

EU RO Mutual Recognition Technical Requirements

FLAMEPROOF LUMINAIRE (LIGHTING FIXTURE)	Version	0.4
	Adoption Date	1 January 2023
	Application Date	1 July 2023
	Tier	2
This document is subject to controlled issue and can be found here: http://www.euromr.org/technical-requirements *** Uncontrolled if downloaded or printed ***		

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1. PRODUCT DESCRIPTION

1.a General description of the product

- Description of product according to IEC IEV 845-10-07;
- Luminaire (or lighting fixture) which satisfies the appropriate regulations applicable to equipment with explosion-proof enclosure, for use in situations where there is a risk of explosion and in vessel's environmental conditions as referred in Table 2.1, 2.2 and 2.3;
- Specification according to requirements of IEC 60092-306 (which mainly refers to IEC 60079-1 for flameproof enclosure "d" luminaires, IEC 60598-1 General Requirements and tests for Luminaires).

1.b Application limitations

- Flameproof lighting fixtures shall be used in low voltage circuits (100V to 250V 50/60Hz ac and 24V dc);
- Performances shall be tested according to IEC60092-306;
- Environmental conditions shall be tested according to IACS UR E10 as applicable.

1.c Intended use

Illumination of areas where an explosive gas or flammable vapour may be present in the atmosphere (referred to as a hazardous area).

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1.d System context

See 1.c

2. DESIGN EVALUATION

2.a Engineering evaluation requirements

2.a i. Technical Requirements

General

Flameproof lighting fixtures shall be in accordance with IEC60079-1 E6.0 2007 "Explosive atmospheres - Part 1: Equipment protection by flameproof enclosures "d"" or the standard deemed appropriate by the Society or equivalent thereto and also to comply with the requirements in this 2.a.i.

Further to the above, light fixtures to be designed according to the following IEC standards as applicable:

- a) IEC 60598-1 (2008-04) Luminaires Part 1: General Requirements and Tests;
- b) IEC 60598-2-1 (1979-01) Part 2: Particular requirements. Section One: Fixed general purpose luminaires + am1 (1987-01);
- c) IEC 60598-2-2 ed.3.0 (2011-11) Part 2: Particular requirements. Section 2: Recessed luminaires;
- d) IEC 60598-2-4 (1997-04) Part 2: Particular requirements. Section 4: Portable general purpose luminaires;
- e) IEC 60598-2-5 (1998-01) Part 2-5: Floodlights;
- f) IEC 60598-2-6 (1994-06) Part 2: Particular requirements. Section 6: Luminaires with built-in transformers for filament lamps + am1 (1996-11);
- g) IEC 60598-2-22 ed.3.2 (2008-04) Part 2-22: Particular requirements - Luminaires for emergency lighting;
- h) IEC 60092-306 (2009-11) Part 306: Equipment - Luminaires and accessories;
- i) IMO Resolution A.752 (18) Adopted on 4 Nov. 1993: Guidelines for the evaluation, testing and application of Low-Location lighting on passenger ships

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or ISO 15370 (2001) Ships and marine technology - Low-location lighting on passenger ships.

Materials

- a) Materials for flameproof construction shall have an adequate electrical, mechanical, thermal and chemical resistance against the environmental condition and flammable gases or vapours (hereinafter referred to as "gases") at the location of the electrical equipment concerned;
- b) Enclosures and outer fittings of portable appliances shall be of materials which minimize the risk of spark by friction, or to have a non-metallic strong cover with hanging strap;
- c) Insulating compounds and sealing compounds used for integral parts of a flameproof construction shall be such that no harmful expansion, contraction, softening or crack is found during in service. The insulating compounds applied to bare live-parts shall be flame-retardant;

Construction

- d) The glazed ports of lighting fittings of flameproof type shall be provided with guards of robust material when the maker considers that the additional mechanical protection is necessary;
- e) Where gaskets are considered necessary, they shall comply with the applicable requirements of IEC 60079-1 and IEC 60079-14;
- f) Leading-in parts of cables shall be of a construction suitable for ship cables. Consideration shall be given so that the cables can be surely fixed at the cable gland, except where the cables are installed in steel conduits.

