Guideline No.E-11 (202607)

E-11

PRESSURE TRANSMITTER

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Foreword

China Classification Society (hereinafter refferred to as 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 service@ccs.org.cn.

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Main changes:

1. Add COR1 2020 to IEC60079-0:2017. Version update of the Guidelines for Type Approval Tests of Electrical and Electronic Products; the insulation strength test voltage has been adjusted to 2×Un+500 V, consistent with the Guidelines for Type Approval Tests of Electrical and Electronic Products.

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PRESSURE TRANSMITTER

1 Application

This Guideline applies to the verification and certification of the marine pressure 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 /COR1:2020 {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 62828-2-2017 Reference conditions and procedures for testing industrial and process measurement transmitters - Part 2: Specific procedures for pressure transmitters

2.2 Test requirement

2.2.1 CCS GD~~22-2015~~019-2024 Guideline ~~on~~ for 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 according to actual conditions.

3 Definitions

3.1 Pressure transmitter: A device that can convert the pressure variable into a transferable standard signal which has a given continuous functional relationship (usually a linear function) between its output signal and the pressure variable.

3.2 Terminal-based conformity: The calibration curve of the device can be adjusted to be close to the specified characteristic curve, so as to make the coincidence degree when the upper limit and lower limit of the range of the input and output curves coincide.

3.3 Dead zone: It indicates the max. input change that does not cause perceptible output change.

3.4 Return difference: It indicates the component feature that represents the dependency of previous stroke and current moving direction via value output for the given input stroke (See Fig. 5.3.3(1) and 5.3.3(2)). That is a common definition, including hysteresis error and dead zero. Since the error generated by the dead zone can be determined via conventional dead zone test, the error related to previous stroke is the hysteresis error.

3.5 Hysteresis error: The error in the return difference caused due to the component energy absorbing of the measuring instrument.

3.6 Non-repeatability: The algebraic difference of the same input value in many consecutive measurements at the time of full-range moving and approaching from the same direction under the same operation condition.

3.7 Max. allowable error: The max. relative error between the actually measured value and the calibration value corresponding to its accuracy (level).

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 (Product model and main technical indicators);

(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 pressure 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 pressure 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 The marine pressure transmitter should have the following general performance and functions:

5.3.1 Appearance and structure

(1) The transmitter should be free of obvious defect, scratch or mildew in appearance; the connection thread should be free of rag, corrosion, or damage; the weld should be firm; the connector should be connected reliably; the painted enclosure should be colored uniformly with smooth film, and free of peeling off or knock trace.

(2) The components of the transmitter should be intact without any damage, the fastener should be free of looseness or damage, and the movable parts should be flexible and reliable. For the transmitter with display unit, the digit should be displayed clearly without any missing.

(3) The nameplate of the transmitter should be complete and legible with the following information: main technical indexes such as the product name, model and specification, measuring range, accuracy level, rated operating pressure, name or trademark of the manufacturer, factory number, manufacturing date, license sign for producing the measuring instrument and number, as well as marine sign for marine products.

5.3.2 Leakproofness

The pressure transmitter must be free of any leakage after being sealed for 15 min with the pressure source switched off when its measuring part bears the upper measuring pressure limit. During the last 5 min., the pressure drop cannot exceed 2% of the measured upper limit.

5.3.3 Accurate 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.

After adjustment of the transmitter accessories, their accuracy class shall not be lower than that specified in table 5.3.3 (1)

Accuracy class after adjustment **Table 5.3.3 (1)**

Before adjustment	Grade 0.025	Grade 0.05	Grade 0.075	Grade 0.1	Grade 0.25	Grade 0.5	Grade 1.0	Grade 1.5
After adjustment	Grade 0.05	Grade 0.075	Grade 0.1	Grade 0.25	Grade 0.5	Grade 1.0	Grade 1.5	Grade 1.5

The indicators related to the accuracy level of the transmitter shall not exceed the provisions in table 5.3.3 (2).

