STANDARD FOR CERTIFICATION
No. 2.9 Approval Programmes

Type Approval Programmes for
EU recognised organisation Mutual Recognition (MR)
No. MR-A003

Computers and
Programmable Logic Controllers

JULY 2013

The electronic pdf version of this document found through http://www.dnv.com is the officially binding version

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CHANGES – CURRENT

General
This is a new document.
The document enters into force July 2013.
The remaining pages of this document are the exact text and format as agreed between the 12 EU recognised organisations.
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1. PRODUCT DESCRIPTION

1.a General description of the product
Computers and programmable logic controllers (PLC) intended to be used in systems that provide control, monitoring, alarm and safety functions that are subject to classification requirements. Aids to navigation and loading instruments are excluded.

1.b Application limitations
(a) The approval shall cover hardware only. This excludes firmware, application software, and hardware designed for specific applications subject to classification. Firmware, system software, and application software are subject to additional separate approval, according to UR E22 and the rules of the classing RO (FAT and on-board review / tests).
(b) The term PLC is here meant to comprise elements such as backplanes, power supplies, CPUs, I/O units and bus communication units when these are considered an integral part, or natural extension, of the PLC. Sensors and actuators typically connected to the PLC in a system are not considered part of the PLC and are excluded from the scope of this programme.
(c) Hardware intended for use in radio- or navigational applications where testing according to IEC Publication 60945 is required is excluded from the scope of this programme. E.g. use in systems covered by the Marine Equipment Directive.
1.c  Intended use
Control, monitoring, alarm, and safety functions provided by computer / PLC based systems subject to classification requirements.

1.d  System context
Application of the control, monitoring, alarm, and safety systems are subject for approval of the individual RO classing the vessel.

2. DESIGN EVALUATION

2.a  Engineering evaluation requirements

2.a i. Technical Requirements

Ambient Conditions
(a) The ambient condition given in Table 2.1 shall be applied to the design, selection and arrangement of electrical installations in order to ensure their proper operation.
(b) Electrical equipment shall be suitable for operations up to 55°C, regardless of location.
(c) Electrical equipment shall be designed to withstand any vibrations that occur under normal conditions.
(d) Electrical equipment, or the installation of electrical equipment, shall be provided with a degree of protection appropriate to the location, as a minimum the requirements of IEC Publication 60092-504. Electrical equipment shall have a minimum degree of protection equivalent to IP20, regardless of location or installation.

Voltage and Frequency
Electrical equipment supplied from main and emergency switchboards shall be designed and manufactured so that it is capable of operating satisfactorily under the normally occurring voltage and frequency fluctuations. Such electrical equipment shall operate satisfactorily under those fluctuations in voltage and frequency that are given in Table 2.2. Any special systems, e.g. electronic circuits, whose functions cannot operate satisfactorily, within the limits given in this table, shall be supplied by suitable means, i.e. through stabilized supply.

Construction, Materials, Installations, etc.
(a) All electrical equipment shall be constructed and installed so as not to cause injury when handled and touched in a normal manner.
(b) Insulating materials and insulated windings shall be resistant to moisture, sea air and oil vapours.
(c) Bolts, nuts, pins, screws, terminals, studs, springs and such other small parts shall be made of corrosion resistant material or to be suitably protected against corrosion.
2.a.ii. Technical documents to be submitted:

For all documentation, the English language shall be used.

(a) Drawings, schematics and functional description necessary to describe all parts of the equipment. The functional description can be in the form of user manuals, installation manuals, etc. as relevant.

(b) Drawings and product specification of physical/electrical and logical interfaces including signal format, converters, I/O-cards, protective circuitry, data protocol, cabling, and required configuration.

(c) Hardware, firmware and system software information necessary to identify the equipment under test. (Application software shall not be reviewed in the framework of type approval of computers / PLC).

(d) Functional tests that are required by tests according to Table 2.3 have to be defined. The tests shall be suitable to monitor all types of signal interfaces, inputs and outputs reliably. The necessary application program, wiring and description of the functional verification should be part of the submitted test program and test reports.

   Note:
   The Manufacturer may submit the draft test programmes to the RO for verification prior to the commencement of any environmental & performance type testing. A certificate of accreditation for the selected laboratory(ies) is generally a demand.

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(e) Environmental- and Performance type test reports.

(f) Special operational limitations, if any.

(g) Documentation about the Production quality assurance system.

(h) Product marking.

2.b Type testing requirements

(a) Tests shall be carried out in accordance with the testing condition and method of the latest revision of IACS UR E10 with modifications given in Table 2.3 in the presence of the RO’s surveyor, and they shall be proven to satisfy the criteria of the last revision of IACS UR E10 and Table 2.3. In case the tests are conducted at a Nationally Accredited Laboratory, the presence of the RO’s surveyor may be omitted.