2.a.ii. Technical documents to be submitted

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

- a) Main drawings for assembled luminaires;
- b) References to design standards, rules, specifications etc.;

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- c) Specification of applied material for enclosure and insulation;
- d) Test results (from tests already carried out, if any). Only one copy;
- e) Applicant's proposal to Product Sample Test and Routine Test;
- f) Documentation of reliability and endurance on board ships and Mobile Offshore Units, if any;
- g) Special operational limitations;
- h) Field of Application;
- i) List of Type designations for each variant;
- j) Construction details:
 - Voltage
 - Power
 - Temperature class
 - Insulation class
 - Enclosure (IP) class
 - List of electrical parts and materials
 - Electric circuit diagrams
 - Explosion protection + certificate from recognised Test laboratory.
 - Special properties, if any.
- k) Test programme, which as a minimum includes the elements for Type testing, Sec.2b. The test programme shall refer to the relevant IEC standards for each test.

2.b Type testing requirements

Type test shall be based on general test for lighting fixtures as stated in the following IEC publications:

- a) IEC 60598-1
- b) IEC 60598-2-2
- c) IEC 60598-2-5
- d) IEC 60598-2-6
- e) IEC 60598-2-22

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Suitability for installation in ex-protected areas shall be tested as per:

- f) IEC 60079-1 alternatively certified or approved by a National or other appropriate authority;
- g) IACS UR ER10 (see **table 2.3**).

Test specimens shall be taken from the production line or from stocks†. 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's surveyor may be omitted†.

† 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>)

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

Refer to EU RO "Product Quality Assurance (PQA)" procedure (Appendix VI of EU RO Framework Document for the Mutual Recognition of Type Approval).

4. MARKING REQUIREMENTS

The product shall be provided with visible marking, based on IEC 60079-0 and IEC 60598-1. As a minimum, the following information shall be provided:

- a) Manufacturer's name or trade mark;
- b) Type designation under which the product is type approved;

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- c) Temperature range of application;
- d) Voltage;
- e) Maximum current;
- f) IP class;
- g) Serial number and date of manufacture;
- h) Caution and warning markings as applicable.

The marking shall be carried out in such a way that it is visible, legible and indelible throughout the anticipated life of the product, and that the marks can be traced back to the type approval certificate.

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.

The following information is specifically applicable to products relevant to this technical requirement and shall be included on the relevant EU RO MR Type Approval Certificate:

- a) Environmental test items and test levels applied;
- b) Approval conditions including limitations, if any;
- c) Hardware, firmware, software name and revision, as applicable.

6. APPROVAL DATE AND REVISION NUMBER

Date	Revision	Comment
2013-04-30	0.0	Accepted by Advisory Board
2014-01-31	0.1	'IEC' to standards listed 2.b (b) to (e) (CRF007) and reference to EU RO Framework Document for the Mutual Recognition of Type Approval added.
2015-01-31	0.2	CRF018 – Revision to par. 2.a.ii - Test results to be in English;

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		CRF020 – Revision to par. 5 - 'Type Approval Certificate Content'.
1 April 2016	0.3	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	0.4	Added para. 2.c. Added para. 9 Copyrights (ref 21030_)

7. BACKGROUND INFORMATION / REFERENCES

- a) IEC60079-1 E6.0 2007 "Explosive atmospheres - Part 1: Equipment protection by flameproof enclosures "d"";
- b) IEC 60598-1 (2008-04) Luminaires Part 1: General Requirements and Tests;
- c) IEC 60598-2-1 (1979-01) Part 2: Particular requirements, Section One: Fixed general purpose luminaires + am1 (1987-01);
- d) IEC 60598-2-2 (1997-09) Part 2: Particular requirements, Section 2: Recessed luminaires;
- e) IEC 60598-2-4 (1997-04) Part 2: Particular requirements, Section 4: Portable general purpose luminaires;
- f) IEC 60598-2-5 (1998-01) Part 2-5: Floodlights;
- g) IEC 60598-2-6 (1994-06) Part 2: Particular requirements, Section 6: Luminaires with built-in transformers for filament lamps;
- h) IEC 60598-2-22 (2008-04) Part 2-22: Particular requirements - Luminaires for emergency lighting + am1 (2008-01);
- i) IEC 60092-306 (2009-11) Part 306: Equipment - Luminaires and accessories;
- j) EU RO Framework Document for the Mutual Recognition of Type Approval.

