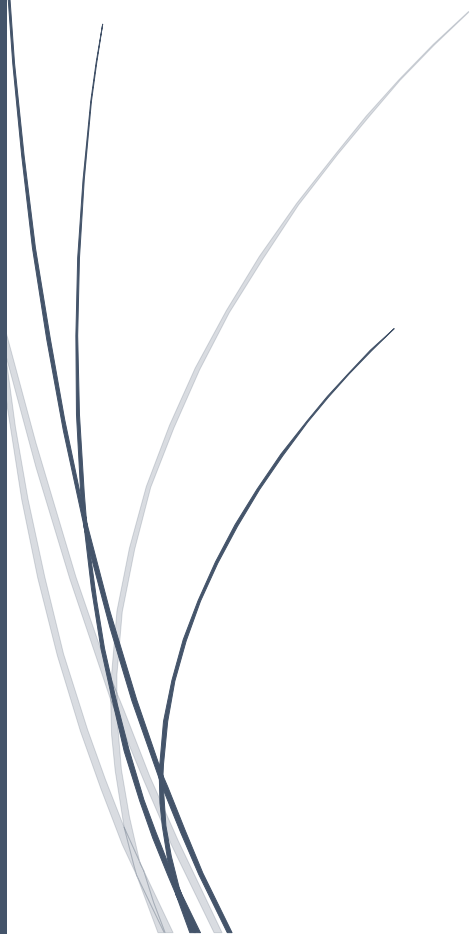
Template No.
CEMILAC_SYSGP_QTP_11

QUALIFICATION TEST PROCEDURE
for <LRU/SYSTEM Name>
for
<Platform Name>

Issue/Rev No: 01/00
Date of Release: 8 Feb 2025



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Title:	**Project/System :**
QUALIFICATION TEST PROCEDURE for<LRU/Module Name> for <Platform name>	<System/Project Name>
	LRU/System Part No.
	<No.>
	Critical Level
	<A/B/C/D/E>

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Amendment History

Issue No.	Issue Date	Brief Description of Amendment	Change Request Ref.	Affected Pages	Affected Section	Change Effective From
001		Initial Issue	NA	NA		All
002						Unit sl.no. <aaa> or Hw mod xx/ Sw ver x.x

TABLE OF CONTENTS

List of Acronyms:

Give all the Acronyms used in this specification Alphabetically

1 Introduction

Brief introduction to the overall functions of the system. (Not more than 1 page)

2 Purpose and Scope

This document establishes the Qualification Test Procedure for evaluating the performance of *<System Name> <Part No.>* for *<platform>.*

The various stakeholders in the project are as follows:

Design Agency	<DLRL, RCI, HAL, BARC etc>
Development Agency	<HAL, BEL, ECIL etc>
Manufacturing Agency	<HAL, BEL, ECIL, BDL, ELIORA etc>
Acquirer	<ADA, RWRDC, ARDC etc>
User	<IAF, IN, Army Aviation, Coast Guard etc>
Certification agency	<CEMILAC, RCMA(Hyd) etc>
Production Quality Control Agency	<ORDAQA, MSQAA, RAQAS etc>

3 System Description

<Give a brief overview of system, project, for which this QTP is applicable. If FTP is not available for this system, describe the test setup covering simulators/ ATE/ Function generator / Testjigs/ Oscilloscopes/Test Equipments connected to UUT that shall be used to verify the specifications and functionality of the UUT. Indicate the test setup in a figure>.

4 Applicable Documents

<All the applicable documents of the system such as Approved Tech spec, ICD, FTP, SOFT, MDI, BOM, aircraft environmental map etc., along with the document number, issue number and date of approval to be given here>

5 Standards Reference

<All the related standards like MIL , DO, JSS Standards and CEMILAC Directives etc., on which the tests are based, should be given here>

6 Qualification Test Applicability

Sl No	TEST and STANDARD	SEVERITY	Remarks
1.	**PHYSICAL INSPECTION**	Weight, Dimensions and compliance of unit with respect to engineering standards and applicable drawings.	
2	**COTS screening**	a) High temperature storage (stabilization bake) At +85°C bake the PCB b) Thermal Shock Stabilized low temp -40°C for 30 min. Stabilized High temp +85°C for 30 min. 2 min transfer operation 1cycle. 10 such cycles c) Power Burn in test At maximum rated operating temp PCB shall be maintained with power ON for 48Hrs. If failure occurs, replace the components with those which have undergone bake and thermal shock.	a) 24 Hrs Duration After test UUT testing at Ambient. b) UUT OFF condition If any components fail, the baking and thermal shock should be repeated on component. c) Last 3 Hrs should be defect free. In case failure observed during 46/ 47/48 Hrs. expose PCB for further 3Hrs.
3	**ESS**	a) Pre-vibration b) Thermal Cycles(10 cycles) c) Post vibration	a) Pre vibration duration is 5min. b) The last 3 cycles of thermal cycling should be defect free. c) Post vibration duration is 5min.
4	**AMBIENT CHECKS**	FTP at nominal voltage	
5	**Continuous Run**	8Hrs at Ambient temperature.	Performance check at every 2Hrs.

6 @	**POWER SUPPLY VARIATION** MIL-STD-704F MIL-HDBK-704-8 (DC) MIL-HDBK-704-2(AC) Table IV Fig 13, 15 (DC) Table I Fig. 3,5,6 (AC) Fig. 14 (DC) Fig. 4 (AC) Sec 5.3.2.3 Sec 5.1	**DC** **a) Normal Steady State** **LDC 102** 22 – 29 V **b)Voltage Distortion** **LDC 103** **Table – II** **c)Total Ripple** **LDC 104 Table II** **d)Normal Voltage transient.** LDC-105 LDC -105-III Test conditions AA-RR **e)Transfer operation:** **LDC 201** Table-II **f) Abnormal Steady State:** **LDC-301** Table –I & II Min : 30minutes Operation **g)Over voltage surge:** 50V for 0.05s Reduce to 31.5V in 7.7s 31.5V till 100 s **LDC-302** Table –IV (AAA to FFF) **h)Under voltage surge:** 0V for 7 sec 20V till 100 sec **LDC-302** Table –IV (GGG to LLL) **I) Combined voltage surge:**	**AC** 108 - 118V & 393 - 407 Hz. **SAC 102** **SAC 106, 107 & 108** **SAC 104 & 105** Voltage and frequency modulation **SAC 109 & 110** Voltage and frequency transients **SAC 201** Table-II A-L 100 - 125V & 380 - 420 Hz. **SAC 301** Table III 180V for 0.05s Reduce to 124.5V in 6.9s 125V till 100 s **SAC 302** Table III AA-GG 0V for 7 sec 100V till 100 sec **SAC 302** Table III AA-GG, HH-NN **SAC 302** Table III	a)Functional checks (at least 30 min) b) Not less than 5min operation at each frequency. c)Not less than 30 min at each test condition. d)The transients are from 29 to 50 at high end and to 18 in low end. e) # continued operation without reset, ensured based on user req. f) LDC-301 Test cases 30 min operation in min. g) LDC-302 Test cases repeated 5 times. h) LDC-302 Test cases repeated 5 times. I) LDC-302

		LDC-302 Table –IV (LLL to NNN) OO condition. **J) Emergency Operation:** **SAC 401** 16V (DC)** Table-II LDC-401 Table –II **k) Starting voltage transient** **LDC-501 Table-III** Test condition AA **l) Power Failure:** **SAC 601** Table LDC-601-I and II Table-II A-to-D **m) Reverse polarity** **SAC 603** LDC-602 Table-I	Test cases repeated 5 times. j) ** If required by user. 12V DC operation for 15 min. during engine start. k) Test to be repeated 5 times. m) Phase reversal should not cause damage.
7	**VIBRATION** CEMILAC directive 14/2015 Dt 13-02-2015 Table 514.6 D-I Cat.7 or Table 514.6 D-II Cat 13 or Fig. 514.6D-3 Cat.14 Table 514.6 D-II Cat 13 Fig. 514.6D-2 Cat.13	**a) Initial Resonance search:** **<u>Rotary wing platform</u>** Resonance search at 0.5g from 5Hz to 500Hz. Record the resonance frequencies >2 times of limit. **<u>Fixed wing platform</u>** Resonance search at 0.5g from 5Hz to 2000Hz. Record the resonance frequencies >2 times of limit. b) **Random Vibration :** (Jet Aicraft)* 15-100 Hz @ 0.040 g^2/Hz 100-300Hz@ 0.040 to w_0 g^2/Hz (+4dB/0ctave) 300Hz-1000Hz @ w_0 g^2/Hz 1000Hz-2000Hz @ w_0 to Level g^2/Hz (@-6dB/0ctave) Mil-std 810G page 514.6D-3 **c) Random on Random (Propeller A/c)** 15 Hz- f0 Hz @ 0.0100 g2/Hz f0 Hz @ L0 g^2/Hz	a) Unit OFF The resonance frequencies should not match platform fundamental. Below 10Hz resonance is not allowed. If impossible to eliminate record the frequencies. b) 1 hr/axis in three axes (Unit ON condition) c) 1 hr/axis in three axes (Unit ON condition) f_0= blade passage frequency

