspension clamps

The following type tests shall be carried out on the suspension clamps.

Test	Applicability	Subclause
Clamp bolt tightening test	insulated and bare neutral messenger	8.2.1
Mechanical test	insulated and bare neutral messenger	8.2.2
Corrosion test	insulated and bare neutral messenger	8.2.3.1
Climatic ageing test	insulated and bare neutral messenger	8.2.3.4
Dielectrical voltage test	insulated neutral messenger only	8.2.4
Swing test	insulated neutral messenger only	8.2.5
Slip test at high temperature	insulated neutral messenger only	8.2.6

NOTE 1 The tests 8.2.2, 8.2.3.1, 8.2.4.1 and 8.2.5 may be performed with the suspension assembly if requested by the customer.

If a cable fails beyond any part of suspension devices, the test result shall be declared void without discrediting the suspension device. Tests shall be repeated using a new suspension device and a new cable.

NOTE 2 When agreed between the manufacturer and the customer, the mechanical test loads may be defined by the smallest cable for the clamp but in this case the clamp may only be considered to conform to this standard for the smaller cable size.

### 8.2.1 Clamp bolt tightening test

This test is common for both suspension and tension clamps.

#### 8.2.1.1 Principle

The purpose of this test is to ensure that the clamp bolts are not damaged or do not damage the clamp.

#### 8.2.1.2 Test arrangement

Two clamps shall be tested.

The test shall be carried out at ambient temperature.

If applicable, the test shall be carried out on all suspension clamps specified.

The test shall be performed by installing the clamp on a conductor or cable with a diameter equal to that for which the clamp is intended to be used. The bolts and/or nuts shall be tightened with the installation torque specified by the supplier.

If a clamp is designed for more than one cross-section of conductor or cable, the test shall be made on both the largest and smallest cross-sections of the supplier's declared design range.

### 8.2.1.3 Procedure

The torque as in 8.2.1.2 shall be increased to the specified installation value by a factor of 1,1.

10 installations and removals shall be completed.

After 10 installations the torque shall be increased to either twice the specified installation value or the maximum torque value recommended by the bolt supplier; whichever is the lower.

### 8.2.1.4 Requirements

There shall be no breakage either to the threaded parts or to the components connected to them which could affect the correct function of the clamp.

## 8.2.2 Mechanical test

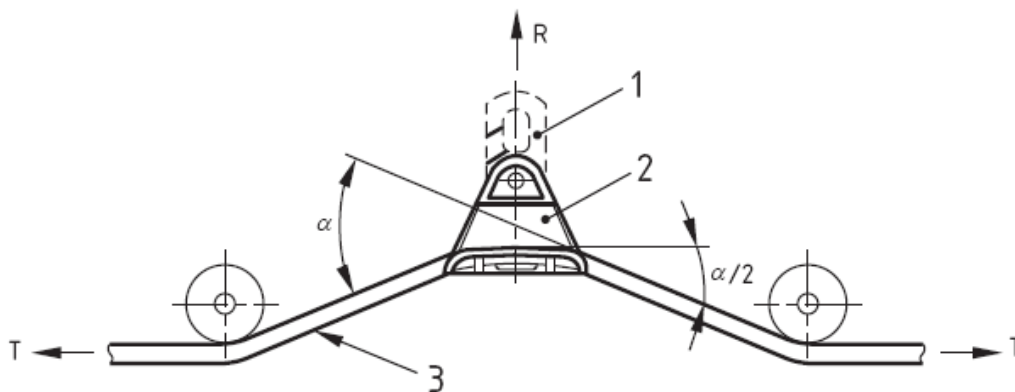
### 8.2.2.1 Tensile test on suspension clamps

#### 8.2.2.1.1 Principle

The purpose of this test is to determine the mechanical performance of the clamps.

#### 8.2.2.1.2 Test arrangement

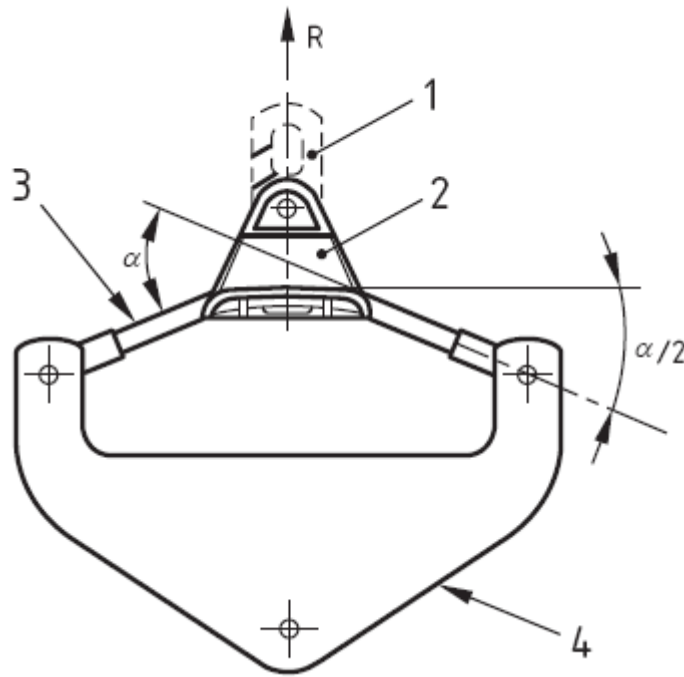
Alternative test arrangements, in which the angle of deviation “ $\alpha$ ” is given, are shown in Figures 7 and 8. A device adapted to the support of the suspension clamp shall be used.