Indicators related to accuracy class **Table 5.3.3 (2)**

Items		accuracy class							
		0.025	0.05	0.075	0.1	0.25	0.5	1.0	1.5
		Indicators (Percentage of output span）							
Inaccuracy		±0.025	±0.050	±0.075	±0.10	±0.25	±0.50	±1.0	±1.5
Terminal base consistency error		±0.025	±0.050	±0.075	±0.10	±0.25	±0.50	±1.0	±1.5
Hysteresis		0.020	0.040	0.060	0.080	0.20	0.40	0.80	1.2
Repeatability error		0.012	0.025	0.037	0.050	0.12	0.25	0.50	0.75
Dead band		0.012	0.025	0.037	0.050	0.10	0.10	0.10	0.15
Step response		Stabilization time is not more than 5 s							
Start-up drift	Maximum error	0.025	0.050	0.075	0.10	0.25	0.50	1.0	1.5
Long-term drift*	Lower limit variation	0.050	0.10	0.15	0.20	0.50	1.0	2.0	3.0

Continued Table 5.3.3 (2)

	Range change variation	0.050	0.10	0.15	0.20	0.50	1.0	2.0	3.0

Note: * Start calculation after power on for 24h.

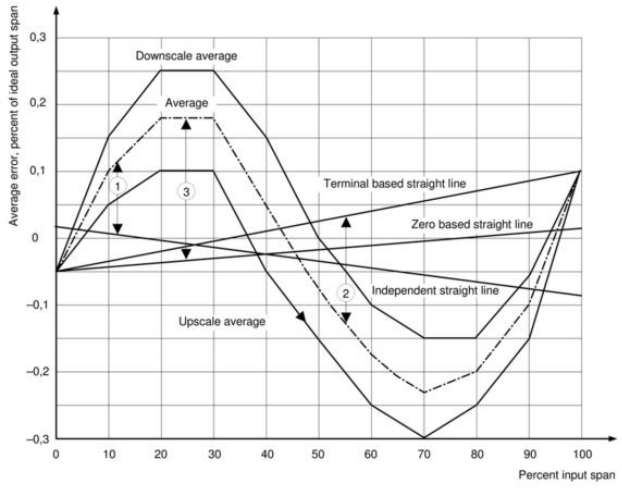

Fig. 5.3.3(1) Deviation curve

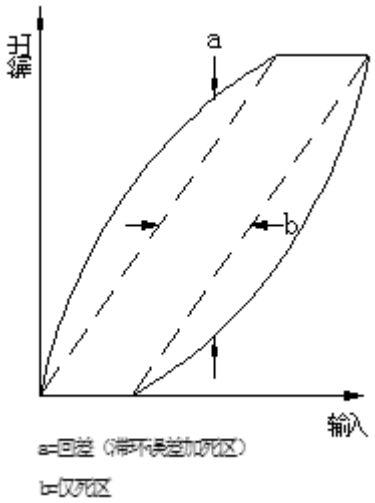

Fig. 5.3.3(2) Return difference

5.3.4 Insulation resistance

The insulation resistances between each terminal and enclosure of the transmitter (meter cover or frame) should not be less than 10MΩ at the ambient temperature of 15℃~25℃ and relative humidity of 50%~70%.

5.3.5 Insulation rating

Unless otherwise specified by manufacture, there should be no breakdown and flashover after the 50 Hz and 2×Un+500V ~~500 V AC~~ test voltage has been applied between each terminal and enclosure of the transmitter for 1 min. at the ambient temperature of 15℃~25℃ and relative humidity of 50%~70%.

5.3.6 Return difference

The return difference should be measured together with the error, and the result should meet the requirement in Table 5.3.3(2).

5.3.7 Conformity

If the conformity adopts the terminal-based conformity, the result should meet the requirement in Table 5.3.3(2).