	Table 514.6 D-III Cat 14 Fig. 514.6D-3 Cat.14 CEMILAC directive 14/2015 Dt 13-02-2015	f1 Hz @ L1 g^2/Hz f2 Hz @ L2 g^2/Hz f3 Hz @ L3 g^2/Hz L0 to L3 @ -6dB/Octave $f_1=2*f_0$, $f_2=3*f_0$ and $f_3=4*f_0$ **d) Sine over Random (Helicopter)** f_1 @ A_1 10- 100 Hz @ 0.0010 to 0.010 g^2/Hz (instrument panel) Table 514.6C-X Cat 9 10-300 Hz @ 0.010 g^2/Hz Between 10-300 Hz introduce spikes as below f_2@ A_2 f_3 @ A_3 f_4 @ A_4 300-f_t @ 0.010 to 0.0010 g^2/Hz (f_t =500Hz) (instrument panel) Table 514.6C-X Cat 9. A_1, A_2, A_3 and A_4 calculated as per the table Table 514.6C-X Cat 9 Column 3.	f_0=(no. of blades)x(propeller RPM)/ 60 Hz L_0= choose this from (Table 514.6 D-II Cat 13) Mil-Std-810G page no:514.6D-6 d) 3 hr/axis in three axes (Unit ON condition) f_1= (Main rotor rpm* no.of blades)/60 f_t= 500Hz (UUT in Equipment Bay) Table 514.6 D-III-Cat 14, page 514.6 D-9 *ALH f_1=5.25Hz $f_2=n*f_1$, $f_3=2*f_2$ $f_4=3*f_1$ n= no of main rotor blades or tail rotor. f_1=Train component rotation frequency $f_2=2*f_1$ $f_3=3*f_1$ $f_4=4*f_1$ Based on exposure area the frequencies should be selected. Fig 514.6C-9 Cat 9, Page 514.6C-21. e) More than 10% deviation from initial resonance frequency is to be noted and analysed.

<table>
<tr><td></td><td></td><td>e) Final Resonance search:
<u>Rotary wing platform</u>
Resonance search at 0.5g from 5Hz to 500Hz.
Record the resonance frequencies >2 times of limit.
<u>Fixed wing platform</u>
Resonance search at 0.5g from 5Hz to 2000Hz.
Record the resonance frequencies >2 times of limit.</td><td></td></tr>
<tr><td>8</td><td>ACCELERATION
MIL-STD-810G
Method 513.6
Procedure I
(Structural)
Table 513.6-I
Procedure II
(Operational)
Table 513.6-II</td><td>
<table>
<tr><th></th><th colspan="2">Operational</th><th colspan="2">Structural*</th></tr>
<tr><th></th><th>A/c</th><th>Heli</th><th>A/c</th><th>Heli</th></tr>
<tr><td>Fore</td><td>2.0g</td><td>2.0g</td><td>3.0g</td><td>4.0g</td></tr>
<tr><td>Aft</td><td>6.0g</td><td>2.0g</td><td>9.0g</td><td>4.0g</td></tr>
<tr><td>Up</td><td>9.0g</td><td>7.0g</td><td>13.5g</td><td>10.5g</td></tr>
<tr><td>Down</td><td>3.0g</td><td>3.0g</td><td>4.5g</td><td>4.5g</td></tr>
<tr><td>Lat(L)</td><td>4.0g</td><td>4.0g</td><td>6.0g</td><td>6.0g</td></tr>
<tr><td>Lat(R)</td><td>4.0g</td><td>4.0g</td><td>6.0g</td><td>6.0g</td></tr>
</table>
</td><td>1 min along each direction
During operational acceleration unit should be in ON condition
* This can be carried out on mockup unit</td></tr>
<tr><td>9</td><td>COMBINED ALTITUDE TEMPERATURE HUMIDITY (CATH)
MIL-STD-810G
Method 520.3
Table 520.3 - VII
Table 520.3 - II
Fig 520.3 - 1</td><td>15 min ramp to temperature OFF
4 Hr -40 °C OFF
20 min -40 °C 22V*
10 min ramp to altitude 22V
30 Min -40 °C <cruise Alt> Km 22V*
10 min ramp to humidity, temp & alt 22V
30 Min +32 °C 95%RH 22V
15 min ramp to temp and humidity 29V
2 Hr +54 °C <30% RH 29V*
15 min ramp to altitude 29V
4 Hr +54 °C <cruise Alt> Km
<30% RH 29V*</td><td>Each cycle of apprx.
12 hr duration.
10 cycles.

*UUT functionality check.</td></tr>
<tr><td>10</td><td>HIGH TEMPERATURE

MIL-STD-810G
Method 501.5
Diurnal cycle ranges
Table 501.5-I.</td><td>
<table>
<tr><th>Hour</th><th>Temperature(^{0}C)</th></tr>
<tr><td>01</td><td>35</td></tr>
<tr><td>02</td><td>34</td></tr>
<tr><td>03</td><td>34</td></tr>
<tr><td>04</td><td>33</td></tr>
<tr><td>05</td><td>33</td></tr>
<tr><td>06</td><td>33</td></tr>
<tr><td>07</td><td>36</td></tr>
</table>
</td><td>Storage:
7 cycles of 24 hrs each (Unit OFF)

Operation:
3 cycles of 24 Hrs each (Unit ON)</td></tr>
</table>

	Procedure I (Storage) Procedure II (operation) Table 501.5 III	08 40 09 44 10 51 11 56 12 63 13 69 14 70 15 71 16 70 17 67 18 63 19 55 20 48 21 41 22 39 23 37 24 35	
	Procedure III Sec 4.5.4 Sec 2.3.2 b) 1.	**Tactical Standby to operational** (maximum non-operating temp) Ambient to +85^{0}C (15 ^{0}C per minute) (OFF) 2 Hrs at +85^{0}C (OFF) Bring The temp to High operational Temp (ON) (6^{0}F/min) Return to ambient (OFF)	Performance check at the end of 2 hrs at high operating temperature, return to ambient. to ambient. Applicable for eqpt in enclosed transparent/ translucent areas of aircraft.
11	**LOW TEMPERATURE** **a) STORAGE** MIL-STD-810G Method 502.5 Table 502.5-II Table 502.5-I Sec 2.3.2 **b) OPERATION** Sec 4.5.3	Soak at -51^{0}C (Eqpt soaking temperature) Operate at -40 ^{0}C (Eqpt Low operating temperature)	4 Hrs for Non hazardous 72 Hr for Hazardous 24 Hrs for eqpt with restrained glass. Unit OFF. 2 Hrs. Unit ON. Operational Check during the test. If check takes >15 min. Restabilize the temp.
12	**Temperature SHOCK**	Ambient to -40^{0}C Stabilize at –40 ^{0}C (Low Operating Temp)	3 cycles. Unit ON.

	MIL-STD-810G Method 503.5 Procedure I-C	Soak for 1 hr. Transfer and stabilize at +65^{0}C (High Operating Temp) and soak for 1 hr. This constitutes 1 cycle. +65^{0}C to Ambient	Not required for forced air-cooled eqpt.
13	**HUMIDITY** MIL-STD-810G Method 507.5 Procedure II Fig. 507.5-7 Table 507.5-IX	30 ^{0}C to 60 ^{0}C in 2 Hrs with 95% RH Soak at +60 ^{0}C for 6 Hrs with 95% RH (This is the most severe humid condition) Mil-std 810G sec 2.3.2 c) +60 ^{0}C to +30^{0}C in 8 Hrs with 85% RH Soak at +30 ^{0}C for 8 Hrs with 95% RH	10 cycles. Unit OFF. Unit ON in 5th and 10th cycles between Hrs 20-24.
14 a)	**LOW PRESSURE** MIL-STD-810G Method 500.5 Procedure II, Sec 4.5.3	Temp=Ambient, Altitude=Ground Altitude = <A/c alt>*, Temperature = Altitude corresponding temperature (Equipment ON) Performance check Temp=Ambient, Altitude=Ground	1 Hr Unit ON. As appropriate for respective a/c or helicopter. (Required to be done even if CATH is done - Sec 2.2 of 500.5 in 810G)
14 b)	**RAPID DECOMPRESSION** MIL-STD-810G Method 500.5 Procedure III	Temp=Ambient, Altitude=Ground Adjust chamber pressure to Altitude=2.5Km Reduce the pressure to Altitude=Ceiling Alt. In not more than 15 seconds, Hold for 10 min Come to ambient conditions with pressure rate 10m/s and temperature rate 3°C/min. Mil-std 810G sec 4.5.4 Page 505.5-6	Hold at Max Alt. for 10 Min. Unit ON.
15	**SALT FOG** MIL-STD-810G Method 509.5 Sec 2.2, 4.1.3	Sodium chloride solution of 5 ± 1% concentration, pH 6.5 to 7.2 Mil-std 810G Sec 4.1.3, 509.5 Atomization of approximately 2.8 litres of salt solution per 0.28m$_3$ (10 ft$_3$) of chamber volume per 24 hours. Mil-std 810G Sec 4.5.2 Exposure at 35 ± 2 ºC and fallout is between 1 and 3 ml/80cm2/hr. Drying at 23 ºC, <50% RH.	24 hrs exposure & 24 hrs drying constitute 1 cycle. 2 cycles. Unit OFF.
16 a)	**BLOWING DUST** MIL-STD-810G Method 510.5	(Temp must be High operating or Storage) Red china clay or Silica flour to be used as dust. Air velocity : 8.9 m/s, +23ºC (Desert conditions)	Unit OFF. 6 Hrs 1 Hr