#### Key

- |   |                  |   |                   |
|---|------------------|---|-------------------|
| 1 | mobile link      | 3 | neutral messenger |
| 2 | suspension clamp |   |                   |

**Figure 7 – Mechanical test arrangement**



**Key**

- |   |                  |   |                                   |
|---|------------------|---|-----------------------------------|
| 1 | mobile link      | 3 | neutral messenger or metallic rod |
| 2 | suspension clamp | 4 | rigid bar                         |

**Figure 8 – Mechanical test arrangement**

NOTE The test may be carried out on the different types of mobile link and suspension clamps together if requested by the customer.

**8.2.2.1.3 Procedure**

The suspension clamp shall be secured to a device similar to the one used for fixing to a typical support. A tension load shall be applied and gradually increased to 60 % of the MBL of the neutral messenger and shall be in the direction “R”. This load shall be maintained for 60 s.

The load shall then be increased to the maximum tension load given in Table 1.

**Table 1 – Tensile loads**

Angle of deviation	Maximum tension load
$\alpha \leq 65^\circ$	75 % MBL of the neutral messenger
$\alpha > 65^\circ$	90 % MBL of the neutral messenger

NOTE When it is agreed between customer and manufacturer, the test may be carried out as follows.

- The previous test arrangement should be used again with a new suspension clamp and a steel cable with a cross-section equivalent to that of the neutral messenger.
- The suspension assembly may be subjected to a load increasing to a value of 110 % of the MBL of the neutral messenger.

#### 8.2.2.1.4 Requirements

No damage shall occur which could affect the correct function of the clamp.

#### 8.2.2.2 Slip test at ambient temperature

The test shall be carried out on the minimum and maximum cross-section for which the clamp is designed.

##### 8.2.2.2.1 Principle

The purpose of this test is to ensure that the suspension clamp can support longitudinal loads without being damaged or allowing the neutral messenger to slip.

##### 8.2.2.2.2 Test arrangement for insulated neutral messenger

The test shall be carried out at ambient temperature.

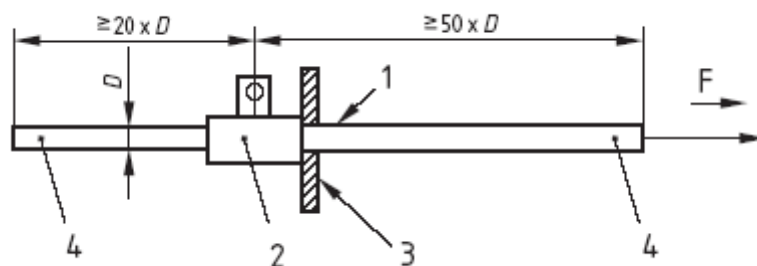
A sample of the maximum and minimum insulated neutral messenger cross-sections shall be placed in a fixed suspension clamp.

A typical arrangement is shown in Figure 9.

##### 8.2.2.2.3 Procedure for insulated neutral messenger

The insulated neutral messenger shall be marked at the point at which it leaves the clamp.

A longitudinal load shall be gradually applied to the neutral messenger and increased to 300 N.



#### Key

1	markings	3	clamp supported so that force $F$ is longitudinal direction
2	clamp to be tested	4	neutral

**Figure 9 – Slip test on the suspension clamps**

##### 8.2.2.2.4 Test arrangement for bare neutral messenger

Two clamps for the largest and the smallest cross-section of neutral messenger shall be tested. Each clamp shall be fitted into a test rig in an arrangement that is as close to the normal operating condition as possible. A typical arrangement is shown in Figure 10.

The test shall be carried out at ambient temperature.

The bare neutral messenger shall be marked at the point at which it leaves the clamp.



A sample of the maximum and minimum neutral messenger cross-sections shall be placed in a fixed suspension clamp.

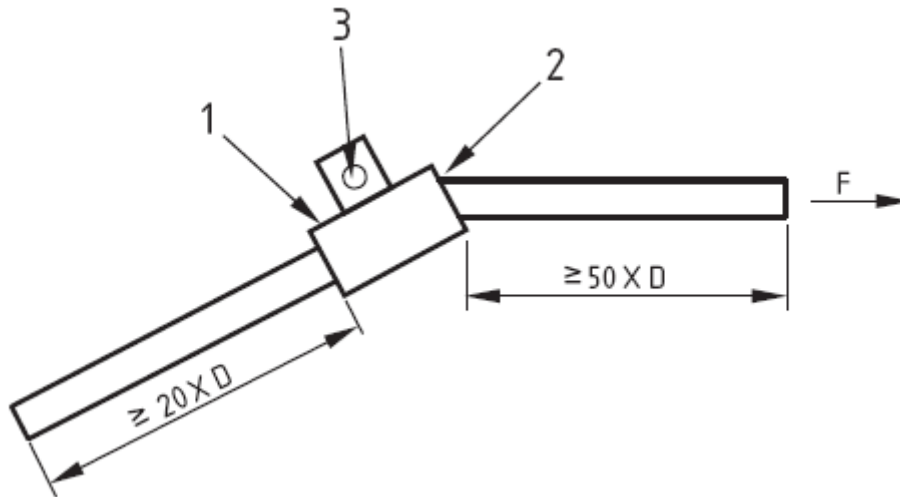
NOTE Another arrangement may be agreed between manufacturer and customer, referring to "Slip test on standard clamps with only specified minimum slip load" as mentioned in EN 61284:1997.

**8.2.2.2.5 Procedure for bare neutral messenger**

A sliding force ( $F$ ) is applied longitudinally to the bare neutral messenger in the direction shown in Figure 10.

The load shall be steadily increased until the messenger begins to slip through the suspension clamp.

This load shall be recorded.



