Guideline No.E-10 (201610 )

# E-10 Temperature Transmitter

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**Foreword**

This Guideline is a part of CCS Rules, which contains technical requirements, inspection and testing criteria related to classification and statutory survey of marine products.

This Guideline is published and updated by CCS and can be found through http://www.ccs.org.cn. Comments or suggestions can be sent by email to ps@ccs.org.cn.

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Main changes and effective date:

"Guideline on Type Approval Test of Electrical and Electronic Products (GD01-2006) (2006)" is modified to "CCS GD22-2015<Guidelines for Type Approval Test of Electric and Electronic Products> (current valid version)". "GD01-2006" appearing in this guideline is modified to <Guidelines for Type Approval Test of Electric and Electronic Products> (current valid version). The CCS GD 22-2015 "Guidelines for Type Approval Test of Electric and Electronic Products" comes into force on January 1 2016.

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# Temperature Transmitter

## 1 Application

This Guideline applies to the verification and certification of the marine temperature transmitter installed independently on the ship and offshore installations, or acting as component on other marine equipment.

## 2 Basis for approval and inspection

2.1 Technical requirement

2.1.1 Chapter 1,Part Four and Section 8, Chapter 2, Part Seven of CCS Rules for Classification of Sea-going Steel Ships.

2.1.2 Part 0 "General Requirement" of IEC60079-0:2007｛Ed.5.0｝ Electrical Equipment Used in Explosive Gas Environment.

2.1.3 Part 1 "Flame-proof Type d" of IEC60079-1:2007｛Ed.6.0｝ Electrical Equipment Used in Explosive Gas Environment.

2.1.4 Part 4 "Intrinsic Safety Type i" of IEC60079-11:2007｛Ed.4.0｝ Electrical Equipment Used in Explosive Gas Environment.

2.1.5 Part 1 "Performance Evaluation Method" of IEC770-1:1989 Transmitter for Industrial Process Control System.

2.1.6 Part 2 "Guideline on Inspection and Routine Test" of IEC770-2:1989 Transmitter for Industrial Process Control System.

2.2 Test requirement

2.2.1 CCS GD22-2015 Guideline on Type Approval Test of Electrical and Electronic Products (Current edition).

2.3 Any standard cited in the chapter can be replaced with other equal standards or those accepted by CCS as requirement.

## 3 Terms and definitions

3.1 Temperature transmitter: A device which changes the tested temperature signal into standard electric signal, consisting of two parts, namely, the convertor (device) and temperature sensing part (component). The temperature sensing part can be further divided as the copper thermistor, platinum thermistor, thermoelectric couple, and thermistor.

3.2 Intrinsic error: The error of the temperature transmitter during measurement under the specified normal conditions, which should be a sum of the intrinsic errors of both the temperature sensing part and the convertor.

3.3 Thermal response time: The time taken for the current output signal of the instrument being changed into certain specified percentage of such step change during temperature step change, which is expressed in τ usually.

**4 Plans and documents**

4.1 The following plans and technical documents should be submitted for approval:

4.1.1 Complete design plans (including the general plan, structure plan, schematic diagram, external wiring diagram and technical product conditions).

4.2 The following plans and technical documents should be submitted for information:

4.2.1 Product operation instructions.

**5 Design and Technical Requirements on the Marine Temperature Transmitter**

5.1 For explosion-proofing marine temperature transmitter, the explosion-proof certificate, issued by the explosion-proof test institute that is accepted by CCS, must be obtained.

5.2 The marine pressure transmitter should meet the general requirements specified in Sections 1 &8 of Chapter 2 of Part Seven of CCS standards.

5.3 Technical requirement on marine temperature transmitter.

5.3.1 Test condition

Test environment:

Environment temperature: (+15~+35)℃; relative humidity: 45%~75%; atmospheric pressure: 86~106 kPa.

5.3.2 Appearance and structure

(1) Each part is installed properly and connected reliably, without any missing or damage.

(2) The terminal board should be provided with wiring mark.

(3) The fastener should be free of looseness or loose screw.

(4) The surface should be free of obvious scratch or corrosion, and the coating and plating free of peeling.

(5) Contents on the nameplate should be complete, legible, and marked with manufacturer name or brand, as well as the name, model, serial number, and manufacturing date of the transmitter (for the special transmitters, the measurement range, accuracy level and graduation number of installed sensor must also be marked).

(6) The locking device of the explosive-proof instrument must be reliable and effective.

5.3.3 Intrinsic error

The intrinsic error of the temperature transmitter should not exceed a sum of the tolerance of the thermistor (couple) and the intrinsic error limit of the transmitter (as well as the error of the display, if it is provided for the temperature transmitter as one additional function). The intrinsic error of the temperature transmitter can be expressed in the form of absolute error or quoted error.

