RULES

PUBLICATION 75/P

ENVIRONMENTAL TESTS ON NAVAL SHIPS EQUIPMENT

January
2006

Publications P (Additional Rule Requirements) issued by Polski Rejestr Statków
complete or extend the Rules and are mandatory where applicable.

GDAŃSK

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PRS/RP, 12/2005

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1 GENERAL

1.1 Application

1.1.1 The present *Publication* specifies the scope and conditions of conducting type tests of products which constitute or are elements of:
- electrical equipment,
- automatic systems,
- computer systems,

to be installed on naval ships.

The present *Publication* may be also applied to type tests of other electrical equipment subject to survey.

1.1.2 In the case of products intended to operate in conditions more severe than those specified in the present *Publication* (see *Part VIII – Electrical Equipment and Automation*, sub-chapter 2.1), the scope and parameters of the tests are subject to special consideration by the *Naval Authority*.

Note: the term *Naval Authority* means PRS or other organization conducting survey of a naval ship or product to be installed on a naval ship.

1.1.3 Type tests of navigational and radio equipment are to be carried out in accordance with the requirements specified in Publication IEC 60945.

1.2 Tests – General

1.2.1 The prototype of the product is to be subjected to tests specified in Chapter 2. It is recommended that the sequence of the tests should be as specified in Chapter 2. The *Naval Authority* may require that series-manufactured products should be also subjected, within full or a limited scope, to the tests.

1.2.2 Unless expressly provided otherwise in the description of particular tests, the tests are to be carried out in the following atmosphere conditions, hereinafter referred to as standard atmosphere conditions:

Temperature:	25 °C ± 10 °C
Relative humidity:	60% ± 30%,
Atmospheric pressure:	960 hPa ± 100 hPa

1.2.3 Unless expressly provided otherwise in the description of particular tests, standard power supply conditions are to be maintained during the tests, i.e.:
- rated voltage and rated frequency of electric energy,
- rated supply pressure of pneumatic and hydraulic systems.

1.3 Definitions

Vibration effects – changes of properties, as well as mechanical resonance occurring in the product due to vibrations.

Preconditioning – exposing the product to specific environmental factors in order to obtain its characteristics as required for preliminary measurements and checks.

Standard atmospheric conditions – the values of temperature, relative humidity and atmospheric pressure specified in 1.2.2.

Recovery – exposing the product to specific environmental factors in order to stabilize its characteristics before the final measurements and checks.

2 TESTS

2.1 Visual Inspection

During visual inspection it is to be verified, as far as it is practicable without the use of tools and the product dismantling, that the product complies with the requirements and data contained in the approved technical documentation.

2.2 Performance Tests

The purpose of the tests is to ascertain that the product operates in compliance with the specified requirements.

For electrical supply devices or devices that transform electric energy used in the ship's network, changes of the electric energy parameters during the tests performed according to sub-chapter 1.2 cannot exceed the values given in Table 2.2, unless provided otherwise in the description of the tests.

Table 2.2

Voltage	rated voltage rated voltage tolerance : the mean of three line-to-line voltages line-to-line-voltage unbalance tolerance voltage modulation transitional voltage tolerance transitional voltage return time voltage surge	400 V ± 5% ± 7% 2% ± 16% 2 s 2.5 kV
Voltage wave form	total harmonic distortion single harmonic deviation ratio	5% 3% 5%
Frequency	Rated Frequency tolerance Frequency modulation Transitional frequency tolerance Transitional frequency return time	50 Hz ± 3% 0.5% ± 4% 2 s

With respect to computer systems, the purpose of the tests is to check their self–monitoring features and protection against an unauthorized access to the computer memory.

2.3 "Power Supply Failure" Test

Power supply is to be interrupted three times within a 5-min period. The switching off time is to be 30 seconds in each case.

The product is to operate properly after the test.

2.4 "Power Supply Variations" Test

2.4.1 Electric Energy

The product is to be supplied with electric energy according to combinations given in Table 2.4.1-1 or 2.4.1-2 and the measurements as well as verifications, provided by the test programme, are to be performed.

Table 2.4.1-1

A.C. power supply		
	Deviation from rated value, [%]	
Combination No.	Voltage	Frequency
	Permanent deviation (at least 15 min.)	
1	+6	+5
2	+6	–5
3	–10	–5
4	–10	+5
	Transient deviation	
	1.5 s	5 s
5	+20	+10
6	–20	–10

Table 2.4.1-2

D.C. power supply	
Voltage variations	Deviation from rated value, [%]
continuous voltage variation	± 10
cyclic voltage variation	5[1)]
voltage ripple	10[2)]

1) variation frequency – 250 to 350 Hz
2) ripple duration – 0.5s.

