Guideline No.E-11 (201705)

E-11 Pressure 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:

"IEC60079-0:2007｛Ed.5.0｝; IEC60079-1:2007｛Ed.6.0｝; IEC60079-11:2007｛Ed.4.0｝; IEC770-1:1989; IEC770-2:1989" is modified to "IEC60079-0:2011{Ed.6.0}; IEC60079-1:2014｛Ed.7.0｝; IEC60079-11:2011｛Ed.6.0｝; IEC60770-1:2010｛Ed.2.0｝; IEC60770-2:2010｛Ed.3.0｝".

Edit modifications and corrections.

CONTENTS

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 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 IEC 60079-0:2011〔Ed.6.0〕 Explosive atmospheres - Part 0: Equipment - General requirements~~Part 0 "General Requirement" of IEC60079-0:2007〔Ed.5.0〕 Electrical Equipment Used in Explosive Gas Environment~~.

2.1.3 IEC 60079-1:2014〔Ed.7.0〕 Explosive atmospheres - Part 1: Equipment protection by flameproof enclosures "d"~~Part 1 "Flame-proof Type d" of IEC60079-1:2007〔Ed.6.0〕 Electrical Equipment Used in Explosive Gas Environment~~.

2.1.4 IEC 60079-11:2011〔Ed.6.0〕 Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "i"~~Part 4 "Intrinsic Safety Type i" of IEC60079-11:2007〔Ed.4.0〕 Electrical Equipment Used in Explosive Gas Environment~~.

2.1.5 IEC 60770-1:2010〔Ed.2.0〕 Transmitters for use in industrial-process control systems - Part 1: Methods for performance evaluation~~Part 1 "Performance Evaluation Method" of IEC770-1:1989 Transmitter for Industrial Process Control System~~.

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~~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 according to actual conditions.

3 Terms and definitions

3.1 Pressure transmitter: A device which changes the measured pressure signal into standard signal, consisting of two parts, namely, the converter (device) and pressure sensor. The pressure is measured by the sensor. The pressure sensor can be classified into the differential-transformer-type pressure sensor, Hall pressure sensor, strain-type pressure sensor, piezoelectric-type pressure sensor, and magnetic-pressure-type (tension) sensor.

3.2 Conformity: For a curve, it indicates the inosculation degree when approaching a specific curve (such as the logarithmic curve and parabolic root curve).

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. B1 and B2). 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 Repeatability: The conformity degree 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 approval:

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

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 pressure transmitter

5.1 The measuring product type approval certificate (as well as relevant measuring product production license) must be applied for and obtained for the pressure transmitter from the national legal unit.

5.2 Explosion-proofing certificate of qualification accepted by CCS must be obtained for the explosion-proof pressure transmitter.

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

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

5.4.1 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.

5.4.2 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.

5.4.3 Accurate level and error

List of accuracy levels and errors **Table 5.4.3**

Accuracy level	Max. allowable error/%	Return difference/%	Conformity /%	Repeatability/%
0.05	±0.05	0.05	±0.05	0.05
0.1	±0.1	0.08	±0.1	0.08
0.25	±0.25	0.20	±0.25	0.20
0.5	±0.5	0.4	±0.5	0.4

5.4.4 Insulation resistance

The insulation resistances between each terminal and enclosure of the transmitter should not be less than 20MΩ at the ambient temperature of 15℃~~35~~25℃ and relative humidity of 45%~75%.

5.4.5 Insulation rating

There should be no breakdown and flashover after the 50 Hz and 500 V test voltage has been applied between each terminal and enclosure of the transmitter for 1 min. at the ambient temperature of 15℃~~35~~25℃ and relative humidity of 45%~75%.

5.4.6 Return difference

The return difference should be measured together with the error, and the result should meet the requirement in Table 5.4.3.

5.4.7 Conformity

The conformity adopts the terminal-based conformity, and the result should meet the requirement in Table 5.4.3.

5.4.8 Repeatability

Conduct pressure measurement for three circles, and calculate the test standard deviation of the same stroke at each measuring point. Take the max. value as the repeatability of the instrument. The result should meet the requirement in Table 5.4.3.

5.4.9 Measuring dead zone

The measuring dead zone of the pressure transmitter is less than 0.1% of the range.