(1) Tolerance level of the thermoelectric couple: It should meet the requirement in Table 5.3.3 (1).

**Tolerance level of the thermoelectric couple (reference junction is 0℃) Table 5.3.3 (1)**

| **Type** | **Level-1 tolerance** | **Level-2 tolerance** | **Level-3 tolerance** |
|---|---|---|---|
| T-shape | | | |
| Temperature range | －40℃~＋125℃ | －40℃~+133℃ | -67℃~+40℃ |
| Tolerance | ±0.5℃ | ±1℃ | ±1℃ |
| Temperature range | -125℃~+350℃ | -133℃~+350℃ | -200℃~+67℃ |
| Tolerance | ±0.004 · \| t \| | ±0.0075 · \| t \| | ±0.015 · \| t \| |

Note:

①The temperature limit mentioned in the table above cannot have to be the extreme operating temperature.

②For the purpose of test, the conductor between the measuring end and the reference junction should not be interrupted.

(2) The tolerance of the platinum thermistor is divided into two levels, namely, A&B. The tolerance is expressed with ∆, which should meet the requirement in Table 5.3.3 (2).

**List of tolerance levels** **Table 5.3.3 (2)**

| Tolerance level | Tolerance Δ |
|---|---|
| A | ±(0.15+0.002·\|t\|) |
| B | ±(0.30+0.005·\|t\|) |

Note:

①｜t｜ shown in the table above is the absolute value of the temperature, expressed in ℃.

②For platinum thermistor with nominal resistance value of 100.00 Ω at 0℃, the level-A tolerance does not apply to the temperature range of t＞650℃.

The level-A tolerance does not apply to platinum thermistor with two-wire system.

(3) The tolerance of copper thermistor at different temperatures is subject to the following formula:

$$\Delta = \pm(0.30+0.006 \cdot |t|)$$

Note:

Where:

① Δ is the tolerance of the copper thermistor, expressed in ℃.

② T is the temperature, expressed in ℃.

③ Temperature applicable in the formula above: -50℃≤t＜0℃ and 0℃＜t≤150℃.

(4) Transmitter accuracy level: Levels 0.2, 0.5 and 1.0.

The intrinsic error of the transmitter should not exceed the requirement in Table 5.3.3 (3).

**List of intrinsic errors of the transmitter** **Table 5.3.3 (3)**

| Accuracy level | 0.2 | 0.5 | 1.0 |
|---|---|---|---|
| Allowable error （xx% of the output range) | ±0.2 | ±0.5 | ±1.0 |

Note:

①The accuracy level is determined generally according to the range of the input (voltage or resistance).

②The allowable error excludes the error caused by the compensation at the reference junction of the thermoelectric couple.

(5) Display (additional function) accuracy level: The simulative indication is level 2.5, and digital display is level 0.5.

5.3.4 Insulation resistance

The insulation resistance of the temperature transmitter should not be less than that specified in Table 5.3.4:

**Insulation resistance value** **Table 5.3.4 Unit: MΩ**

| Test position | Technical requirement |
|---|---|
| Short circuit of the input and output terminals - ground terminal | 20 |
| Short circuit of the power terminal - ground terminal | 50 |
| Short circuit of the input and output terminals - power terminal* | 50 |
| Input terminal - output terminal* | 20 |

Note: * applies to the transmitter with isolation of power from the input and output, as well as the input from output.

5.3.5 Insulation rating

The temperature transmitter should bear an AC test voltage with frequency of 50 Hz and effective value meeting the requirement specified in Table 5.3.5. For determination, the current is generally set to 1 mA, which should be free of breakdown or flashover after being tested for 1 min.

**List of test voltages** **Table 5.3.5 Unit: V**

| Test position | Technical requirement | |
|---|---|---|
| | Operating voltage: DC24V | Operating voltage: AC 220V |
| Short circuit of the input and output terminals - ground terminal | 500 | 500 |
| Short circuit of the power terminal - ground terminal | 500 | 1500 |

**Continued Table 5.3.5**

| Test position | Technical requirement | |
|---|---|---|
| | **Operating voltage: DC24V** | **Operating voltage: AC 220V** |
| Short circuit of the input and output terminals - power terminal* | 500 | 1500 |
| Input terminal - output terminal* | 500 | 500 |

Note: * applies to the transmitter with isolation of power from the input and output, as well as the input from output.

5.3.6 Thermal response time

The thermal response time of the marine temperature transmitter is expressed in $\tau_{0.5}$ (50% of the response percentage). Generally, $\tau_{0.5} \leq 12S$.

