Guideline No.E-10 (202211)

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. “EC60770-1:2010｛Ed.2.0｝, IEC60770-2:2010｛Ed.3.0｝” is replaced by “IEC62288-1:2017, IEC62828-3:2018”.Relevant parts are modified.

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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 1 and 2, Part Seven of China Classification Society Rules for Classification of Sea-Going Steel Ships and its Changing Notices

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 62828-1:2017 Reference conditions and procedures for testing industrial and process measurement transmitters - Part 1: General procedures for all types of transmitters

2.1.6 IEC 62828-3-2018 Reference conditions and procedures for testing industrial and process measurement transmitters - Part 3: Specific procedures for temperature transmitters

2.1.7 IEC 60751:2022 Industrial platinum resistance thermometers and platinum temperature sensors

2.1.8 IEC 60584-1:2013 Thermocouples - Part 1: EMF specifications and tolerances

2.2 Test requirement

2.2.1 CCS GD22-2015 Guideline on Type Approval Test of Electrical and Electronic Products (Current edition) and IACS UR E10 Test Specification for Type Approval.

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 Thermocouple temperature transmitters: The transmitter whose output is linear with the temperature detected by the thermocouple (i.e. has the linearization function) is called the thermocouple temperature transmitter.

3.3 Resistance temperature transmitters: The transmitter whose output is linear with the temperature detected by the thermal resistance (i.e. has the linearization function) is called the thermal resistance temperature transmitter.

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) Drawings and technical documents (Outline, structure diagram, electrical schematic diagram, technical documents, product operation manual, external wiring diagram, system function block diagram including system input and output signals, feedback and

self-inspection block diagram (if applicable)).The technical documentation must make it possible to assess the product's compliance with the technical requirements.

5 Design and Technical Requirements

5.1 For explosion-proofing marine temperature transmitter should meet the requirements specified in Article 1.3.3, Chapter 1, Part Four of China Classification Society Rules for Classification of Sea-Going Steel Ships and its Changing Notices.

5.2 The marine temperature transmitter should meet the requirements specified in Chapter 1 and 2, Part Seven of China Classification Society Rules for Classification of Sea-Going Steel Ships and its Changing Notices.

5.3 Technical requirement for marine temperature transmitter.

5.3.1 Test condition

Test environment:

Environment temperature: (+15~+25) ℃; relative humidity: 50%~70%; 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 and grounding device of the explosive-proof instrument should be reliable and effective.

5.3.3 Accuracy class

Unless otherwise specified, for the transmitter with adjustable range and movable zero point, the relevant accuracy and technical requirements shall be met on a certain range set by the transmitter

The accuracy class of the transmitter is divided according to the range: It should meet the requirement in Table 5.3.3 (1) and 5.3.3(2).

(1) Thermocouple temperature transmitter accuracy class: It should meet the requirement in Table 5.3.3 (1).

Thermocouple temperature transmitter accuracy class Table 5.3.3 (1)

Span ΔV/mV	Accuracy class of transmitter
ΔV≥28	0.1
28>ΔV≥5	0.2
5>ΔV≥3	0.5
3>ΔV≥2	1.0

Note: The Span ΔV in the table refers to the electrical input millivolts within the corresponding temperature measurement range of the transmitter.

(2) Resistance temperature transmitter accuracy class: It should meet the requirement in Table 5.3.3 (2).

Resistance temperature transmitter accuracy class Table 5.3.3 (2)

Cu50 Span of Resistance temperature ΔR/Ω	Cu100 and Pt100 Span of Resistance temperature ΔR/Ω	Accuracy class of transmitter
ΔR≥20	ΔR≥40	0.1
20>ΔR≥10	40>ΔR≥20	0.2
10>ΔR≥2	20>ΔR≥4	0.5
2>ΔR≥1	4>ΔR≥2	1.0

Note: The Span ΔV in the table refers to electrical input resistance change of the transmitter corresponding to the temperature measurement range.

(3) Indicators related to accuracy class: The indicators related to the accuracy level of the transmitter shall not exceed the provisions in table 5.3.3 (3).

Indicators related to accuracy class **Table 5.3.3 (3)**

Items		Accuracy class			
		0.1	0.2	0.5	1.0
		Indicators (Percentage of output span）			
Inaccuracy		±0.10	±0.20	±0.50	±1.0
Terminal base consistency error		±0.10	±0.20	±0.50	±0.50
Hysteresis		0.050	0.10	0.25	0.50
Repeatability error		0.050	0.10	0.20	0.35
Dead band		0.050	0.10	0.20	0.35
Step response		Stabilization time is not more than 6 s			
Start-up drift	Maximum error	0.25	0.50	1.0	2.0
Long-term drift		0.25	0.50	1.0	2.0

Note:①This table does not include errors caused by thermocouple cold junction compensation for thermocouple temperature transmitter.