The battery supplied product is to be additionally fed, for at least 15 minutes, with electric energy of the voltage:
- 25% lower and 30% higher than the rated value – for the product connected to the battery during charging;
- 25% lower and 20% higher than the rated value – for the product not connected to the battery during charging.

On completion of the test, the product is to be checked for failure and for operational capability.

2.4.2 Hydraulic and Pneumatic Energy

The product is to be supplied, for 15 minutes, with hydraulic or pneumatic energy of the pressure varying within ±20%.

On completion of the test, the product is to be checked for failure and for operational capability.

2.5 "Dry Heat" Test

(Test B in accordance with Publication IEC 60068-2-2 or test in accordance with the relevant military standard, if applicable)

The switched on product is to be placed in a chamber in standard atmosphere conditions and the chamber temperature is then to be raised up to the value T_p within τ_1 time period. After the temperature of the product has stabilized, the T_p temperature and the corresponding relative humidity RH_w are to be maintained for τ_p period of time. During the last hour of the exposure, the product is to be subjected to performance tests. Next, within τ_2 time period, the temperature is to be lowered to the standard value. The test parameters are given in Table 2.5.

τ_1 and τ_2 time periods are to be so selected that the rate of the temperature change, averaged for any 5 min period, will not exceed 1 °C/min.

After the product has reached the standard temperature, it is to be subjected to recovery, as well as to performance tests to check it for failure and for operational capability.

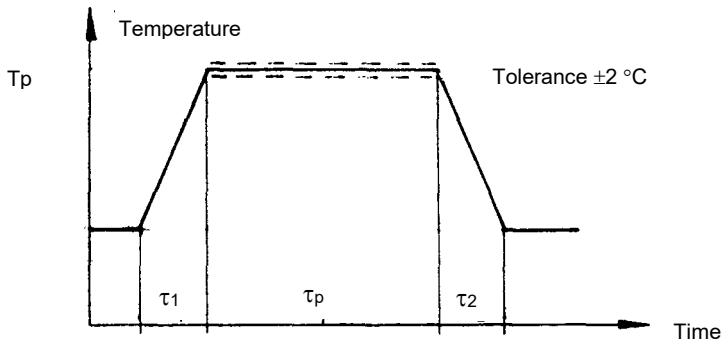


Table 2.5

Location of the product	T_p, [°C]	τ_p, [h]	RH_w, [%]
Air-conditioned space	55 ± 2	16	Less than 50
Non-air-conditioned space	70 ± 2	2	Less than 50

The cooling system of the product (if provided) is to be connected to the appliance during preconditioning and testing.

2.6 "Damp Heat–Cyclic" Test

(*Test Db in accordance with Publication IEC 60068-2-30 or test in accordance with the relevant military standard, if applicable*)

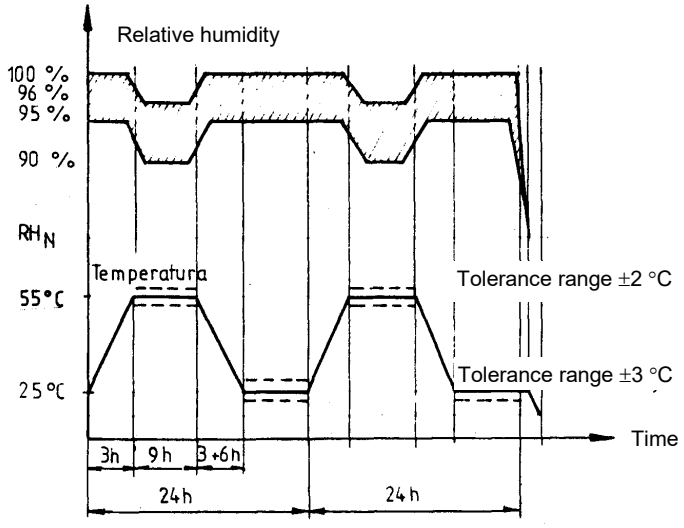
Before the test, insulation resistance is to be measured – see 2.17. The switched on product is then to be placed in a chamber at a temperature of 25±3 °C.

After the temperature of the product has stabilized, the relative humidity of the chamber is to be increased up to 95 ÷ 100%, within not more than 1h, and the 24h testing cycle is to be commenced.