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.

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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>.

9. LEGAL PROVISIONS / COPYRIGHT

- a) Underlying legal provisions in accordance with EU RO Framework Document for the Mutual Recognition of Type Approval;
- b) Copyright © 2022. All EU RO MR Group rights reserved. For a list of EU RO MR Group members please see <https://www.euomr.org/about-us>.
(The year is either the year of the inclusion of the copyright notice, 2022 for existing TRS, or the year of the adoption of any new TR.)

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Tables 2.1 – 2.3:

Table 2.1 – Angles of Inclination

Static inclination	Dynamic inclination
22.5° ⁽¹⁾	22.5° ⁽¹⁾

Note:

In ships carrying liquefied gases in bulk and ships carrying dangerous chemicals in bulk, emergency power supplies shall remain operable with the ship flooded to a final athwart ships inclination up to a maximum of 30°. In this case the test level has to be named on the certificate.

Table 2.2 - Voltage and Frequency Fluctuation

(a) Voltage and frequency fluctuations for a.c. distribution systems ^(Note 1)

Type of fluctuation	Fluctuation ^(Note 4)	
	Permanent	Transient
Voltage	± 10%	± 20% (1.5s duration)
Frequency	± 5%	± 10% (5s duration)

(b) Voltage fluctuations for d.c. distribution systems ^(Note 2)

Type of fluctuation	Fluctuation ^(Note 4)
Voltage fluctuation (Permanent)	± 10%
Voltage cyclic fluctuation deviation	5%
Voltage ripple	10%

(c) Voltage fluctuations for battery systems

Systems	Fluctuation ^(Note 4)
Components connected to the battery during charging ^(Note 3)	+30%, -25%
Components not connected to the battery during charging	+20%, -25%
All components	± 25% (2s duration)

Notes

- 1: A.C. distribution systems mean *a.c.* generator circuits and *a.c.* power circuits produced by inverters.
- 2: D.C. distribution systems mean *d.c.* generator circuits and *d.c.* power circuits produced by converters.
- 3: Different voltage fluctuations as determined by charging and discharging characteristics, including voltage ripples from the charging devices, may be considered.

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4: The numerical values given in the table, excluding those values for time, mean percentages of rated values.

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Table 2.3 – Testing condition and method

(Any changes made to IACS UR E10 in Revision 6.0 needs to be implemented in this test plan. Red text in the below table indicate requirements stricter than, or additional to, the ones defined in IACS UR E10 rev.5.)

NO.	TEST	PROCEDURE ACC. TO:*	TEST PARAMETERS	OTHER INFORMATION
* indicates the testing procedure which is normally to be applied. However, equivalent testing procedure may be accepted by the RO provided that the requirements stated in the other columns are fulfilled.				
1.	Visual inspection	-	-	<ul style="list-style-type: none"> conformance to drawings, design data, marking of product
2.	Performance test	Manufacturer performance test programme based upon specification and relevant Rule requirements.	<ul style="list-style-type: none"> standard atmosphere conditions temperature: -25 to +70 centigrade relative humidity: 60% ± 30% air pressure: 96 KPa ± 10KPa 	<ul style="list-style-type: none"> confirmation that operation is in accordance with the requirements specified for particular system or equipment; checking of self-monitoring features; checking of specified protection against an access to the memory; checking against effect of unerroneous use of control elements in the case of computer systems.
3.	External power supply failure	-	<ul style="list-style-type: none"> 3 interruptions during 5 minutes; switching-off time 60 s each case 	<ul style="list-style-type: none"> The time of 5 minutes may be exceeded if the equipment under test needs a longer time for start up, e.g. booting sequence For equipment which requires booting, one additional power supply interruption during booting to be performed Verification of: <ul style="list-style-type: none"> equipment behaviour upon loss and restoration of supply; possible corruption of programme or data held in programmable electronic systems, where applicable.