(b) In cases where the RO's surveyor is not present for testing, the RO shall require to perform/witness the "Visual inspection" and "Performance test" as described by items 1 and 2 of Table 2.3.

(c) All type testing shall be documented in accordance with ISO/IEC 17025.

(d) It is the manufacturers’ responsibility to make sure that the type testing is performed in accordance with approved test programme so being acceptable to the RO.

(e) All tests are normally to be carried out on the same unit. Using different units for the different type of tests is acceptable provided that all EMC tests are
carried out on the same unit(1), and all environmental tests are carried out on the same unit(2).

3. PRODUCTION REQUIREMENTS
Refer to “EU RO Production Quality Assurance”

4. MARKING REQUIREMENTS
Manufacturers of the approved equipment are, in principle, to mark the product before shipment for identification of approved equipment and, in addition, at least the following items to be marked at the suitable place:
(a) Manufacturer’s name or equivalent,
(b) Type No. or symbol,
(c) Serial No. and date of manufacture,
(d) Particulars or ratings.

5. TYPE APPROVAL CERTIFICATE CONTENT
(a) Certificate number,
(b) Name and address of manufacturer,
(c) Issue date and validity of certificate / expiry date,
(d) Product description,
(e) Type / model name(s),
(f) Technical specifications, ratings,
(g) List of approval documents,
(h) Rules / standards applied,
(i) Test items and test levels applied,
(j) Approval conditions including limitations, if any,
(k) Hardware, firmware, system software names / versions.

6. APPROVAL DATE AND REVISION NUMBER

<table>
<thead>
<tr>
<th>Date</th>
<th>Revision</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-04-30</td>
<td>0.0</td>
<td>Accepted by Advisory Board</td>
</tr>
</tbody>
</table>

7. BACKGROUND INFORMATION / REFERENCES
(a) IACS UR E10 “Test specification for type approval”
(b) IEC 60945 “Maritime Navigation and Radio communication Equipment and Systems – General Requirements”
(c) IEC 60533 “Electrical and electronic installations in ships – Electromagnetic compatibility”
(d) IACS UR E22 "On Board Use and Application of Programmable Electronic Systems"
Table 2.1 – Angles of Inclination

<table>
<thead>
<tr>
<th>Static inclination</th>
<th>Dynamic inclination</th>
</tr>
</thead>
<tbody>
<tr>
<td>22.5° (Note 1)</td>
<td>22.5° (Note 1)</td>
</tr>
</tbody>
</table>

Note 1: 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)

<table>
<thead>
<tr>
<th>Type of fluctuation</th>
<th>Fluctuation (Note 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Permanent</td>
</tr>
<tr>
<td>Voltage</td>
<td>±10%</td>
</tr>
<tr>
<td>Frequency</td>
<td>±5%</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Type of fluctuation</th>
<th>Fluctuation (Note 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage fluctuation (Permanent)</td>
<td>±10%</td>
</tr>
<tr>
<td>Voltage cyclic fluctuation deviation</td>
<td>5%</td>
</tr>
<tr>
<td>Voltage ripple</td>
<td>10%</td>
</tr>
</tbody>
</table>

(c) Voltage fluctuations for battery systems

<table>
<thead>
<tr>
<th>Systems</th>
<th>Fluctuation (Note 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Components connected to the battery during charging (Note 3)</td>
<td>±30%, -25%</td>
</tr>
<tr>
<td>Components not connected to the battery during charging</td>
<td>±20%, -25%</td>
</tr>
<tr>
<td>All components</td>
<td>25% (2 s duration)</td>
</tr>
</tbody>
</table>

Note 1: A.C. distribution systems mean a.c. generator circuits and a.c. power circuits produced by inverters.
Note 2: D.C. distribution systems mean d.c. generator circuits and d.c. power circuits produced by converters.
Note 3: Different voltage fluctuations as determined by charging and discharging characteristics, including voltage ripples from the charging devices, may be considered.
Note 4: The numerical values given in the table, excluding those values for time, mean percentages of rated values.
# EU Mutual Recognition Technical Requirements

**Computers and programmable logic controllers**

<table>
<thead>
<tr>
<th>Date</th>
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</tr>
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<tbody>
<tr>
<td>2013-04-30</td>
<td>0.0</td>
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</tbody>
</table>