**Key**

- 1 clamp to be tested
- 2 marking
- 3 fixed point

**Figure 10 – Slip test on the suspension clamps**

**8.2.2.2.6 Requirements**

No slippage shall occur at 300 N for insulated neutral messenger.

No slippage shall occur at 45 N/mm<sup>2</sup> for bare neutral messenger.

NOTE 1 For bare neutral messenger, another slippage load may be agreed between manufacturer and customer, referring to EN 61284:1997, 11.4.3.

NOTE 2 Any relevant movement less than 2 mm should be accepted. The possible elongations produced by the cable as a result of the test itself are not regarded as slippage.

No damage shall occur which could affect the correct function of the suspension clamp and cable.

No component of the clamp shall be dislodged.

### **8.2.3 Environmental tests**

In order to meet the requirements of the type tests at least one of the three corrosion tests (as detailed in 8.2.3.1) and one of the two climatic test methods (as detailed in 8.2.3.4) shall be carried out. The choice of the test shall be agreed between the manufacturer and the customer.

#### **8.2.3.1 Corrosion ageing test**

See EN 50483-6, 8.4.

#### **8.2.3.2 Salt mist test**

See EN 50483-6, 8.4.1.

##### **8.2.3.2.1 Test criteria**

The following criteria shall be used during this test.

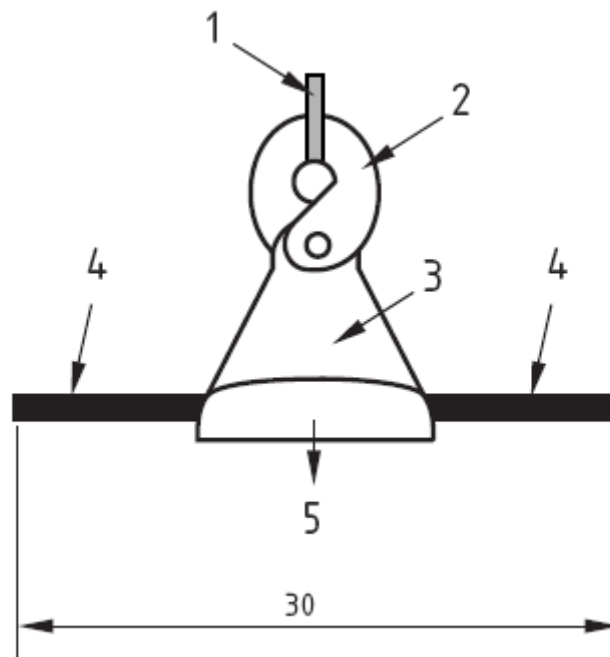
Number of suspension samples shall be 2 or 4 in the case of an optional swing test.

Number of cycles shall be 4 (4 weeks).

Each sample shall be installed in its normal service position.

A 30 cm piece of neutral messenger shall be installed in the clamp. A mass of  $(1,0 \pm 0,1)$  kg shall be hung onto the clamp articulation of the suspension clamp to the articulation of the suspension clamp, so as to make contact between the metallic parts, and possibly induce, galvanic corrosion of dissimilar metals (see Figure 11).

Dimensions in centimetres



**Key**

1	hooking	4	piece of neutral messenger
2	mobile link (if present)	5	mass
3	suspension clamp		

**Figure 11 – Corrosion test**

**8.2.3.2.2 Requirements**

Visual inspection shall be carried out and there shall be no significant trace of red rust.

NOTE Significant rusting would constitute more than 10 % of the exposed surface area.

The sample's identification marking shall be legible when examined with normal or corrected vision, without magnification.

No damage shall occur which would affect the correct function of the suspension clamp.

Suspension clamps shall meet the requirements of the mechanical test as given in 8.2.2.1. If the test in 8.2.2.1 is carried out before the corrosion test, a reduced value of 55 % of MBL of the neutral messenger shall be applied when the test is repeated after the corrosion test.

**8.2.3.3 Gas atmosphere test**

**8.2.3.3.1 Test criteria – Method 1 – Combined test**

See EN 50483-6, 8.4.1 and EN 50483-6, 8.4.2.

The following criteria shall be used during this test.

Number of suspension samples shall be 2 or 4 in the case of an optional swing test.

There shall be 4 cycles of 14 days. This 14-day cycle consists of 7 days of salt mist and 7 days in SO<sub>2</sub> atmosphere as defined in EN 50483-6, 8.4.1 and EN 50483-6, 8.4.2.1.

A 30 cm piece of neutral messenger shall be installed in the clamp. A mass of  $(1,0 \pm 0,1)$  kg shall be hung onto the clamp or the messenger in order to apply the vertical force to the articulation of the suspension clamp, so as to make contact between the metallic parts, and possibly induce, galvanic corrosion of dissimilar metals (see Figure 11).

#### **8.2.3.3.2 Test criteria – Method 2**

See EN 50483-6, 8.4.2.2.

The following criteria shall be used during this test.

Number of tension samples shall be 2 or 4 in the case of an optional swing test.

There shall be 500 cycles of 2 h (approximately 6 weeks).

A 30 cm piece of neutral messenger shall be installed in the clamp. A mass of  $(1,0 \pm 0,1)$  kg shall be hung onto the clamp or the messenger in order to apply the vertical force to the articulation of the suspension clamp, so as to make contact between the metallic parts, and possibly induce, galvanic corrosion of dissimilar metals (see Figure 11).

#### **8.2.3.3.3 Requirements (Method 1 and Method 2)**

Visual inspection shall be carried out and there shall be no significant trace of red rust.

NOTE Significant rusting would constitute more than 10 % of the exposed surface area.