5.3.8 Non-repeatability

The Non-repeatability should be measured, and the result should meet the requirement in Table 5.3.3(2).

5.3.9 Measuring dead zone

The result of measuring dead zone of the pressure should meet the requirement in Table 5.3.3(2).

5.4 The marine pressure transmitter with explosion-proof mark shall obtain the explosion-proof certificate of relevant institutions accepted by CCS.

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 pressure transmitters should be subject to type test, and samples should be selected as per the representativeness of pressure 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 the 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

~~**Continued Table 7.2.1**~~

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
~~2.2~~	~~Static behaviour~~		

Continued Table 7.2.1

2.2	Static behaviour		
2.2.1	Insulation resistance	IEC62828-1clauses6.2.3.2	Meet the requirement specified in Article 5.3.4 of the Guideline or IEC 60751 clause 6.3.2
2.2.2	Dielectric strength	IEC62828-1clauses6.2.3.3	Meet the requirement specified in Article 5.3.5 of the Guideline
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)	IEC62828-1clauses6.2.3.5	Meet the requirement on technical product conditions
2.2.5	Power supply variations	IEC62828-1clauses6.2.3.6 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)	IEC62828-1clauses6.2.3.10	Meet the requirement on technical product conditions
~~2.3~~	~~Dynamic behaviour~~		

Continued Table 7.2.1

2.3	Dynamic behaviour		
2.3.1	Step response	IEC62828-1clauses6.2.4.2	Meet the requirement on technical product conditions
2.3.2	Frequency response	IEC62828-1clauses6.2.4.3	Meet the requirement on technical product conditions
2.3.3	Start-up drift	IEC62828-1clauses6.2.4.4.1	Meet the requirement on technical product conditions
2.3.4	Long-term drift	IEC62828-1clauses6.2.4.4.2	Meet the requirement on technical product conditions
2.3.5	Long-term stability	IEC62828-1clauses6.2.4.4.3	Meet the requirement on technical product conditions
2.4	Influence of atmospheric parameters		
2.4.1	Ambient temperature effects	IEC62828-1clauses6.3.2	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	IEC62828-1clauses6.3.4	Comply with guideline on type approval test of electrical and electronic products (current edition) 2.7

Continued Table 7.2.1

2.4.4	Shock, drop and topple	IEC62828-1clauses6.3.5	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	IEC62828-1clauses6.3.9.2	Meet the requirement on technical product conditions
2.5.2	Interoperability and interchangeability	IEC62828-1clauses6.3.9.3	Meet the requirement on technical product conditions
2.6	Additional tests		
2.6.1	Influence of static pressure on zero and span(For differential pressure PMTs)	IEC62828-2 clauses 6.2.4.2; Pressure test equal to 150% of maximum nominal pressure is generally a demand. 2 minute static pressure test at 150% of design	Meet the requirement on technical product conditions

		pressure is required. The accuracy of the equipment should be documented before and after the static pressure test.	
2.6.2	Leakage test	IEC62828-2 clauses 6.2.6	Meet the requirement on technical product conditions
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

Continued Table 7.2.1

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	No deformation, cracking, stratification, buckling , ungluing 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	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

Continued Table 7.2.1

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
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

Continued Table 7.2.1

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

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 and visual inspection	Technical product conditions approved by CCS	Meet the requirement on technical product conditions
2	Inaccuracy	Technical product conditions approved by CCS	Meet relevant technical requirements on the product
3	Hysteresis	Technical product conditions approved by CCS	Meet relevant technical requirements on the product
4	Static pressure (if applicable)	Technical product conditions approved by CCS	Meet relevant technical requirements on the product
5	Insulation resistance (if applicable)	Technical product conditions approved by CCS	Meet relevant technical requirements on the product
6	Insulation rating (if applicable)	Technical product conditions approved by CCS	Meet relevant technical requirements on the product
7	Leakage test	Technical product conditions	Meet the requirement on

		approved by CCS	technical product conditions

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