While the relative humidity is maintained at 95–100%, the temperature is to be raised up to 55±2 °C within 3 hours. During the next 9 h, the temperature is to be maintained at 55±2 °C and the relative humidity at 90 – 96%. Then, within 3 – 6 hours, the temperature is to be lowered to reach 25±3 °C and maintained at this level to complete the 24 h cycle. During the temperature decrease stage until the end of the cycle the relative humidity should be maintained at 95-100%.

Two test cycles are to be performed. The product is to be switched on during the first testing cycle. During the second testing cycle, the product is to be switched off, except for performance tests.

Performance tests are to be carried out during the first two hours of the first testing cycle at a temperature of 55±2 °C, as well as during the last two hours of the second testing cycle at a temperature of 55±2 °C.



After the standard temperature has been attained, the product is to be subjected to recovery, performance tests and insulation resistance measurements.

2.7 "**Cold" Test** (*Test A in accordance with Publication IEC 60068–2-1 or test in accordance with the relevant military standard, if applicable*)

Before the test, insulation resistance is to be measured – see 2.17. The switched off product is then to be placed in a chamber at a standard temperature and, within τ_1 time period, the temperature is to be lowered to the value T_p. After the temperature of the product has stabilized, temperature T_p is to be maintained for τ_p time period. Next, the temperature is to be raised up to the standard value within τ_2 time period. The test parameters are given in Table 2.7.

τ_1 and τ_2 time periods are to be so selected that the rate of temperature change in the chamber, averaged for any 5 min period, will not exceed 1 °C/min.

Performance tests are to be carried out during the last hour of exposure to cold.

After the temperature has reached the standard value, the product is to be subjected to recovery, performance tests and insulation resistance measurements.

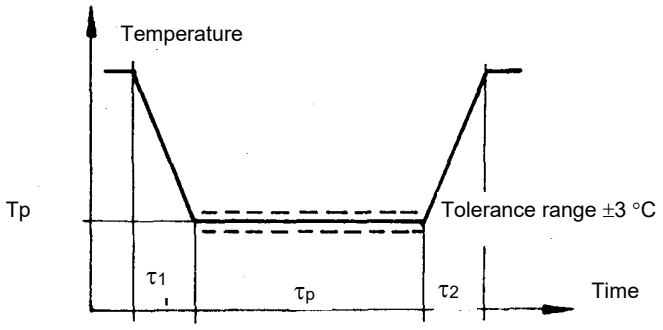


Table 2.7

Item	Location of the product	T_p, [°C]	τ_p, [h]
1	All places, except those specified in item 2	+5 ± 3	2
2	Non-weather-protected locations or cold locations	–25 ± 3	2

2.8 "Vibration resistance" Test (*Test Fc in accordance with NO–20–A500–4 Standard*)

2.8.1 Test Stands

Vibration resistance tests are to be performed using test stands capable of generating forced vibrations and characterized by the following technical parameters.

Forced vibrations – frequency range from 5 Hz to 500 Hz; the measuring accuracy – not less than ± 1Hz for frequencies not greater than 100 Hz and not less than ± 1 % for higher frequency.

Displacement amplitude – up to 2.0 mm; the accuracy of amplitude setting and measurement is to be not less than ± 10 %.

The vibration table control system is to allow continuous forced vibrations frequency tuning and continuous adjustment of vibration amplitude within the whole operation range.

2.8.2 Test Methods

The equipment under test is to be symmetrically mounted on the vibration table. The equipment not normally mounted on shock absorbers and the equipment blocks are to be fastened to the vibration table directly or by means of additional elements as follows:
- equipment normally mounted during operation – in its fixing points,
- equipment not normally mounted during operation – using additional elements that ensure reliable and rigid attachment to the vibration table;
- equipment divided into blocks or parts is to be attached to the vibration table as described above.

The equipment normally mounted on shock absorbers is to be tested with absorbers. Where it is necessary to test such equipment without shock absorbers, this, together with vibration hazards values should be stated in the test programme.

The equipment is to be tested in the normal operational configuration and is to be subjected to vibrations in three mutually perpendicular directions:
- horizontal transverse – H,
- horizontal longitudinal – L,
- vertical – V.

The equipment under test is classified according to Table 2.8.2.