The sample's identification marking shall be legible when examined with normal or corrected vision, without magnification.

No damage shall occur which could affect the correct function of the suspension clamp.

Suspension clamps shall meet the requirements of the mechanical test given in 8.2.2.1. If the test in 8.2.2.1 is carried out before the corrosion test, a reduced value of 55 % of MBL of the neutral messenger shall be applied when the test is repeated after the corrosion test.

#### **8.2.3.4 Climatic ageing test**

See EN 50483-6, 8.5.

##### **8.2.3.4.1 Test criteria – Method 1**

See EN 50483-6, 8.5.1.

The following criteria shall be used during this test.

Number of suspension clamps shall be 2 or 4 in the case of an optional swing test.

There shall be 6 cycles of 1 week.

The temperature during periods A and C shall be in accordance with EN 50483-6, 8.5.1.4.

The samples shall be installed perpendicular to radiation of the light source. One unit shall be installed so that the opening for introducing the cable is facing the light source and the other shall be installed on the opposite side.

NOTE The test may be carried out for complete assemblies if the customer requests this.

#### **8.2.3.4.2 Test criteria – Method 2**

See EN 50483-6, 8.5.2.

The following criteria shall be used during this test.

Number of tension clamps shall be 2 or 4 in the case of an optional swing test.

There shall be 56 cycles of 1 day (8 weeks).

The samples shall be installed perpendicular to radiation of the light source. One unit shall be installed so that the opening for introducing the cable is facing the light source and the other shall be installed on the opposite side.

NOTE The test may be carried out for complete assemblies if the customer requests this.

#### **8.2.3.4.3 Requirements (Method 1 and Method 2)**

This test shall be carried out after 24 h and within 72 h of completion of the climatic ageing test.

The sample's identification marking shall be legible when examined with normal or corrected vision, without magnification.

No damage shall occur which would affect the correct function of the suspension clamp.

The clamps shall meet the requirements of the dielectrical voltage test given in 8.2.4.1.

The two samples having passed the dielectrical voltage test shall be subjected to the following test.

Suspension clamps shall meet the requirements of the mechanical test given in 8.2.2.1. If the test in 8.2.2.1 is carried out before the climatic ageing test, a reduced value of 55 % of MBL of the neutral messenger shall be applied when the test is repeated after the climatic ageing test.

No damage shall occur which could affect the correct function of the samples.

### **8.2.4 Dielectrical voltage test (only for insulated messenger clamps)**

The voltage test for the suspension clamps and ABC with neutral messenger shall be carried out according to 8.2.4.1 and 8.2.4.2.

#### **8.2.4.1 Dielectrical voltage test in air**

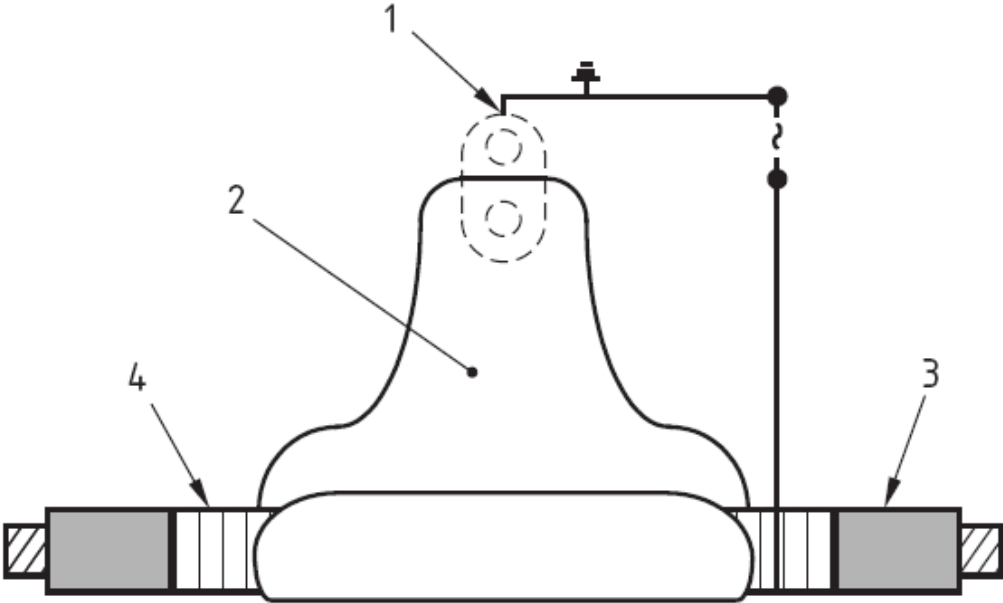
##### **8.2.4.1.1 Principle**

This test shall be carried out to ensure that the insulation properties of the suspension clamps have not been damaged during testing.

**8.2.4.1.2 Test arrangement**

The test shall be carried out on the different types of suspension clamp.

