

EU RO Mutual Recognition Technical Requirements

DUAL TEMPERATURE AND PRESSURE SWITCHES	Version	0.1
	Adoption Date:	1 January 2023
	Application Date:	1 July 2023
	Tier	7
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1. PRODUCT DESCRIPTION

1.a General description of the product

Dual Temperature and Pressure Switches (hereinafter switches) have both temperature and pressure measurement capabilities with relevant output change-over and combined within the same device. Switches may have electric and/or electronic parts and be externally power supplied.

Temperature sensors may be based on several working principles: bi-metallic (BM), liquid expansion (LE), gas-expansion (GE), thermo-resistors (RTD), thermocouples (TC), infrared (IR), etc.; the relevant features of which vary accordingly. According to their working principle the movement directly act on the opening and closing of an electrical switch or the sensor respond to temperature by changing the electrical performance.

Pressure sensors of different types of sensing elements can be used but they have one thing in common: they move in response to changes in the system pressure. Through their movement, they directly act on the opening and closing of an electrical switch (without requiring any power supply).

Electronic/solid state pressure sensors use the same technology found in analogue pressure transmitters to sense changes in pressure rather than harnessing the energy of the pressure changes to mechanically operate a switch (as with electromechanical pressure switches).

Electronic/solid state pressure sensors electrically measure pressure change and internal electronic circuitry is used to activate one or more electronic switch outputs.

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1.b Application limitations[†]

- a) These Technical Requirements are applicable to dual temperature and pressure switches for control, safety or alarm device of plant or system on board with rated voltage in electric circuit not exceeding 1000V a.c. or 1500 V d.c.;
- b) Explosion proof 'Ex' certification is not within the scope of these Technical Requirements for all switches;
- c) Not applicable for a mobile offshore drilling unit (MODU);
- d) Not applicable for fishing vessels.

[†]The EU MR type approved product is generally not used as a stand-alone product, but integrated as component in a sub-system or system. When a product is presented with an EU RO MR Type Approval Certificate for given application, its acceptability with regards to conditions defined in 1b, 1c and 1d of this Technical Requirement will be evaluated by the EU RO in charge of classing the ship or being in charge of the unit/system certification.

1.c Intended use

Switches intended to be used in all control, monitoring and instrumentation systems necessary for the applications mentioned in 1.b.

1.d System context

Refer to item 1c.

2. DESIGN EVALUATION

2.a Engineering evaluation requirements

2.a.i. Technical Requirements

All technical requirements shall fulfil IACS Unified Requirements E10, latest revision in use – Test Specification for Type Approval:

- a) Reliable operation shall be ensured at relative air humidity of 100% (referred to at +55°C) under the following ambient temperatures:
 - 0°C to +55°C in enclosed spaces,
 - +5°C to +70°C close to combustion engines, boilers and similar,
 - -25°C to +45°C on open deck (-25°C to +55°C for electronic equipment)

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- No damage to electrical and electronic parts shall be caused by temperature up to +70°C;
- b) Reliable operation shall be ensured under the conditions of shocks having an acceleration of $\pm 5,0$ g and at a frequency of 40 to 80 shocks per minute;
 - c) Reliable operation of switches shall be ensured at vibrations having a frequency of 2 to 100 Hz, namely, with shift amplitude of ± 1 mm where the vibration frequency is between 2 and 13,2 Hz, and with an acceleration of $\pm 0,7$ g where the vibration frequency is between 13,2 and 100 Hz;
 - d) Reliable operation of switches mounted upon vibration sources (engines (ICE), compressors, etc.) or installed in steering flats shall be ensured at vibration frequencies of 2 to 100 Hz, namely, with a shift amplitude of $\pm 1,6$ mm where the frequency is between 2 and 25 Hz, and with an acceleration of $\pm 4,0$ g where the frequency is between 25 and 100 Hz. For more severe conditions which may exist, for example, on exhaust manifolds of high-speed ICE, 40 Hz to 2000 Hz – acceleration ± 10.0 g at 600 °C;
 - e) Reliable operation of switches shall be ensured at long term heel up to 22,5° and at motions of 22,5° with a period of 10s;
 - f) The protective enclosure of electrical and electronic sensors shall be chosen in accordance with IEC 60529.;
 - g) Switches to be installed in locations with specific operating conditions (high or low temperature, excessive mechanical loads, etc.) shall be designed and tested with regard to the conditions;
 - h) Electrical and electronic switches shall be made of materials resistant to the marine environment or shall be reliably protected from its harmful effects;
 - i) Switches having electric or electronic parts shall operate reliably in case of deviation of the power source parameters listed in Table 1 from nominal values:

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Table 1

Parameter	Deviation from nominal value		
	Long-term, %	Short-term	
		%	Time, s
Voltage (a.c.)	+6...-10	±20	1,5
Frequency	±5	±10	5
Voltage (d.c.)	±10	5	Cyclic deviation Ripple
		10	