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4.	Power supply variations a) electric	-	<p>AC SUPPLY</p> <table border="1"> <thead> <tr> <th>Combination</th> <th>Voltage (%) variation permanent</th> <th>Frequency (%) variation permanent</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>+6</td> <td>+5</td> </tr> <tr> <td>2</td> <td>+6</td> <td>-5</td> </tr> <tr> <td>3</td> <td>-10</td> <td>-5</td> </tr> <tr> <td>4</td> <td>-10</td> <td>+5</td> </tr> <tr> <th></th> <th>Voltage transient 1,5 s (%)</th> <th>Frequency transient 5s (%)</th> </tr> <tr> <td>5</td> <td>+20</td> <td>+10</td> </tr> <tr> <td>6</td> <td>-20</td> <td>-10</td> </tr> </tbody> </table> <p>DC SUPPLY</p> <table border="1"> <tbody> <tr> <td>Voltage tolerance Continuous</td> <td>± 10%</td> </tr> <tr> <td>Voltage cyclic Variation</td> <td>5%</td> </tr> <tr> <td>Voltage ripple</td> <td>10%</td> </tr> </tbody> </table> <p>Electric battery supply:</p> <ul style="list-style-type: none"> +30% to -25% for equipment connected to charging battery or as determined by the charging/discharging characteristics, including ripple voltage from the charging device; +20% to -25% for equipment not connected to the battery during charging. 	Combination	Voltage (%) variation permanent	Frequency (%) variation permanent	1	+6	+5	2	+6	-5	3	-10	-5	4	-10	+5		Voltage transient 1,5 s (%)	Frequency transient 5s (%)	5	+20	+10	6	-20	-10	Voltage tolerance Continuous	± 10%	Voltage cyclic Variation	5%	Voltage ripple	10%	
	Combination	Voltage (%) variation permanent	Frequency (%) variation permanent																															
1	+6	+5																																
2	+6	-5																																
3	-10	-5																																
4	-10	+5																																
	Voltage transient 1,5 s (%)	Frequency transient 5s (%)																																
5	+20	+10																																
6	-20	-10																																
Voltage tolerance Continuous	± 10%																																	
Voltage cyclic Variation	5%																																	
Voltage ripple	10%																																	
	b) pneumatic and hydraulic		<ul style="list-style-type: none"> Pressure: ±20% Duration: 15 minutes 																															

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5.	Dry heat	IEC Publication 60068-2-2	<ul style="list-style-type: none"> • Temperature: 55° ± 2°C • Duration: 16 hours or <ul style="list-style-type: none"> • Temperature: 70°C ± 2°C • Duration: 16 hours (see note 1)	<ul style="list-style-type: none"> • equipment operating during conditioning and testing; • functional test during the last hour at the test temperature; • For equipment specified for increased temperature the dry heat test shall be conducted at the agreed test temperature and duration.
6	Damp heat	IEC Publication 60068-2-30 test Db	<ul style="list-style-type: none"> • Temperature: 55°C • Humidity: 95% • Duration: 2 cycles 2 x (12 + 12 hours) 	<ul style="list-style-type: none"> • measurement of insulation resistance before test; • The test shall start with 20°C±3°C and at least 95% humidity • equipment operating during the complete first cycle and switched off during second cycle except for functional test; • functional test during the first 2 hours of the first cycle at the test temperature and during the last 2 hours of the second cycle at the test temperature; • recovery at standard atmosphere conditions; • insulation resistance measurements and performance test.