5.5 Explosion-proofing certificate of qualification issued by relevant institute that is accepted by CCS should be obtained for marine pressure transmitters with explosion-proofing mark.

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 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 Type test

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**

No.	Test items	Test method (test standard)	Technical test requirement
1	Structure and visual inspection	Technical product conditions of the manufacturer	Meet the requirement on technical product conditions

Continued Table 7

No.	Test items	Test method (test standard)	Technical test requirement
2	Performance requirement	Obtain the sample test certificate of qualification	Meet the requirement on technical product conditions
2.1	Measurement tolerance (accuracy)	5.~~3~~4.3 of the Guideline	Meet the requirement specified in 5.~~3~~4.3
2.2	Return difference measurement	5.~~3~~4.6 of the Guideline	Meet the requirement specified in 5.~~3~~4.6
2.3	Conformity measurement	5.~~3~~4.7 of the Guideline	Meet the requirement specified in 5.~~3~~4.7
2.4	Repeatability	5.~~3~~4.8 of the Guideline	Meet the requirement specified in 5.~~3~~4.8
2.5	Measuring dead zone	5.~~3~~4.9 of the Guideline	Meet the requirement specified in 5.~~3~~4.9
3	Explosion-proof performance requirement	Obtain relevant explosion-proofing certificate of qualification	Meet the requirement of technical product documents
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.~~3~~4.4 of the Guideline	Meet the requirement specified in 5.~~3~~4.4
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

Continued Table 7

No.	Test items	Test method (test standard)	Technical test requirement
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~~4.5 of the Guideline	Retirement in 5.~~3~~4.5 of the Guideline
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

Continued Table 7

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: immunity test on conducted disturbance induced in radio-frequency field	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	Leakproofness	Technical product conditions approved by CCS	Meet the requirement on technical product conditions
3	Measurement error (accuracy)	Technical product conditions approved by CCS	Meet the requirement on technical product conditions
4	Insulation resistance (if applicable)	Technical product conditions approved by CCS	Meet relevant technical requirements on the product

Continued Table 8

No.	Test items	Test method (test standard)	Technical test requirement
5	Insulation rating (if applicable)	Technical product conditions approved by CCS	Meet relevant technical requirements on the product

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

Figures:

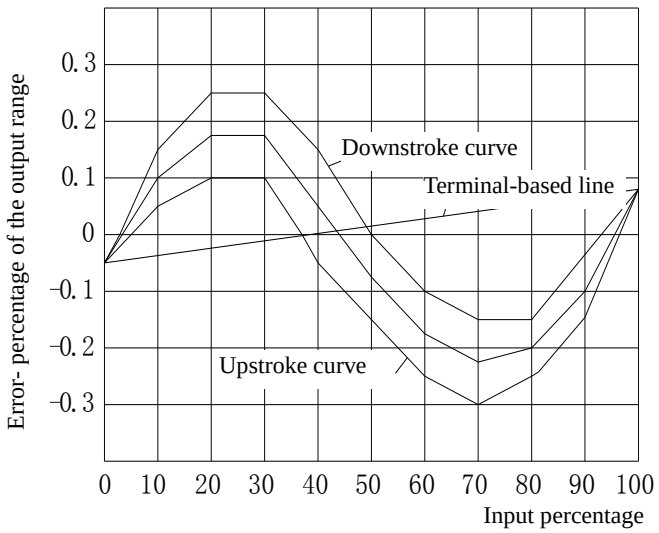
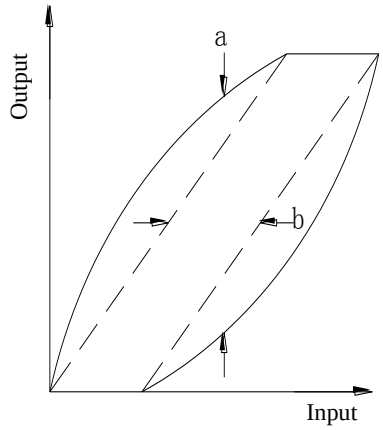


Fig. B1 Deviation curve



a=Return difference (hysteresis error plus dead zone)
b=Dead zone only

Fig. B2 Return difference