- j) Switches having electrical and/or electronic parts and supplied from accumulator batteries shall operate reliably with the following voltage variations from the nominal value:
 - from +30 to -25 per cent for the equipment, which is not disconnected from the battery during battery charging;
 - from + 20 to -25 per cent for the equipment, which is disconnected from the battery during battery charging.
- k) Provision shall be made to ensure the electromagnetic compatibility of electrical and electronic parts of switches as specified IEC Publication 61000-4-2, IEC Publication 61000-4-3, IEC Publication 61000-4-4, IEC Publication 61000-4-5, IEC Publication 61000-4-6;
- l) Provision shall be made to prevent incorrect connection of plug-in-sockets to the switches outputs;
- m) The devices shall be capable of being tested during normal operation;
- n) Replaceable components, which require adjustment, as well as check-up points (terminals, monitoring jacks) shall be so arranged that easy access is possible at any time;
- o) The minimum degree of protection, as applicable, shall be in accordance with the requirements set forth by the EU RO in charge of the vessel's classification, as a function of the intended location;
- p) The materials shall be suitable for intended service and location, and the wetted parts (the pressure connection and sensor) material shall be compatible with the process media; Process media temperature should also be considered as each of the different wetted materials would have different operating properties

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- The material of sensor shall be compatible with the fluid whose temperature is intended to be sensed and have high thermal conductivity;
- q) Pressure components and devices shall not be damaged by overloads due to a working medium pressure rise equal to 2,0 times of the maximum working pressure;
 - r) Anti-loosing means shall be provided to pressure setting devices;
 - s) Switches used for measuring temperature of fire-hazardous, toxic liquids, vapours and gases, liquids, vapours and gases under pressure shall be isolated from the medium tested;
 - t) The damage of temperature measurement channel shall not influence ability to measure the pressure and vice versa.

2.a.ii. Technical documents to be submitted

IMPORTANT: The English Language shall be used for all submitted documents.

- a) Technical data and specifications
- b) Dimensional/sectional views drawings
- c) Functional block diagrams of the article with indication of input and output signals, feedbacks, self-monitoring system, etc.;
- d) Product description including application, working area, working principle and operation
- e) Installation manuals
- f) Type test reports done previously if available
- g) Proposed test program and test schedule
- h) Description of the test specimens and explanation of the selected test sample(s) providing evidence that the selected sample meets the most rigorous and demanding requirements;
- i) Details of the production site(s), production facility inspection report, production specifications and a valid QM certificate according to ISO 9001.
- j) Complete accreditation certificate of the Test laboratory (prior the first test only; changes in the scope of accreditation shall also be advised);
- k) For tests witnessed by the RO, the test report after completion of the testing shall contain:
 - an identification number;
 - all relevant data and test results including the place, date and names of personnel responsible for conducting the test;

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- type references and serial numbers of the products tested;
 - details of the test equipment used including the calibration certificates and serial numbers;
- Test reports shall be signed and dated by the person(s) responsible for conducting the test and by the attending EU RO witnessing the test.
- l) Test reports for tests performed at accredited test laboratories shall be in accordance with ISO/IEC 17025.

2.b Type testing requirements

- a) In general, the type test plan is to be agreed between the Manufacturer and the RO based on the characteristics of the product subject to testing.
- b) The type tests are intended to demonstrate the performance of the prototype according to the requirements of the applicable International Standards and the relevant Manufacturer's specification.
- c) The ability of the product to function as intended under the testing conditions specified in the latest revision of IACS UR E10 shall also be verified. Testing procedures according to the International Standards mentioned in this TR may be accepted by the RO, in lieu of those indicated in the IACS UR E10, provided that the test severity conditions set by the IACS UR E10 are fulfilled as a minimum.
- d) Performance type tests according to the Manufacturer's specification and the applicable International Standards shall be carried out.
- e) Visual inspection to check conformance to relevant drawings and design data shall be carried out.
- f) Type tests shall be carried out in accordance with IACS UR E10. Additional tests and tests differing from the test specifications in IACS UR E10 shall be carried out as per Table 2. Tests for specific operating conditions to be carried out as relevant (increased temperatures, vibration levels, etc.);

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Table 2

No.	Test	Test parameters or normative document	Test conditions	Test purpose, performance criteria
1	Protective enclosure	IEC 60529	The test is applicable for enclosures of the articles with operating voltage up to 1000V.	The equipment is considered to have passed the test, if it satisfies the Performance Criterion A and the requirements of IEC 60529.
2	Impact	IEC 60068-2-27, Test Ea: - Acceleration: 5 g, - Duration: 10 ms – 15 ms, - No of impacts: 20 (10 per direction) - Frequency of impacts: 40 – 80 impacts/min.	The test shall be carried out under working condition, in three mutually perpendicular planes. Sinusoidal shape of the impact momentum is recommended	The equipment is considered to have passed the test, if during and after the test it complies with the requirements specified in the technical documentation.
3	Exposure to solar radiation	-Temperature in the chamber: + 55°C.	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	The equipment is considered to have passed the test, if:
- Radiation intensity: 1125W/m ² .		- No deformation, cracking, stratification, buckling, ungluing of plastic pieces and other materials has taken place;		
(Including flux density of the ultra-violet portion of spectrum with a wavelength of 280 – 400 nm shall be not less than 42 W/m ²)		- No degradation of readability of inscriptions and signs on the instrument scales has not been detected; -Parameters and		