Table 2.8.2

Equipment group	Equipment	Equipment enclosure group	Environmental conditions
M.1	Surface ships and submarines equipment	M.1.1	Equipment designed for installation in special spaces, wheelhouses, control stations and accommodation spaces
		M.1.2	Equipment designed for installation in machinery spaces, holds and boiler rooms
		M.1.3	Equipment designed for installation on open decks, outside ship spaces
		M.1.4	Equipment designed for direct immersion in water (overboard and in floodable compartments), including towed equipment and lowered into water equipment
M.2	Cutters and hydrofoil (craft) equipment	M.2.1	Equipment designed for installation in below deck spaces (compartments, wheelhouses, combat stands, machinery spaces, steering gear compartments) and holds

Equipment group	Equipment	Equipment enclosure group	Environmental conditions
		M.2.2	Equipment designed for installation in open stands, outside ship spaces
		M.2.3	Equipment designed for direct immersion in water, including towed equipment
M.3	Equipment fitted directly on the engines	M.3	Equipment fitted directly on the engines: fuel ejection pumps, circulating pumps, turbochargers, etc.
M.4	Stationary and mobile devices (excluding mines, buoys and other automatic devices) equipment	M.4.1	Equipment of devices laid by submarines and surface ships
		M.4.2	Equipment of devices dropped from flying apparatus
M.5	Jet depth charges and torpedoes equipment	M.5.1	Equipment of objects fired (or dropped) from surface ships and submarines
		M.5.2	Equipment of objects fired (or dropped) from flying apparatus

2.8.3 Structure Resonance Search Test

The purpose of the test is to detect resonances in any part of electrical equipment within the frequency range below 40 Hz.

The equipment under test may be mounted with enclosures removed to enable to observe obvious signs of any resonances of the equipment components.

The equipment is to be tested in switched on or off condition (to be recorded in the test report), continuously changing the frequency of vibrations. The acceleration or displacement amplitudes are to be adequate to allow the detection of the resonance. The frequency sweeping time is to be sufficient to detect the resonance, but not shorter than 120 s in each frequency subrange. To facilitate measurements, it is allowed to decrease the frequency changes speed or even to stop the frequency change.

The recommended values of sinusoidal vibrations for structure resonance search test are given in Table 2.8.3.

Table 2.8.3

Frequency subrange Hz	Displacement amplitude $x10^{-3}m$	Acceleration amplitude m/s^2
5-10	0.8	3
10-20	0.8	8
20-25	0.5	12
25-30	0.5	20
30-35	0.5	20
35-40	0.3	20
Note: The tolerance on all values is + 10 %		

For M.1 equipment group, structure resonance search test is to be performed within the frequency range of 5 Hz to 25 Hz, for the remaining equipment specified in Table 2.8.2 – within the frequency range of 5 Hz to 40 Hz.

2.8.4 Sinusoidal Vibration Resistance Test

The purpose of this test is to determine the ability of electrical equipment to perform its desired functions and maintain its operating parameters within the specified limits when subjected to sinusoidal vibrations.

The switched on equipment is to be subjected to vibrations of the values given in Table 2.8.4, changing the frequency of vibrations from lower to upper frequency and vice versa, with a sweep ratio, over the given frequency subrange, not greater than 1 octave per 60 sec.

In well-justified cases discrete changing of frequency may be permitted. In such case the values of displacement and acceleration amplitude, given in Table 2.8.4, are to be used and technical parameters, given in technical specification, should be verified during the test.

The equipment exposure time to sinusoidal vibrations in each frequency subrange is to be sufficient to check the technical parameters given in technical specification but is to be not less than 120 s.

Where resonance vibrations of equipment with shock absorbers occur, the decrease by 50 % of displacement or acceleration amplitude within the equipment resonance frequency range of 0.7 to 1.4 is permitted.

Where the equipment is fitted with underslung elastic elements, vibrations acceleration may be decreased or test at resonance frequencies of the elements need not be carried out if these frequencies are determined in technical specification.

The tests of M.l and M.2 groups equipment within 0.7 to 1.4 shock absorbers resonance frequency range are to be performed without shock absorbers, applying the values given in Table 2.8.4. It is permitted to perform the above tests with shock absorbers, but in such case the values given in Table 2.8.4 are to be checked on the equipment. Description of vibration measuring point location on the equipment is to be included in test results.

Table 2.8.4

Equipment group or equipment enclosure group	Frequency subrange Hz	Displacement amplitude $x10^{-3}$m	Acceleration amplitude m/s^2
M.1 M.4.1	5-10	2.0	–
	10-18	1.0	–
	18-32	0.5	–
	32-60	–	20
M.5.1	5-10	1.0	–
	10-22	0.5	–
	22-35	–	10
M.2	5-15	2.0	–
	15-22	1.0	–
	22-32	0.5	–
	32-200	–	20
M.3 M.4.2 M.5.2	5-22	2.0	-
	22-36	1.0	–
	36-50	0.5	–
	50-500	-	50
Note: The tolerance on all values is + 10 %			

Should instability (within the limits stated in technical specification) of any parameter of the equipment occur, the equipment is to be subjected to additional vibrations for a duration of 15 minutes in each frequency range where instability occurred, unless stated otherwise in technical specification.