## 6 Selection of typical samples

The product applied for type approval from CCS should be subject to type test.

6.1 The model and specification of the sample for type test should cover the product range applied for approval with technical representativeness, so as to determine, via type test, whether the manufacturer is capable of manufacturing the approved products according to the requirement of CCS.

6.2 Each series of transmitters should be subject to type test, and samples should be selected as per the representativeness of temperature measurement range, accuracy, structure type, protection level, and manufacturing process, with at least 2 sets for each series.

## 7 Type test

The factory (or CCS) should formulate type test program according to relevant provisions, which should be approved by CCS. For specific test items, methods and requirements as stated in the type test program, see the table below:

**List of type test items** **Table 7**

| No. | Test items | Test method (test standard) | Technical test requirement |
|---|---|---|---|
| 1 | Structure and visual inspection | Technical product conditions approved by CCS | Meet the requirement on technical product conditions |
| 2 | Performance requirement | | |

**Continued Table 7**

| No. | Test items | Test method (test standard) | Technical test requirement |
|---|---|---|---|
| 2.1 | Measurement (intrinsic) error | 5.4.3 of the Guideline | Meet the requirement specified in 5.4.3 |
| 2.2 | Thermal response time | 5.4.6 of the Guideline | Meet the requirement specified in 5.4.3 |
| 3 | Explosion-proof performance requirement | Meet the requirement specified in Article 5.1 of the Guideline | Meet the requirement on technical product conditions |
| 4 | Power supply variation test | GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 2.5 | Comply with GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 2.5 |
| 5 | Insulation resistance | 5.4.6 of the Guideline | Meet the requirement specified in 5.4.6 |
| 6 | Vibration test | GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 2.7 | Comply with GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 2.7 |
| 7 | Dry heat test | GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 2.8 | Comply with GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 2.8 |
| 8 | Low-temperature test | GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 2.9 | Comply with GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 2.9 |
| 9 | Cyclic damp heat test | GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 2.10 | Comply with GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 2.10 |
| 10 | Salt mist test Kb | GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 2.12 | Comply with GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 2.12 |
| 11 | Insulation rating test | 5.4.4 of the Guideline | Retirement in 5.4.4 of the Guideline |

**Continued Table 7**

| No. | Test items | Test method (test standard) | Technical test requirement |
|---|---|---|---|
| 12 | Enclosure protection test | GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 2.15 | Comply with GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 2.15 |
| 13 | Electromagnetic compatibility test 1: Conduction emission measurement | GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 3.2 | Comply with GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 3.2 |
| 14 | Electromagnetic compatibility test 2: Radiation emission measurement at the enclosure port | GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 3.3 | Comply with GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 3.3 |
| 15 | Electromagnetic compatibility test 3: Electrostatic discharge immunity test | GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 3.4 | Comply with GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 3.4 |
| 16 | Electromagnetic compatibility test 4: Radio-frequency electromagnetic field radiated immunity test | GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 3.5 | Comply with GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 3.5 |
| 17 | Electromagnetic compatibility test 5: Electrical fast transient burst immunity test | GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 3.6 | Comply with GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 3.6 |
| 18 | Electromagnetic compatibility test 6: Surge immunity test | GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 3.7 | Comply with GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 3.7 |
| 19 | Electromagnetic compatibility test 7: Low frequency conduction immunity test | GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 3.8 | Comply with GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 3.8 |
| 20 | Electromagnetic compatibility test 8: Radio-frequency field conducted disturbance immunity test | GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 3.9 | Comply with GUIDELINE ON TYPE APPROVAL TEST OF ELECTRICAL AND ELECTRONIC PRODUCTS (CURRENT EDITION) 3.9 |

## 8 Product Inspection

The product, after being subject to type approval from CCS, should undergo delivery inspection. The Surveyor can conduct a delivery inspection on the products with sampling proportion of 5% (but at least 2 sets) based on the full inspection of the factory. For factory test items, methods, and technical requirements, see the table below:

**List of factory test items** **Table 8**

| No. | Test items | Test method (test standard) | Technical test requirement |
|---|---|---|---|
| 1 | Structure and visual inspection | Technical product conditions approved by CCS | Meet the requirement on technical product conditions |
| 2 | Measurement error | 5.3.3 of the Guideline | Meet the requirement specified in 5.3.3 |
| 3 | Insulation resistance | 5.3.4 of the Guideline | Meet the requirement specified in 5.3.4 |
| 4 | Insulation rating test | 5.3.5 of the Guideline | Retirement in 5.3.5 of the Guideline |

Note: Subject to the technical features of the products, the insulation resistance measurement and insulation rating test can be optional during the factory test.