

EU RO Mutual Recognition Technical Requirements

SOLENOID VALVE ASSEMBLY	Version	0.3
	Adoption Date	1 January 2023
	Application Date	1 July 2023
	Tier	3
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1. PRODUCT DESCRIPTION

1.a General description of the product

- a) Solenoid valve assembly is a type of directional remote control valve which is controlled by an electric solenoid. It is composed of a solenoid component and actuator of valve, intended for controlling medium conveying on-off or changing of conveying medium direction in hydraulic fluid system and pneumatic fluid system on board ships;
- b) The move of the (pilot) valve core is pushed by the iron core of solenoid, and reset is usually controlled by spring force.

1.b Application limitations

- a) This Technical Requirement applies to directional control valves of hydraulic control system and pneumatic control system on board ships;
- b) This Technical Requirement is not applicable for:
 - Proportional valves;
 - Servo-valves;
 - Digital solenoid valves;
 - Electrically modulated hydraulic control valves;
- c) The approval is applicable to the mechanical parts and electric hardware of the solenoid valve only. This excludes solid-state and programmable electronics as well as firmware, application software, and hardware designed for specific applications subject to classification. Firmware, system software,

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and application software shall be subject to additional separate approval, according to UR E22 and the rules of the classing RO (FAT and on-board review / tests).

1.c Intended use

- a) Hydraulic fluid system on board ships;
- b) Pneumatic fluid system on board ships;
- c) Medium: Including air, vapour and gas, water, hydraulic oil, lubricating oil, fuel oil etc.

1.d System context

See 1.c above

2. DESIGN EVALUATION

2.a Engineering evaluation requirements

2.a i. Technical Requirements

Design

- a) The solenoid valve assembly shall be suitable for the effective operation at the rated pressure and flow they will experience in service. Rated pressure, flow and temperature of valve to be in accordance with a recognized standard for valves, and it should be guaranteed by the manufacturer of valves. Selected material to be among those contemplated by that standard. Geometrical parameters of pressure retaining parts shall comply with that standard.
- b) Type, ratings and characteristics of solenoid valve assembly for intended applications shall be evaluated. The performance of the valve assembly, include:
 - action;
 - pressure differential / flow characteristics;
 - rated flow;
 - leakage;
 - response time;

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- medium flow direction;
- reversing time;
- changing-over frequency;
- control pressure etc.,

The above shall be as per relevant national or international standards.

- c) Solenoid valve assembly shall be operated satisfactory in both vertical and level position. Special requirements for installation position limitation shall be cautioned.
- d) The temperature rise of solenoids at windings shall not exceed the values given in the **Table 2.1** below during continuous operation, and the ambient air temperature is based on 45°C, and the voltage of the electric power supply is at the highest permissible value.

Table 2.1

Insulation level of solenoid	Limit of temperature rise(K) windings
Class A insulation	55
Class E insulation	70
Class B insulation	75
Class F insulation	95
Class H insulation	120

- e) Unless otherwise stated in international standards, solenoid valve assembly shall operate satisfactorily within the variations in voltage and frequency from the rated value shown in **Table 2.2** below (measured at input terminals of the assembly). Power failure of the remote control system is not to cause an undesired change of the valve position:

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Table 2.2

Power Supply	Parameters	Permanent (%)	Transient (%)
AC	Voltage	±10	±20 (within 1.5 sec)
	Frequency	±5	±10 (within 5 sec)
DC	Voltage	+30 ~ -25	-

- f) Life time of solenoid valve assembly should be not less than following **Table 2.3** below requirements or according to the relevant acceptable standards:

Table 2.3

DN (mm)	Medium	
	Liquids/Vapour	Air/Gas
≤ 25	100000 times	500000 times
32~65	50000 times	300000 times
80~150	30000 times	150000 times
200~300	10000 times	30000 times

Materials

- g) The materials to be used for the solenoid valve assembly shall be compatible with the medium and service for which the piping systems are intended;
- h) The use of asbestos is prohibited;
- i) The material used to make solenoid shall comply with the following requirements:
- It is, in general, to be durable, flame-retardant, moisture resistant unless it is adequately protected against the atmospheric environment and temperatures to which it is likely to be exposed;
 - Insulating materials and insulated windings shall be resistant to moisture, sea air and oil vapour unless special precautions are taken to protect them;
 - The current carrying parts of electrical equipment are, in general, to be made of copper or copper alloys;
 - Metal parts of electrical equipment shall be covered with proper protective coating against corrosion unless they are made of

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satisfactory corrosion-resistant material. (Note: Salt spray test may be necessary. Please reference to ISO9227 NSS Test).