2.8.5 Equipment Resonance Test Result

The resonance test result is considered satisfactory if, in the required frequency range, the vibration acceleration, velocity or displacement amplitude measured on particular parts of the equipment is not twice or more the vibration acceleration, velocity or displacement amplitude measured on the equipment parts fixing points.

2.9 "Inclination" Test

(*in accordance with Publication IEC 60092–504 or test in accordance with the relevant military standard, if applicable*)

2.9.1 Static Inclination 22.5°

The switched on product is to be inclined from the vertical to an angle of at least 22.5° and then to at least 22.5° on the opposite side in the same plane.

Next the product is to be inclined from the vertical to an angle of at least 22.5° perpendicularly to the previous plane, then inclined to at least 22.5° on the opposite side in the same plane.

The period of testing in each position is to be sufficient to fully evaluate the product operation.

2.9.2 Dynamic Inclination 22.5°

2.9.3 The test is not required for products which are not provided with movable parts.

The switched on product is to be rolled to an angle of 22.5° on each side of the vertical in both planes, as specified in 2.9.1. The rolling period is to be 10 seconds. The test in each plane is to be carried out for at least 15 minutes.

During the test and on its completion, the product is to operate properly.

2.10 "Enclosure Protection" Test

The test on penetration of water and alien elements into the enclosure of products, having the specified protection level, is to be carried out according to standards agreed with PRS, e.g. IEC 60529 or other acceptance conditions approved by PRS.

2.11 "Salt Mist" Test

(*Test Kb in accordance with Publication IEC 60068–2–52 or test in accordance with the relevant military standard, if applicable*)

The test is intended for products exposed to sea weather conditions.

PRS may allow the test to be performed on the selected, representative parts of the product.

Before the test, insulation resistance of the product is to be measured in accordance with 2.17 and performance tests are to be carried out. Next, the switched off product is to be placed in a chamber and exposed to salt mist.

The product is to be exposed to sprayed salt solution 4 times for a period of 2h each, within the temperature range of 25 °C±10 °C. After each spraying, the product is to be kept for 7 days in a humidity chamber at a temperature of 40±2 °C and relative humidity of 93^{+2}_{-3} %.

A solution, prepared by dissolving 5±1 parts by weight of chemically pure natrium chloride in 95 parts by weight of distilled or demineralized water, is to be used as the spraying agent. The hydrogen ion exponent (pH) of the solution is to range between 6.5 and 7.2 at a temperature of 20±2°C. For pH control, diluted muriatic acid or sodium chloride is to be used.

The density of the salt mist is to be such that each 80 cm^2 of horizontal surface will be reached by at least 2 ml of the solution during 1 hour. The condensed mist is not to be reused.

The air used to produce the salt mist is to be free from oil and other contaminations, and is to be heated to allow the solution to reach the required temperature.

Performance test is to be carried out on the 7th day of each storage period in a humid environment.

After the test, the product is to be rinsed for 5 minutes in running water, then rinsed in distilled water, water drops being shaken off. Then, the product is to undergo recovery for a period from 1 hour to not more than 2 hours and is to be subjected to visual examination. The surface of metal parts is not to show significant corrosion. However, some traces of corrosion on sharp edges may be permitted.

Finally, after the lapse of 4 – 6 hours from the moment of removing the product from the chamber, insulation resistance measurement and performance tests are to be carried out.

2.12 Explosion and Intrinsic Safety Test

The tests of explosion and intrinsic safety of the equipment are to be performed according to valid standards. The tests are to be carried out in specialized and approved laboratories.

2.13 Test of Product Immunity to Gases Generated by Warfare Agents and Rocket Fuels

The test applies to products to be installed in armament equipment; it is to be performed according to valid standards in specialized and approved laboratories.

2.14 "Mould Growth" Test

(*Test J in accordance with Publication IEC 60068–2-10 or test in accordance with the relevant military standard, if applicable*)

The test is to be carried out on the switched off product. Upon agreement with PRS, in lieu of the assembled product, the product representative parts or samples of the relevant materials may be tested.