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7.	Vibration	IEC Publication 60068-2-6 Test Fc	<ul style="list-style-type: none"> • 2(+3, -0)Hz to 13.2 Hz – amplitude $\pm 1\text{mm}$ • 13.2 Hz to 100 Hz – acceleration $\pm 0.7\text{ g}$. <p>For severe vibration conditions such as, e.g. on diesel engines, air compressors, etc.:</p> <ul style="list-style-type: none"> • 2.0 Hz to 25 Hz – amplitude $\pm 1.6\text{ mm}$ • 25.0 Hz to 100 Hz – acceleration $\pm 4.0\text{ g}$. <p>Note; More severe conditions may exist for example on exhaust manifolds or fuel oil injection systems of diesel engines. For equipment specified for increased vibration levels the vibration test shall be conducted at the agreed vibration level, frequency range and duration Values may be required to be in these cases 40 Hz to 2000 Hz – acceleration $\pm 10.0\text{g}$ at 600°C, duration 90 min.‡</p>	<ul style="list-style-type: none"> • duration in case of no resonance condition 90 minutes at 30 Hz; • duration at each resonance frequency at which $Q \geq 2$ is recorded – 90 minutes; • during the vibration test, functional tests shall be carried out; • tests to be carried out in three mutually perpendicular planes; • Q should not exceed 5; • where sweep test shall be carried out instead of the discrete frequency test and a number of resonant frequencies is detected close to each other duration of the test shall be 120 min. Sweep over a restricted frequency range between 0.8 and 1.2 times the critical frequencies can be used where appropriate. Note: Critical frequency is a frequency at which the equipment being tested may exhibit: • malfunction and/or performance deterioration • mechanical resonances and/or other response effects occur, e.g. chatter • mechanical resonances with amplification greater than 5 will not be accepted
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8.	Inclination	Publication IEC 60092-504	Static 22.5°	<p>a) inclined to the vertical at an angle of at least 22.5°</p> <p>b) inclined to at least 22.5° on the other side of the vertical and in the same plane as in (a),</p> <p>c) inclined to the vertical at an angle of at least 22.5° in plane at right angles to that used in (a),</p> <p>d) inclined to at least 22.5° on the other side of the vertical and in the same plane as in (c).</p> <p>Note: The period of testing in each position should be sufficient to fully evaluate the behaviour of the equipment.</p>
			Dynamic 22.5°	<ul style="list-style-type: none"> • using the directions defined in a) to d) above, the equipment shall be rolled to an angle of 22.5° each side of the vertical with a period of 10 seconds. The test in each direction shall be carried out for not less than 15 minutes • On ships for the carriage of liquefied gases and chemicals, the emergency power supply shall remain operational with the ship flooded up to a maximum final athwart ship inclination of 30°. <p>Note: These inclination tests are normally not required for equipment with no moving parts.</p>

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9.	Insulation resistance	-	<table border="1"> <thead> <tr> <th rowspan="2">Rated supply voltage Un (V)</th> <th rowspan="2">Test voltage Un (V)</th> <th colspan="2">Min. insulation resistance</th> </tr> <tr> <th>before test (M ohms)</th> <th>after test (M ohms)</th> </tr> </thead> <tbody> <tr> <td>Un ≤ 65</td> <td>2 x Un, min. 24V</td> <td>10</td> <td>1.0</td> </tr> <tr> <td>Un > 65</td> <td>500</td> <td>100</td> <td>10</td> </tr> </tbody> </table>	Rated supply voltage Un (V)	Test voltage Un (V)	Min. insulation resistance		before test (M ohms)	after test (M ohms)	Un ≤ 65	2 x Un, min. 24V	10	1.0	Un > 65	500	100	10	<ul style="list-style-type: none"> for high voltage equipment, reference is made to IACS UR E11. insulation resistance test shall be carried out before and after: damp heat test, cold test, salt mist test, and high voltage test; between all phases and earth; and where appropriate, between the phases. <p>Note: Certain components e.g. for EMC protection may be required to be disconnected for this test.</p>
Rated supply voltage Un (V)	Test voltage Un (V)	Min. insulation resistance																
		before test (M ohms)	after test (M ohms)															
Un ≤ 65	2 x Un, min. 24V	10	1.0															
Un > 65	500	100	10															
10.	High voltage		<table border="1"> <thead> <tr> <th>Rated voltage Un (V)</th> <th>Test voltage (A.C. voltage 50 or 60 Hz) (V)</th> </tr> </thead> <tbody> <tr> <td>• Up to 60</td> <td>• 1000</td> </tr> <tr> <td>• 61 to 300</td> <td>• 2000</td> </tr> <tr> <td>• 301 to 690</td> <td>• 2500</td> </tr> </tbody> </table>	Rated voltage Un (V)	Test voltage (A.C. voltage 50 or 60 Hz) (V)	• Up to 60	• 1000	• 61 to 300	• 2000	• 301 to 690	• 2500	<ul style="list-style-type: none"> for high voltage equipment, reference is made to IACS UR E11. separate circuits shall be tested against each other and all circuits connected with each other tested against earth; printed circuits with electronic components may be removed during the test; period of application of the test voltage: 1 minute 						
Rated voltage Un (V)	Test voltage (A.C. voltage 50 or 60 Hz) (V)																	
• Up to 60	• 1000																	
• 61 to 300	• 2000																	
• 301 to 690	• 2500																	
11.	Cold	IEC Publication 60068-2-1	<ul style="list-style-type: none"> Temperature: +5°C ± 3°C Duration: 2 hours or Temperature: -25°C ± 2°C Duration: 16 hours (see Note 2) 	<ul style="list-style-type: none"> initial measurement of insulation resistance; equipment not operating during conditioning and testing except for functional test; functional test during the last hour at the test temperature; insulation resistance measurement and the functional test after recovery 														

