



रक्षा मंत्रालय
MINISTRY OF DEFENCE

संयुक्त सेवा स्पेसिफिकेशन
JOINT SERVICES SPECIFICATION

ON

ENVIRONMENTAL TEST METHODS
FOR
ELECTRONIC AND ELECTRICAL EQUIPMENT

JSS 55555: 2012
(Revision No. 3)

मानकीकरण निदेशालय
रक्षा उत्पादन विभाग
रक्षा मंत्रालय
'एच' ब्लॉक, डाकघर निर्माण भवन
नई दिल्ली – 110 011

DIRECTORATE OF STANDARDISATION
DEPARTMENT OF DEFENCE PRODUCTION
MINISTRY OF DEFENCE
'H' BLOCK, NIRMAN BHAWAN PO
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1. This Joint Services Specification has been approved by Shri KS Manjunatha, Dir Gde-1 Chairman, Electronic Standardisation Sub Committee through circulation among LSSC members and in the meeting of Electronics Standardisation Sub Committee.
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IN O	Date	to S. IN O/ Para No/column No.		Name and appointment (IN BLOCK LETTERS)	and Date

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equipment developed and produced has to meet the most stringent quality standards and should fully meet the operational requirements laid down by the users . This calls for the relevant equipment specification, which is a governing document for production and supply of the equipment for the users and shall always invoke the tests and conditions laid down in this specification, to provide a common basis for comparison for performance of various electronic and electrical equipment under Service environments.

Keeping in view the stringent quality and operational requirements of the users, the Joint Services Specification No. 55555 on “Environmental Test Methods for Electronic and Electrical Equipment” (JSS 55555) was prepared in 1979 which was later revised in 1988. Considerable experience has been gained over the years since 1988 and this has necessitated revision of the existing JSS 55555 .

This document JSS 55555 on “Environmental Test Methods for Electronic and Electrical Equipment” has been reprinted with the various amendments incorporated . In this revised JSS 55555, major changes like introduction of modified L-2 Table and recasting of five Tables pertaining to Naval and Naval Air Services, have been incorporated. In addition Test No. 8 on “ Corrosion (Alkaline)”, Test No. 30 on “Temperature, Humidity, Vibration and Altitude” and Test No. 31 on “ Vibro Acoustic, Temperature” have been added in this revised document.

**AIR CMDE
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0.1 This specification has been prepared by the Electronic Components Standardisation Organisation (LCSO) on behalf of Electronic Standardisation Sub Committee (LSSC) on the authority of the Standardisation Committee, Ministry of Defence.

0.2 This specification is a revision of JSS 55555:2000 (Revision No.2) and supersedes the same.

0.3 This specification has been approved by the Ministry of Defence and is mandatory for use by the Defence Services.

0.4 This specification shall be used to design, manufacture, quality assurance and procurement of the item.

0.5 Quality Assurance Authority for the item covered by this specification is CQA (L), Bangalore for Army, DQAN, New Delhi for Navy and DGAQA, New Delhi for Air Force. Enquiries regarding this specification relating to any contractual conditions shall be addressed to the Quality Assurance Authority named in the tender or contract. Other technical enquiries shall be referred to: -

The Director
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'H' Block, Nirman Bhawan PO,
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0.6 Copies of this specification can be obtained on payment from: -

The Director
Directorate of Standardisation
Standardisation Documents Centre
Room No. 5, 'J' Block,
Nirman Bhawan PO, New Delhi – 110 011

0.7 Indian Standard (IS) specification are available free of cost for registered users on:-

Directorate of Standardisation Website :- www.defstand.gov.in
For registration visit our website.

0.8 This specification holds good only for the supply order for which it is issued.

0.9 Directorate of Standardisation Website. All the approved JSS/JSGs are available on the Directorate of Standardisation Website www.defstand.gov.in. Defence organisations desirous of procuring a copy of this document are requested to approach the Directorate of Standardisation for obtaining user id/password to access the website.

GENERAL INFORMATION

1. SCOPE

1.1 This specification describes standard procedures and conditions for Environmental tests for Service Electronic and Electrical Equipment (except those associated with explosives and guided missiles).

1.2 This specification includes environmental conditions obtainable in the laboratory, such that if an item is exposed to these conditions and continues to operate in a satisfactory manner, a high degree of confidence will have been established that the item could survive the field environment during its expected operational and storage life. The tests described herein are not to be interpreted as an exact and conclusive representation of actual operational and storage conditions. It is also the purpose of this document to standardize environmental tests in order to obtain, as much as possible, reproducible test results.

1.3 The tests specified herein are intended to serve the need for predetermining the potential causes of failure of equipment under operational and storage environments. In some of the tests, the test conditions are varied in order to enable the designers to select the conditions which will be adequate to meet the users (qualitative) requirements, commensurate with the design efforts.

1.4 The acceptable performance limits of the equipment when subjected to environmental tests are not included in this specification. The relevant equipment specification shall define the acceptable performance limits during and after the specified environmental tests.

1.5 The relevant equipment specification, which is the governing document for production and supply of the equipment for the users, shall always invoke the tests and conditions laid down in this specification, to provide a common basis for comparison for performance of various Electronic and Electrical Equipment under Service environments.

1.6 This specification, in itself, does not constitute an instruction to apply the tests. Such instructions, together with the incidence and grouping of Equipment for tests for the purposes of design approval and the acceptance (inspection) shall be specified in the relevant equipment specification. While conducting any test described in Section 4 of this specification, standard procedures and conditions of tests shall be followed (see clause 1.9).

1.7 In section 4 and elsewhere terms "specified", "as specified", "unless otherwise specified", "as required", "if required", and "when required" have been used. In such cases the details shall be as given in the relevant equipment specification.

environments and additional tests, where necessary, may need to be specified in the relevant equipment specification.

1.9 The relevant equipment specification shall specify the deviations in test procedure which may be necessary when applying the tests and also any special procedures which may be required.

1.10 This specification covers the Object, Test equipment, Test procedure and the information to be obtained from relevant equipment specification in respect of all climatic and dynamic test severities at the test laboratory. It is essential to tailor and select the environmental forcing functions to which electronic/electrical equipment would be subjected during its life cycle purely based on the end use of the equipment. This shall be borne in mind while applying any test as per this specification on the test samples.

2. RELATED SPECIFICATIONS

2.1 Joint Services Specifications

50101:1996 (Revision No. 1) Reaffirmed 2012	Environmental test methods for service electronic components
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2.2 Other Specifications

IS 10005 : 1994/ISO 1000 : 1992 (second revision) Reaffirmed 2000	SI units and recommendations for the use of their multiples and of certain other units
IS 554 : 1999 /ISO 7-1 : 1994 (Fourth Revision) Amend 1	Pipe Threads Where Pressure-Tight Joints are Made on the Threads - Dimensions, Tolerances and Designation
IS 460 : Part 1 : 1985 (Third revision) Reaffirmed 2004 Amend 1	Specification for test sieves: Part I Wire cloth test sieves
BS 2475 : 1964 (1988)	Specification for Octave and MC-third Octave band-pass filter

2.3.1 All technical enquiries regarding this document may be addressed to :-

The Director,
Directorate of Sandardisaiton,
Ministry of Defence,
'H' Block, Nirman Bhawan PO,
New Delhi-110 011

3. **DEFINITIONS**

3.1 **Ambient Temperature**

3.1.1 **For Non-Heat Dissipating Equipment** - The temperature of the medium surrounding the equipment.

3.1.2 For Heat Dissipating Equipment - Where the conditions are those of ideal cooling by convection, the temperature of the medium at such a distance from the equipment that the effect of dissipation is negligible.

Note : 1 In practice it is taken as the average of temperatures measured at a number of points in a horizontal plane through a point 0 mm to 50 mm below the equipment at half the distance between the equipment and the wall of the test chamber or at 1 m distance, whichever is less.

2 If forced circulation is used in the testing of heat dissipating equipment, the concept of ambient temperature is no longer valid. Under these conditions, the testing should be based on the specification of the surface temperature or on the requirements of the relevant equipment specification.

to determine the effect of such a condition on it.

3.3 Final Measurement - The final measurement made at the conclusion of a test to make comparison with the initial measurement will show the effect of the on the equipment.

Note : Final measurement made at the end of one test may be taken as the initial measurement for the subsequent tests.

3.4 Heat Dissipating Equipment - For the purpose of environmental testing, an equipment is considered as heat dissipating when the hottest point on its surface, measured in free air conditions, is more than 5 degC above the ambient temperature of the surrounding atmosphere after temperature stability has been reached.

Note : Measurement required to prove that an equipment can be regarded as non-heat dissipating, can be made in normal laboratory conditions, if care has been taken that no outside influence (for example, draughts or sunlight) affects the measurements. In the case of large or complicated equipment, it may be necessary to make measurements at several points.

3.5 Initial Measurements - The measurements made prior to a test to determine the characteristics of the equipment.

3.6 Performance checks - Tests specified in the relevant equipment specification, generally in the form of electrical test, in order to check the performance of an equipment during the conditioning or immediately after it.

3.7 Preconditioning - The treatment of an equipment with the object of removing or partly counteracting the effects of its previous history. Where called for, it is the first process in the test procedure.

3.8 Recovery - The treatment of an equipment, after conditioning, in order that the properties of the equipment may be stabilized before final measurement.

3.9 Relevant Equipment Specification - A document specially drawn up or provided which lays down the characteristics and performance capabilities of an equipment under specified conditions of operation and storage as required by the Services.

3.10 Temperature Stability - Temperature stability has been reached when the temperature of all the parts of the equipment are within 3 degC, or as otherwise specified, of their final temperature.

3.10.1 For non-heat dissipating equipment, the final temperature will be the mean (in time) temperature of the chamber in which the equipment is placed.

ascertain the interval of time required for the temperature to change 3 degC or as otherwise specified. Temperature stability has been reached when the ratio between consecutive intervals exceeds 1.7.

Note : 1 Where the thermal time constant of the equipment is short compared with the duration of the exposure to a given temperature, no measurement is needed.

2 Where the thermal time constant of the equipment is of the same order as the duration of the exposure, checks should be made to ascertain :-

(a) That non-heat dissipating Equipment are within the required limit from the mean (in time) temperature of the atmosphere in which the equipment is placed.

(b) That for heat dissipating Equipment the ratio between two consecutive time intervals exceeds 1.7 when repeated measurements are made to ascertain the interval of time required for the temperature to change by 3 degC or as specified.

3 In practice, it may not be possible to make direct measurements of the internal temperature of the equipment. A check may then be made by measuring some other parameter which is temperature dependent and for which the law of temperature dependence is known.

3.11 Test - A complete series of operations covered under a test heading.

3.12 Test Chamber - An enclosure in which the equipment can be exposed to the specified environmental test conditions.

3.13 Test Procedure - A complete series of operations covered by any one heading and shall normally consist of the following ;

- (a) Preconditioning (where required).
- (b) Initial measurements (where required).
- (c) Conditioning, including performance check (when specified).
- (d) Recovery.
- (e) Final measurements.

conditioning in each test and form a part of Initial and Final Measurements. During the visual examination of the equipment, defects in construction, the presence of foreign bodies, moisture, dust, etc., corrosion of metal parts and any form of deterioration of materials and finishes, distortion or mechanical imperfections shall be noted.

3.15 Working Space - That part of the test chamber in which the specified environmental test conditions can be maintained within the specified tolerances.

4. STANDARD ATMOSPHERIC CONDITIONS

4.1 Standard Reference Conditions - If the parameters to be measured depend on temperature and/or air pressure and if the law of dependence is known, the values are measured at conditions specified under clause 4.3 and, if necessary, corrected by calculation to the following reference values ;

Temperature	20°C
Air pressure	101.3 kPa

Note : No requirement for relative humidity is given because its correction by calculation is generally not possible.