②The basic error refers to the maximum error value in the three measurement cycles

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 2 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 Enclosure protection requirements

The degree of protection of temperature transmitter shall comply with the relevant requirements of the current CCS rules.

6 Main components and parts

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

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 principle of temperature measurement, span, 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
2.1	Accuracy-related factors		
2.1.1	Inaccuracy and measured error	Three to five upscale and downscale full-range traverse measurements, with at least six points along the scale every nearly 20 %. Calculation of the errors and plotting of the error curves	Meet the requirement on technical product conditions
2.1.2	Maximum measured error	IEC62828-1clause 6.2.2.4.3	Meet the requirement on technical product conditions
2.1.3	Non linearity	IEC62828-1clause 6.2.2.4.4	Meet the requirement on technical product conditions
2.1.4	Non-conformity	IEC62828-1clause 6.2.2.4.5	Meet the requirement on technical product conditions
2.1.5	Hysteresis	IEC62828-1clause 6.2.2.4.6	Meet the requirement on technical product conditions
2.1.6	Non-repeatability	IEC62828-1clause 6.2.2.4.7	Meet the requirement on technical product conditions
2.1.7	Uncertainty	IEC62828-1clause 6.2.2.5	Meet the requirement on technical product conditions

Continued Table 7.2.1

2.2	Static behaviour		
2.2.1	Insulation resistance	IEC62828-1clause 6.2.3.2	Meet the requirement specified in Article 5.3.4 of the Guideline or IEC 60751 clause 6.3.2
2.2.2	Dielectric strength	IEC62828-1clause 6.2.3.3	Meet the requirement specified in Article 5.3.5
2.2.3	Power consumption(if applicable)	IEC62828-1clause 6.2.3.4	Meet the requirement on technical product conditions
2.2.4	Operation region (if applicable)	IEC62828-1clause 6.2.3.5	Meet the requirement on technical product conditions
2.2.5	Power supply variations	IEC62828-1clause 6.2.3.6 and 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
2.2.6	Output load effect (if applicable)	IEC62828-1clause 6.2.3.7	Meet the requirement on technical product conditions
2.2.7	Output ripple (if applicable)	IEC62828-1clause 6.2.3.8	Meet the requirement on technical product conditions
2.2.8	Over-range (if applicable)	IEC62828-1clause 6.2.3.9	Meet the requirement on technical product conditions
2.2.9	Mounting positions (if applicable)	IEC62828-1clause 6.2.3.10	Meet the requirement on technical product conditions
2.3	Dynamic behaviour		
2.3.1	Step response	IEC62828-1clause 6.2.4.2	Meet the requirement on technical product conditions
2.3.2	Frequency response	IEC62828-1clause 6.2.4.3	Meet the requirement on technical product conditions
2.3.3	Start-up drift	IEC62828-1clause 6.2.4.4.1	Meet the requirement on technical product conditions
2.3.4	Long-term drift	IEC62828-1clause 6.2.4.4.2	Meet the requirement on technical product conditions
2.3.5	Long-term stability	IEC62828-1clause 6.2.4.4.3	Meet the requirement on technical product conditions
2.4	Influence of atmospheric parameters		

Continued Table 7.2.1

2.4.1	Ambient temperature effects	IEC62828-1clause 6.3.2	Meet the requirement on technical product conditions
2.4.2	Cyclic damp heat test	IEC62828-1clause 6.3.3, IEC 60654-1 and 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
2.4.3	Vibration test	IEC62828-1clause 6.3.4	Comply with guideline on type approval test of electrical and electronic products (current edition) 2.7
2.4.4	Shock, drop and topple	IEC62828-1clause 6.3.5	Meet the requirement on technical product conditions
2.4.5	Accelerated operational life test	IEC62828-1clause 6.3.6	Meet the requirement on technical product conditions
2.5	Additional tests for digital PMT only		
2.5.1	Compliance to fieldbus protocol	IEC62828-1clause 6.3.9.2	Meet the requirement on technical product conditions
2.5.2	Interoperability and interchangeability	IEC62828-1clause 6.3.9.3	Meet the requirement on technical product conditions
2.6	Additional tests for Platinum thermistor		
2.6.1	Tolerances	IEC60751clause 6.5.1	IEC60751clause 6.5.1
2.6.2	Sheath integrity	IEC60751clause 6.3.3	IEC60751clause 6.3.3
2.6.3	Dimensional test	IEC60751clause 6.3.4	Meet the requirement on technical product conditions or IEC 61152
2.6.4	Stability at upper temperature limit	IEC60751clause 6.5.2	IEC60751 第 6.5.2 条
2.6.5	Self-heating	IEC60751clause 6.5.3	IEC60751 第 6.5.3 条
2.6.6	Thermal response time	IEC60751 clause 6.5.5	IEC60751 6.5.5 条
2.6.7	Thermoelectric effect	IEC 60751 clause 6.5.6	IEC 60751 6.5.6