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12.	Salt mist	IEC Publication 60068-2-52 Test Kb	<ul style="list-style-type: none"> Four spraying periods with a storage of 7 days after each. 	<ul style="list-style-type: none"> initial measurement of insulation resistance and initial functional test; equipment not operating during conditioning; functional test on the 7th day of each storage period; insulation resistance measurement and performance test 4 to 6h after recovery (see Note 3) <p>On completion of exposure, the equipment shall be examined to verify that deterioration or corrosion (if any) is superficial in nature.</p>
13.	Electrostatic discharge	IEC 61000-4-2	<ul style="list-style-type: none"> Contact discharge: 6kV Air discharge: 8kV Interval between single discharges: 1 sec. No. of pulses: 10 per polarity According to test level 3 	<ul style="list-style-type: none"> to simulate electrostatic discharge as may occur when persons touch the appliance; the test shall be confined to the points and surfaces that can normally be reached by the operator; Performance Criterion B (See Note 4).
14.	Electro-magnetic field	IEC 61000-4-3	<ul style="list-style-type: none"> Frequency range: 80 MHz to 6 GHz Modulation**: 80% AM at 1000Hz Field strength: 10V/m Frequency sweep rate: $\leq 1.5 \times 10^{-3}$ decades/s (or 1%/3 sec) According to test level 3 	<ul style="list-style-type: none"> to simulate electromagnetic fields radiated by different transmitters; the test shall be confined to the appliances exposed to direct radiation by transmitters at their place of installation. performance criterion A (See Note 5) <p>** If for tests of equipment an input signal with a modulation frequency of 1000 Hz is necessary a modulation frequency of 400 Hz may be chosen.</p>

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15.	Conducted low frequency	IEC 60533	<p>AC:</p> <ul style="list-style-type: none"> • Frequency range :rated frequency to 200th harmonic; • Test voltage (rms) : 10% of supply to 15th harmonic reducing to 1% at 100th harmonic and maintain this level to the 200th harmonic, min 3 V r.m.s, max 2 W. <p>DC:</p> <ul style="list-style-type: none"> • Frequency range : 50 Hz - 10 kHz; • Test voltage (rms) :10% of supply max. 2 W 	<ul style="list-style-type: none"> • to stimulate distortions in the power supply system generated for instance, by electronic consumers and coupled in as harmonics; • performance criterion A (see Note 5). • See figure – test set-up
16.	Conducted radio frequency	IEC 61000-4-6	<p>AC, DC, I/O ports and signal/control lines:</p> <ul style="list-style-type: none"> • Frequency range : 150 kHz-80 MHz • Amplitude : 3 V rms (See Note 6) • Modulation ***: 80% AM at 1000 Hz • Frequency sweep range: $\leq 1.5 \times 10^{-3}$ decades/s (or 1%/3sec.) • According to test level 2. <p>For bridge and deck mounted equipment (in accordance with IEC 60945):</p> <ul style="list-style-type: none"> • Amplitude 10V rms; at Spot frequencies: 2, 3, 4, 6.2, 8.2, 12.6, 16.5 18.8, 22 and 25MHz • Modulation: 80% $\pm 10\%$ at 1000 Hz $\pm 10\%$; or 400 Hz $\pm 10\%$ where an input signal at a modulation frequency of 1000 Hz is necessary. 	<ul style="list-style-type: none"> • Equipment design and the choice of materials shall stimulate electromagnetic fields coupled as high frequency into the test specimen via the connecting lines. • performance criterion A (see Note 5) <p>*** If for tests of equipment an input signal with a modulation frequency of 1000 Hz is necessary a modulation frequency of 400 Hz may be chosen.</p>