4.2 Standard Reference Conditions - If the parameters to be measured depend on temperature and/or air pressure and if the law of dependence is not known, the measurements shall be made under the following reference conditions ;

Temperature	:	20°C +2 degC
Relative humidity	:	65 to 75 percent
Air pressure	:	85 to 106 kPa

Note : In the case of large Equipment or test chambers where temperature and relative humidity and/or air pressure limits specified above are difficult to maintain, where tolerance may be permissible. In such cases, the actual values used shall be given in the specification.

out at any combination of temperature, relative humidity and air pressure, within the following limits :

Temperature	:	15° to 35°C
Relative Humidity	:	45 to 75 percent
Air pressure	:	85 to 106 kPa

Note : 1 The temperature range may be extended beyond these limits, upto 10 to 40°C for large Equipment.

2 The limits of variation of temperature and relative humidity during a series of measurements carried out as part of one test on any equipment shall, if necessary, be specified in the relevant equipment specification.

4.3.1 Where it is impracticable to carry out measurements within the limits of the standard atmospheric conditions for testing, a note to this effect, stating the actual conditions of tests shall be added to the test report.

4.4 Standard Recovery Conditions - The standard conditions for recovery shall be actual laboratory conditions subject to the overriding requirements of clause 4.3. above.

GENERAL PRECAUTIONS IN TESTING

1. GENERAL

1.1 This section covers certain general precautions which the test engineers and test personnel are required to observe.

2. MODIFICATION TO TESTS

2.1 In certain cases, there may be very good reasons for departing from the standard test methods, given in Section 4. It is therefore, essential to refer, before carrying out a test, to the relevant equipment specification to ascertain, if any modifications, have been made in the test conditions.

3. EQUIPMENT UNDER TESTS

3.1 Carriers, Covers etc. - Complete equipment should be tested with the appropriate carriers, covers, shock and vibration mounts etc, which would be fitted to the equipment under normal services conditions, unless otherwise specified by the relevant equipment specification.

3.2 Equipment with Air Conditioning - Where plant for air conditioning or refrigeration forms an integral part of an equipment, such plant is to be operated normally throughout the tests, described in this specification unless the tests represent storage conditions.

3.3 Equipment of Large Size - When the physical size of an equipment would prohibit its being tested as a complete unit, it may be broken down into sections of the largest possible size which can be accommodated satisfactorily (see clause 5.1) in the test chamber available. While doing so, attention should be paid to the thermal geometry considerations of the equipment, if any, and if so specified in the relevant equipment specification.

4. CONDITIONS AT START AND END OF THE TEST

4.1 The equipment shall be introduced into or removed from the test chamber at the laboratory atmospheric conditions unless otherwise specified by the relevant equipment specification. While conducting the temperature low air pressure test, the temperature of the chamber shall be stabilized at the specified temperature before reducing/increasing the air pressure.

5.1 **Volume of Test Chamber** - The volume of the test chamber shall be such that the bulk of the equipment under test shall not interfere with the control and maintenance of test conditions in the working space of the chamber and any heat dissipated from the equipment under test shall not appreciably influence the conditions in the chamber. For this purpose, the volume of the test chamber should preferably be not less than eight times the volume of the equipment under test.

5.2 **Control of Temperature and Relative Humidity** - Wet and dry bulb thermometers of mercury in glass type or thermocouples or equivalent sensors shall be used to control or determine the specified chamber temperature and relative humidity. These sensors shall be centrally located within the test chamber, where possible, or in the return air-stream and shall be baffled or otherwise protected against direct impingement of supply air and against radiation effects.

5.3 **Rate of Change of Temperature** - Unless otherwise specified, the rate of change of temperature within the test chamber shall not exceed 1 degC per minute, averaged over a period of not more than 5 minutes.

5.4 **Uniformity of Conditions in Test Chamber** - Necessary measures shall be taken to ensure that conditions throughout the chamber are homogeneous and are as near as possible to those prevailing in the immediate vicinity of the temperature and relative humidity sensors. The high/low temperature conditions inside the chamber should, therefore, be achieved only by circulating hot/cold air. The air in the chamber shall be continuously agitated but not so vigorously as to cause undue cooling of the equipment under test.

5.5 **Heat Source for Test Chamber** - The heat source for the test chamber shall be so located that the radiant heat does not fall directly on the equipment under test except where radiant heat is one of the test conditions.

**FOR GROUND EQUIPMENT PARTIALLY PROTECTED (DESERT
CONDITION) CLASS L2E**

(Clause 3.1)

SEQUENCE	TESTS	TEST NUMBER
1	Vibration (Refer Table 4.28.2 Sl.3) (see Note 8)	28
2.	High temperature (Procedure 6, Test Condition 'M')	17
3.	Damp heat(See Note 9)	10
4.	Low temperature (Test Condition 'H')	20
5.	Rapid temperature cycling (see Note 1)	22
6.	Sealing (see Note 2)	23
7.	Dust	14
8.	Tropical exposure (14 Cycles)	27
9.	Mould growth (see Note 3 & 4)	21
10.	Corrosion (salt) (Procedure 2) (see Note 3,4, 5, & 10)	9
11.	Contamination (see Note 1 & 5)	6
12.	Drop (see Note 6)	13
13.	Toppling (see Note 7)	26
14.	Bump	5
15.	Bounce/Roadability (see Note 8)	4/29

Tailoring is very essential. Select severity and procedure for each test after reading Cl. 1.10 under Scope of this specification.

- Note :**
- 1 Depending on the operational/storage conditions encountered, this test may be omitted by the relevant equipment specification.
 - 2 This test is meant only for hermetically sealed equipment.
 - 3 Separate equipment can be used for this test.
 - 4 For sealed equipment a dummy unit may be used and this test may be applied only to the components and finishes located outside the seal.
 - 5 This test may be omitted in accordance with the relevant equipment specification.
 - 6 This test may be omitted if the equipment is not likely to be dropped.
 - 7 This test is applicable only for portable equipment and spares which are not fitted permanently.
 - 8 Bounce test may be carried out instead of Vibration Test on items which are not rigidly mounted and Roadability test may be carried out on items which are large in size for which the Vibration Testing may not be feasible.
 - 9 This test shall be strictly carried out prior to Mould growth, corrosion and dust growth test. If not feasible, separate equipment be used for this test.
 - 10 This test shall be strictly carried out after Tropical exposure & Mould growth test. If not feasible, separate equipment be used for this test.

FOR GROUND EQUIPMENT PARTIALLY PROTECTED (HIGH HUMID CONDITIONS) CLASS L2F

(Clause 3.1)

SEQUENCE	TESTS	TEST NUMBER
1.	Vibration (Refer Table 4.28.2 Sl.3) (see Note 8)	28
2.	High temperature (Procedure 6, Test Condition 'K')	17
3.	Damp heat(See Note 9)	10
4.	Low temperature (Test Condition 'H')	20
5.	Rapid temperature cycling (see Note 1)	22
6.	Sealing (see Note 2)	23
7.	Dust	14
8.	Tropical exposure (14 Cycles)	27
9.	Mould growth (see Note 3 & 4)	21
10.	Corrosion (salt) (Procedure 2) (see Note 3,4, 5 &10)	9
11.	Contamination (see Note 1 & 5)	6
12.	Drop (see Note 6)	13
13.	Toppling (see Note 7)	26
14.	Bump	5
15.	Bounce/Roadability (see Note 8)	4/29

Tailoring is very essential. Select severity and procedure for each test after reading Cl. 1.10 under Scope of this specification.

- Notes :**
- 1 Depending on the operational/storage conditions encountered, this test may be omitted by the relevant equipment specification.
 - 2 This test is meant only for hermetically sealed equipment.
 - 3 Separate equipment can be used for this test.
 - 4 For sealed equipment a dummy unit may be used and this test may be applied only to the components and finishes located outside the seal.
 - 5 This test may be omitted in accordance with the relevant equipment specification.
 - 6 This test may be omitted if the equipment is not likely to be dropped.
 - 7 This test is applicable only for portable equipment and spares which are not fitted permanently.
 - 8 Bounce test may be carried out instead of Vibration Test on items which are not rigidly mounted and Roadability test may be carried out on items which are large in size for which the Vibration Testing may not be feasible.
 - 9 This test shall be strictly carried out prior to Mould growth, corrosion and dust. growth test. If not feasible, separate equipment be used for this test.
 - 10 This test shall be strictly carried out after Tropical exposure & Mould growth test. If not feasible, separate equipment be used for this test.

FOR GROUND EQUIPMENT PARTIALLY PROTECTED (STATIONERY USE) CLASS L2G

(Clause 3.1)

SEQUENCE	TESTS	TEST NUMBER
1.	Vibration (Refer Table 4.28.2 Sl.3)(see Note 8)	28
2.	High temperature (Procedure 6, Test Condition 'K')	17
3.	Damp heat(See Note 9)	10
4.	Low temperature (Test Condition 'H')	20
5.	Rapid temperature cycling (see Note 1)	22
6.	Sealing (see Note 2)	23
7.	Dust	14
8.	Tropical exposure (14 Cycles)	27
9.	Mould growth (see Note 3 & 4)	21
10.	Corrosion (salt) (Procedure 2) (see Note 3,4, 5 & 10)	9
11.	Contamination (see Note 1 & 5)	6
12.	Drop (see Note 6)	13
13.	Toppling (see Note 7)	26
14.	Bump	5
15.	Bounce/Roadability (see Note 8)	4/29

Tailoring is very essential. Select severity and procedure for each test after reading Cl. 1.10 under Scope of this specification.

- Notes :**
- 1 Depending on the operational/storage conditions encountered, this test may be omitted by the relevant equipment specification.
 - 2 This test is meant only for hermetically sealed equipment.
 - 3 Separate equipment can be used for this test.
 - 4 For sealed equipment a dummy unit may be used and this test may be applied only to the components and finishes located outside the seal.
 - 5 This test may be omitted in accordance with the relevant equipment specification.
 - 6 This test may be omitted if the equipment is not likely to be dropped.
 - 7 This test is applicable only for portable equipment and spares which are not fitted permanently.
 - 8 Bounce test may be carried out instead of Vibration Test on items which are not rigidly mounted and Roadability test may be carried out on items which are large in size for which the Vibration Testing may not be feasible.
 - 9 This test shall be strictly carried out prior to Mould growth, corrosion and dust growth test. If not feasible, separate equipment be used for this test.
 - 10 This test shall be strictly carried out after Tropical exposure & Mould growth test. If not feasible, separate equipment be used for this test.

**FOR GROUND EQUIPMENT PARTIALLY PROTECTED (INSTALLED IN
WHEELED VEHICLES) CLASS L2H**

(Clause 3.1)

SEQUENCE	TESTS	TEST NUMBER
1.	Vibration (Refer Table 4.28.2 Sl.1 & 4) & 4.28.3) (see Note 8)	28
2.	High temperature (Procedure 6, Test Condition 'M')	17
3.	Damp heat(See Note 9)	10
4.	Low temperature (Test Condition 'J')	20
5.	Altitude	3
6.	Rapid temperature cycling (see Note 1)	22
7.	Sealing (see Note 2)	23
8.	Dust	14
9.	Tropical exposure (14 Cycles)	27
10.	Mould growth (see Note 3 & 4)	21
11.	Corrosion (salt) (Procedure 2) (see Note 3,4, 5 & 10)	9
12.	Contamination (see Note 1 & 5)	6
13.	Drop (see Note 6)	13
14.	Toppling (see Note 7)	26
15.	Bump	5
16.	Bounce/Roadability (see Note 8)	4/29

Tailoring is very essential. Select severity and procedure for each test after reading Cl. 1.10 under Scope of this specification.