	Procedure I	Start Dust feed for 6Hrs Stop Dust feed; Bring the temp to High Operating Temp. Air velocity 1.5 m/s, +55ºC for 1Hr Start Dust feed Air velocity : 8.9 m/s, +55ºC(Desert conditions) Other conditions : RH = 30% Dust concentration : 10.6 ± 7 gm/ m^3 4.1.1.5 page 510.5-5 Particle size< 150 µm.	6 Hrs Allow dust to settle for 12 hrs before operational check.
16 b)	**BLOWING SAND** MIL-STD-810G Method 510.5 Procedure II	For the sand test use silica sand. Air velocity 18 to 29 m/s, RH = 30%, +55ºC Concentration: 0.18 gm/ m^3 (+0.2 gm/ m^3 tolerance) (natural conditions) [2.2± 0.5 gm/ m^3 for helicopters] Particle size : 150 µm to 850 µm. Adjust chamber temp to highest operating temperature and Air velocity as above. Start sand feed. (90 min/ face) Stop sand feed.	90 min/ face Unit OFF If the test item needs to be operated the test plan should be at least 10 min during last hour.
17 a)	**BLOWING RAIN** MIL-STD-810G Method 506.5 Procedure I Sec 2.3, 4.1.1, 5.2	Rain fall rate 4. inches/hr (Heavy Rain fall rate). Droplet size 0.5-4.5 mm (Droplet size during intense rain). Wind velocity 18 m/s (64 kmph) (Wind velocity during storm). Test item temperature to be stabilized at 10 ±2°C above the rain water temperature at the start of exposure. Measure water found inside the UUT. Water penetration of not more than 4 cm_3 per cubic feet of UUT. Section 5.2	30 min for each surface Unit ON/OFF as required The unprotected equipment should be in ON condition. Sec 4.4.2 step2 page 506.5-9 If required, operate the unit in last 10 min of 30min. If unit functionality is not pk, replace with the new one or repair the unit and restart. Sec 4.3.2 point a.
17 b)	**RAIN DRIP** MIL-STD-810G Method 506.5 Procedure III	Vol. Flow rate 280 lt/m^2/hr. Dispenser app. 1m above equipment. Ensure the temperature differential between the test item and the water is 10°C or greater.	15 minutes Unit ON as required. This is applicable when the unit is protected

	Sec 2.3, 4.1.3, 5.2	Measure water found inside the UUT. Water penetration of not more than 4 cm^3 per cubic feet of UUT. Section 5.2, 506.5	from rain but may be exposed to falling water from condensation or leakage from above surface. Not applicable to unit with ventilating holes.
18	**ICING/ FREEZING RAIN** MIL-STD-810G Method 521.3 Sec 4.5.2	Chamber temperature stabilised at 0ºC. Droplet size 1 to 1.5 mm. Water at 5ºC on all 4 sides @ 25mm/ hr. Change chamber temperature to -10 ºC. Continue water spray. Ice of 6 mm (light loading) layer followed by 13 mm (medium loading) layer. Ice of 6 mm layer. Operational check. Remove ice and Repeat process for ice thickness of 13 mm.	Unit OFF Applicable for the equipment having de-icing capability (AOA,OAT probes etc). 1 Hr 4 Hrs If required try to operate the system at low operating temp.
19	**IMMERSION** MIL-STD-810G Method 512.5 Procedure I, Sec 2.3.2.6, 4.4.2	Temperature of UUT 10ºC (Typical temperature difference between water and UUT) above water temperature. Depth of immersion = 1 mt.	30 minutes immersion. Unit OFF. Operational check after the test.
20 a)	**FUNCTIONAL SHOCK** MIL-STD-810G Method 516.6 Procedure I Table 516.6-II	20g sawtooth , 11mSec Pulse width (Under Operating Condition)	3 shocks in each of 6 directions. Unit ON.
20 b)	**TRANSIT DROP** MIL-STD-810G Method 516.6 Procedure IV Table 516.6-IV	Height of drop 122 cm for eqpts up to 45.4 Kgs. Height of drop 76 cm for eqpts weight 45.4 Kgs to 90.8Kg. Height of drop 61 cm for eqpts weigh heavier than 90.8Kg.	26 drops (1 drop / each face edge and corner). 8 drops (1 drop/each corner) Unit packed.
20 c)	**CRASH HAZARD** MIL-STD-810G Method 516.6 Procedure V Table 516.6-VII Sec 4.6.6.3	40 g saw tooth, 11 msec	2 shocks in each of six directions. Unit ON.
20 d)	**BENCH HANDLING** MIL-STD-810G	Rise 1 edge by 10 cm or 45^0 whichever is less.	4 drops on each face. Unit OFF.

	Method 516.6 Procedure VI Sec 4.6.7.1		
20 e)	**ARRESTOR LANDING TEST** MIL-STD-810G Method 516.6 Procedure VIII Sec 4.6.9.1	30 constant-amplitude-sine bursts, each of 2 sec duration, with resting period of 10 sec in between. Wave frequency and amplitude to be decided based on aircraft structural analysis. Wave damping Q=20.	Unit ON.
21	**SOLAR RADIATION (Actinic effect)** MIL-STD-810G Method 505.5 Procedure II Fig 505.5-2, Sec 2.3.7, 4.1.2, Table 505.5-II	Intensity of heat flux : 1120 ± 45 W/m^2 Airspeed : 1.5 to 3.0 m/sec (0.25 m/sec for eqpt. in enclosure). Temperature : +49 ºC Radiation Source at least 30 inches away from eqpt. On – 20 Hrs, OFF – 4 Hrs constitutes one cycle.	Occasional exposure – 10 cycles Continuous exposure – 56 cycles
22	**FUNGUS** MIL-STD-810G Method 508.6 Sec 4.1.3, 4.4.2, 4.5.2, 4.5.3, 4.5.4	Preparation: Wet the entire surface with Spore suspension in 10 min. Incubate at 30ºC, RH >=90% but less than 100% for 4Hr Sec 4.5.1 step3 Incubation: Incubate the item for 28days (5-6 test fungi to be identified).	28 days incubation. Inspect inside and outside after test. Carryout operational checks.
23	**CONTAMINATION BY FLUIDS (Occasional)** MIL-STD-810G Method 504.1 Procedure I Table 504.1-I Table 504.1-II (for Helicopter parts)	Test temp 65 ± 3 ºC. Test fluids (As applicable) 1. Aviation fuel 2. Hydraulic oil 3. Lubricating oil 4. Solvent/ cleaning fluid 5. De-icing fluid 6. Coolant fluid Apply test fluid to entire surface (dip, immerse or spray). Maintain Wet for 8 hrs and drying period of 16 hrs at soaking temperature. This constitutes 1 cycle, remove the test item from chamber allow it to stabilize at ambient.	3 cycles of 24 hrs each / test fluid