Types of connections

- j) Types of connections and dimensions of solenoid valve assembly shall be determined in accordance with national or international standards;
- k) The relative bolts shall be chosen in accordance with the national or international standards.

Ambient conditions:

- l) Temperatures: -25°C to $+55^{\circ}\text{C}$;
- m) Relative humidity: 100%;
- n) Solenoid valve assembly shall operate satisfactorily under the vibration conditions listed in following **Table 2.4**:

Table 2.4

Location of installation	Parameters of vibration	
General space	2.0 ~ 13.2 Hz Amplitude ± 1 mm	13.2 ~ 100 Hz Acceleration ± 0.7 g
On reciprocating engines (e.g. diesel engines, air compressors) and other similar spaces	2.0 ~ 25 Hz Amplitude ± 1.6 mm	25 ~ 100 Hz Acceleration ± 4.0 g
Other special locations, e.g. exhaust pipes for (particularly medium or high speed) diesel engines	40 ~ 2,000 Hz Acceleration ± 10.0 g (temperature 600°C)	

- o) Solenoid valve assembly shall be suitable for the normal conditions encountered on board ships, e.g. salt air, oil-laden atmosphere, mold and dust.

Constructions

- p) The valve assembly shall be so designed, constructed and installed as to ensure safe operation and facilitate inspection and repair;

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- q) The distance between live parts of different potential and between live parts and earthed metal, whether across surfaces or in air, shall be adequate for the working voltage, having regard to the nature of the insulating material and the conditions of service. Insulation resistance and high voltage test shall be carried out according to Table 2.5 below;
- r) All nuts and screws used for the connection and fastening of the valve assembly shall be provided with means to ensure that they cannot work loose by vibration and shock;
- s) In the event of failure of the electric power supply, the valve assembly shall be capable of being local manually operated without using any other tools for safety purposes. Opening and/or closing of the valve by local means shall not render the remote control system inoperable;
- t) Indicators shall be provided to show the condition of the solenoid, unless this can be observed in some other ways;
- u) Insulation resistance between windings and shell shall be not less than 20MΩ.
- v) The type of protective enclosures selected for the solenoid shall be appropriate to the condition of the location at which such assembly is installed (Ref. IEC 60092-504). Degrees of protection (IP Code) of solenoid usually shall be no less than IP54;
- w) Where the assembly is installed in areas where explosive gas or vapour atmospheres may be present, it shall be of a certified explosion protection safe type complying with the following requirements:
 - The construction and type testing of the safe type electrical equipment is to be in accordance with the relevant acceptable standards;
 - The explosion protection safe type of assembly, if applicable, shall be certified by a competent testing authority approved by EU RO.

2.a.ii. Technical documents to be submitted

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

- a) The following documentation shall be submitted by the Manufacturer before type testing:
 - The request for type approval shall be submitted by the Manufacturer or by the Applicant, if authorized by the Manufacturer;

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- Product descriptions (including intended services, installation locations, intended fluids, working medium temperature range, certificates and reports of relevant tests previously carried out), instructions on operation, data sheets or specification;
 - Details of relevant standards;
 - All relevant design drawings, catalogues, Assembly drawings, dimension drawings, external connection terminal drawings, nameplate etc. clearly identifying the product;
 - Drawings of main parts/components including body of valve, cores, springs, electromagnetic wire, etc.;
 - Proposed test program and test schedule;
 - Description of test specimens and explanation of the selected test sample(s) providing evidence that the selected sample meets the most rigorous and demanding requirements;
 - Complete accreditation certificate of the Test laboratory;
 - Details of production sites and working area;
 - QM-certificate according to ISO 9001 or equivalent by an accredited certifying body.
- b) On completion of proto type tests, a report shall be issued, identified by number and date, which accurately, clearly and unambiguously presents the test results and all other relevant information;
- c) Test report(s) shall include the following information:
- Type of product, with type number / serial number(s) and quantity tested;
 - Test specification for the product identified by number, revision and date;
 - Details of test equipment and measuring instruments stating serial numbers and calibration certificates;
 - Names of the test engineer and the engineer approving the report.
 - Ambient environmental conditions during the test;
 - The test results with a description of any failures encountered.
 - Conclusion.