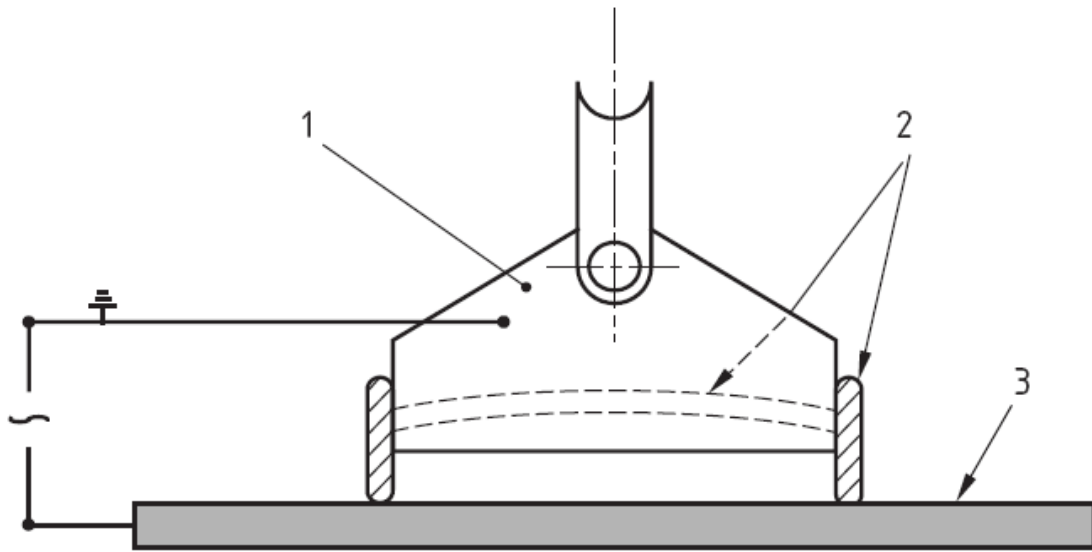
The test arrangement is given diagrammatically in Figure 12.



**Key**

- |   |                  |   |                 |
|---|------------------|---|-----------------|
| 1 | earthing point   | 3 | neutral sheath  |
| 2 | suspension clamp | 4 | conductive foil |

**Figure 12 – Dielectrical voltage test arrangement in air**



**Key**

- 1 metallic clamp
- 2 insulated parts of the clamp
- 3 un-insulated conductive rod

**Figure 13 – Dielectrical voltage test arrangement for metallic body**

**8.2.4.1.3 Procedure**

A conductive foil shall be wrapped around the insulated neutral messenger of maximum cross-section specified for the clamp. This assembly shall then be placed into the clamp. The conductive part of the clamp, or if there is no conductive part, its fixing point, shall be earthed, and an a.c. voltage of 4 kV shall be applied to the conductive foil at a rate of approximately 1 kV/s.

NOTE 1 A bare conductor, of the same outside diameter as the insulated messenger, may be used instead of the foil wrapped around the neutral messenger.

Where a bare conductor is used, then the connection shall be made directly to the conductor.

Where a metallic body, with insulated parts, is used an additional voltage test shall be performed according to Figure 13.

NOTE 2 A voltage of 6 kV may be used when this is agreed between customer and manufacturer.

This voltage shall be maintained for 60 s.

**8.2.4.1.4 Requirements**

No failure or flashover shall occur. The maximum leakage current is defined in of EN 50483-1, 9.1.5.

**8.2.4.2 Dielectrical voltage test in water**

This test shall be carried out after the swing test defined in 8.2.5 and the slip test at high temperature defined in 8.2.6.

#### **8.2.4.2.1 Principle**

This test shall be carried out to ensure that the insulation properties of the suspension clamps have not been damaged during testing.

#### **8.2.4.2.2 Test arrangement**

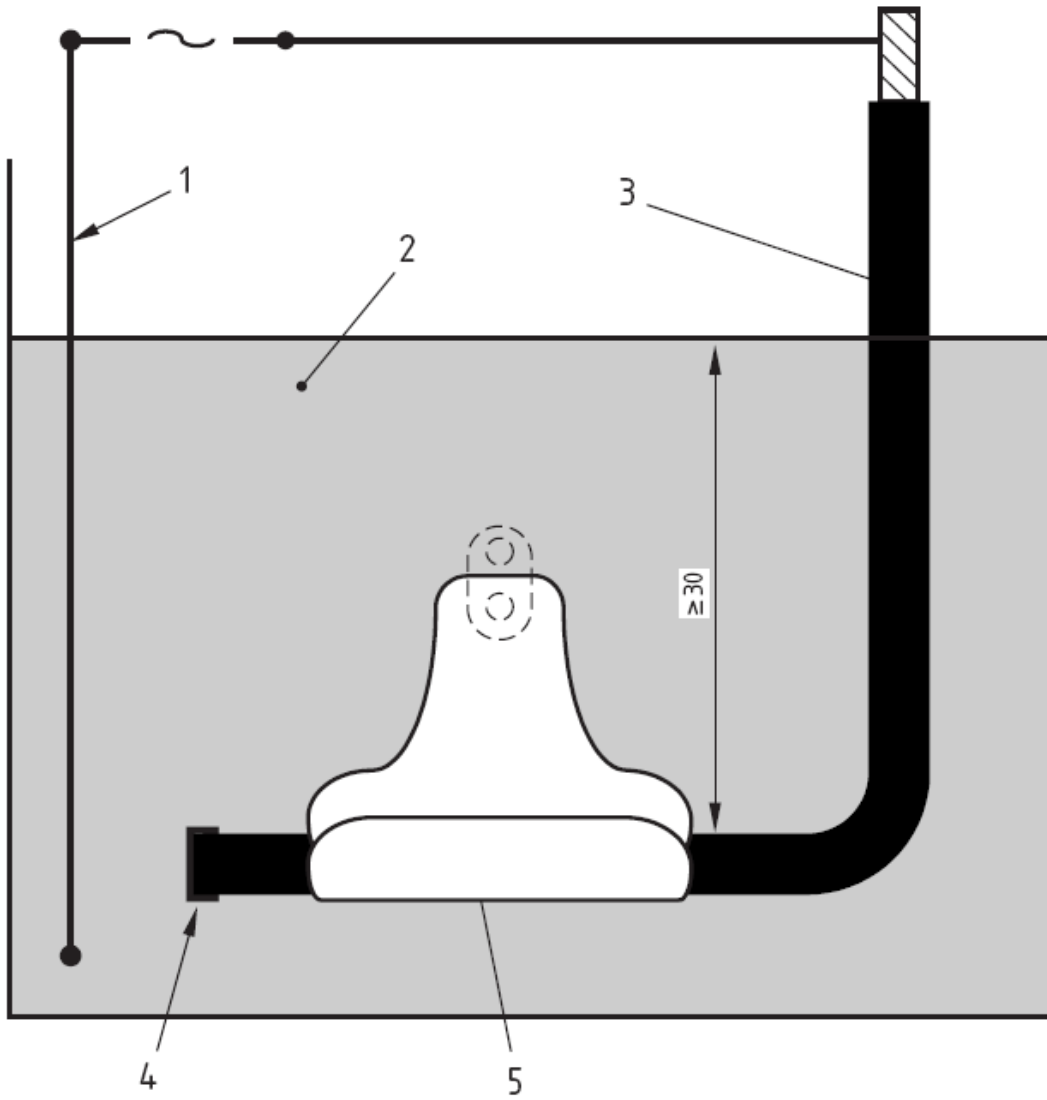
The neutral messenger and its suspension clamp shall be immersed under a minimum of 30 cm of water.