- Note :**
- 1 Depending on the operational/storage conditions encountered, this test may be omitted by the relevant equipment specification.
 - 2 This test is meant only for hermetically sealed equipment.
 - 3 Separate equipment can be used for this test.
 - 4 For sealed equipment a dummy unit may be used and this test may be applied only to the components and finishes located outside the seal.
 - 5 This test may be omitted in accordance with the relevant equipment specification.
 - 6 This test may be omitted if the equipment is not likely to be dropped.
 - 7 This test is applicable only for portable equipment and spares which are not fitted permanently.
 - 8 Bounce test may be carried out instead of Vibration Test on items which are not rigidly mounted and Roadability test may be carried out on items which are large in size for which the Vibration Testing may not be feasible.
 - 9 This test shall be strictly carried out prior to Mould growth, corrosion and dust growth test. If not feasible, separate equipment be used for this test.
 - 10 This test shall be strictly carried out after Tropical exposure & Mould growth test. If not feasible, separate equipment be used for this test.

**FOR GROUND EQUIPMENT PARTIALLY PROTECTED (INSTALLED IN
TRACKED VEHICLES) CLASS L2J**
(Clause 3.1)

SEQUENCE	TESTS	TEST NUMBER
1.	Vibration (Refer Table 4.28.2 and Sl.1.4.28.3) (see Note 8)	28
2.	High temperature (Procedure 6, Test Condition 'M')	17
3.	Damp heat(See Note 9)	10
4.	Low temperature (Test Condition 'J')	20
5.	Altitude	3
6.	Rapid temperature cycling (see Note 1)	22
7.	Sealing (see Note 2)	23
8.	Dust	4
9.	Tropical exposure (28 Cycles)	27
10.	Mould growth (see Note 3 & 4)	21
11.	Corrosion (salt) (Procedure 2) (see Note 3,4, 5, 10)	9
12.	Contamination (see Note 1 & 5)	6
13.	Drop (see Note 6)	13
14.	Toppling (see Note 7)	26
15.	Bump	5
16.	Bounce/Roadability (see Note 8)	4/29

Tailoring is very essential. Select severity and procedure for each test after reading Cl. 1.10 under Scope of this specification.

- Note :**
- 1 Depending on the operational/storage conditions encountered, this test may be omitted by the relevant equipment specification.
 - 2 This test is meant only for hermetically sealed equipment.
 - 3 Separate equipment can be used for this test.
 - 4 For sealed equipment a dummy unit may be used and this test may be applied only to the components and finishes located outside the seal.
 - 5 This test may be omitted in accordance with the relevant equipment specification.
 - 6 This test may be omitted if the equipment is not likely to be dropped.
 - 7 This test is applicable only for portable equipment and spares which are not fitted permanently.
 - 8 Bounce test may be carried out instead of Vibration Test on items which are not rigidly mounted and Roadability test may be carried out on items which are large in size for which the Vibration Testing may not be feasible.
 - 9 This test shall be strictly carried out prior to Mould growth, corrosion and dust growth test. If not feasible, separate equipment be used for this test.
 - 10 This test shall be strictly carried out after Tropical exposure & Mould growth test. If not feasible, separate equipment be used for this test.

GROUND EQUIPMENT EXPOSED AND IMMERSIBLE (CLASS L3)

(Clause 3.1)

SEQUENCE	TESTS	TEST NUMBER
1.	Vibration	28
2.	High temperature	17
3.	Solar radiation (see Note 1)	25
4.	Damp heat(See Note 6)	10
5.	Low temperature	20
6.	Altitude	3
7.	Rapid temperature cycling (see Note 1)	22
8.	Sealing	23
9.	Driving rain (see Note 1)	12
10.	Immersion (see Note 1)	19
11.	Dust	14
12.	Tropical exposure (see Note 2)	27
13.	Mould growth (see Note 2 and 3)	21
14.	Corrosion (salt) (see Note 2, 3, 4 & 5)	9
15.	Corrosion (acid) (see Note 1, 2 and 3)	7
16.	Corrosion (alkaline) (see Note 1,2 and 3)	8
17.	Contamination (see Note 1 and 3)	6
18.	Drop	13
19.	Toppling	26
20.	Bump	5
21.	Shock	24

Tailoring is very essential. Select severity and procedure for each test after reading Cl. 1.10 under Scope of this specification.

- Note :**
- 1 Depending upon the operational/storage conditions encountered, this test may be omitted by the relevant equipment specification.
 - 2 Separate equipment can be used for this test.
 - 3 For sealed equipment a dummy unit may be used and this test may be applied only to the components and finishes located outside the seal.
 - 4 This test may be omitted in accordance with the relevant equipment specifications.
 - 5 This test shall be strictly carried out after Tropical exposure & Mould growth test. If not feasible, separate equipment be used for this test.
 - 6 This test shall be strictly carried out prior to Corrosion (salt), dust & Mould growth test. If not feasible, separate equipment be used for this test.

FOR SHIPBORNE EQUIPMENT PROTECTED (CLASS N1)
 (Clause 3.1)

SEQUENCE	TESTS	TEST NUMBER
1.	Vibration (see Note 7 & 8)	28
2.	High temperature (Procedure 6, Test Condition K)	17
3.	Damp heat(See Note 10)	10
4.	Low temperature (Test Condition H, -10° C 16 hrs)	20
5.	Drip proof	11
6.	Sealing (for hermetically sealed eqpt only) (see Note 2)	23
7.	Immersion (see Note 1)	19
8.	Tropical exposure (Condition A, 7 Cycles)(see Note 3)	27
9.	Mould growth (see Note 3 & 4) (On samples)	21
10.	Corrosion (salt) (see Note 3, 4, 5 & 9) (Procedure 2)	9
11.	Corrosion (acid) (see Note 1, 3 and 4)	7
12.	Corrosion (alkaline) (see Note 1,3 and 4)	8
13.	Contamination (see Note 1 and 4)	6
14.	Toppling (see Note 1 & 6)	26
15.	Bump (See Note 1)	5
16.	Shock or impact (NSS Gr.I or Gr.II, 3 shocks as per face)	24

Tailoring is very essential. Select severity and procedure for each test after reading Cl. 1.10 under Scope of this specification.

- Note :**
- 1 Depending upon the operational/storage conditions encountered, this test may be omitted by the relevant equipment specification.
 - 2 This test is meant only for hermetically sealed equipment.
 - 3 Separate equipment can be used for this test.
 - 4 For sealed equipment a dummy unit may be used and this test may be applied only to the components and finishes located outside the seal.
 - 5 This test may be omitted in accordance with the relevant equipment specifications.
 - 6 This test is applicable only for portable equipment and spares which are not Fitted permanently.
 - 7 Bounce test may be carried out instead of Vibration Test on items which are not rigidly mounted and Roadability Test may be carried out on items which are large in size for which the Vibration testing may not be feasible.

electrically and mechanically checked as specified.

- Note :**
- 1 For procedure 1 or 3 the final measurements shall be made only when the relevant equipment specification requires the performance of the equipment to be checked at the laboratory atmospheric conditions.
 - 2 In case of procedure 2, method B, the equipment shall be completely stripped down and examined for ingress of moisture, if so required.

4. INFORMATION TO BE GIVEN IN THE RELEVANT EQUIPMENT SPECIFICATION

- 4.1 Initial measurements (see clause 3.1).
- 4.2 The applicable test procedure or test procedures (see clause 3.2).
 - 4.2.1 For Procedure 1:
 - (a) The applicable test condition for temperature (see clause 3.2.1.2.)
 - (b) The applicable test conditions for altitude (see clause 3.2.1.4),
 - (c) The details and period of operation (see clause 3.2.1.5)
 - (d) Whether the operation of the equipment to be stopped during the temperature/low air pressure conditioning phase or not (see clause 3.2.1.6), and
 - (e) Details of performance check (see clause 3.2.1.7).

- (a) The applicable test method (see clause 3.2.2)
- (b) Details of operation and performance check (see clause 3.2.2.1 [c]).
- (c) Number of cycles, if other than 4 cycles (see clause 3.2.2.2[b]),
- (d) Whether the equipment should be completely stripped down for examination of ingress of moisture (see clause 3.4 Note 2),
- (e) Whether test method C shall follow Test Number 22 (procedure 2 or 3) or procedure 1 of this test (see clause 3.2.2.3[a]),
- (f) Whether one chamber or two chambers to be used (see clause 3.2.2.3[a]), and
- (g) Details of operation and performance check (see clause 3.2.2.3[d]).

4.2.3 For procedure 3:

- (a) The applicable test condition for temperature (see clause 3.2.3.2)
- (b) The applicable test conditions for altitude (see clause 3.2.3.4), and
- (c) The details and period of operation, if other than 4 hours (see clause 3.2.3.5),
- (d) Whether maximum surface temperatures attained by the components shall be measured and recorded or not (see clause 3.2.3.5.), and
- (e) Details of performance check (see clause 3.2.3.6).

4.2.4 For Procedure 4:

- (a) The applicable test condition for temperature (see clause 3.2.4.3),
- (b) The applicable test condition for altitude (see clause 3.2.4.4). and
- (c) Other details as required for procedure 3 [see clause 4.2.3 (c), (d) and (e)]

- (a) The applicable test condition for temperature (see clause 3.2.5.1.),
 - (b) The applicable test condition for altitude (see clause 3.2.5.2), and
 - (c) Details of performance check (see Clauses 3.2.5.4 and 3.2.5.7).
- 4.3 Final measurements (see clause 3.4).
- 4.4 Any deviation from the normal test procedure.

Tailoring is very essential. Select severity and procedure for each test after reading Cl. 1.10 under Scope of this specification

1. OBJECT

1.1 To determine the ability of electronic and electrical equipment as prepared for field use to withstand transportation when they are carried as loose cargo on a wheeled vehicle traversing irregular surface where it has some freedom, however slight, to bounce, scuff, or collide with other items of cargo or the sides of the vehicle.

2. TEST EQUIPMENT

2.1 A Bounce Tester shall be used for this test. The bounce tester shall consist of a flat table assembly coupled to two shaft driven eccentric assemblies which are mounted on a base frame.

2.2 The table assembly shall be of 25 ± 1 mm plywood firmly secured by recessed fasteners to a steel frame.

2.3 The eccentrics shall produce a maximum peak to peak vertical displacement of $25+1$ mm or -0.5 mm of table assembly, in the region between drive shafts.

2.4 The bounce tester when loaded with the equipment and any other necessary devices for the test shall have the characteristics specified in appropriate test procedures.

3. TEST PROCEDURE

3.1 Initial Measurements

3.1.1 Equipment to be tested shall be visually examined and shall be electrically and mechanically checked as specified in the relevant specification.

3.2 Method of Mounting

3.2.1 The equipment to be tested, prepared as for transportation shall be placed on the table centrally with respect to drive shafts.

3.2.2 The presence of the vehicle side walls or of other similar constraints shall be simulated by a rectangular arrangement of retaining barriers securely attached to the table frame. These barriers shall consist of 76 mm steel channel section faced with firmly secured 25 ± 1 mm plywood.

shall be 50 ± 25 mm below the top of the test specimen and not more than 600 mm from the top surface of the plywood table.

3.2.4 Where the aspect ratio of the test specimen (the ratio of its longest to its shortest) does not exceed 3:1 on each of its faces (normally 3 for a cylinder and 6 for a rectangular object) orientated with respect to the table surface as stated in the relevant specification. For packages of greater aspect ratio or weight, the test shall be carried out as required by the relevant specification.