Test report(s) shall be signed by the test personnel and verified by the EU RO or the agreed independent representative witnessing the tests.

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d) The complete product test report(s) shall be submitted to the EU RO.

2.b Type testing requirements

General:

- a) Type tests shall be in accordance with applicable standards, such as IEC 60068-2 series;
- b) Test specimens shall be selected from production line or 'at random' from stock†. Where there are various sizes from type of solenoid valve assembly requiring approval, the maximum size for each kind of solenoid with the same rated pressure shall be the representative of the range;
- c) 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 EO RO surveyor may be omitted †.
- d) The explosion protection safe type, if applicable, is to be certified by a competent testing authority approved by the EU RO;
- e) Unless otherwise specified, such as IEC 60068-1, all tests shall be carried out under the following atmospheric conditions:
 - Ambient temperature between +15 °C and +35 °C;
 - Relative humidity: between 25 %RH and 75 %RH;
 - Air pressure: 86 ~ 106 kPa.

† For further clarification of witnessing of tests and sampling the test specimen(s), refer to paragraphs 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

<http://www.euromr.org/Guidance%20for%20Mutual%20Recognition>)

Testing items:

- f) Hydrostatic & burst/pressure test:

Each type of solenoid valve assembly shall be subject to the hydrostatic pressure test at the following value of pressure:

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$P_H = 1.5P$ (holding pressure time 5min.)

where P_H = Hydraulic test pressure (bar), but in no case less than 4 bar,

P = Rated pressure (bar)

Each type of solenoid valve actuator housing, subject to internal pressure, shall be subject to the burst test at the following value of pressure:

$P_b = 4P$ (holding pressure time 2min.)

where P_b = Burst test pressure (bar),

P = Rated pressure (bar)

g) Measurement of temperature rise (Clause 2.a.i of this technical requirement);

Notes:

- For solenoid subject to temperature rise test, the high voltage test shall be carried out immediately after the temperature rise test.
- The high voltage test is in general not to be repeated, but if it is necessary, one additional test is permitted to be carried out with a test voltage equal to 75% of the voltage at the first test.

End of Notes

h) Degrees of protection (IP Code) test: according to IEC 60529;

i) Leakage test: conformance to drawings, design data;

j) Life test (clause 2.a.i of this technical requirement);

k) The tests listed in **Table 2.5** specified in IACS UR E10 shall be performed:

Table 2.5

Test items	Requirements	Test method
1. Visual Inspection	conformance to drawings, design data	IACS UR E10 Table E10.1 Item 1
2. Performance test	conformance to design data;	IACS UR E10 Table E10.1 Item 2;

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	Clause 2.a.i of this part	ISO 4411;
3. External power supply failure/Emergency operation	Clause 2.a.i of this part	Clause 2.a.i of this part
4. Power supply variations	Clause 2.a.i of this part	IACS UR E10 Table E10.1 Item 4
5. Dry heat	IACS UR E10	IACS UR E10 Table E10.1 Item 5
6. Damp heat	IACS UR E10	IACS UR E10 Table E10.1 Item 6
7. Vibration	Clause 2.a.i of this part	IACS UR E10 Table E10.1 Item 7
8. Inclination	Clause 2.a.i of this part; IACS UR E10	Clause 2.a.i of this part; IACS UR E10 Table E10.1 Item 8
9. High Voltage	IACS UR E10	IACS UR E10 Table E10.1 Item 10
10. Insulation resistance	IACS UR E10 Clause 2.a.i of this part	IACS UR E10 Table E10.1 Item 9
11. Cold	IACS UR E10	IACS UR E10 Table E10.1 Item 11
12. Salt mist	IACS UR E10	IACS UR E10 Table E10.1 Item 12
13. Flame retardant	IACS UR E10	IACS UR E10 Table E10.1 Item 21

2.c Type testing requirement for certificate renewal

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

3.a General requirements

- a) The manufacturer shall ensure that the solenoid valve assemblies comply with the drawings and technical documents approved by the RO;

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- b) A Quality Management System meeting the requirements of EU RO Product Quality Assurance (Appendix VI of EU RO Framework Document for the Mutual Recognition of Type Approval) shall be implemented effectively by the manufacturer.