The neutral messenger may be cut on both sides of the suspension assembly before immersion.

The suggested test arrangement is given diagrammatically in Figure 14. The resistivity of the water shall be in accordance with EN 50483-1, 9.1.6.



Dimensions in centimetres



**Key**

- |   |                   |   |                  |
|---|-------------------|---|------------------|
| 1 | electrode         | 4 | cap              |
| 2 | water             | 5 | suspension clamp |
| 3 | neutral messenger |   |                  |

**Figure 14 – Dielectrical voltage test arrangement in water**

**8.2.4.2.3 Procedure**

After a minimum of 30 min immersion, an a.c. voltage of 4 kV shall be applied to the sample for 60 s.

NOTE A voltage of 10 kV may be used when this is agreed between customer and manufacturer.

The a.c. voltage shall be in accordance with EN 50483-1, 9.1.7.

#### **8.2.4.2.4 Requirements**

No failure or flashover shall occur. The maximum leakage current is defined in EN 50483-1, 9.1.5.

#### **8.2.5 Swing test (optional)**

It shall be carried out on two suspension clamps and, when included, associated mobile links which have passed either

- the climatic ageing test defined in 8.2.3.4 for fixing parts made from synthetic materials, or
- the corrosion test defined in 8.2.3.3.1 for fixing parts made from metal.

##### **8.2.5.1 Principle**

The purpose of this test is to ensure that movement of the neutral, messenger does not cause deterioration of the suspension clamp, or mobile link, where it is supported by a fixture.

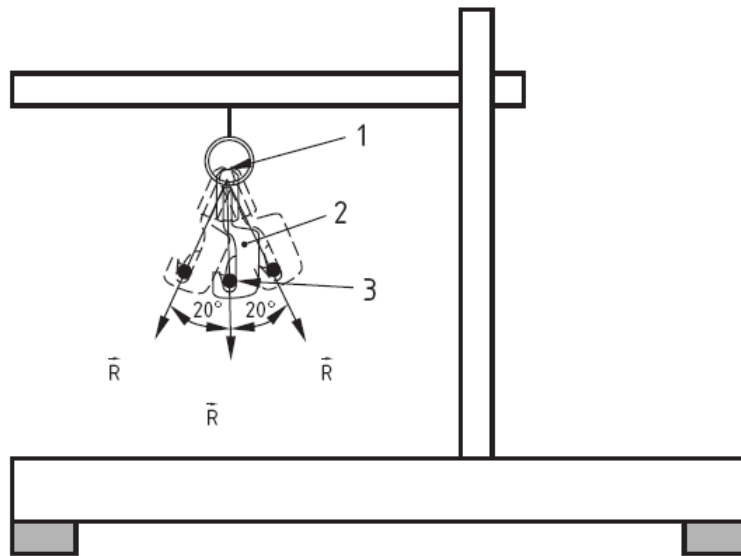
The test shall be carried out on the suspension assembly. The suspension clamp shall be tested with its mobile link, when required, and the bracket or fixture for which it is designed or which is specified by the customer.

##### **8.2.5.2 Test arrangement**

A conductive rod with a diameter determined by the average diameter of the neutral messenger shall be placed into the suspension clamp.

A load,  $R$ , shall be applied to the clamp that acts through the clamp to the suspension point and shall remain constant throughout the test irrespective of the degree of wear. Swings with fixed frequency and angular displacement shall be carried out.

The test arrangement is given diagrammatically in Figure 15.



**Key**

- 1 clamp fixture
- 2 suspension clamp
- 3 conductive rod

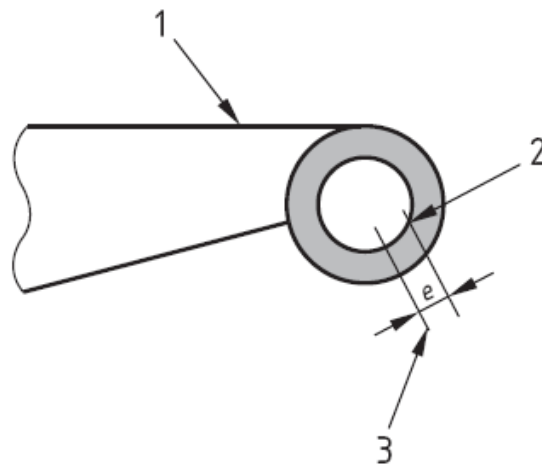
**Figure 15 – Swing test arrangement**

**8.2.5.3 Procedure**

The test is carried out as follows:

- swing frequency  $2,5 \text{ Hz} \pm 5 \%$ ;
- applied load  $R$   $1\,300 \text{ N}$ ;
- angular oscillation (from vertical)  $(20 \pm 5)^\circ$ ;
- total angular displacement  $(40 \pm 5)^\circ$ ;
- minimum temperature limit  $40 \text{ }^\circ\text{C}$ ;
- maximum temperature limit  $60 \text{ }^\circ\text{C}$ .