3.2.5 Unless otherwise stated in the relevant specification whenever the package dimension and the number of specimens available for test allow, they shall be stacked to a level not exceeding one metre in height.

3.3 Conditioning - The specimen shall be subjected to one of the following procedures as specified in the relevant specification.

3.3.1 Procedure 1 - Synchronous circular motion.

3.3.1.1 The movement of the platform of the bounce machine shall be such that each point of the platform which is always in a horizontal position describes a circle with a diameter of 25.0 ± 0.5 mm in the vertical plane.

3.3.1.2 The horizontal motion allowed by the barriers shall be adjusted to a total of 50 ± 5 mm, i.e. the specimen when placed at the centre of the platform in its normal position shall have a free movement in any horizontal direction of a nominal 25 mm.

3.3.1.3 The duration of test shall be as given in clause 3.4 .

3.3.2 Procedure 2- Non-synchronous motion.

3.3.2.1 The motion of the platform shall vary cyclically between a linear vertical and oscillatory motion. This motion shall be produced by a nominally vertical drive applied to the platform along two transverse lines spaced not less than 600 mm apart and not more than 1700 mm. The applied peak to peak value at the drive points shall be 25.0 ± 0.5 mm.

3.3.2.2 The relative speeds of the two drive shafts shall be in the ratio 1: 0.9 ± 0.03 . The higher speed shaft shall rotate at mean speed of 285 ± 5 r.p.m.

3.3.2.3 The duration of test shall be as given in clause 3.4.

Test condition A : 180 minutes

Test condition B : 60 minutes

Test condition C : 15 minutes

3.4.1 If the relevant specification specifies a number of test attitudes (see clause 3.2.4) then the total test time shall be equally divided between the specified attitudes and orientations.

3.5 Recovery - Tests exceeding five minutes duration must be split into five minute test periods followed by a recovery period of five minutes or longer to prevent excessive temperature rise within the specimen.

3.6 Final Measurements - The equipment shall be visually examined and shall be electrically and mechanically checked as specified.

4. INFORMATION TO BE GIVEN IN THE RELEVANT EQUIPMENT SPECIFICATION

- 4.1 Initial measurements (see clause 3.1).
- 4.2 Specimen to be tested with or without its transport case (see clause 3.2.1).
- 4.3 Attitude and orientation of specimen (see clause 3.2.4).
- 4.4 Stacking of specimens if applicable (see clause 3.2.5).
- 4.5 The applicable test procedure (see clause 3.3).
- 4.6 The severity (see clause 3.4).
- 4.7 Final measurements (see clause 3.6).
- 4.8 Any deviation from the normal test procedure.

Tailoring is very essential. Select severity and procedure for each test after reading Cl. 1.10 under Scope of this specification

1. OBJECT

1.1 To determine the ability of electronic and electrical equipment to withstand repeated bumps without malfunctioning and mechanical damage.

2. TEST EQUIPMENT

2.1 Characteristics of Bump Machine - A bump machine shall be used for this test. When the bump machine and fixtures are loaded with the equipment and any other necessary load for the testing, the applied bump shall, at the monitoring points have the characteristics specified in clauses 2.2 to 2.5.

2.2 Basic Pulse Shape - The bump machine shall be capable of generating a pulse approximating to one half cycle of a sine wave as shown by dotted lines in Fig. 4.5-1. The nominal Pulse shall have a peak acceleration and duration as indicated in table under clause 3.3.2, The acceleration and time duration shall be achieved within tolerance shown by thick lines in Fig. 4.5-1 unless otherwise specified in the relevant equipment specifications.

2.3 Repetition Rate - The bump repetition rate shall be such that between impacts, the relative motion within the equipment shall be substantially zero and the value of the acceleration at the monitoring point shall be within the limits shown in Fig. 4.5-1.

Note : A bump repetition rate of 1 to 3 bumps per second is usually adequate to reduce secondary bumps to a minimum.

2.4 Velocity Change - The actual velocity change shall be within ± 20 percent of the value corresponding to the nominal pulse, i.e. 1.50 m/s. To determine the velocity change, the actual pulse should be integrated from 0.4 D before the pulse to 0.1 D beyond the pulse where D is the duration of the nominal pulse (see Fig. 4.5- 1).

2.5 Transverse Motion - The positive or negative peak acceleration at the monitoring point perpendicular to the intended direction of bumps shall not exceed at any time 30 percent of the nominal value of the peak acceleration in the intended direction, when determined with a measuring system conforming to clause 2.6.

TABLE 4.5-1 TEST SEVERITIES
(Clause 3.3.2)

PEAK ACCELERA- TION (m/s²)	TEST SEVERITIES		APPLICATION
	PULSE DURATION (ms)	NUMBER OF BUMPS	
100	16	4000 + 10	General ruggedness test. Equipment attached or installed in vehicles with no cross country requirement.
250	6	@4000 ± 10	Equipment attached or installed in vehicles with Full cross country requirement.
400	6	@1000 ± 10	Equipment which may be carried loose on floors of vehicles for short distances
400	6	@4000 ± 10	Equipment which may be carried loose in any type of vehicle for an indefinite period

@ These severities are usually applied to equipment of nominal mass up to 100 kg. For heavier Equipment the 100 or 50 m/s² severity should be considered.

3.3.3 If required, the equipment shall be operated at any stage and for the period specified. Performance check, if any, shall be carried out as specified.

3.4 Final Measurements - The equipment shall be visually examined for any mechanical damages and shall be electrically and mechanically checked as specified.

SPECIFICATION

- 4.1 Initial measurements (see clause 3.1).
- 4.2 Details of mounting (see clause 3.2), whether isolators are to be used during the test (see clause 3.2.3) and number of bumps (see clause 3.2.5).
- 4.3 The attitude or directions in which the equipment to be tested (see clause 3.3.1).
- 4.4 Details of operation and performance check, if applicable (see clause 3.3.3).
- 4.5 Final measurements (see clause 3.4).
- 4.6 Any deviation from the normal test procedure.



FIGURE 4.5-1 (PARA 2.2)

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FIGURE 4.5-2 (PARA 2.6.3)

Tailoring is very essential. Select severity and procedure for each test after reading Cl. 1.10 under Scope of this specification

1. OBJECT

1.1 To determine the suitability of electronic and electrical equipment to withstand contamination from fuels, oils and such other substances that may be encountered in Service use and storage.

2. TEST EQUIPMENT

2.1 A dry heat chamber and a sprayer shall be used for this test.

2.2 The dry heat chamber shall conform to the requirements specified in the high temperature test (Test Number 17).

2.3 The sprayer used for this test shall be capable of spraying the contaminants specified in clause 3.2.2 on to the equipment so that the equipment is thoroughly wet by the spray.

3. TEST PROCEDURE

3.1 Initial Measurements - The equipment shall be visually examined and shall be electrically and mechanically checked as specified. In case dummy equipment is used for the test, only visual examination shall be done.

3.2 Conditioning

3.2.1 The equipment under test shall be subjected to this test in the 'unpacked' and 'switched off condition.

3.2.2 One or more of the following contaminating fluids shall be applied as required at the laboratory atmospheric conditions:

- (a) Paraffin
- (b) Petrol
- (c) Lubricating oil
- (d) Hydraulic fluids
- (e) Ester based lubricating oils

Note : 1 When the equipment is to be subjected to more than one contaminants they may be applied in succession.

of flammable vapours during the test.

3.2.3 The equipment shall be thoroughly wetted by the contaminating fluid or fluids which may be applied by brush, dip or spray according to the geometry of the equipment and the nature of contaminating fluid.

3.2.4 After spraying with the contaminant specified in clause 3.2.2, the equipment, while still being under the laboratory atmospheric conditions, shall be introduced into the dry heat chamber, the latter also being under the same conditions. The chamber temperature shall then be raised to 50°C.

3.2.5 The equipment shall be maintained at this temperature for a period of not less than 48 hours.

3.2.6 The temperature of the chamber shall then be restored to the laboratory atmospheric conditions.

3.3 Recovery - The equipment shall then be allowed to remain under standard recovery conditions for a period sufficient to attain temperature stability.

3.4 Final Measurements - The equipment shall be visually examined and shall be electrically and mechanically checked as specified. In case dummy equipment is used for the test, only visual examination shall be done.

4. INFORMATION TO BE GIVEN IN THE RELEVANT EQUIPMENT SPECIFICATION

- 4.1 Initial measurements (see clause 3.1).
- 4.2 The contaminant (s) to be used (see clause 3.2.2).
- 4.3 Final measurements (see clause 3.4).
- 4.4 Any deviation from the normal test procedure.

Tailoring is very essential. Select severity and procedure for each test after reading Cl. 1.10 under Scope of this specification

1. OBJECT

1.1 To determine the suitability of electronic and electrical equipment for use and/or storage under the influence of atmospheres containing Sulphur dioxide.

2. TEST CHAMBER

2.1 An acid spray chamber meeting the requirements specified in clauses 2.2 to 2.6 shall be used for this test.

Note : The chamber used for this test is similar in all respects to the chamber specified in Test Number 8 Corrosion (Salt).

2.2 The acid spray chamber shall be constructed from materials that will not be affected adversely by the corrosive influence of the Sulphur dioxide solution used in this test.

2.3 The acid mist shall freely circulate around the equipment under test. There shall be no direct impingement of the acid mist on the equipment under test. The liquid which has come in contact with the equipment under test shall not be allowed to return to the reservoir containing the solution. Drops of liquid condensate accumulating on the walls, ceiling and other parts of the chamber shall not fall on the equipment under test.

2.4 The chamber shall be properly vented to prevent pressure build up inside the chamber.

2.5 The acid spray shall be produced by an atomiser employing compressed air which is free from impurities.

2.6 It shall be possible to adjust the air pressure for spraying of the solution in the chamber such that the quantity of acid solution sprayed per hour shall be approximately one percent of the volume of the chamber.

2.7 The acid spray chamber or a humidity chamber shall be used for storage of the equipment under test for exposure to the conditions specified in clauses 3.3.1.4 and 3.3.2.4. Whichever chamber is used for this purpose, it shall be capable of maintaining its working space at a temperature of $35^{\circ}\text{C} \pm 2 \text{ degC}$ and a relative humidity of 90 to 95 percent during the periods of storage of the equipment under test. The chamber used for this purpose shall satisfy the requirements specified for damp heat chamber in the Damp Heat Test (Test Number 10).

3.1 Initial Measurements - The equipment shall be visually examined and shall be electrically and mechanically checked as specified. In case dummy equipment is used for the test, only visual examination shall be done.

3.2 Preparation of Acid Solution

3.2.1 The acid solution to be sprayed shall consist of a solution of Sulphur - dioxide in distilled water. The composition of the solution shall be 0.3 percent (W/V) Sulphur dioxide in distilled water. The solution shall be prepared as per Clauses 3.2.2 to 3.2.3.

3.2.2 A small quantity of distilled water at ambient temperature shall be saturated with sulphur dioxide (use of a fume cup board is desirable). This takes about half an hour. Towards the end of this period, the temperature of the solution shall be raised to 36°C. This will yield a stock solution containing approximately 6 percent (W/V) Sulphur dioxide in distilled water. The stock solution shall be kept in a well stoppered dark bottle in a cool place and used within 28 days. (Readily available Sulphur dioxide solution of required concentration may also be used).

3.2.3 The test solution shall be prepared by diluting 5 ml of stock solution with 95 ml of distilled water. It shall be kept in a well stoppered bottle in a cool place and used within 7 days.