## Table 2.3 – Modified testing condition and method of IACS UR E10

<table>
<thead>
<tr>
<th>NO.</th>
<th>TEST</th>
<th>PROCEDURE ACC. TO:*</th>
<th>TEST PARAMETERS</th>
<th>OTHER INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Visual inspection</td>
<td>-</td>
<td>-</td>
<td>- conformance to drawings, design data, marking of product, quality of workmanship and construction</td>
</tr>
</tbody>
</table>
| 2.  | Performance test | Manufacturer performance test programme based upon specification and relevant Rule requirements. | - standard atmosphere conditions  
- temperature: 25°C ± 10°C  
- relative humidity: 60% ± 30%  
- air pressure: 96 kPa ± 10 kPa | - 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 | - | - 3 interruptions during 5 minutes;  
- switching-off time 30 s each case | - 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:  
- equipment behaviour upon loss and restoration of supply;  
- possible corruption of programme or data held in programmable electronic systems, where applicable. |
| 4.  | Power supply variations | - | AC SUPPLY | - power supply variations  
| | | | | DC SUPPLY |
| | | | | Verification of:  
- equipment behaviour upon loss and restoration of supply;  
- possible corruption of programme or data held in programmable electronic systems, where applicable. |

| Combi 
nation | Voltage variation permanent % | Frequency variation permanent % |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+10</td>
<td>+5</td>
</tr>
<tr>
<td>2</td>
<td>+10</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>
<td>transient</td>
<td>1.5 s</td>
<td>transient 5 s %</td>
</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>

Electric battery supply:  
- +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.
### EU Mutual Recognition Technical Requirements

**Computers and programmable logic controllers**

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</table>
| 5.  | Dry heat | IEC Publication 60068-2-2 | Temperature: 55°C ± 2°C  
Duration: 16 hours  
or  
Temperature: 70°C ± 2°C  
Duration: 16 hours (see note 1) | - equipment operating during conditioning and testing;  
- performance 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 | Temperature: 55°C  
Humidity: 95%  
Duration: 2 cycles 2 x (12 +12 hours) | - measurement of insulation resistance before test;  
- the test shall start with 25°C±3°C and at least 95% humidity  
- equipment operating during the complete first cycle and switched off during second cycle except for performance test;  
- performance 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. |
| 7.  | Vibration | IEC Publication 60068-2-6 Test Fc | Hz to 13.2 Hz – amplitude ±1mm  
13.2 Hz to 100 Hz – acceleration ± 0.7 g.  
≥ 30 severe vibration conditions such as, e.g. on diesel engines, air compressors, etc.:  
2.0 Hz to 25 Hz – amplitude ±1.6 mm  
25.0 Hz to 100 Hz – acceleration ± 4.0 g.  
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 ± 10.0g at 600°C, duration 90 min. | - duration in case of no resonance condition 90 minutes at 30 Hz;  
- duration at each resonance frequency at which Q ≥ 2 is recorded - 90 minutes;  
- during the vibration test, performance tests shall be carried out;  
- tests to be carried out in three mutually perpendicular planes;  
- Q should not exceed 5;  
- mechanical resonances with amplification greater than 10 will not be accepted.  
- 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 |
### EU Mutual Recognition Technical Requirements

**Computers and programmable logic controllers**

**Version**: 0.0  
**Date**: 2013-04-30

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</table>
| 8.  | Inclination | Publication IEC 60092-504 | Static 22.5° and Dynamic 22.5° | a) inclined to the vertical at an angle of at least 22.5°  
b) inclined to at least 22.5° on the other side of the vertical and in the same plane as in (a),  
c) inclined to the vertical at an angle of at least 22.5° in plane at right angles to that used in (a),  
d) inclined to at least 22.5° on the other side of the vertical and in the same plane as in (c).  
Note: The period of testing in each position should be sufficient to fully evaluate the behaviour of the equipment.  
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 liquified gases and chemicals, the emergency power supply shall remain operational with the ship flooded up to a maximum final athwart ship inclination of 30°.  
Note: These inclination tests are normally not required for equipment with no moving parts. | |
| 9.  | Insulation resistance | 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                     |
|     |                  |                        |                      |                        | - for high voltage equipment, reference is made to 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.  
Note: Certain components e.g. for EMC protection may be required to be disconnected for this test. |
| 10. | High voltage     | Rated voltage Un (V)  | Test voltage (A.C. voltage 50 or 60Hz) (V) |                      |                        |
|     |                  |                        |                     |                      | - for high voltage equipment, reference is made to 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 |
|     | Up to 65         | 2 x Un + 500          |                      |                        |
|     | 66 to 250        | 1500                  |                      |                        |
|     | 251 to 500       | 2000                  |                      |                        |
|     | 501 to 690       | 2500                  |                      |                        |
| 11. | Cold             | IEC Publication 60068-2-1 | Temperature: +5°C ± 3°C Duration: 2 hours or Temperature: –25°C ± 3°C Duration: 2 hours (see note 2) | - initial measurement of insulation resistance;  
- equipment not operating during conditioning and testing except for performance test;  
- performance test during the last hour at the test temperature;  
- insulation resistance measurement and the performance test after recovery |
### EU Mutual Recognition Technical Requirements