Continued Table 7.2.1

2.6.8	Effect of temperature cycling	IEC 60751 clause 6.5.7	IEC 60751 6.5.7
2.6.9	Effect of hysteresis	IEC 60751 clause 6.5.8	IEC 60751 clause 6.5.8
2.6.10	Minimum immersion depth	IEC 60751 clause 6.5.9	IEC 60751 clause 6.5.9
3	Power supply failure test	Comply with 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
4	Dry heat test	Comply with guideline on type approval test of electrical and electronic products (current edition) 2.8 and IACS UR E10 Test Specification for Type Approval	Comply with guideline on type approval test of electrical and electronic products (current edition) 2.8 and IACS UR E10 Test Specification for Type Approval
5	Low temperature Test	Comply with 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
6	Enclosure test	Comply with 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
7	Exposure to solar radiation	+Temperature in the chamber: +55℃, Radiation intensity: 1125W/m2(Including flux density of the ultra-violet portion of spectrum with a wave length of 280 – 400 nm shall be not less than 42 W/m2) Subjected to the test are appliances with the use of plastics which are intended for operation on the open deck in areas where they are continuously exposed to solar radiation	No deformation, cracking, stratification, buckling , ungluing of plastic pieces and other materials has taken place; No degradation of readability of inscriptions and signs on the instrument scales has not been detected; Parameters and resistance of insulation have remained normal
8	Salt mist test Kb	Comply with 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
9	Explosion-proof performance requirement	Meet the requirement specified in Article 5.1 of the Guideline	Meet the requirement specified in Article 5.1 of the Guideline
10	Flame retardant test	Comply with guideline on type approval test of electrical and electronic products (current edition) 2.16	Comply with guideline on type approval test of electrical and electronic products (current edition) 2.16

Continued Table 7.2.1

11	Electromagnetic compatibility test 1: Conduction emission measurement	Comply with guideline on type approval test of electrical and electronic products (current edition) 3.2 and IACS UR E10 Test Specification for Type Approval	Comply with guideline on type approval test of electrical and electronic products (current edition) 3.2 and IACS UR E10 Test Specification for Type Approval
12	Electromagnetic compatibility test 2: Radiation emission measurement at the enclosure port	Comply with guideline on type approval test of electrical and electronic products (current edition) 3.3 and IACS UR E10 Test Specification for Type Approval	Comply with guideline on type approval test of electrical and electronic products (current edition) 3.3 and IACS UR E10 Test Specification for Type Approval
13	Electromagnetic compatibility test 3: Electrostatic discharge immunity test	Comply with 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
14	Electromagnetic compatibility test 4: Radio-frequency electromagnetic field radiated immunity test	Comply with guideline on type approval test of electrical and electronic products (current edition) 3.5 and IACS UR E10 Test Specification for Type Approval	Comply with guideline on type approval test of electrical and electronic products (current edition) 3.5 and IACS UR E10 Test Specification for Type Approval
15	Electromagnetic compatibility test 5: Electrical fast transient burst immunity test	Comply with 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
16	Electromagnetic compatibility test 6: Surge immunity test	Comply with 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
17	Electromagnetic compatibility test 7: Low frequency conduction immunity test	Comply with 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
18	Electromagnetic compatibility test 8: Radio-frequency field conducted disturbance immunity test	Comply with 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

Note: Thermocouple temperature transmitters should also comply with IEC60584, Resistance temperature transmitters should also comply with IEC60751.

8 Unit/batch inspection

8.1 After type approval B, the single piece/batch inspection shall be carried out after the manufacturer completes the installation and delivery test.. The factory test report shall be

submitted to CCS together with the product inspection notice. The Surveyor can conduct the single piece/batch 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 dimension and visual inspection	Technical product conditions approved by CCS	Meet the requirement on technical product conditions
	Performance test	Upscale and downscale full-range traverse measurements, with at least four points along the scale; Maximum positive and negative deviation measurement	Meet the requirement on technical product conditions
2	Insulation resistance	5.3.4 of the Guideline	Meet the requirement specified in 5.3.4
3	Dielectric strength	5.3.5 of the Guideline	5.3.5 of the Guideline
4	Over-range (if applicable)	IEC62828-1clause 6.2.3.9	Meet the requirement on technical product conditions
5	Sheath integrity	IEC60751clause 6.3.3	IEC60751clause 6.3.3

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