3.b Special requirements

Routine tests.

The tests indicated below shall be carried out by manufacturer:

- a) Visual Inspection;
- b) Hydrostatic/pressure test at the following value of pressure:

$$P_H = 1.5P$$

where P_H = test pressure (bar), but in no case less than 4 bar,

P = Rated pressure (bar)

- c) Performance test (including action, leakage, medium flow direction);
- d) High Voltage test;
- e) Insulation resistance test;
- f) Emergency operation test.

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) Each solenoid valve assembly shall be provided with clear symbols or marks according to recognised standards. Hydraulic solenoid valve assembly ports and solenoids shall be permanently marked with identification as per ISO 9461;
- b) A clear earth mark shall be provided near the earth terminal. (If applicable);
- c) Rating plate fitted to the assembly;
- d) Each solenoid valve assembly shall be provided with a rating plate of weatherproof material, fitted in a visible position, showing the items indicated as below. The plate shall be indelibly marked (that is, by etching, engraving, stamping or by a photo-chemical process):

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- Manufacturer's name or trade mark;
- Type designation under which the product is type approved;
- Power supply: Rated voltage, Rated frequency (AC machines, if applicable), Rated power or Rated current;
- Insulation class, Degree of protection, Explosion protection type (if applicable);
- Rated pressure, medium;
- Data of manufacture;
- Manufacturer's serial number.

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 EU RO MR Type Approval Certificate Information.

6. APPROVAL DATE AND REVISION NUMBER

Date	Revision	Comment
31 January 2014	0.0	Accepted by Advisory Board
31 January 2015	0.1	CRF018 – Revision to par. 2.a.ii - Technical documents to be submitted in English; CRF020 – Revision to par. 5 - 'Type Approval Certificate Content'
1 April 2016	0.2	CRF025 – Updated to new MR TR document format incl. par. 8; CRF026/026a – Witness testing & control of test specimen; CRF028 – addition of 6 month application clause.
1 January 2023	0.3	Added para 2.c Added para 9 Copyright

7. BACKGROUND INFORMATION / REFERENCES

- a) IACS UR E10 - "Test Specification for Type Approval";
- b) IACS UR P2 – "Rules for piping design, construction and testing";
- c) IACS UR M40 – "Ambient conditions – Temperatures";

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- d) IEC 60529:2001 – “Degrees of protection provided by enclosures (IP Code)”;
- e) ISO 4401:2005 - “Hydraulic fluid power - Four-port directional control valves - Mounting surfaces”;
- f) ISO 4411:2008 - “Hydraulic fluid power - Valves - Determination of pressure differential / flow characteristics”;
- g) ISO 5783:1995 - “Hydraulic fluid power - Code for identification of valve mounting surfaces and cartridge valve cavities”;
- h) ISO 7368:1989 – “Hydraulic fluid power; two-port slip-in cartridge valves; cavities”;
- i) ISO 7789:2007 - “Hydraulic fluid power - Two-, three- and four-port screw-in cartridge valves – Cavities”;
- j) ISO 9461:1992 - “Hydraulic Fluid Power; Identification of Valve Ports, Sub-plates, Control Devices and Solenoids”;
- k) ISO 15218:2003 - “Pneumatic fluid power - 3/2 solenoid valves - Mounting interface surfaces”;
- l) IEC publication 60079: “Electrical Apparatus for Explosive Gas Atmospheres” or an equivalent national standard;
- m) IEC 60092-504 Electrical installations in ships - Part 504: Special features - Control and instrumentation;
- n) IEC 60068-1 Environmental testing - Part 1: General and guidance;
- o) IEC 60068-2 Environmental testing - Part 2 Series;
- p) EU RO Framework Document for the Mutual Recognition of Type Approval;
- q) ISO9227 Corrosion test in artificial atmospheres-Salt spray tests.

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: <http://www.euomr.org/Guidance%20for%20Mutual%20Recognition>.

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