24	**EXPLOSIVE ATMOSPHERE** MIL-STD-810G Method 511.5 Procedure I	N-hexane reagent grade fuel to be used. 3.8% fuel by volume in test atmosphere. (Air to vapour ration of 8.33 by weight) Altitude : (maximum ceiling altitude) or 40000 ft + 2000 ft. reduce at 100 Mts/ min to Ambient ground altitude. Temperature: 71 ºC (Highest operating temp) Verify the explosiveness of the vapour mixture by trying to ignite a sample in another chamber or use calibrated explosive gas meter. Attempt operation of the equipment at 40000 ft. Note the altitude at start of correct operation. At ground altitude conduct performance check.	
25	**GUNFIRE SHOCK** MIL-STD-810G Method 519.6	As per distance 0-180 cm, 2.2 – 0.034 g^2/Hz	7 min/axis. Unit ON.
26	**CRASH SAFETY (ACCELERATION)** MIL-STD-810G Method 513.6 Procedure III Table 513.6-III	Manned a/c / Tpt a/c / Helicopter Fore 40g / 20g / 20g Aft 20g / 10g / 20g Up 10g / 10g / 10g Down 20g / 20g / 20g Lat(L) 14g / 10g / 18g Lat(R) 14g / 10g / 18g	Unit ON.
27 @	**EMI/EMC** MIL-STD-461F	CE102, CS101, CS106, CS114, CS115, CS116 RE102, RS103 and other applicable tests.	Unit ON.
28 @	**LIGHTENING PROTECTION (Indirect Effects)** DO-160F, Section 22	PIT 300V/60A, 600V/24A @ 1MHz CBIT (SS) 300V/60A, 600V/120A CBIT(MS) 300V/300A (First) & 150/150 (Sub), 600V/120A (First) & 300/60 (Sub) CBIT(MB) 360V/6A	Waveforms as per Fig 22-4, 22-5 Fig 22-3, 22-4 Fig 22-3, 22-4 Fig 22-8
29 @	**ESD** DO 160F Section 25	15,000 V 10 pulses on identified locations (10 +ve pulses, and 10 –ve pulses)	
30 @	**LIGHTNING PROTECTION (Direct Effects)** MIL-DTL-85670C	Current waveforms A, B C and D. Peak current 200 kA for ≤ 500 µs.	Unit ON

	Appendix A, Fig A-1		
31	**FINAL INTEGRATION**	Integration of the Unit with external interfaces and verification of functional requirements.	
32	**SW IV & V**	Verification of S/W by independent team as per applicable Standard.	

@ If these tests are carried out during SOFT, they need not be repeated during QT as long as the hardware SOP is the same.

Unit that undergoes Qualification Testing shall be yellow banded after the completion of Qualification test.

6.1 Qualification Test Sequence

Sl.no.	Test	Preferable sequence to carry out the test
1.	Physical Inspection	
2.	COTS Screening	
3.	ESS	
4.	Initial ambient functional checks	
5.	Continuous Operation	
6.	Power supply variation	Before all other, since component changes are expected
7.	Lightning protection	
8.	EMI/EMC	
9.	ESD	After EMI/EMC
10.	Solar radiation	Any time, but better before vibration
11.	Vibration	After Power supply variation
12.	High Temp	After dynamic tests
13.	Acceleration	After high temperature
14.	Crash safety	After high temperature
15.	Low temp	After dynamic tests
16.	Thermal shock	After low and high temperature tests
17.	Functional shock	After vibration and thermal tests
18.	Bench Handling	After vibration and thermal tests
19.	Crash hazard	After vibration and thermal tests
20.	Arrestor Landing test	After vibration and thermal tests
21.	Gunfire shock	After Vibration, mechanical and thermal shock
22.	Low Pressure	After dynamic tests
23.	CATH	Before Humidity
24.	Rain drip/blowing rain	After dynamic tests
25.	Icing/ freezing rain	After dynamic tests
26.	Immersion	After dynamic tests
27.	Fungus test	Before salt fog, sand/ dust, humidity

28.	Humidity	After dynamic tests
29.	Salt fog	After fungus and humidity. Before sand and dust.
30.	Explosive Atmosphere	After vibration, shock and temperature
31.	Blowing sand and dust	After fungus, humidity, salt fog
32.	Rapid decompression	After low and high temperature and dynamic tests
33.	Fluid Contamination	After climatic tests

The procedure for each of the above tests is indicated in the section 7.0. Qualification test clearance shall be obtained based on the compilation of test report and preparation of compliance chart.

7 Qualification test procedure:

7.1 Physical Examination

a) The Unit shall be inspected along with components and modules to determine the compliance with requirements of Engineering Standards and applicable drawings as per MDI document

b) The Unit and sub-modules shall be examined visually and any damage or fault noted should be reflected in the physical inspection report. This may include defects in construction, presence of foreign bodies, moisture, dust etc., and corrosion of materials/ finish distortion or mechanical imperfection.

c) The weight and dimensions shall be measured and recorded as specified in the Technical specifications

d) Any item which does not meet this requirement shall be rejected and recorded.

7.2 COTS Screening Test

The following tests are carried out as per "Screening Procedure for COTS components", "Appendix A" to CEMILAC/5390/1 Dated: 10th Jan 2004" PART B.

7.2.1 High Temperature storage (stabilization bake) test

Temperature : +85°C± 5°C

Duration : 24 Hours

Power : OFF

Test Procedure : Check the performance of the module in standalone mode. Keep the module in a thermal chamber. Set the temperature of the chamber to +85°C and bake it for 24 Hours without energizing the module. Check the performance of the module after the bake test as per Annexure *<give test sheet reference>*

7.2.2 Thermal shock Test

Low Temperature : -40°C± 5°C Duration:30 minutes

High Temperature : +85°C± 5°C Duration:30 minutes

Number of cycles : 10

Transfer time : 2 minutes

Operation : OFF condition

Test Procedure : Place the module in a chamber which is maintained at a temperature of +85°C and keep it for 30 minutes, change the module to a cold chamber which is maintained at a temperature of -40°C and keep it for 30 minutes. Repeat the process 10 times. Check the performance of the module after the thermal shock test as per *<give test sheet reference>*

7.2.3 Power Burn in test

Temperature : +65°C± 5°C

Duration : 48 Hours

Power : ON

Test Procedure : Module shall be paced inside the chamber. The temperature of the chamber shall be raised to +65°C .Module shall be maintained at this temperature continuously for 48 hours in power on condition. Check the performance of the module at every 5 hours period and record the parameters as per < *give test sheet reference >*

In case of failure, the component(s) shall be replaced by components which have under gone and passed high temperature storage and thermal shock before assembly and continue the test for remaining hours. If the failure occurs after the $46^{th}/47^{th}/48^{th}$ hour, expose the module for further 03 hours to confirm the adequacy of the repair work. (The last 3 hours shall be defect free)

7.3 Environment Stress Screening (ESS) Tests:

7.3.1 Pre-Thermal Vibration:

The pre thermal vibration is to be carried out in all the three axes as per following specifications and profile in figure 1.

Frequency	Level
20 Hz to 80 Hz	3 db/Octave rise (+ 3 dB/Oct)
80 Hz to 350 Hz	0.04 g^2 /Hz
50 Hz to 2 K Hz	3 dB/Octave roll off (-3 dB/Oct)

Duration: 5 Min/ Axis

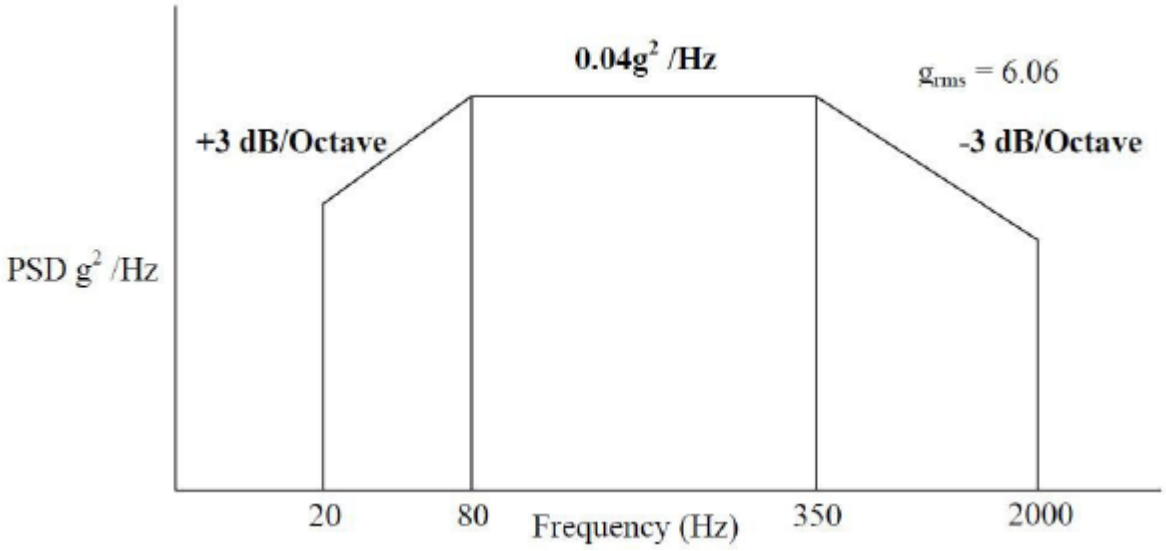

Figure 1: ESS Vibration profile

Test setup : The UUT is mounted on the vibration with similar fixture as in the platform.

Test Procedure:

Fix the mounting plate on the vibration stand. Fix the UUT on the plate with the help of suitable tools. Switch ON the equipment and Apply random vibration for 5 min in 3 axes with equipment in ON condition. Verify and record parameters in test sheets *<give test sheet reference >*

7.3.2 Thermal Cycling

Severity : -40˚C to +65˚C as per Fig (Thermal Cycling profile)

Test setup : The UUT shall be kept inside the temperature chamber.