Caution - Sulphur dioxide and solutions of Sulphur dioxide are harmful to human beings and clothing. Operators carrying out this test must take precautions. They should not enter the chamber during spraying and the chamber should be purged with clean air to lower the concentration of Sulphur dioxide in the air of the chamber to a level acceptable to a safety limits before they enter after spraying. Rubber gloves should be used to handle equipment. If necessary, a suitable respirator should be worn.

3.3 Conditioning - The equipment under test shall be subjected to this test in its 'unpacked' and 'switched-off' condition. Two procedures are specified for this test. The equipment shall be subjected to one of these procedures as specified.

3.3.1 Procedure - 1.

3.3.1.1 The equipment under test, while being under the laboratory atmospheric conditions, shall be introduced into the acid spray chamber, the latter also being under the same conditions.

3.3.1.2 The equipment shall then be exposed to the acid mist. with the spray operating for a period of 2 hours under the laboratory atmospheric conditions.

3.3.1.4 The equipment shall then be stored at a temperature of $35^{\circ}\text{C} \pm 2 \text{ degC}$ and relative humidity of 90 to 95 percent for a period of 7 days.

3.3.1.5 The procedure specified in clauses 3.3.1.2 to 3.3.1.4 constitutes one cycle. The equipment shall be subjected to a total of four consecutive cycles as above.

3.3.1.6 The equipment shall then be removed from the chamber and shall be examined for corrosion and deterioration of metal parts, finishes, materials, components and contact materials.

3.3.2 Procedure 2

3.3.2.1 The equipment under test, while being under laboratory atmospheric conditions, shall be introduced into the acid spray chamber, the latter also being under the same conditions.

3.3.2.2 The equipment shall then be exposed to the acid mist with the spray operating for a period of 2 hours under the laboratory atmospheric conditions.

3.3.2.3 The quantity of solution sprayed per hour shall be approximately one percent of the volume of the chamber.

3.3.2.4 The equipment shall then be stored at a temperature of $35^{\circ}\text{C} \pm 2 \text{ degC}$ and a relative humidity of 90 to 95 percent for a period of 22 hours.

3.3.2.5 The procedure specified in Clauses 3.3.2.2 to 3.3.2.4 constitutes one cycle. The equipment shall be subjected to a total of three consecutive cycles as above.

3.3.2.6 The equipment shall then be removed from the chamber and shall be examined for corrosion and deterioration of metal parts, finishes, materials, components and contact materials.

3.4 Recovery - If required, the equipment may be washed in running tap water for 5 minutes, rinsed in distilled water or demineralised water, then shaken by hand or subjected to airblast to remove droplets of water and dried for 1 hour at $+55^{\circ}\text{C} \pm 2 \text{ degC}$. The equipment shall then be allowed to remain under standard recovery conditions for a period of 2 to 4 hours.

3.5 Final Measurements - The equipment shall be visually examined and shall be electrically and mechanically checked as specified. In case dummy equipment is used for the test, only visual examination shall be done.

- 4.1 Initial Measurements (see clause 3.1).
- 4.2 The applicable procedure (see clause 3.3).
- 4.3 Recovery (see clause 3.4).
- 4.4 Final Measurements (see clause 3.5).
- 4.5 Any deviation from the normal test procedure.

Tailoring is very essential. Select severity and procedure for each test after reading Cl. 1.10 under Scope of this specification

1. OBJECT

1.1 To determine the suitability of electronic and electrical equipment for use and/ or storage under the influence of atmosphere containing Potassium hydroxide.

2. TEST CHAMBER

2.1 An alkaline spray chamber meeting the requirements specified in Clauses 2.2 to 2.6 shall be used for the test.

Note : The chamber used for the test is similar in all respect to the chamber specified in Test No. 9 Corrosion (Salt).

2.2 The alkaline spray chamber shall be constructed from materials that will not be affected adversely by the influence of Potassium hydroxide solution used in this test.

2.3 The alkaline mist shall freely circulate around the equipment under test. There shall be no direct impingement of the alkaline mist on the equipment under test. The liquid which has come in contact with the equipment under test shall not be allowed to return to the reservoir containing the solution. Drops of liquid condensate accumulating on the walls, sealing and other parts of the chamber shall not fall on the equipment under test.

2.4 The chamber shall be properly vented to prevent pressure build up inside the chamber.

2.5 The alkaline spray shall be produced by an atomizer employing compressed air which is free from impurities.

2.6 It shall be possible to adjust the air pressure for spraying of the solution in the chamber such that the quantity of alkaline solution sprayed per hour shall be approximately 1% of the volume of the chamber.

2.7 The alkaline spray chamber or a humidity chamber shall be used for storage of the equipment under test for exposure to the conditions specified in clauses 3.3.1.4 and 3.3.2.4. Whichever chamber is used for this purpose it shall be capable of maintaining its working space at a temperature of $35^{\circ}\text{C} + 2 \text{ degC}$ and a relative humidity of 90 to 95% during the periods of storage of the equipment under test. The chamber used for this purpose shall satisfy the requirement specified for damp heat chamber in the Damp Heat Test (Test No. 10).

3.1 Initial Measurements:

The equipment shall be visually examined and shall be electrically and mechanically checked as specified. In case dummy equipment is used for the test, only visual examination shall be done.

3.2 Preparation of Alkaline solution.

The alkaline solution to be sprayed shall consist of a solution of Potassium hydroxide in distilled water. The composition of the solution shall be 10% (Weight/Volume) Potassium hydroxide in distilled water.

Caution : Potassium hydroxide and solutions of Potassium hydroxide are harmful to human beings and clothing. Operators carrying out this test must take precautions. They should not enter the chamber during spraying and the chamber should be purged with clean air to lower the concentration of Potassium hydroxide in the air of the chamber to a level acceptable to a safety limit before they enter after spraying. Rubber gloves should be used to handle equipment. If necessary, a suitable respirator should be worn.

3.3 Conditioning.

The equipment under test shall be subjected to this test in its ‘unpacked’ and ‘switched off’ condition. Two procedures are specified for this test. The equipment shall be subjected to one of these procedures as specified.

3.3.1 Procedure – 1

3.3.1.1 The equipment under test, while being under the laboratory atmospheric conditions, shall be introduced into the alkaline spray chamber, the latter also being under the same conditions.

3.3.1.2 The equipment shall then be exposed to the alkaline mist with the spray operating for a period of 2 hours under the laboratory atmospheric conditions.

3.3.1.3 The quantity of solution sprayed per hour shall be approximately one percent of the volume of the chamber.

3.3.1.4 The equipment shall then be stored at a temperature of $35^{\circ}\text{C} + 2 \text{ degC}$ and relative humidity of 90 to 95 percent for a period of 7 days.

3.3.1.5 The procedure specified in Clauses 3.3.1.2 to 3.3.1.4. constitutes one cycle. The equipment shall be subjected to a total of four consecutive cycles as above.

3.3.1.6 The equipment shall then be removed from the chamber and shall be examined for corrosion and deterioration of metal parts, finishes, materials, components and contact materials.

3.3.2.1 The equipment under test, while being under laboratory atmospheric conditions, shall be introduced into the alkaline spray chamber, the latter also being under the same conditions.

3.3.2.2 The equipment shall then be exposed to the alkaline mist with the spray operating for a period of 2 hours under the laboratory atmospheric conditions.

3.3.2.3 The quantity of solution sprayed per hour shall be approximately one percent of the volume of the chamber.

3.3.2.4 The equipment shall then be stored at a temperature of $35^{\circ}\text{C} + 2\text{degC}$ and relative humidity of 90 to 95 percent for a period of 22 hours.

3.3.2.5 The procedure specified in Clauses 3.3.2.2 to 3.3.2.4. constitutes one cycle. The equipment shall be subjected to a total of three consecutive cycles as above.

3.3.2.6 The equipment shall then be removed from the chamber and shall be examined for corrosion and deterioration of metal parts, finishes, materials, components and contact materials.

3.4 Recovery

3.4.1 If required, the equipment may be washed in running tap water for 5 minutes, rinsed in distilled water or demineralised water, then shaken by hand or subjected to air blast to remove droplets of water and dried for 1 hour at $+ 55^{\circ}\text{C} \pm 20\text{degC}$. The equipment shall then be allowed to remain under standard recovery conditions for a period of 2 to 4 hours.

3.5 Final Measurements

3.5.1 The equipment shall be visually examined and shall be electrically and mechanically checked as specified. In case dummy equipment is used for the test, only visual examination shall be done.

4. INFORMATION TO BE GIVEN IN THE RELEVANT EQUIPMENT SPECIFICATION

- 4.1 Initial Measurements (see clause 3.1)
- 4.2 The applicable procedure (see clause 3.3)
- 4.3 Recovery (see clause 3.4)
- 4.4 Final Measurements (see clause 3.5)
- 4.5 Any deviation from the normal test procedure.

Tailoring is very essential. Select severity and procedure for each test after reading Cl. 1.10 under Scope of this specification

1. OBJECT

1.1 To determine the suitability of electronic and electrical equipment for use and/or storage in salt laden atmosphere. This test is intended mainly for evaluating the quality and uniformity of protective coatings.

2. TEST CHAMBER

2.1 A salt spray chamber meeting the requirements of clauses 2.2 to 2.6 shall be used for this test.

2.2 The salt spray chamber shall be constructed from material, that will not be affected adversely by the corrosive influence of the salt mist.

2.3 The salt mist shall freely circulate around the equipment under test. There shall be no direct impingement of salt mist on the equipment under test. The liquid which has come in contact with the equipment under test, shall not be allowed to return to the salt solution reservoir. Drops of liquid condensate accumulating on the walls, ceiling and other parts of the chamber shall not fall on the equipment under test.

2.4 The chamber shall be properly vented to prevent pressure build-up inside the chamber.

2.5 The salt spray shall be produced by atomiser employing compressed air which is free from all impurities.

2.6 It shall be possible to adjust the air pressure for the spraying of salt solution in the chamber such that the quantity of solution sprayed per hour shall be approximately one percent of the volume of the chamber.

2.7 The salt mist chamber or a humidity chamber shall be used for the storage of the equipment under test for exposure to the condition specified in clause 3.3.1.4 or 3.3.2.4 Whichever chamber is used for this purpose, it shall be capable of maintaining its working space at a temperature of $35^{\circ}\text{C} \pm 2 \text{ degC}$ and relative humidity of 90 to 95 percent during the periods of storage of the equipment under test. The chamber used for this purpose shall satisfy the requirements specified for damp heat chamber in the damp heat test (Test Number 10).

3.1 Initial Measurements - The equipment shall be visually examined and shall be electrically and mechanically checked as specified. In case dummy equipment is used for the test, only visual examination shall be done.

3.2 Preparation of Salt Solution

3.2.1 Salts, given in Table 4.9-1 shall be dissolved in distilled water for preparation of the salt solution. The proportions of the ingredients in the solution are to be within 10 percent of those given in the Table 4.9- 1.

**TABLE 4.9-1 COMPOSITION OF SALT SOLUTION
(Clause 3.2.1)**

INGREDIENT	QUANTITY PER 1 LITRE OF SOLUTION
Sodium chloride (NaCl)	26.5 g
Magnesium chloride (MgCl ₂)	2.4 g
Magnesium sulphate (MgSO ₄)	3.3 g
Calcium chloride (CaCl ₂)	1.1 g
Potassium chloride (KCl)	0.73 g
Sodium bicarbonate (NaHCO ₃)	0.20 g
Sodium bromide (NaBr)	0.28 g
Distilled Water	To make up 1 litre of solution

3.2.2 Fresh solution shall be used for each spray.

3.3 Conditioning - The equipment under test shall be subjected to this test in its ‘unpacked’ and ‘switched- off’ condition. Two procedures are specified for this test. Third procedure is applicable only for Airborne Equipment, as specified in the relevant Equipment specification. The equipment shall be subjected to one of these procedures as specified.