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No.	Test	Test parameters or normative document	Test conditions	Test purpose, performance criteria
				resistance of insulation have remained normal
4	Inclination test	Limiting inclination angle 22,5°. Motions period 7...9 seconds.	Conditioning of equipment sequentially in two mutually perpendicular positions at an angle of 22,5° to the horizontal and measurement of parameters, but not less than 15 min in each position. Parameters shall be read at least 3 times in each position.	During and after the test, the switches shall be in good working order.
5	Pressure test	200% of the switch max. working pressure. Duration 2 minutes.	The test shall be carried out under working condition.	During and after the pressure test the switches shall be in good working order.
6	Cold test	As per UR E10 Cold test requirements except the duration. Duration is 16 hours.	As per UR E10 Cold test, but duration -16 hours	As per UR E10

- g) All tests to be performed on agreed test samples.
- h) Test specimens shall be selected from production line or at random from stocks*.
- i) Tests shall be carried out in the presence of the EU RO Surveyor. In cases where the tests are conducted at Nationally Accredited Laboratories, the presence of the EU RO surveyor may be omitted*.

†For further clarification of witnessing of tests and sampling the test specimen(s), refer to paragraph 6, 7 and 8 of the EU RO "Design Evaluation Scheme" procedure (Appendix V of EU RO Framework Document for the Mutual Recognition of Type Approval found on <https://www.euromr.org/technical-requirements>)

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2.c Type testing requirement for certificate renewal

- a) The manufacturer is to notify the RO of any modification or changes to the manufacturing specifications that may affect the MR TA to be renewed.

3. PRODUCTION REQUIREMENTS

Refer to EU RO "Product Quality Assurance (PQA)" procedure (Appendix VI of EU RO Framework Document for the Mutual Recognition of Type Approval) found on <https://www.euromr.org/technical-requirements>)

4. MARKING REQUIREMENTS

Manufacturers of the approved equipment are, in principle, to mark the product before shipment for identification of approved equipment as per referenced standard. In addition, and as a minimum, the following items to be marked at the suitable place:

- a) Manufacturer's name or equivalent;
- b) Type No. or symbol;
- c) Particulars or ratings;
- d) IP ratings
- e) Operating temperature
- f) Date of Manufacture.

5. TYPE APPROVAL CERTIFICATE CONTENT

The EU RO MR Type Approval Certificate shall contain the minimum information as defined in the EU RO Framework Document for the Mutual Recognition of Type Approval - see Appendix I of EU RO MR Type Approval Certificate Information.

- a) The following information is specifically applicable to products relevant to this technical requirement for all kind of switches and shall be included on the EU RO MR Type Approval Certificate: Environmental test items and test levels applied, if any;
- b) Name and version/revision of hardware, firmware and software, as applicable;
- c) Approval conditions including limitations, if any.
- d) Intended use and system context;
- e) List of EMC test levels applied, as applicable;
- f) List of process media for which certification is granted, as applicable.

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6. APPROVAL DATE AND REVISION NUMBER

Date	Revision	Comment
2019-01-01	0.0	Approved by EU RO MR Steering Committee
2023-01-01	0.1	Alignment of text for switches (TG Grouping of TRs, ref 20058) Added para 2.c. CRF056 Alignment of TRs by aligning reliable operations with a period of 10 s Added para 9 Copyright (ref 21030_)

7. BACKGROUND INFORMATION / REFERENCES

- EU RO Framework Document for the Mutual Recognition of Type Approval;
- IACS UR E10 latest revision in use – Test Specification for Type Approval;
- IEC 60529 Degrees of protection provided by enclosures (IP Code);
- IEC 60068-2-27

8. MAINTENANCE & CLARIFICATION OF TECHNICAL REQUIREMENTS

Anyone wishing to propose changes to this document or request clarification of technical issues should contact the EU RO MR Group Secretariat in the first instance:
Secretariat@euomr.org.

Review and approval of change requests shall follow the EU RO MR Maintenance Process detailed in the EU RO Framework Document for the Mutual Recognition of Type Approval: <https://www.euomr.org/technical-requirements>

9. LEGAL PROVISIONS / COPYRIGHT

- Underlying legal provisions in accordance with EU RO Framework Document for the Mutual Recognition of Type Approval;
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