Test Procedure and performance:

Thermal cycling consists of 10 nos. of COLD-HOT cycles as per figure 2. The last three cycles should be defect free. The procedure for thermal cycling is as follows.

(a) The equipment shall be kept in calibrated temperature chamber.
(b) With unit in OFF condition, raise the chamber temperature to +65°C.
(c) Soak the unit to this temperature for 60 minutes.
(d) Lower the chamber temperature to –40°C.
(e) Soak the unit to this temperature for 60 minutes.
(f) Switch ON the unit.
(g) Monitor and record parameters.

(h) Raise the chamber temperature to +65°C.

(i) Soak the unit to this temperature for 60 minutes.

(j) Monitor and record parameters.

(k) Switch off the unit.

Above steps (d) to (k) constitute one cycle. Remaining cycles have to be carried out same as above.

(l) Rate of change of temperature: During thermal cycling , the rate of change of temperature shall be at the rate of min 5°C/ minute.

Verify and record parameters in test sheets *<give test sheet reference>*

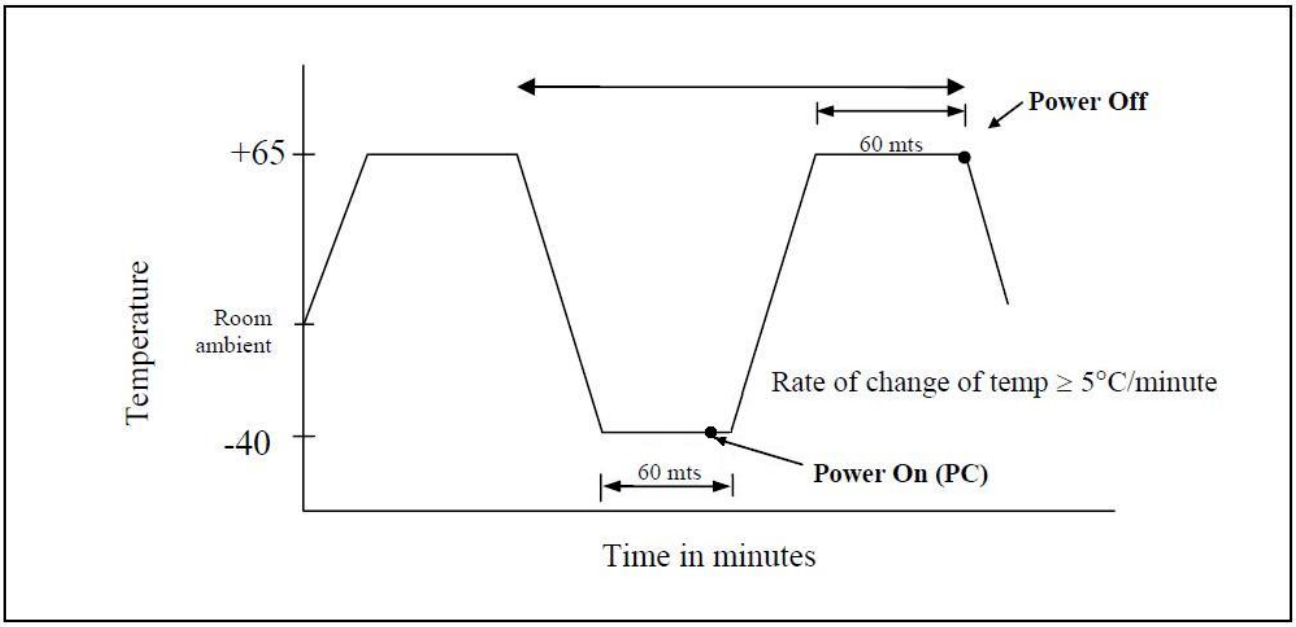

Fig 2: Thermal cycle profile

7.3.3 Post-Thermal Vibration:

Same as Sec 7.3.1.

7.4 Initial Ambient functional checks:

During Initial Ambient tests, Performance of the Equipment shall be measured at 28 VDC power supply under ambient temperature, as per the function test procedure parameters shall be noted as per *< give test sheet reference >*

7.5 Continuous Operation Test

Test Procedure*:* The Unit shall be kept ON for 8 Hours at normal input power supply(28V) and ambient temperature conditions. Parameters shall be recorded before start of the test, at every 2 hours during the operation and after completion of the test as per *<give test sheet reference>*

7.6 Power Supply Tests

Power supply tests are as per MIL-STD-704F and the procedure is as per Mil-HDBK-704-8 for DC and Mil-HDBK-704-2 for AC.

7.6.1 Transfer operation test :

During transfer operation test,

- Set supply voltage to 28V DC followed by
- Switch Power supply to zero volts for a period of 50msec followed by switch back to 28V.

<Specify whether the unit is expected to continue operation during the power supply micro-cut or reset-and-restart is allowed>. The transfer of operation voltage test must be performed as per the Mil-Std 704-8 LDC201.

7.6.2 Reverse polarity protection test :

During the reverse polarity protection test, reverse the negative and positive connections of the 28 V power supply to the unit. The unit shall not be damaged. Check the performance after correcting the connections. The reverse polarity test must be performed as per the Mil-Std 704-8 LDC 602.

7.6.3 Emergency operation test :

Set the power supply at 16VDC (Emergency condition) and carry out the selected functional checks at extreme voltages as per FTP/ATP for at least 10 minutes and record the parameters as per *<give test sheet reference>*. The emergency operation test must be performed as per the Mil-Std 704-8 LDC401.

7.6.4 Steady State Normal and Abnormal Voltage tests:

1. Connect the UUT and the power supplies for the readiness of the test.
2. Set the supply voltage to 22VDC and carry out the selected functional checks as per *<give test sheet reference>* at extreme voltages as per FTP/ATP for at least 30 minutes. Repeat the test with 29VDC. The steady state normal voltage test must be performed as per the Mil-Std 704-8 LDC102 and the normal voltage transients as per Mil-Std 704-8 LDC 105.
3. Set the supply voltage to 20VDC and carry out the selected functional checks as per *<give test sheet reference>* at extreme voltages as per FTP/ATP for at least 30 minutes. Repeat the test with 31.5VDC. The steady state abnormal voltage test must be performed as per the Mil-Std 704-8 LDC301.

7.6.5 Over voltage surge (Transient) test:

During over voltage test vary the supply voltage from 28VDC to 50 VDC. Hold at 50 V for 50 ms, bring it back to 31.5V in 7.7s and hold it at 31.5V as shown in figure 3. Carry out the selected

functional checks at steady state voltage as per FTP/ATP and record the desired parameters as per *<give test sheet reference>*. The over voltage surge test must be performed as per the Mil-Std 704-8 LDC302.

7.6.6 Under voltage surge(Transient) test :

During Under voltage test vary the supply voltage from 28VDC to 0V within less than 1 ms, and hold it for 7sec and in less than 1 ms bring it to 20VDC as shown in the figure 3. Unit shall not be damaged. Carry out the selected functional checks at extreme voltages as per FTP/ATP and record the desired parameters. The under voltage surge test must be performed as per the Mil-Std 704-8 LDC302.

7.6.7 Power failure test :

The power failure test must be conducted to see the unit functionality under failure conditions. The test must be performed as per the Mil-Std 704-8 LDC601.