3.3.1 Procedure 1

3.3.1.1 The equipment under test, while being under the laboratory atmospheric conditions shall be introduced into the salt spray chamber, the latter also being under the same conditions.

3.3.1.2 The equipment shall then be exposed to the salt mist with the spray operating, for a period of 2 hours under the laboratory atmospheric conditions.

3.3.1.3 The quantity of solution sprayed per hour shall be approximately one percent of the volume of the chamber.

3.3.1.5 The procedure specified in clauses 3.3.1.2 to 3.3.1.4 constitutes one cycle. The equipment shall be subjected to a total of four consecutive cycles as above.

3.3.1.6 The equipment shall then be removed from the chamber and shall be examined for corrosion and deterioration of metal parts, finishes, materials and components.

3.3.2 Procedure 2

3.3.2.1 The equipment under test, while being under laboratory atmospheric conditions shall be introduced into the salt spray chamber, the latter also being under the same conditions.

3.3.2.2 The equipment shall then be exposed to the salt mist, with the spray operating, for a period of 2 hours under the laboratory atmospheric conditions.

3.3.2.3 The quantity of solution sprayed per hour shall be approximately one percent of the volume of the chamber.

3.3.2.4 The equipment shall then be stored at a temperature of $35^{\circ}\text{C} \pm 2 \text{ degC}$ and a relative humidity of 90 to 95 percent for a period of 22 hours.

3.3.2.5 The procedure specified in clauses 3.3.2.2 to 3.3.2.4 constitutes one cycle. The equipment shall be subjected to a total of three consecutive cycles as above.

3.3.2.6 The equipment shall then be removed from the chamber and shall be examined for corrosion and deterioration of metal parts, finishes, materials and components.

3.3.3 Procedure 3

3.3.3.1 The equipment under test while being under laboratory atmospheric conditions shall be introduced into the salt spray chamber, the latter also being under the same conditions.

3.3.3.2 The equipment shall then be exposed to the salt mist with the spray operating for a period of 48 hours or as specified in the equipment specification laboratory atmospheric condition.

3.3.3.3 The quantity of solution sprayed per hour shall be approximately one percent of the volume of the chamber.

3.3.3.4 The equipment shall then be stored at standard ambient atmosphere for 48 hours or as specified in the equipment specification for drying.

3.3.3.6 The equipment shall then be visually inspected. If necessary to aid in examination, a gentle wash in running water may be used.

3.4 Recovery - If required, the equipment may be washed in running tap water for 5 minutes, rinsed in distilled water or demineralised water, then shaken by hand or subjected to air blast to remove droplets of water and dried for 1 hour at $55^{\circ}\text{C} \pm 2^{\circ}$ degC. The equipment shall then be allowed to remain under standard recovery conditions for a period of 2 to 4 hours.

3.5 Final Measurements - The equipment shall be visually examined and shall be electrically and mechanically checked as specified. In case dummy equipment is used for the test, only visual examination shall be done.

4. INFORMATION TO BE GIVEN IN THE RELEVANT EQUIPMENT SPECIFICATION

- 4.1 Initial measurements (see clause 3.1).
- 4.2 The applicable procedure (see clause 3.3).
- 4.3 Recovery (see clause 3.4).
- 4.4 Final measurements (see clause 3.5).
- 4.5 Any deviation from the normal test procedure.

Tailoring is very essential. Select severity and procedure for each test after reading Cl. 1.10 under Scope of this specification

1. OBJECT

1.1 To determine the suitability of electronic and electrical equipment for use under conditions of high humidity.

2. TEST CHAMBER

2.1 A damp heat chamber meeting requirements of clauses 2.2 to 2.8 shall be used for this test.

2.2 The damp heat chamber shall be capable of maintaining at any point in its working space a temperature, with a tolerance of ± 0.5 degC, of any value up to $40^{\circ}\text{C} \pm 2$ degC with a relative humidity of $93\pm 5\%$.

Note : The temperature tolerance of ± 2 degC is introduced in order to take account of absolute errors in the measurements of slow change of this temperature and of temperature variation in the working space. The temperature control shall keep the short term temperature fluctuation within ± 0.5 degC.

2.3 Condensed water shall be continuously drained from the chamber and shall not be used again until it has been purified.

2.4 When the humidity conditions in the chamber are obtained by using demineralised water, this shall have a resistivity of not less than 500 ohm meters.

2.5 The temperature and relative humidity of the chamber shall be monitored by sensing devices suitably located in the working space.

2.6 The conditions prevailing throughout the working space shall be uniform and shall be as similar as possible to those prevailing in the immediate vicinity of sensing devices.

2.7 The properties of the equipment or its operation shall not appreciably influence the conditions within the working space of chamber.

2.8 Any condensed water from the walls and roof of the chamber shall not fall on the equipment.

3. TEST PROCEDURE

3.1 The equipment shall be visually examined and shall be electrically and mechanically checked as specified.

3.2.1 The equipment under test shall be subjected to the test in its' unpacked' and 'switched-off condition.

3.2.2 The equipment under test, while being under the laboratory atmospheric conditions shall be introduced into the chamber, the latter also being under the same conditions. The temperature and relative humidity of the chamber shall then be raised to $40^{\circ}\text{C} \pm 2 \text{ degC}$ and $93\pm 5\%$ respectively, over a period of not less than one hour.

3.2.3 The equipment shall be conditioned under these conditions for a period of 16 hours.

3.2.4 During the last 30 minutes of the period, specified in clause 3.2.3, the equipment shall be switched on and a performance check, as specified, shall be carried out.

Note : In the case of equipment having high heat dissipation and requiring large volume of fresh air intake for cooling purposes, the performance check will be done at the nearest possible, specified test conditions depending on the limitations of the chamber.

3.2.5 The temperature of the chamber, shall then be restored to the laboratory atmospheric conditions in not less than an hour. Saturation of the chamber atmosphere with water vapour shall occur during this period. The equipment shall then be exposed to these conditions for a period of not less than 3 hours.

3.3 Recovery - The equipment shall be recovered from the chamber and shall be allowed to remain under standard recovery conditions for a period of 2 to 4 hours.

Note : The relevant equipment specification may specify whether removal of condensed moisture is required and recommended method of removal, before final measurements.

3.4 Final Measurements - The equipment shall be visually examined and shall be electrically and mechanically checked as specified.

4. INFORMATION TO BE GIVEN IN THE RELEVANT EQUIPMENT SPECIFICATION

- 4.1 Initial measurements (see clause 3.1).
- 4.2 Details of performance check (see clause 3.2.4).
- 4.3 Final measurements (see clause 3.4).
- 4.4 Any deviation from the normal test procedure.

Tailoring is very essential. Select severity and procedure for each test after reading Cl. 1.10 under Scope of this specification

1. OBJECT

1.1 To determine the suitability of unsealed electronic and electrical equipment in service to water droplets falling on it.

2. TEST EQUIPMENT

2.1 One or more dispensers fitted with nozzles of the type shown in Fig. 4.11-1 shall be used for conducting this test.

2.2 The number of dispenser units employed shall be sufficient to cover the area of the equipment surface under test. In case of large areas, it may be acceptable for sections to be conditioned sequentially. In this case the areas must overlap and each is to be conditioned for specified duration.

2.3 The water used for the test shall be clean tap water. The water from the nozzle shall fall vertically downwards on to the surface of the equipment from a height of one metre. The water level in dispenser shall be maintained constant by adjusting the water flow to the dispenser.

2.4 Distance between two dispensers shall be 25 mm and distance between water level and dispenser level shall be 76 ± 1.6 mm. Total level of water shall be 300 mm.

3. TEST PROCEDURE

3.1 Initial Measurements - The equipment shall be visually examined and shall be electrically and mechanically checked as specified.

3.2 Conditioning - The equipment shall be subjected to this test in its unpacked condition.

3.2.1 The equipment under test, while being under the laboratory atmospheric conditions shall be positioned below the drip dispenser in its normal operational attitude.

3.2.2 Unless otherwise specified, any removable covers of the equipment shall be fixed in position as in normal operations. Sockets, terminal boxes, pipe and other entries shall be protected either by fitting the normal connectors and pipes or equivalent sealing blocks.

3.2.3 The equipment shall be subjected to this test for a period of 15 minutes.

3.2.5 At the conclusion of the test, the equipment shall be visually examined for ingress of water.

3.3 Recovery - Unless otherwise specified, all the external surfaces of the equipment shall be dried by wiping or by applying a clean blast of air at room temperature.

3.4 Final Measurements - The equipment shall then be visually examined and electrically and mechanically checked as specified.

4. INFORMATION TO BE GIVEN IN THE RELEVANT EQUIPMENT SPECIFICATION

- 4.1 Initial Measurements (see clause 3.1).
- 4.2 Details of operation (see clause 3.2.4).
- 4.3 Final measurements (see clause 3.4).
- 4.4 Any deviation from the normal test procedure.

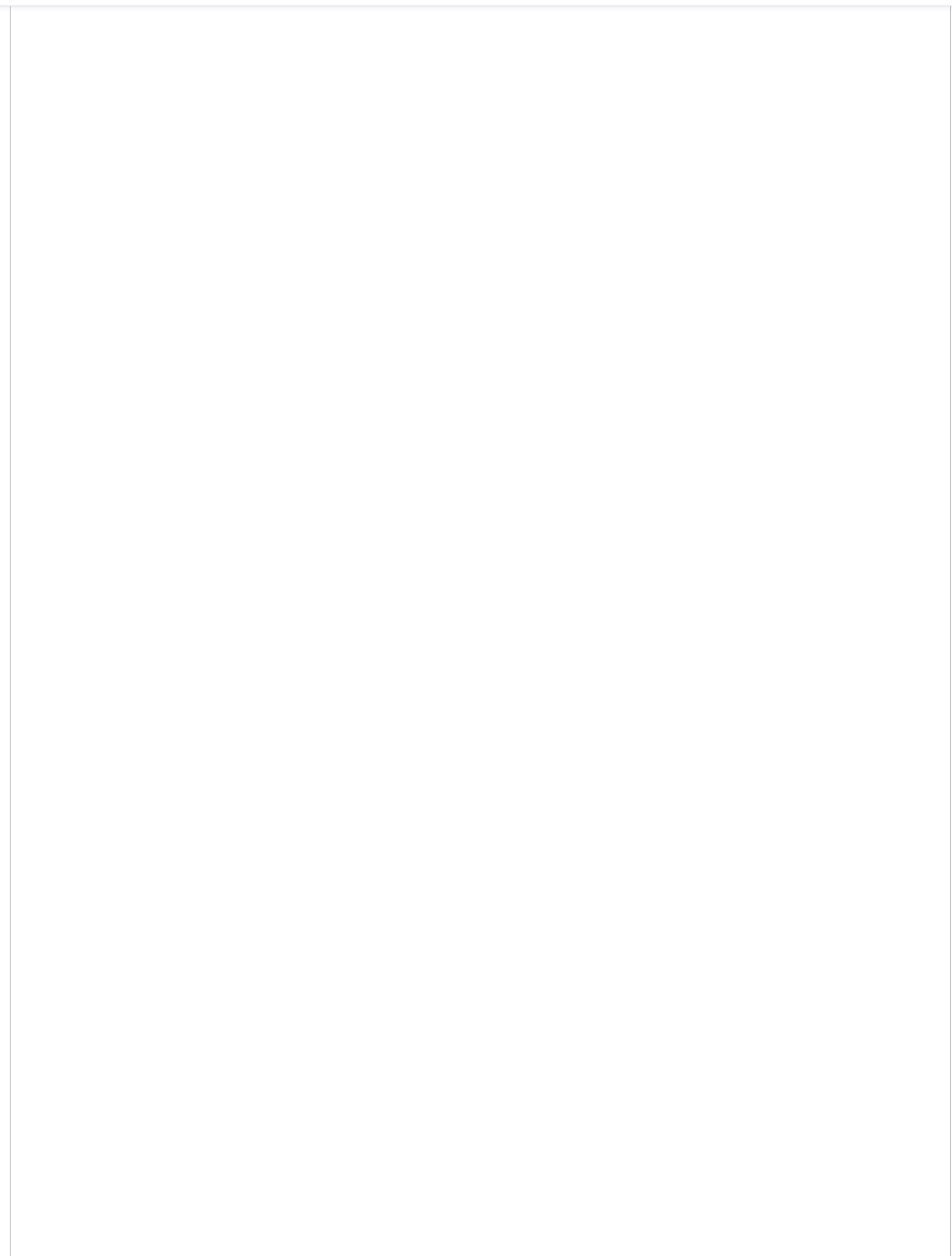


FIGURE 4.11-1

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Tailoring is very essential. Select severity and procedure for each test after reading Cl. 1.10 under Scope of this specification

1. OBJECT

- 1.1 To determine the suitability of electronic and electrical equipment under conditions of rain.