The product and 3 reference strips are to be sprayed with aqueous suspension of mould spores according to Table 2.14 and placed in a dark and tight container or chamber. Inside the container or chamber, the temperature of 29 °C±1 °C and the relative humidity of more than 90% are to be developed and maintained for 28 days. The temperature in the chamber or container are not to vary by more than 1 °C.

After 7 days of treatment, the chamber or container is to be opened, the growth of mould checked on reference strips and then the chamber tightly closed again. When no growth of mould on any of the strips is observed, the test is to be conducted again by using a fresh suspension of mould spores.

On 14th and 21st day of the test, the chamber or container is to be opened for 5 seconds or 5 minutes, depending on their volume.

The reference strips are to be made of clean white filter paper placed on Petri dishes, sterilized and soaked by means of modified solution of Czapek–Dox nutrient salt with saccharose.

On completion of the test, the product and the reference strips, immediately after being taken out of the chamber or container, are to be subjected to visual examination with the naked eye and 50–fold magnification. The product is considered to be resistant to mould growth when no focus of mould can be seen in 50–fold magnification or only some single germinated spores are observed.

Table 2.14

Item	Name of the spore
1	Aspergillus niger (v. Tieghem)
2	Aspergillus terreus (Thom)
3	Aureobasidium pullulans [/De Barry/Arnaud]
4	Paecilomyces varioti (Bainier)
5	Penicillium funicolosum (Thom)
6	Penicillium ochrochloron (Biourge)
7	Scopulariopsis brevicaulis [/Sacc./Bain Var. Glabra Thom.]
8	Trichoderma viride (Pers. ex Fries.)

2.15 "Electrostatic Discharge" Test

(*in accordance with IEC Publication 61000-4-2 or test in accordance with the relevant military standard, if applicable*)

The purpose of the test is to check the product resistance to electrostatic discharge which may occur when the product is touched by personnel.

Test parameters:
- contact discharge 6 kV
- air discharge 8 kV
- voltage polarization + , –
- discharge electrode according to IEC 61000-4-2.

First, the resistance of the product is to be checked while generating discharges to the earth clamp. The discharge is to be generated by means of discharge electrode which is to be moved towards and perpendicularly to discharge place plane, until the spark–over is reached and then the electrode is to be withdrawn.

At least 10 discharges of each voltage polarization are to be generated in different places on the product that can normally be reached by the personnel, the interval between single discharges being 1s.

After the test, the product shall continue to operate as intended. No degradation of performance or loss of function is allowed, as defined in the manufacturer's technical specification. 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.

For products fitted close to switchboards and power installations:

Frequency range	Permissible limit
10-150 kHz	120-69 dBμV
0.15-0.5 MHz	79 dBμV
0.5-30MHz	73 dBμV.

2.16 Electromagnetic Compatibility Tests – Test Methods and Application *(in accordance with PN-V-84010 Standard or STANAG 4435 and STANAG 4436)*

2.16.1 Test Methods

2.16.1.1 Test methods for determining the equipment characteristics and the interference characteristics are given in Tables 2.16.1.1a and 2.16.1.1b.

Table 2.16.1.1a
Test methods for emission level measurement

Test method	Tested equipment characteristics	Interference characteristics	
		Frequency range	Measured parameter
NCE 01	Conducted emission level – power lines	From 30Hz to 50MHz	Current
NCE 02	Conducted emission level – control and signal lines	From 30Hz to 50MHz	Current
NRE 01	Radiated emission level – magnetic field	From 30Hz to 50MHz	Magnetic induction
NRE 02	Radiated emission level –electric field	From 10kHz to 10GHz	Intensity of electric field

Table 2.16.1.1b
Test methods for susceptibility level measurement

Test method	Tested equipment characteristics	Interference characteristics	
		Frequency range	Measured parameter
NCS 01	Conducted susceptibility level – power line	From 30Hz to 100MHz	Voltage
NCS 02	Conducted susceptibility level – control and signal lines	From 30Hz to 100MHz	Current
NCS 03	Susceptibility level on pulse interference	Pulse interference	Peak voltage
NCS 04	Conducted susceptibility level – damped sinusoid	Sinusoid exponential damped	Peak current
NRS 01	Radiated susceptibility level – magnetic field	From 30Hz to 50kHz	Intensity of magnetic field
NRS 02	Radiated susceptibility level – electric field	From 10kHz to 40GHz	Intensity of electric field