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17.	Burst/fast transients	IEC 61000-4-4	<ul style="list-style-type: none"> • Single pulse rise time: 5ns (between 10% and 90% value) • Single pulse width: 50 ns (50% value) • Amplitude (peak): <ul style="list-style-type: none"> • 2kV line on power supply port/earth; • 1kV on I/O data control and communication ports (coupling clamp) • Pulse period: 300 ms; • Burst duration: 15 ms; • Duration/polarity: 5 min • According to test level 3. 	<ul style="list-style-type: none"> • arcs generated when actuating electrical contacts; • interface effect occurring on the power supply, as well as at the external wiring of the test specimen; • performance criterion B (see Note 4)
18.	Surge/voltage	IEC 61000-4-5	<p>Open-circuit voltage:</p> <ul style="list-style-type: none"> • Pulse rise time: 1.2 μs (front time) • Pulse width: 50 μs (time to half value) • Amplitude (peak) : 1kV line/earth; 0.5kV line/line <p>Short-circuit current:</p> <ul style="list-style-type: none"> • Pulse rise time: 8 μs (front time) • Pulse width: 20 μs (time to half value) • Repetition rate: \geq 1 pulse/min • No of pulses: 5 per polarity • Application: continuous • According to test level 2. 	<ul style="list-style-type: none"> • interference generated for instance, by switching "ON" or "OFF" high power inductive consumers; • test procedure in accordance with figure 10 of the standard for equipment where power and signal lines are identical; • performance criterion B (see Note 4)

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19.	Radiated emission (less than 1GHz)	CISPR 16-1, 16-2	<p>For equipment installed in the bridge and deck zone.</p> <ul style="list-style-type: none"> Frequency range: quasi peak Limits : <ul style="list-style-type: none"> 0.15-0.3 MHz: 80-52dBμV/m 0.3-30 MHz: 52-34dBμV/m 30 - 1000MHz: 54dBμV/m except for: <ul style="list-style-type: none"> 156-165 MHz: 24 dBμV/m <p>For equipment installed in the general power distribution zone.</p> <ul style="list-style-type: none"> Frequency range: quasi peak Limits: <ul style="list-style-type: none"> 0.15 - 30 MHz: 80 - 50 dBμV/m 30-100 MHz: 60-54 dBμV/m 100 - 1000 MHz: 54 dBμV/m except for: <ul style="list-style-type: none"> 156-165 MHz: 24 dBμV/m 	<ul style="list-style-type: none"> procedure in accordance with the standard but distance 3 m between equipment and antenna Alternatively the radiation limit at a distance of 3 m from the enclosure port over the frequency 156 MHz to 165 MHz shall be 30 dB micro-V/m peak.
20.	Radiated emission above 1GHz	CISPR 16-1, 16-2	<ul style="list-style-type: none"> Frequency range: Limits: <ul style="list-style-type: none"> 1-3 GHz: 50dBμV/m average, 70dBμV/m peak 3-6 GHz: 54dBμV/m average, 74dBμV/m peak <p>The limits of this test depends on the maximum used frequency within the EUT.</p> <ul style="list-style-type: none"> <108 MHz : not applicable 108 MHz - 500 MHz: 2 GHz 500 MHz – 1 GHz: 5 GHz Above 1 GHz: 6 GHz 	<ul style="list-style-type: none"> distance 3 m between equipment and antenna
21	Conducted emission	CISPR 16-1, 16-2	<p>For equipment installed in the bridge and deck zone.</p> <ul style="list-style-type: none"> Frequency range: Limits: <ul style="list-style-type: none"> 10-150kHz: 96 - 50dBμV 150-350 kHz: 60 - 50 dBμV 350 kHz-30 MHz: 50 dBμV <p>For equipment installed in the</p>	.