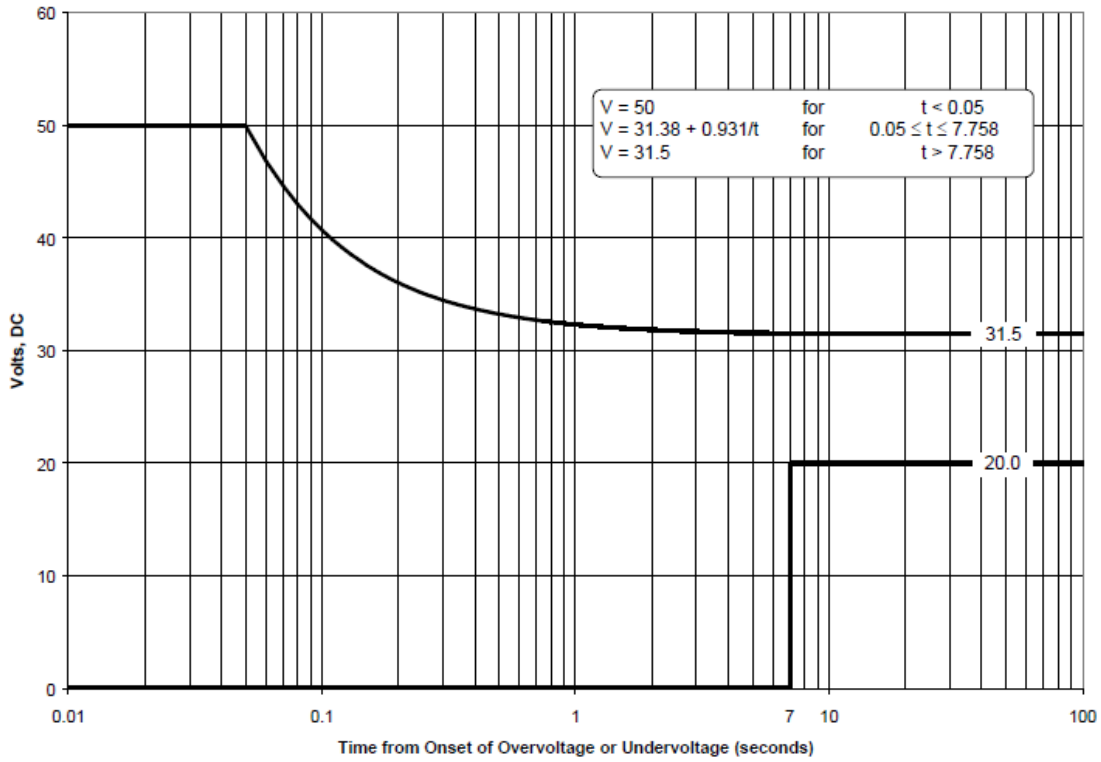

FIGURE 3 . Under-voltage and Over-voltage test profile.

7.6.8 Voltage distortion Spectrum

This is to verify whether the equipment operates and maintains specified performance when subjected to voltage distortion of frequencies and amplitudes. The test must be performed as per Mil-Std 704-8 LDC 103.

7.6.9 Ripple test

This is to verify whether the equipment operates and maintains specified performance when subjected to voltage having ripples. The test must be performed as per Mil-Std 704-8 LDC 104.

7.6.10 Starting voltage transient

This is to verify whether the equipment operates and maintains specified performance when the unit is started and transients are expected. The test must be performed as per Mil-Std 704-8 LDC 501.

7.7 Lightning Protection Test

Lightning Protection test is as per *<specify standard>*

Test Objective:

Lightning protection test is to assess the system performance for indirect effects of lightning. This involves

1. Pin Injection Test and
2. Cable Bundle/Ground plane susceptibility test as per the test levels and wave forms

The Bulk head connector's pins corresponding to various signals and power supply are grouped separately.

Test Specification:

Environment : T*he test Environment shall be in accordance with the section 22.4 of the RTCA 160E/F*

Category *: The category designation for equipment shall be in accordance with the section 22.3 of the RTCA 160E/F*

Waveform Set Designators *: <Indicate The Waveform Set designation for equipment shall be in accordance with the section 22.3.1 of the RTCA 160E/F >*

Test Level Designators *: <Indicate The Test level designation for equipment shall be in accordance with the section 22.3.2 of the RTCA 160E/F >*

Test Setup for Pin Injection Tests:

1. The test setup for pin injection test for signal pins is shown in Fig 4.
2. The test setup for pin injection test for power supply pins as shown in Fig 5

Test Procedure*:*

Pin Injection Tests :

Signal Pins (Refer Table.. , Group ……)

1. Prior to lightening test functionality of UUT should be ensured.

2. Arrange the test setup as per Fig 4
3. Connect the power supply to the Power supply pins of UUT and turn on the 28V DC.
4. Ensure all the ground connections are proper as per the test setup
5. Connect the SAE pulse generator output to the CRO and check the waveform before connecting the generator output to the test pins.

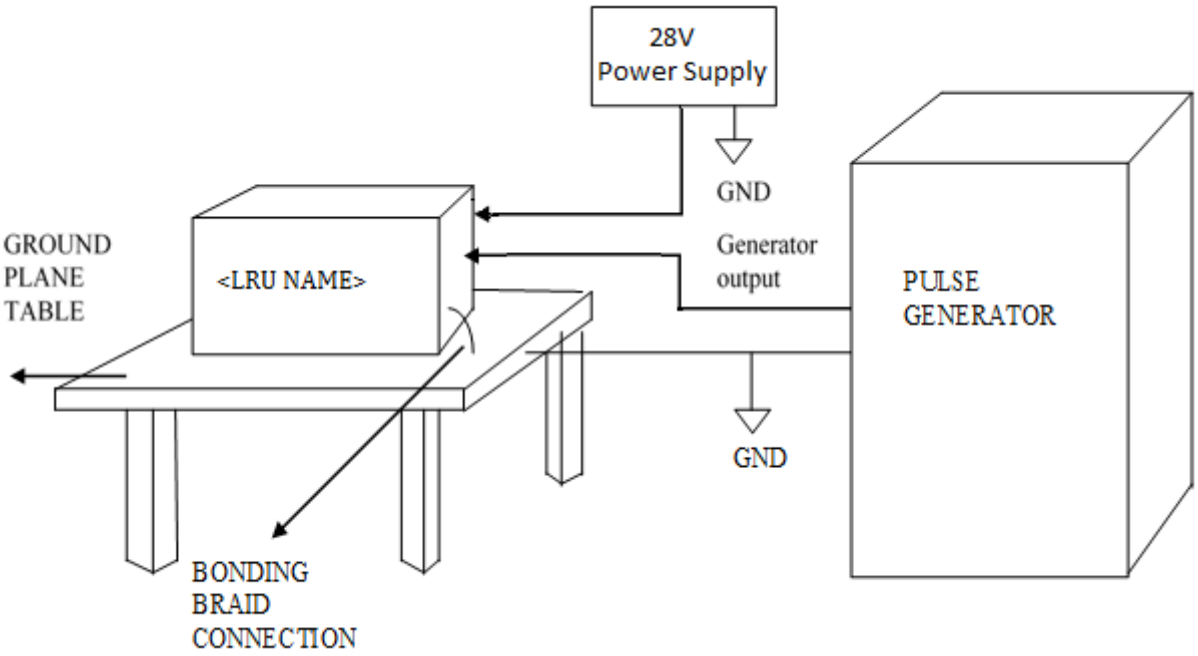

Fig.4 : PIN INJECTION TEST SETUP FOR SIGNAL LINES ON <UUT>.

6. Apply the output of generator to the pins under test as identified in Table… (Group …..).
7. Apply four successive positive pulses (SAE waveform ..) at intervals of not greater than 60 seconds between each pulse.
8. Carryout functionality tests on UUT as per *<give test sheet reference>*
9. Observe each of the tested pins for any damage.
10. Repeat the steps 7,8 and 9 on all the identified test pins
11. After completing the test with positive polarity on all the test pins, reverse the polarity of the output voltage on the generator and repeat the steps 7 to 10.

Note: If the functionality test reveals failure of the pin after the pin injection test, it is considered that the pin under test has failed during the lightening test.

POWER SUPPLY PINS (Refer Table.. , Group ……)

Prior to lightening test , the functionality of UUT should be ensured.

1. Arrange the setup as per Fig. 5

2. Connect a 30V back to back zener diode between Supply and Return of the 28V power supply. Connect the 28V supply(isolated from the ground plane table) to power supply and return pins(Supply Pins ..... and Return pin .....) of UUT and power supply .
3. Ensure all the ground connections are proper and as per the test setup explained.

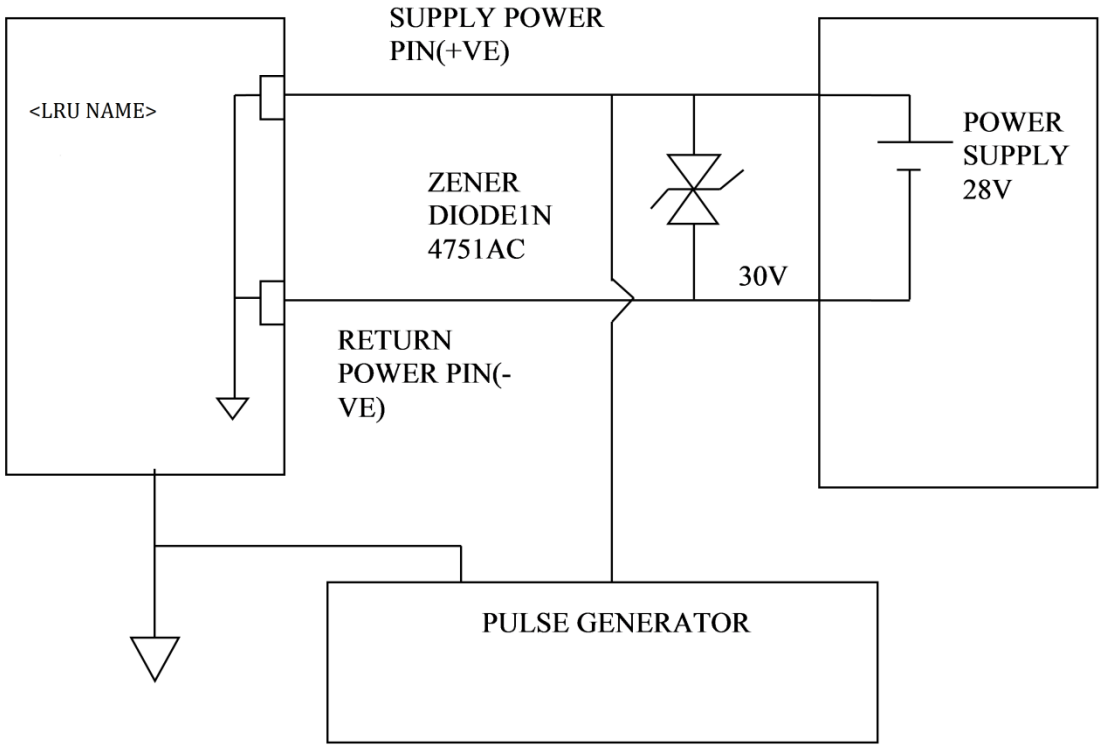

Fig.5: PIN INJECTION TEST SETUP ON SUPPLY POWER PIN(+VE)