2.16.2 Application

2.16.2.1 The applicability of test methods, specified in 2.16.1, is given in Table 2.16.2.1.

Table 2.16.2.1

Test method	Equipment									
	R	T	S	I	CE	DE	H/S	+ FS	–FS	EDP
NCE 01	+	+	+	+	+	+	+	+	+	+
NCE 02	+	+	+	+	+	+	+	+	+	–
NCS 01	+	+	+	+	+	+	+	+	–	–
NCS 02	+	+	+	+	+	+	+	+	–	–
NCS 03	+	+	+	+	+	+	+	+	–	–
NCS 04	+	+	+	+	–	+	+	+	–	–
NRE 01	+	+	+	+	+	–	+	+	+	–

Test method	Equipment									
	R	T	S	I	CE	DE	H/S	+ FS	–FS	EDP
NRE 02	+	+	+	+	+	+	+[1)]	+	+[2)]	+
NRS 01	+	+	+	+	+	–	+	+	–	–
NRS 02	+	+	+	+	+	+	+	+	–	+

Note – symbol description

R – receivers
T – transmitters
S – electric power supply
I – informatics technique equipment
CE – control equipment
DE – deck gear auxiliary equipment
H/S – hydroacoustic equipment (sonar)
+FS – electric equipment with ferrite elements and semiconductors
–FS – electric equipment without ferrite elements and semiconductors
EDP – electrically driven portable equipment

\+ Applicable

– Not applicable

2.17 Insulation Resistance Measurement

The insulation resistance is to be measured at the following tests:
– "damp heat–cyclic",
– "cold",
– "salt mist".

The insulation resistance measurement is to precede and succeed the test. The insulation resistance is to be not lower than the values given in Table 2.17.

Table 2.17

Rated voltage, [V]	Test voltage, [V]	Minimum insulation resistance	
		Preceding the test, [MΩ]	Following the test, [MΩ]
$U_n \leq 65$	2 x U_n, min. 24	10	1
$U_n > 65$	500	100	10

The insulation resistance is to be measured subsequently between each phase (pole) and the earth. Certain elements, i.e. protection against electromagnetic interference may be disconnected for the test.

2.18 "High Voltage" Test

The insulation dielectric strength of the product is to be checked by means of test voltage of rms value, as specified in Table 2.18. The test duration is 1 minute.

1) This test method applies to frequency range from 10kHz to 1GHz.
2) This test method applies to frequency range from 10kHz to 400MHz.

Table 2.18

Rated voltage U_n, [V]	Test voltage (alternating of frequency 50 or 60Hz), [V]
Up to 65	2 x U_n+500
to 250	1500
to 500	2000
to 690	2500

The test voltage is to be applied between phases (poles) connected together with the earth and subsequently between phases (where practicable).

Printed circuit boards may be removed for the test.

2.19 "Flame Retardance" Test

The flame retardance test is to be carried out in accordance with Publication IEC 60092-101 or IEC 60695-2-2, or the relevant military standard, if applicable. The product is to be subjected 5 times to flame test, for a period of 15 seconds each time(interval between the tests – 15 seconds) or once – for a period of 30 seconds. The length of the burntout or damaged part of the specimen cannot exceed 60 mm.

The electrical equipment design and the choice of material are to be such as to reduce the likelihood of fire, ensuring that:
- where an energized part of the electrical equipment can cause ignition and fire, it is provided with an appropriate enclosure,
- the design, material and construction of the enclosure minimize, as far as practicable, any ignition of adjacent materials,
- the design, material and construction of the enclosure do not propagate fire where the surfaces of the product can be exposed to external fire.

2.20 Flammability Test of Electro–Insulating Materials

2.20.1 The Purpose of the Test

The purpose of the test is to assess flammability of solid insulating materials used as supporting members of live parts, as well as those acting as insulating covering for electrical and electronic equipment.

The above method cannot be applied for testing the cable and conductor insulation and sheaths.

2.20.2 Specimens

The specimens dimensions are to be as follows:
- length – 200 mm,
- width – 35 mm,
- thickness – 3 ± 1.5 mm.

The possibility of testing specimens having different dimensions, as well as another method of testing are subject to special consideration by the Naval Authority.

When testing the materials of more than 4.5 mm in thickness, the specimen is to be one–side machined so as to obtain the dimensions given above. In such case, the test is to be carried out on the unmachined side of the specimen.

Prior to tests, the specimens are to be preconditioned at a temperature of 20 ± 2 °C and a relative humidity of 65 ± 3%.

2.20.3 Testing Device

The testing device is to consist of a filament loop, a movable grip for specimen with a scale indicating the flame height, as well as a portable weight to regulate the filament thrust.