2. TEST CHAMBER

- 2.1 A driving rain chamber meeting requirements of clause 2.2 to 2.4 shall be used for this test.

- 2.2 The driving rain chamber shall be capable of spraying water under laboratory conditions at a static pressure of $200 \text{ kPa} \pm 15$ percent from eight shower heads.

Note : The static pressure shall be measured nearest to each shower head.

- 2.3 It shall be possible to direct the spray from four of these shower heads downwards, at an angle of 45 degree, at each of the four uppermost corners of the equipment under test and from the remaining four shower heads, horizontally at the centre of the area of each of the four sides of the equipment without excessive overlap from the adjacent shower heads. It shall also be possible to locate the shower heads at such a distance that the intensity of water spray at the equipment under test shall be not less than the equivalent of the rainfall of 250 mm per hour.

- 2.4 The shower heads shall conform to Figs. 4.12-1 to 4.12-4. Use of such shower head will result in water consumption of approximately 450 litres per hour at a static pressure of 200 kPa.

3. TEST PROCEDURE

- 3.1 Initial Measurements - The equipment shall be visually examined and shall be electrically and mechanically checked as specified.

- 3.2 Conditioning - The equipment shall be subjected to this test, in its 'unpacked' and 'switched-off' condition. Three test conditions are specified for this test. The equipment shall be subjected to one of the test conditions as specified.

- 3.2.1 The equipment under test, while being under the laboratory atmospheric conditions shall be suitably positioned inside the chamber in its normal operational attitude as specified.

Test Condition A	25 mm	Test Condition D	250 mm
Test Condition B	50 mm	Test Condition E	500 mm
Test Condition C	100 mm	Test Condition F	1000 mm

Note : The height of drop shall be measured from the point of the equipment, nearest to the surface of the steel plate, when suspended prior to dropping.

3.2.4 The equipment attitude for drop (that is, drop on corner, edge or face) and number of drops in each attitude shall be as specified.

3.2.5 If required, the equipment shall be visually examined after each drop.

3.3 Final Measurements - The equipment shall be visually examined and shall be electrically and mechanically checked as specified.

4. INFORMATION TO BE GIVEN IN THE RELEVANT EQUIPMENT SPECIFICATION

- 4.1 Initial measurements (see clause 3.1).
- 4.2 The required test condition for the height of drop (see clause 3.2.3).
- 4.3 The equipment attitude (s) and number of drops in each attitude (see clause 3.2.4).
- 4.4 Whether visual examination is required at the end of each drop (see clause 3.2.5).
- 4.5 Final measurements (see clause 3.3).
- 4.6 Any deviation from the normal test procedure.

Tailoring is very essential. Select severity and procedure for each test after reading Cl. 1.10 under Scope of this specification

1. OBJECT

1.1 To determine the suitability of electronic and electrical equipment for use and/or storage under dust laden environment.

2. TEST CHAMBER

2.1 A dust chamber meeting requirements of clauses 2.2 and 2.3 shall be used for this test.

2.2 The dust chamber shall be capable of circulating dust in its working space in such a manner as to produce a dust concentration sufficient to deposit requisite quantity of dust in the dust measuring device as specified in clause 2.6.

Note : Fig. 4.14-1 indicates a suggested layout the dust inducing components in the dust chamber.

2.3 The chamber shall also be capable of maintaining its working space at a temperature of $40^{\circ}\text{C} \pm 3 \text{ degC}$ with a relative humidity not exceeding 50 percent. In all other respects, the chamber shall satisfy the requirements specified for the test chamber in high temperature test (Test Number 17).

2.4 The dust used for this test shall be dry. It shall be heated to $40^{\circ}\text{C} \pm 3 \text{ degC}$ before the agitation of the dust in the chamber is commenced. Sufficient quantity of dust shall be made available in the chamber originally, in order to give the specified dust concentration throughout the chamber.

2.5 The dust shall conform to the following requirements.

2.5.1 Physical Characteristics

- (a) 100 percent dust shall pass through 150 Micron IS Sieve.
- (b) 98 ± 2 percent dust shall pass through 106 Micron IS Sieve.
- (c) 90 ± 2 percent dust shall pass through 75 Micron IS Sieve .
- (d) 75 ± 2 percent dust shall pass through 45 Micron IS Sieve.

TABLE 4.14-1 CHEMICAL COMPOSITION OF DUST

(Clause 2.5.2)

SUBSTANCE	PERCENTAGE BY WEIGHT
SiO ₂	97 to 99
Fe ₂ O ₃	0 to 2
Al ₂ O ₃	0 to 1
TiO	0 to 2
MgO	0 to 1
Ignition	0 to 1

losses

2.6 A dust measuring device is shown in Fig. 4.14-2. The device shall be kept at any place within the dust chamber. The air shall be circulated for 5 minutes and the dust shall be allowed to settle down. The amount of dust collected in the device shall be 25 ± 5 grams.

3. TEST PROCEDURE

3.1 Initial Measurements - The equipment shall be visually examined and shall be electrically and mechanically checked as specified.

3.2 Conditioning - The equipment shall be subjected to this test in its 'unpacked' and 'switched - off' condition.

3.2.1 The equipment under test, shall be introduced into the chamber, under the laboratory atmospheric conditions, the chamber also being under the same conditions.

3.2.2 The temperature of the chamber shall then be raised to a value of $40^\circ\text{C} \pm 3$ degC. The relative humidity shall be maintained at a value not exceeding 50 percent.

3.2.3 After temperature stability has been attained, the equipment shall then be subjected to a stream of dust laden air for a period of one hour. During this period the dust concentration shall be maintained as in clause 2.2.

3.2.4 If required, equipment shall be switched on and a performance check shall be carried out at any time during the period specified in clause 3.2.3.

3.2.5 The circulation of dust shall then be discontinued and the temperature of the chamber shall be restored to the laboratory atmospheric conditions.

3.4 **Final Measurements.** - The equipment shall be visually examined as specified, and any local accumulation of dust shall be noted. If required, the equipment shall then be electrically and mechanically checked.

Note : The accumulated dust shall be removed before electrical and mechanical checks are made. The dust shall be removed by brushing, wiping or shaking. Under no circumstances shall the dust be removed by an air blast or by vacuum cleaning.

4. INFORMATION TO BE GIVEN IN THE RELEVANT EQUIPMENT SPECIFICATION

- 4.1 Initial measurements (see clause 3.1).
- 4.2 Performance checks required (see clause 3.2.4).
- 4.3 Final measurements (see clause 3.4).
- 4.4 Any deviation from the normal test procedure.

DUST CHAMBER

FIGURE 4.14-1

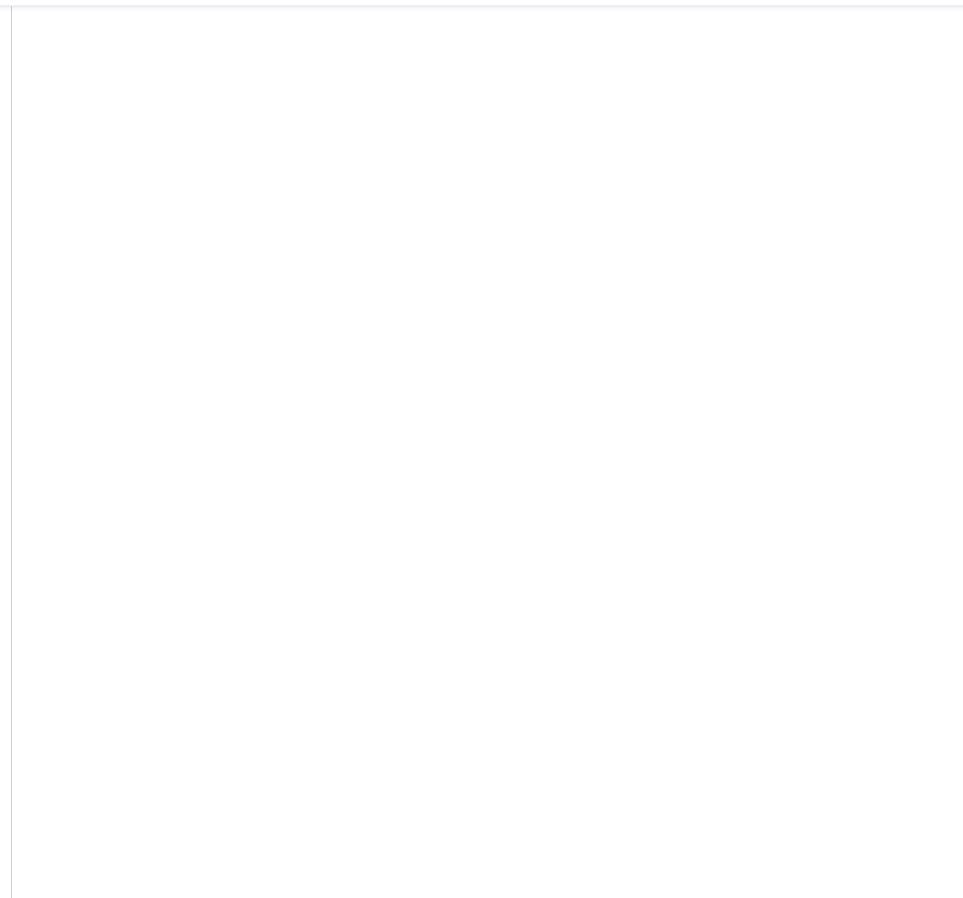


FIGURE 4.14-2

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EXPLOSION

(UNDER CONSIDERATION)

3.2.4 Procedure 4

3.2.4.1 The chamber temperature shall be adjusted to one of the following test conditions as required.

- (a) Test condition E : 70°C + 3 degC
- (b) Test condition F : 100°C + 5 degC

3.2.4.2 The equipment temperature shall be stabilized at the appropriate test condition stated in clause 3.2.4.1.

3.2.4.3 The equipment shall then be operated for a period of 1 hour or for any other period as specified.

3.2.4.4 At the end of the period specified in clause 3.2.4.3 performance check shall be carried out, If necessary, the duration specified in clause 3.2.4.3 shall be extended to allow the performance check to be completed.