4. Connect the SAE pulse generator output to the CRO and check the waveform before connecting the generator output to the test pin.
5. Connect the output of the generator to one of the Supply Pins(+ve) under test .
6. Apply Four successive positive pulses (SAE waveform ...) at intervals not greater than 60 seconds between pin and chassis of the transceiver.
7. Carry out functionality tests on the UUT as per Test Sheet.
8. Record the test results in test sheet *<give test sheet reference>*.
9. After completing the test with positive polarity on identified supply pins, reverse the polarity of the output of the generator and repeat the test.
10. Similar procedure should be followed to test the Return pins of the UUT

Note: If the functionality tests reveal failure of the power pin after the pin injection test, it is considered that the power pin under test has failed during the lightening test.

<Indicate all the required waveforms where and when necessary>

Verify and record parameters in test sheets *<give test sheet reference>*

7.8 EMI-EMC Tests

The following EMI/EMC measurements shall be as part of full qualification tests. There shall be no repetition of these tests on subsequent models of the equipment, unless the equipment is redesigned or major modification is carried out.

The list of EMI/EMC tests to be conducted on the unit are given in Table 1 as per MIL-STD-461F. <The tests sl.no. 1, 3, 5, 6, 7, 8, 9, 13, 15, 16 and 18 are applicable selectively. Depending on the applicability, these tests may be removed from the table>

Sl.no.	Test	Applied to	Frequency Range
1.	CE101	Power leads	30 Hz to 10 kHz
2.	CE102	Power leads	10 kHz to 10 MHz
3.	CE106	Antenna Terminals	10 kHz to 40 GHz
4.	CS101	Power leads	30 Hz to 150 kHz
5.	CS103	Antenna port Inter-modulation	15 kHz to 10 GHz
6.	CS104	Antenna Port, Rejection of undesired signals	30 Hz to 20 GHz
7.	CS105	Antenna port Cross modulation	30 Hz to 20 GHz
8.	CS106	Power leads (400V peak , 5Microsec, impulse) Ships/submarines.	
9.	CS109	Structure Current	60 Hz to 100 kHz
10.	CS114	Bulk cable injection	10 kHz to 200 MHz
11.	CS 115	Bulk cable injection, Impulse excitation	
12.	CS116	Damped sinusoidal transients, cables and power leads	10 kHz to 100MHz
13.	RE101	Magnetic field	30 Hz to 100 kHz
14.	RE102	Electric field	10 kHz to 18 GHz
15.	RE103	Spurious and harmonics	10 kHz to 40 GHz
16.	RS101	Magnetic field	30 Hz to 100 kHz
17.	RS103	Electric field	2 MHz to 40 GHz, 200 V/m
18.	RS105	Transient Electromagnetic field	

Table 1: EMI/ EMC applicable tests

7.9 ESD Test

Purpose of the Test :

The electrostatic discharge test is designed to determine the immunity or the ability of UUT to perform its intended function without permanent degradation of performance as a result of an air

discharged electrostatic pulse.

Test setup*:* The test setup diagram for ESD is shown below.

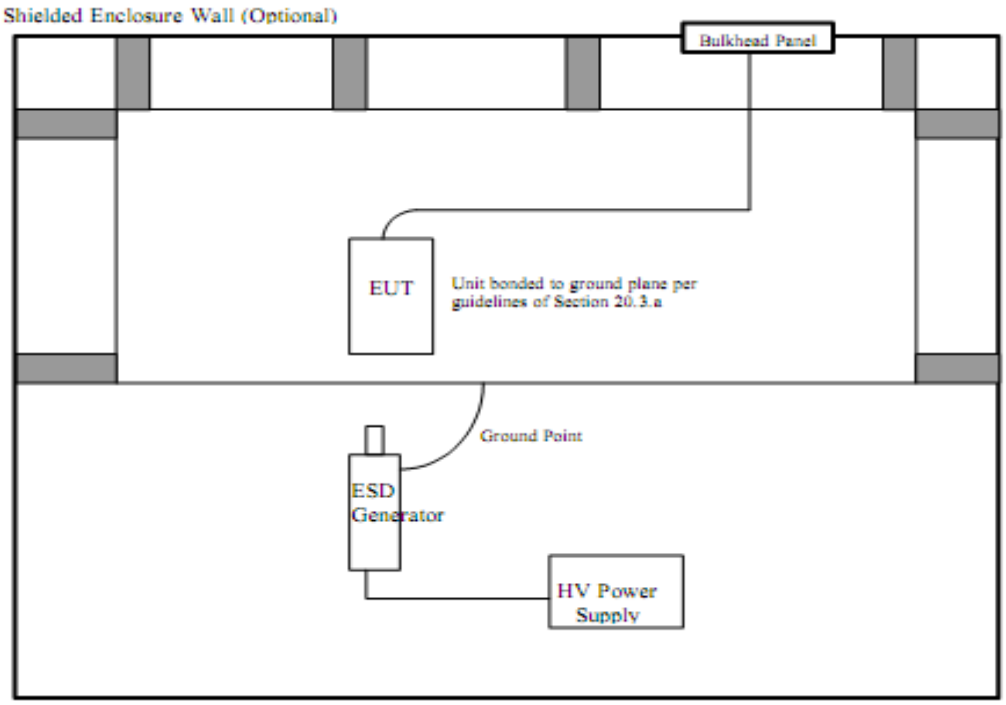

Fig 6: Test setup for ESD Test

Test Procedure*:*

1) Connect the UUT as per figure 6.
2) Ensure that the ESD generator, with a discharge resistor of 330 ohms (±20%) and an energy storage capacitor of 150 pf (±20%), is capable of generating a pulse of 15,000 volts. Ensure that the ESD generator also has an air discharge tip.
3) Prior to performing the test, the output of the ESD generator should be calibrated to produce a 15,000 volt minimum peak output pulse. This is to be done by verifying the output waveform of the ESD generator or by setting the high voltage power supply to 15,000 volts minimum. The generator setting required to produce this output should be recorded.
4) Identify the test points to be considered for the UUT (such as in the control or keyboard area and any other point of human contact, such as switches, knobs, buttons, indicators, LEDs, slots, grilles, connector shells and other operator accessible areas.)
5) Power on the UUT. Trigger the ESD generator for a single Discharge.
6) Move the tip of the ESD generator toward the UUT at the same speed a human hand would reach to touch an object (approximately 0.3 meters/second) until the generator discharges or until contact is made with the UUT at test point 1. Remove the ESD generator (discharge electrode) from the UUT after the discharge.

7) Retrigger the ESD generator for a single discharge.
8) Repeat the Step No 6 and 7 until the 10 discharges in positive polarity for one test location (test point 1) is completed.
9) Set the ESD generator for single discharge to test in negative polarity for the test location (test point 1). Repeat step 6,7 and 8 for negative polarity.
10) Perform the Functional test of UUT as per *<give test sheet reference>*.
11) Repeat the Steps No 6,7,8,9, and 10 for each Test locations (test points) on the UUT.

7.10 Solar Radiation

No of cycles : 10

Test Procedure*:*

Steady State. (Actinic effect)

1. Adjust the chamber air temperature to 49°C (120°F).
2. Adjust the solar radiation source to a radiant energy rate of 1120 ±45 W/m2. Use 1.5 – 3.0 m/sec air speed.
3. Maintain these conditions for 20 hours, measuring and recording the UUT temperatures.
4. Conduct operational checks during the last four hours of each 20-hour exposure when test temperatures are maximized. If the UUT fails to operate as intended, follow the test failure procedure.
5. Turn off the solar radiation source for four hours.
6. This constitutes one cycle.
7. Repeat Steps 1 through 4 for 10 cycles.
8. At the end of the last radiation cycle, allow the UUT to return to standard ambient conditions.
9. Conduct a visual examination and an operational check and document the results. Take photographs of the UUT for comparison between pre- and post-test condition.