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| 12  | Salt mist | IEC Publication 60068-2-52 Test Kb | Four spraying periods with a storage of 7 days after each | - initial measurement of insulation resistance and initial performance test;  
- equipment not operating during conditioning;  
- performance test on the 7th day of each storage period;  
- insulation resistance measurement and performance test 4 to 6h after recovery. (see Note 3)  
- on completion of exposure, the equipment shall be examined to verify that deterioration or corrosion (if any) is superficial in nature. |
| 13  | Electrostatic discharge | IEC 61000-4-2 | Contact discharge: 6kV  
Air discharge: 8kV  
Interval between single discharges: 1 sec.  
No. of pulses: 10 per polarity  
According to test level 3. | - 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  | Electromagnetic field | IEC 61000-4-3 | Frequency range: 80 MHz to 2 GHz  
Modulation**: 80% AM at 1000Hz  
Field strength: 10V/m  
Frequency sweep rate: d1.5 x 10³ decades/s (or 1%/3 sec)  
According to test level 3. | - 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)  
**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. |
| 15  | Conducted low Frequency | AC: 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.  
DC: Frequency range: 50 Hz - 10 kHz;  
Test voltage (rms): 10% of supply max. 2 W | - 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 | AC, DC, I/O ports and signal/control lines: Frequency range: 150 kHz - 80 MHz  
Amplitude: 3 V rms (See Note 6)  
Modulation ***: 80% AM at 1000 Hz  
Frequency sweep range: d 1.5 x 10-3 decades/s (or 1%/3sec.)  
According to test level 2 | - 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).  
*** 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. |
<table>
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</table>
| 17  | Burst/Fast Transients       | IEC 61000-4-4       | Single pulse rise time: 5 ns (between 10% and 90% value)  
Single pulse width: 50 ns (50% value)  
Amplitude (peak): 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.                                                      | - 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 immunity              | IEC 61000-4-5       | Open-circuit voltage:  
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  
Short-circuit current:  
Pulse rise time: 8 μs (front time)  
Pulse width: 20 μs (time to half value)  
Repetition rate: 1 pulse/min  
No of pulses: 5 per polarity  
Application: continuous  
According to test level 2.                                                      | - 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).                                                                                                                                                                                                                                                                  |
| 19  | Radiated Emission           | CISPR 16-1, 16-2    | For equipment installed in the bridge and deck zone.  
For equipment installed in the general power distribution zone. | 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 dBμV/m peak.                                                                                                                                                                                                                   |
# EU Mutual Recognition Technical Requirements

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</tr>
</thead>
</table>
| 20. | Conducted Emission | CISPR 16-1, 16-2 | For equipment installed in the bridge and deck zone. | Frequencies range: Limits:  
10 - 150 kHz: 96 - 50 dBμV  
150 - 350 kHz: 60 - 50 dBμV  
350 kHz - 30 MHz: 50 dBμV  
For equipment installed in the general power distribution zone. | Frequencies range: Limits:  
10 - 150 kHz: 120 - 69 dBμV  
150 - 500 kHz: 79 dBμV  
0.5 - 30 MHz: 73 dBμV  |
| 21. | Flame retardant | IEC 60992-101 or IEC 60695-11-5 | Flame application: 5 times 15 s each. Interval between each application: 15 s or 1 time 30 s. Test criteria based upon application. | IEC 60992-101: The test is performed with the EUT or housing of the EUT applying needle-flame test method. | - 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.  |
| 22. | Compass safe distance measurement | IEC 60945 | | | - the test is applied to equipment intended for installation on the navigation bridge |
| 23. | Acoustic noise and signals measurement | IEC 60945 | | | - the test is applied to equipment intended for installation on the navigation bridge |

Notes:
1. Equipment to be mounted in consoles, housing etc. together with other equipment shall be tested with 70°C.  
2. For equipment installed in non-weather protected locations or cold locations test shall be carried out at –25°C.  
3. Salt mist test shall be carried out for equipment installed in weather exposed areas.  
4. 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.  
5. Performance Criterion A: (For continuous phenomena): The Equipment Under Test shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed as defined in relevant equipment standard and the technical specification published by the manufacturer.  
6. For equipment installed on the bridge and deck zone, the test levels shall be increased to 10V rms for spot frequencies in accordance with IEC 60945 at 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22, 25 MHz.
Figure - Test Set-up – Conducted Low Frequency Test