

Guideline No.E-10 (201909)



E-10

TEMPERATURE TRANSMITTER

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Foreword

CCS Product Inspection and Testing Guideline (hereinafter referred to as this Guideline) contains the technical requirements, inspection and testing criteria related to classification and statutory survey of marine products to be applied for CCS approval/inspection.

This Guideline frees the users to adopt other test methods and requirements which are equivalent to or are stricter than this Guideline.

This Guideline is published and updated by CCS, and is released at <http://www.ccs.org.cn>. Your comments or suggestions are welcomed and may be sent to our email addressed mp@ccs.org.cn.

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Main changes:

1. “IEC60079-0:2011 {Ed.6.0} ; IEC60079-1:2014 {Ed.7.0} ; IEC60079-11:2011 {Ed.6.0} ;” is modified to “IEC60079-0:2017 { Ed.7.0 } ; IEC60079-1:2014/COR1:2018 { Ed.7.0 } ; IEC60079-11:2011/COR1:2012 {Ed.6.0} ”.

2. Edit modifications and corrections.

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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 Normative reference documents

2.1 Technical requirement

2.1.1 Chapter 1, Part Four and Chapter 2, Part Seven of China Classification Society Rules for Classification of Sea-Going Steel Ships and its Amendments.

2.1.2 IEC 60079-0:2017 {Ed.7.0} Explosive atmospheres - Part 0: Equipment - General requirements.

2.1.3 IEC 60079-1:2014/COR1: 2018 {Ed.7.0} Explosive atmospheres - Part 1: Equipment protection by flameproof enclosures "d".

2.1.4 IEC 60079-11:2011/COR: 2012 {Ed.6.0} Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "i".

2.1.5 IEC 60770-1:2010 {Ed.2.0} Transmitters for use in industrial-process control systems - Part 1: Methods for performance evaluation.

2.1.6 IEC 60770-2:2010 {Ed.3.0} Transmitters for use in industrial-process control systems - Part 2: Methods for inspection and routine testing.

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 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 review:

- (1) Factory profile: factory name, address, production history, production capacity, technicians and testing personnel, main products, membership relation, product brand and etc.;
- (2) Details of the products applying for approval;
- (3) List of the main production equipment;
- (4) List of the main testing equipment;
- (5) Brief production processes of the product applying for approval, at least including the assembly, commissioning and other key processes;
- (6) Quality management documents or quality system certificates;
- (7) Corporate registration certificate;
- (8) Qualification certificate and/or production license, if applicable;
- (9) Copies of product quality certificates or certificates of conformity;
- (10) Quality control plan, if applicable;
- (11) List of eligible suppliers;
- (12) Complete design plans (including the general plan, structure plan, schematic diagram, external wiring diagram and technical product document);
- (13) Product Operation Instructions.

5 Design and Technical Requirements

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 temperature transmitter should meet the requirements specified in Sections 1 and 7, Chapter 2, Part Seven of China Classification Society Rules for Classification of Sea-Going Steel Ships and its Amendments.

5.3 Technical requirement on marine temperature transmitter.

5.3.1 Test condition

Test environment:

Environment temperature: (+15~+25)°C; 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°C) Table 5.3.3 (1)

Type	Level-1 tolerance	Level-2 tolerance	Level-3 tolerance
T-shape			

Continued Table 5.3.3 (1)

Type	Level-1 tolerance	Level-2 tolerance	Level-3 tolerance
Temperature range	-40°C~+125°C	-40°C~+133°C	-67°C~+40°C
Tolerance	±0.5°C	±1°C	±1°C
Temperature range	-125°C~+350°C	-133°C~+350°C	-200°C~+67°C
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 Δ , 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 °C.

②For platinum thermistor with nominal resistance value of 100.00 Ω at 0°C, the level-A tolerance does not apply to the temperature range of $t > 650^\circ\text{C}$.

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:

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$$\Delta = \pm(0.30 + 0.006 \cdot |t|) \quad ^\circ\text{C}$$

Where:

Δ -- the tolerance of the copper thermistor, expressed, $^\circ\text{C}$

T -- the temperature, expressed, $^\circ\text{C}$

Note: Temperature applicable in the formula above: $-50^\circ\text{C} \leq t < 0^\circ\text{C}$ and $0^\circ\text{C} < t \leq 150^\circ\text{C}$.

(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 (4).

List of intrinsic errors of the transmitter **Table 5.3.3 (4)**

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

Note:

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

② The 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: M Ω**

Test position	Technical requirement
Short circuit of the input and output terminals - ground terminal	20

Continued Table 5.3.4 Unit: MΩ

Test position	Technical requirement
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
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 Main components and parts

The raw materials and parts of the product shall be controlled in accordance with the current regulations of the state.

7 Type test

7.1 Selection of typical samples

7.1.1 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.

7.1.2 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.

7.2 Type approval test items

7.2.1 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 7.2.1

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		
2.1	Measurement (intrinsic) error	5.3.3 of the Guideline	Meet the requirement specified in 5.3.3
2.2	Thermal response time	5.3.4 of the Guideline	Meet the requirement specified in 5.3.4
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) 2.4	Comply with guideline on type approval test of electrical and electronic products (current edition) 2.4
5	Insulation resistance	5.4.6 of the Guideline	Meet the requirement specified in 5.4.6

Continued Table 7.2.1

No.	Test items	Test method (test standard)	Technical test requirement
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	5.3.5 of the Guideline	Retirement in 5.3.5 of the Guideline
1 2	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

Continued Table 7.2.1

No.	Test items	Test method (test standard)	Technical test requirement
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 Unit/batch inspection

8.1 According to the requirements of the LIST OF CERTIFICATION REQUIREMENTS FOR CLASSED MARINE PRODUCTS of “Rules for Classification of sea-going steel ships” and its Amendments, the product is approved only for non-inspection. If the manufacture applies for unit/batch 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 8.1

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.