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			<p>general power distribution zone.</p> <ul style="list-style-type: none"> • Frequency range: Limits: <ul style="list-style-type: none"> • 10-150 kHz: 120 - 69 BμV • 150-500kHz: 79dBμV • 0.5 - 30 MHz: 73 dBμV 	
22.	Flame retardant	IEC 60092-101 or IEC 60695-11-5	<ul style="list-style-type: none"> • Flame application: 5 times 15 s each. • Interval between each application: 15s or 1 time 30s. • Test criteria based upon application. <p>The test is performed with the EUT or housing of the EUT applying needle-flame test method.</p>	<ul style="list-style-type: none"> • the burnt out or damaged part of the specimen by not more than 60 mm long • no flame, no incandescence or • in the event of a flame or incandescence being present, it shall extinguish itself within 30 s of the removal of the needle flame without full combustion of the test specimen • any dripping material shall extinguish itself in such a way as not to ignite a wrapping tissue. The drip height is 200 mm \pm 5 mm
23	Compass safe distance measurement	IEC 60945		<ul style="list-style-type: none"> • the test is applied to equipment intended for installation on the navigation bridge
24	Acoustic noise and signals measurement	IEC 60945		<ul style="list-style-type: none"> • the test is applied to equipment intended for installation on the navigation bridge
25	Enclosure Ingress Protection	IEC Publication 60529 "Degrees of protection provided by enclosures (IP code)" or an acceptable National Standard.	<ul style="list-style-type: none"> • minimum IP56 for open deck 	

Notes:

1. Equipment to be mounted in consoles, housing etc. together with other equipment shall be tested with 70°C.

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- For equipment installed in non-weather protected locations or cold locations test shall be carried out at -25°C .
- Salt mist test shall be carried out for equipment installed in weather exposed areas.
- Performance Criterion B: (For transient phenomena): The EUT shall continue to operate as intended after the tests. No degradation of performance or loss of function is allowed as defined in the technical specification published by the manufacturer. During the test, degradation or loss of function or performance which is self-recoverable is however allowed but no change of actual operating state or stored data is allowed.

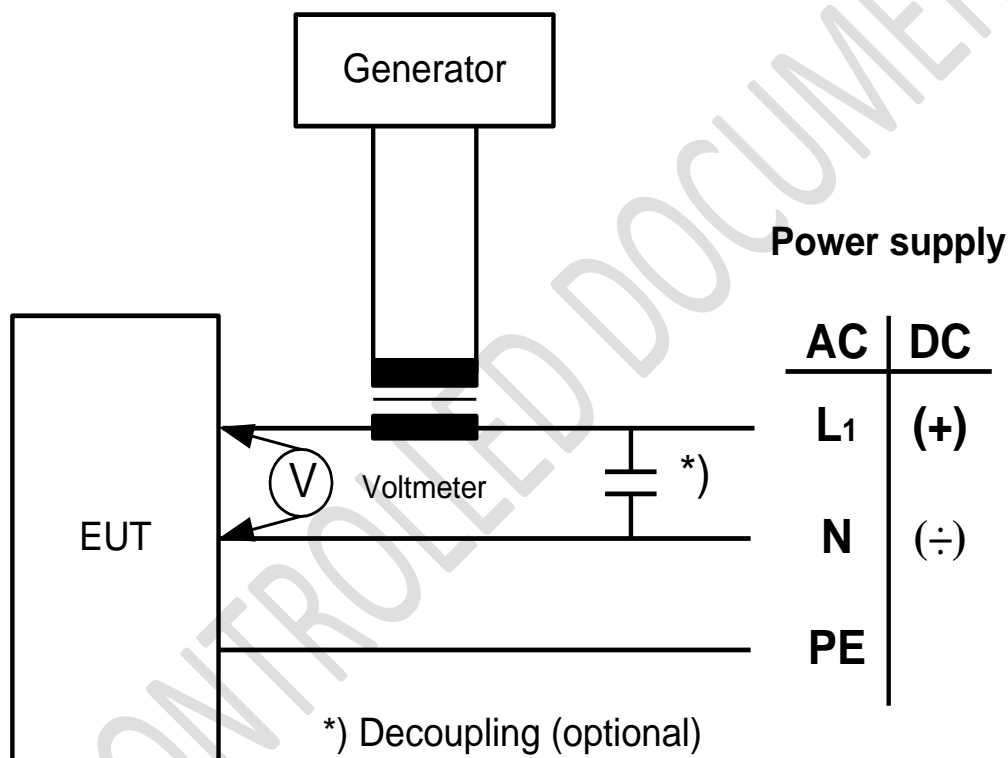


Figure - Test Set-up – Conducted Low Frequency Test