The junction, of the fixture and the mobile link or suspension clamp, shall be cooled using air at ambient temperature. The temperature shall be maintained between the temperature limits. The temperature shall be measured at a distance,  $e$ , which is shown in Figure 16. The distance,  $e$ , shall be between 5 mm and 10 mm.

**Key**

- 1 fixture
- 2 thermocouple
- 3 limit of displacement

**Figure 16 – Swing test temperature measurement**

The clamp, or clamp and mobile link, are swung for a period of 30 min. During this period the temperature of the junction is monitored and adjusted, if necessary, to ensure that the junction remains within the required temperature limits.

The test shall continue and no change to the cooling arrangement shall be made. The temperature of the junction shall be monitored for a further 30 min. However, if the temperature exceeds 60 °C, or is lower than 40 °C during these 30 min, the test shall be stopped. In such a case, a new test shall be carried out with a new clamp and fixture, and a better adjusted cooling arrangement.

The test shall continue for a period of 180 h.

The load  $R$  shall be measured at the start and at the end of the test and while the clamp is stationary.

#### 8.2.5.4 Requirements

No breakdown shall occur.

#### 8.2.6 Slip test at high temperature (optional)

##### 8.2.6.1 Principle

The test is only for insulated neutral messenger installed in suspension clamps where the customer specifies a high slippage load.

##### 8.2.6.2 Test arrangement

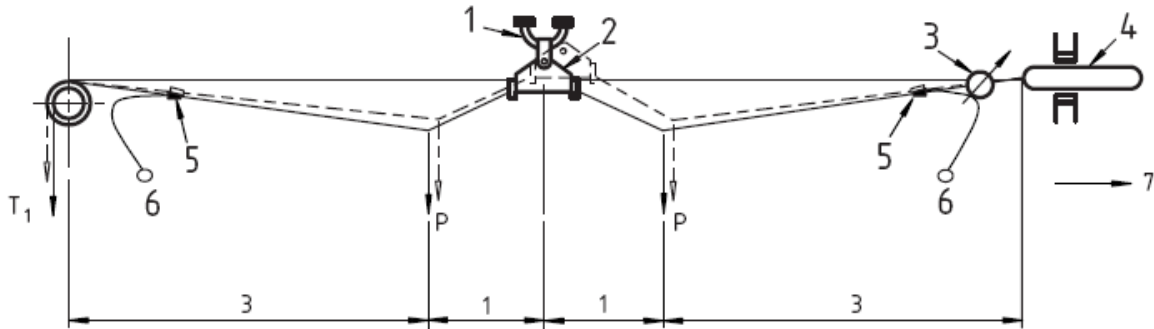
The test combines a heat cycle test with mechanical load applied to the neutral messenger where the suspension clamp is attached to the fixture.

Figure 17 shows a typical test set up. The test configuration may differ from this arrangement as long as it complies with the neutral messenger lengths.

The test shall be carried out for the maximum and minimum insulated neutral messenger cross-section, for which the suspension clamp is designed.

Suspension clamps and the neutral messenger shall be subjected to this test, which comprises of 250 cycles, of 90 min each in which a heat cycle is combined with mechanical loads.

Dimensions in metres



**Key**

1	fixture	—	suspension clamp with balanced load ( $T_2 = T_1$ )
2	suspension clamp	-----	suspension clamp with unbalanced load ( $T_2 > T_1$ )
3	mechanical load measurement device	P	400 N (constant weight)
4	tensioning device	$T_1$	10 % MBL of neutral messenger (tensile load of neutral messenger by application of a suspended constant weight)
5	tension clamp	$T_2$	25 % MBL of neutral messenger (tensile overload of the neutral messenger by tensile load machine (4))
6	current source connection		
7	$T_1$ or $T_2$		

**Figure 17 – Test arrangement for slip test at high temperature**

**8.2.6.3 Procedure**

A suspension clamp shall be fitted on the neutral messenger in the middle of a span with a length of about 8 m.

At a distance of 100 cm from both sides of the suspension clamp two fixed weights, of about 400 N, shall be attached on the neutral messenger.

NOTE 1 A different length of the span may be agreed between the manufacturer and the customer.

Before starting the first cycle the neutral messenger shall be subjected to 10 % of its MBL and the sheath shall be marked so that any slippage can be measured with respect to the suspension clamp.

An alternating current is passed through the neutral messenger until its temperature rises to  $(60 \pm 3) \text{ }^\circ\text{C}$ . The temperature rise shall be achieved within 15 min and then maintained at this temperature for the next 30 min or until the total time is 45 min, if the temperature is achieved more quickly.

The temperature of the neutral messenger shall be measured with a thermocouple.

NOTE 2 For further information on thermocouple application, see EN 50483-5, 5.4.1.