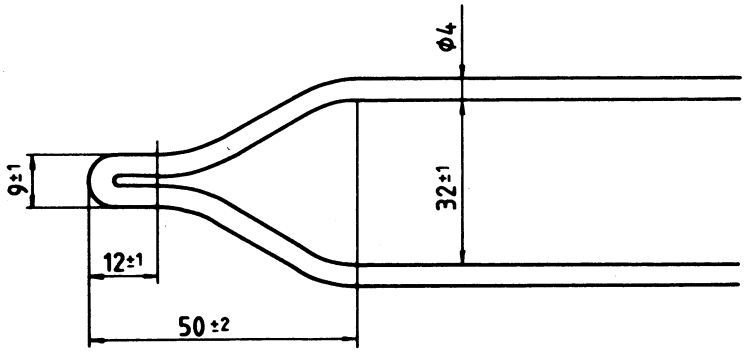


Fig. 1 Filament loop (dimensions in mm)

The filament loop is to be made of nichrome wire or of a ferrous chromealuminium alloy.

The shape and dimensions of filament loop are to be as shown in Fig. 1.

The movable grip for specimen is to be so placed that the specimen is pressed to the filament at right angle (see Figs. 2 and 3).

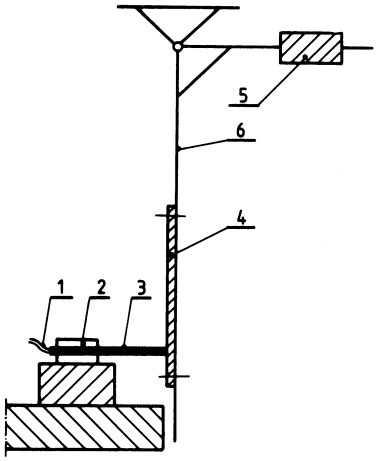


Fig.2 Testing device scheme

1 – feeder; 2 – grip with clamps; 3 – filament loop; 4– specimen; 5 – weight; 6 – frame with specimen grip.

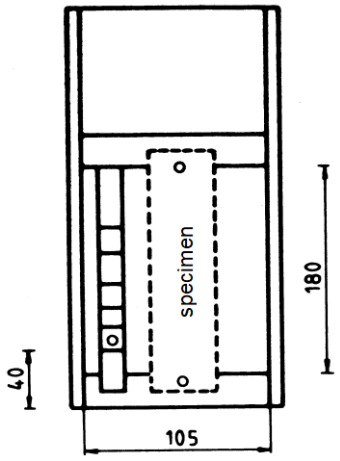


Fig. 3 Grip for specimen with a scale (dimensions in mm).

2.20.4 Test

The filament loop is to be heated by electric current up to the temperature given in Table 2.20.5.

The loop temperature is to be constant at a continuous power supply during at least 120 seconds prior to the commencement of the test.

The grip with the specimen is to be pressed to the filament loop with a force of 1 N, within the time given in Table 2.20.5.

If, during that time, the insulating material catches fire, the flame height is to be indicated on the scale and the specimen burning duration is to be determined, recording the time from the moment of the specimen removal from the filament to the moment of the flame going out.

2.20.5 Test Parameters

Parameters for testing insulating materials flammability are given in Table 2.20.5.

Table 2.20.5

Item	Test parameters	Test group	
		test group 1	test group 2
1	Temperature, [°C]	650	960
2	Duration of filament operation, [s]	60	30
3	Pressing force, [N]	1	1

2.20.6 Test Results

2.20.6.1 Insulating materials which do not ignite under exposures corresponding to the test group 1 or ignite, but the burning duration time is not longer than 30 seconds, irrespective of the flame height, are considered as fire–retardant and may be used as insulating coverings. However, they cannot be used for grips of current–carrying parts.

2.20.6.2 Insulating materials which do not ignite under exposures corresponding to the test group 2 or ignite, but the flame height does not exceed 3 cm, and the burning duration is not longer than 60 seconds, are considered as fire–retardant and may be used as insulating coverings, as well as for grips of current–carrying parts.

2.20.6.3 The tests are to be carried out on three specimens.

If one of the specimens does not comply with the requirements set forth in 2.20.6.1 or 2.20.6.2, then the new three specimens are to be tested.

If more than one specimen is found not to comply with the requirements set forth in 2.20.6.1 and 2.20.6.2, then such insulating material cannot be considered as fire–retardant.

Insulating material is considered as fire–retardant when, after the second test, all specimens may be considered as fire-retardant in accordance with the criteria given in 2.20.6.1 and 2.20.6.2.