3.2.4.5 Unless otherwise specified, the equipment, while the chamber temperature is being maintained at the specified test condition, shall be switched off and its operation shall be stopped for 5 minutes. The equipment shall be switched on again. The equipment shall then be operated for a minimum period required and a limited performance check shall be carried out only to demonstrate that the equipment is not deranged by hot 'switch-on' or 'start-up'.

3.2.4.6 The equipment shall then be immediately subjected to conditioning specified in procedure 3 or 4 of Test Number 3 as specified.

3.2.5 Procedure 5

3.2.5.1 The equipment under test while being under the laboratory atmospheric conditions, shall be introduced into the chamber, the latter also being under the same conditions. The chamber temperature shall then be raised to one of the following test conditions as required:

- (a) Test condition G: 55°C + 3 degC
- (b) Test condition H: 70°C + 3 degC
- (c) Test condition J: 80°C + 3 degC

3.2.5.2 The equipment shall be exposed to this temperature for a period of 24 hours.

temperature attained by the components or materials in the equipment shall be measured and recorded, if required .

3.2.5.4 During the final hour of the period specified in clause 3.2.5.2, a performance check shall be carried out on the equipment as required.

Note : Performance check is required to be conducted after equipment internal temperatures have stabilised. For the purpose a period longer than 24 hours (see clause 3.2.5.2) is permitted, when necessary.

3.2.5.5 The temperature of the chamber shall then be restored to the laboratory atmospheric conditions.

3.2.6 Procedure 6

3.2.6.1 The equipment shall be subjected to one of the following test conditions, as required.

(a) Test condition K : Operation at $55^{\circ}\text{C} \pm 3 \text{ degC}$ followed by storage at $70^{\circ}\text{C} \pm 3 \text{ degC}$

(b) Test condition M : Operation at $55^{\circ}\text{C} \pm 3 \text{ degC}$ followed by storage at $85^{\circ}\text{C} \pm 3 \text{ degC}$

3.2.6.2 The equipment under test, while being under the laboratory atmospheric conditions shall be introduced into the chamber, the latter also being under the same conditions. The temperature of the chamber shall then be raised to $55^{\circ}\text{C} \pm 3 \text{ degC}$. the equipment shall be exposed to this temperature for a period of 24 hours.

3.2.6.3 If required, the equipment shall be switched on and operated for the specified duration at any time during this period of exposure to high temperature. Unless otherwise specified, the maximum surface temperatures attained by the components or materials in the equipment shall be measured and recorded .

3.2.6.4 During the final hour of the period specified in clause 3.2.6.2 a performance check shall be carried out on the equipment as required (see Note in clause 3.2.5.4).

3.2.6.5 The temperature of the chamber shall then be raised to storage temperature corresponding to test condition K or M as specified. The equipment shall be exposed to this temperature for a period of 24 hours.

3.2.6.6 At the end of this period, the temperature of the chamber shall be restored to the laboratory atmospheric conditions.

Note : For procedures, 1,2,3 and 4 the recovery conditions shall be applicable only when these procedures are not immediately followed by another procedure of the test or Test Number 3 and final measurements at laboratory atmospheric conditions are required to be made.

3.4 Final Measurements - The equipment shall then be visually examined and shall be electrically and mechanically checked as specified.

Note : For procedures 1,2,3, and 4, the final measurements shall be made only when the relevant equipment specification requires the performance of the equipment to be checked at the laboratory atmospheric conditions.

4. INFORMATION TO BE GIVEN IN THE RELEVANT EQUIPMENT SPECIFICATION

4.1 Initial measurements (see clause 3.1)

4.2 The applicable procedure or procedures (see clause 3.2)

4.3 For Procedure 1:

(a) Applicable test conditions (see clause 3.2.1.1)

(b) Details of operation and performance check (See clause 3.2.1.3)

4.4 For Procedure 2:

(a) Applicable test condition (see clause 3.2.2.1)

(b) Details of operation and performance checks (see clause 3.2.2.3), and

(c) Details and period of operation (see 3.2.2.3), and details of limited performance check (see clause 3.2.2.4).

4.5 For Procedure 3:

(a) Applicable test conditions (see clause 3.2.3.1)

(b) Details of operation (see clause 3.2.3.2)

(c) Details of performance check (see clause 3.2.3.3), and

(d) Details and period of operation and details of limited performance check (see clause 3.2.3.4).

- (a) Applicable test conditions (see clause 3.2.4.1)
- (b) Period and details of operation (see clause 3.2.4.3)
- (c) Details of performance check (see clause 3.2.4.4), and
- (d) Details and period of operation and details of limited performance check (see clause 3.2.4.5).

4.7 For Procedure 5:

- (a) Applicable test conditions (see clause 3.2.5.1)
- (b) Duration of operation of equipment and the time at which this operation should commence (see clause 3.2.5.3)
- (c) If measurement of surface temperature of components or materials is required (see clause 3.2.5.3), and
- (d) Details of performance check (see clause 3.2.5.4).

4.8 For Procedure 6:

- (a) Applicable test conditions (see clause 3.2.6.1)
- (b) Duration of operation of equipment and time at which such operation should commence (see clause 3.2.6.3), and
- (c) Details of performance check (see clause 3.2.6.4), and

4.9 Final measurements (see clause 3.4).

4.10 Any deviation from the normal test procedure.

Tailoring is very essential. Select severity and procedure for each test after reading Cl. 1.10 under Scope of this specification

1. OBJECT

- 1.1 To determine the effect of various icing conditions on the performance of Airborne Electronic and Electrical Equipment.

Note : Icing test is specified to simulate the effect that occurs when an aircraft flying in a cold atmosphere encounters free water or descends through clouds into a moist atmosphere near the ground. Ice may build up on the equipment immediately, or frosting or condensation may occur and freeze to Ice. Such tests also simulate the converse effect when water which may have been trapped or condensed inside an equipment or may have collected on pockets on the outside either through wet conditions on the ground or through accumulation of moisture by frosting and subsequent melting of frost, freezes as the aircraft ascends.

2. TEST CHAMBER

- 2.1 A chamber conforming to the requirements of altitude test (Test Number 3) shall be used for Icing as per Test Procedures 1,2, and 3.

3. TEST PROCEDURE

- 3.1 Initial Measurements - The equipment shall be visually examined electrically and /or mechanically checked, as required by the relevant equipment specification.

- 3.2 Conditioning - The equipment to be tested shall in all cases, be in a condition representative of operational use. Unrepresentative coatings and contaminants such as oils grease and dirt, which could affect the adhesion between the Ice and the surface of the equipment, shall be removed before commencing the test.

- 3.2.1 The operation of the equipment shall be checked at the most adverse phase of the test which for most applications would be a switch on and brief functional checks under Icing conditions. Excessive operation of equipment which generates heat shall be avoided.

3.2.2.1 The chamber temperature shall be raised from the level of procedure 1 of Altitude Test (Test No. 3) to 30°C in a period of 1 to 2 hours with relative humidity held at or close to saturation (nominally not less than 95 percent). Visible frosting should occur on the surface of the equipment (Refer procedure 2 clause 3.2.2.1(b) of Altitude Test).

3.2.2.2 When the temperature of equipment has risen to $-5^{\circ}\text{C} \pm 3$ deg C and before the restoration of the chamber pressure to normal atmospheric conditions, a functional test shall be conducted to check for satisfactory operation.

Note : 1 If in the case of vented equipment, there is a possibility of the vent holes being closed by the presence of Ice, the test procedure shall be amended so that pressure is restored before the Ice has melted.

2 The relevant equipment specification shall specify whether it is permissible during the functioning tests for more than one attempt to be made to obtain satisfactory operation.

3.2.3 Procedure 2

3.2.3.1 The equipment shall be conditioned to a temperature not higher than -20°C until temperature stabilisation has been achieved.

3.2.3.2 The chamber pressure shall then be reduced to that used in the Altitude Test (Test No.3) Procedure 1 (clause 3.2.1) but not lower than 15200 metres. After a period of not less than 10 minutes, the temperature of the chamber shall be raised at a rate not exceeding 3°C per minute and humidified so that the chamber humidity is held at or close to saturation. The chamber temperature shall not exceed 30°C .

3.2.3.3 When the equipment temperature has reached above 0°C and after a period which would allow all frost or Ice to melt, the pressure shall be increased to that corresponding to normal atmospheric conditions at a uniform rate, in a period of 15 to 30 minutes. At the completion of repressurisation the next cycle shall be commenced.

3.2.3.4 A total of twenty five such cycles should be made consecutively. If it becomes necessary to interrupt this sequence, the interruption shall take place whilst the equipment is held in low temperature conditions.

3.2.3.5 A functional check shall be made in the final cycle as required in the relevant equipment specifications at the lowest temperature in the cycle i.e. -20°C .

3.2.4.1 The equipment shall be conditioned in a low temperature chamber as specified in low temperature Test No.20 until its temperature has stabilised at level determined by previous experiments, that will permit hard clear Ice to form on the item when water is sprayed upon it. The optimum temperature is likely to be between -1 to -10°C depending upon the thermal mass of the item. A homogeneous layer of hard clear Ice (not white or Air pocketed) shall be produced on the relevant surfaces of the item, to the required thickness and distribution by hand spraying/atomizer with a fine mist of water the temperature of which is close to freezing (say +2°C).

3.2.4.2 When the Ice accretion has reached the level specified in the relevant equipment specifications, spraying shall be stopped and the test temperature restabilised unless otherwise stated, at the relevant temperature of the Altitude Test (Test No. 3) Procedure 1. (clause 3.2.1) before making the performance check required by the relevant equipment specification.

3.3 Recovery: - The temperature of the chamber shall then be restored to the laboratory atmospheric conditions.

3.4 Final Measurements: - For tests demonstrating survival of the equipment only, the equipment shall be operated and a performance evaluation made when the temperature and humidity have returned to standard laboratory conditions.

4. INFORMATION TO BE GIVEN IN THE RELEVANT EQUIPMENT SPECIFICATIONS

4.1 Initial Measurements (see clause 3.1).

4.2 The applicable test procedure or test procedures (see clauses 1.1, 3.2.2, 3.2.3 and 3.2.4).

4.3 Permissible number of attempts to operate (see clause 3.2.2 Note 2).

4.4 Final Measurements (see clause 3.4).

4.5 Any deviation from the proposed procedures.

Tailoring is very essential. Select severity and procedure for each test after reading Cl. 1.10 under Scope of this specification

1. OBJECT

1.1 To determine the water tightness of electronic and electrical equipment when subjected to immersion under stated conditions of pressure and time.

2. TEST CHAMBER

2.1 An immersion tank or a high pressure water chamber shall be used for this test.

2.2 When an immersion tank is used, the specified depth of water shall be measured above the top most point of the equipment.

2.3 When a high pressure water chamber is used, the excess pressure shall be adjusted to the value specified.

3. TEST PROCEDURE

3.1 Preconditioning - Preconditioning of the equipment and seals shall be carried out, as required.

3.2 Initial Measurements - The equipment shall be visually examined and shall be electrically and mechanically checked as specified. All sealing features shall be checked to ascertain that they have been correctly mounted.

3.3 Conditioning - The equipment shall be subjected to this test in its 'unpacked' and 'switched-off' condition.

3.3.1 The water used for this test shall be at a temperature between 15°C and 35°C.

3.3.2 The equipment temperature shall be 5 to 10°C above the temperature of the water, immediately before the start of the test.

3.3.3 The equipment shall be placed in the attitude specified and shall be completely immersed in the water. The depth of immersion or excess pressure shall be adjusted to any of the severities specified in clause 3.3.4, as required.

Note : Sea water may be used in case of severities G,H or J (see Table 4.19-1).

3.3.4 The depth of immersion or excess pressure shall be corresponding to one of the test conditions listed in Table 4.19-1.

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