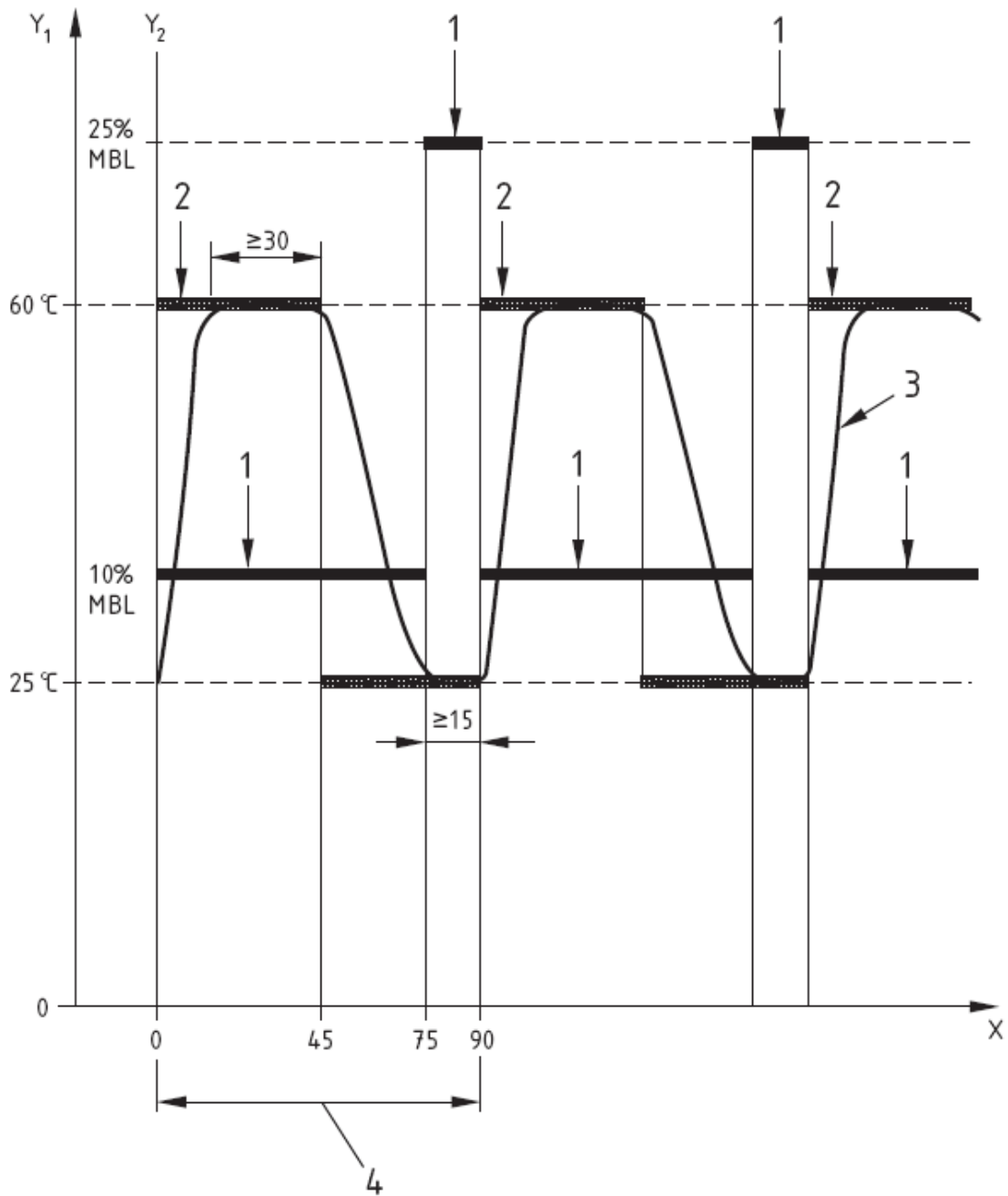
NOTE 3 The temperature may be measured at a position that is not under mechanical tension. The measuring position may be at least 1 m from the tension clamp and the end of the neutral messenger. It may be also at the same horizontal level as the suspension clamp in order to avoid any difference in air temperature.

The neutral messenger shall be allowed to cool to 25 °C during the next 30 min. This temperature shall be maintained for the next 15 min until the end of the cycle.

The mechanical load of 10 % of the MBL of the neutral messenger shall be maintained for the first 75 min of the cycle. During the last 15 min, once the neutral messenger has cooled to 25 °C, the load shall be increased to 25 % of the MBL of the neutral messenger. This increase in load shall be gradually applied in not less than 5 s and not more than 60 s.

If accelerated cooling is used, it shall act on the whole of the loop, and use air within ambient temperature limits.

The mechanical and temperature cycle are shown diagrammatically in Figure 18.



**Key**

- |   |                                   |       |  |
|---|-----------------------------------|-------|--|
| 1 | selected value of mechanical load | $X$   | time in minutes                                      |
| 2 | selected value of temperature     | $Y_1$ | temperature in °C                                    |
| 3 | temperature profile               | $Y_2$ | mechanical load in % of MBL of the neutral messenger |
| 4 | one cycle                         |       |  |

**Figure 18 – Cycle and temperature profile**

## **8.2.6.4 Requirements**

### **8.2.6.4.1 Slippage checking**

The neutral messenger sheath slippage with regard to the suspension clamp shall comply with the following conditions:

- slippage after 15 cycles:  $g_{15} \leq 2 \text{ mm}$ ;
- slippage after 250 cycles:  $g_{250} \leq 4 \text{ mm}$ .

### **8.2.6.4.2 Dielectrical voltage test in water**

The suspension clamp shall pass the dielectrical voltage test requirements given in 8.2.4.2 with 3 kV a.c.



## **Bibliography**

EN 50182, *Conductors for overhead lines – Round wire concentric lay stranded conductors*

EN 61284:1997, *Overhead lines – Requirements and tests for fittings* (IEC 61284:1997)