7.11 Vibration

7.11.1 Initial Resonance Search

The equipment shall be mounted on vibration stand with the similar fixing as mounted on the platform.

Test Specifications:

Environment: Vibration test stand

Duration: 1 octave/ min. sweep and 1 Hr 15 min at resonant frequency band.

Test setup: The UUT will be mounted on the vibration table as per the mounting configuration of the UUT

Test Procedure:

Initial Resonance search:

Rotary wing platform

Resonance search at 0.5g from 5Hz to 500Hz. Record the resonance frequencies >2 times of limit.

Fixed wing platform

Resonance search at 0.5g from 5Hz to 2000Hz. Record the resonance frequencies >2 times of limit.

7.11.2 Random/ sine on random/ random-on-random Vibration

<Give the vibration profile of the platform as applicable>

The UUT shall be mounted on the vibration table with similar fixing as on the platform. Vibration test is carried out in all three axes as per the above profile for *<duration>*/ axis

Performance of the unit shall be monitored and tabulated in the test sheet.

7.11.3 Final Resonance Search

The procedure is similar to that of section 7.11.2. The final resonance frequencies and initial frequencies should match; any deviation from initial frequencies should be corrected.

7.12 Gun Fire Shock

As per distance 0-180 cm, 2.2 – 0.034 g^2/Hz the duration f exposure is 7min/axisv

Test Specification:

Number of Bursts:

Total time of effect : min (During assigned service/calendar life)

Total rms vibration acceleration , g^2/Hz :

Δf (Hz)	Acceleration (in g^2/Hz)

Table 2 : Gun fire shock levels

Test Procedure :

The UUT shall be mounted on the vibration table.

The Gun Fire shock shall be conducted in all 3 axes, confirming the performance.

Performance of the unit shall be monitored and tabulated in the test sheet *<Test sheet ref>.*

7.13 Acceleration Test

The severity levels are as given below:

ACCELERATION LEVEL	STRUCTURAL		FUNCTIONAL	
	Aircraft	**Helicopter**	**Aircraft**	**Helicopter**
Fore	3.0g	4.0g	2.0g	2.0g
Aft	9.0g	4.0g	6.0g	2.0g
Lat (L)	6.0g	6.0g	4.0g	4.0g
Lat(R)	6.0g	6.0g	4.0g	4.0g
Up	13.5g	10.5g	9.0g	7.0g
Down	4.5g	4.5g	3.0g	3.0g

Duration*:* One min dwell in each direction after following the centrifuge stabilization.

Direction *:* Three mutually perpendicular axes in two opposite directions along each axis.

Test Procedure:

Procedure I - Structural Test.

1. After the UUT is mounted on the acceleration test setup, bring the centrifuge to the speed required to induce the specified g level. Maintain this g level for at least one minute after the centrifuge rpm has stabilized.
2. Stop the centrifuge and inspect the UUT for structural deformities/ cracks etc.
3. Repeat steps 1 & 2 for the remaining five test directions
4. Upon completing the tests in the six test directions, remove the UUT from the centrifuge and perform physical inspection and operational check.

Procedure II - Operational Test.

1. After the UUT is mounted on the acceleration test setup, check operation of the UUT.
2. With the UUT operating, bring the centrifuge to the speed required to induce specified g level. Maintain this g level for at least one minute after the centrifuge rpm has stabilized.
3. Conduct an operational check and document the results.
4. Repeat Steps 1-3 for the five remaining orientations

5. Upon completing the tests in the six test directions, remove the UUT from the centrifuge and perform physical inspection and operational check.

Verify and record parameters in test sheets <*Refer the test sheets >*

7.14 Crash Safety

Environment : The severity levels are as given below

DIRECTION	ACCLERATION LEVEL
Fore	40g
Aft	20g
Lat (L)	10g
Lat(R)	20g
Up	14g
Down	14g

Duration*:* .... min dwell in each direction after following the centrifuge stabilization

Direction *:* Three mutually perpendicular axes in two opposite directions along each axis.

Test Procedure*:*

1. Install the UUT on acceleration test setup and bring the centrifuge to the speed required to induce the specified g level above. Maintain this g level for at least one minute after the centrifuge rpm has stabilized.
2. Stop the centrifuge and inspect the UUT
3. Repeat this test procedure for the other test directions
4. Upon completing the tests in the six test directions, inspect the UUT

Verify and record parameters in test sheets < *Refer the test sheets* >

7.15 High Temperature Storage Test :

Test Procedure*:*

Procedure I - Storage:

1. Place the UUT in its storage configuration (UUT OFF) and install it in the chamber.
2. Expose the UUT to the temperature conditions of the storage cycle as per Table 3 for a minimum of seven 24-hour cycles. Record the thermal response of the UUT.
3. At the completion of last cycle, adjust the chamber air temperature to controlled ambient conditions and maintain until the UUT temperature is stabilized.

4. Conduct a visual examination and operational checkout of the UUT, and record the results.

Procedure II – Operation:

1. With the UUT in the chamber in its operational configuration (UUT ON), install any additional temperature sensors necessary to measure the maximum temperature response of the UUT, ensuring the functioning components are included.
2. Expose the UUT to at least three cycles as per Table 3. Document the maximum test item response temperature.
3. Operate the UUT during the maximum UUT temperature response period of the exposure cycle and record the results as per < *Refer the test sheets* > If the UUT fails to operate as intended, follow the test failure procedure.
4. At the end of three cycles Conduct a complete visual examination and operational check.

HIGH TEMPERATURE MIL-STD-810G Method 501.5 Table 501.5-III Sec. 2.3.2 b	Storage-cum-operation 01 35 02 34 03 34 04 33 05 33 06 33 07 36 08 40 09 44 10 51 11 56 12 63 13 69 14 70 15 71 16 70 17 67 18 63 19 55 20 48 21 41 22 39 23 37 24 35	7 cycles of 24 hrs each for storage in UUT OFF condition. 3 cycles of 24 Hrs each for operation in UUT ON condition.

Table 3 : High Temperature test profile

Procedure III : Tactical Standby to operational

Procedure :

5. With the test item in the chamber and in its tactical configuration, install any additional temperature sensors necessary to measure the temperature response of the test item, ensuring the functioning components are included.
6. Adjust the chamber air temperature to the anticipated maximum non-operating temperature, and maintain this temperature until the test item temperature has stabilized, plus a minimum of two additional hours to ensure complete stabilization.
7. Adjust the chamber air temperature to the high operational temperature identified in the LCEP as quickly as possible (at a rate no less than 3.6oF per-minute). As soon as the chamber instrumentation indicates this temperature has been reached, operate the test item in accordance with the approved test plan
8. With the test item not operating, adjust the chamber air temperature to controlled ambient conditions and maintain until the test item temperature has stabilized.
9. Conduct a complete visual examination and operational checkout

7.16 Low Temperature Test :

Test Procedure:

Procedure I - Storage.

1. Place the UUT in its storage configuration (Unit OFF) and install it in the test chamber.
2. Adjust the chamber air temperature to -54°C(UUT specified Low temperature storage) at a rate not to exceed 3°C/min.
3. Following temperature stabilization of the UUT, maintain the storage temperature for a period of …. Hrs.
4. At the end of the storage period, conduct a visual examination of the UUT. Record any pertinent physical changes.
5. Adjust the chamber air temperature to standard ambient conditions (at a rate not to exceed 3°C/min and maintain it until the UUT has achieved temperature stabilization.
6. Conduct an operational checkout of the UUT and document the results.

Procedure II - Operation.

1. With the UUT in its operational configuration (Unit ON) and installed in the test chamber, adjust the chamber air temperature to the -46°C (UUT lowest operating temperature)at a rate not to exceed 3°C/min .
2. Maintain this for at least two hours following temperature stabilization of the UUT.
3. Conduct visual examination of the UUT and document the results.
4. Adjust the chamber air temperature to standard ambient conditions at a rate not to exceed 3°C/min and maintain it until temperature stabilization of the UUT has been achieved.
5. Conduct a complete visual examination of the UUT, and document the results.

7.17 Low Pressure (Altitude)

Severity *:* Pressure corresponding to ..... ft.

Test Procedure:

1. With the UUT in its operational configuration, install it in the chamber and adjust the chamber air pressure to the required operational altitude at a rate not to exceed 10m/sec & temperature rate not to exceed 3°C/min.
2. Maintain the low pressure for a minimum of one hour.
3. Conduct an operational check of the UUT as per < *Refer the test sheets* >
4. Adjust the chamber air to standard ambient conditions. Conduct an operational check of the UUT as per < *Refer the test sheets* >

7.18 Rapid Decompression:

Test Procedure*:*

1. With the UUT in the storage or transit configuration (Unit OFF), install it in the chamber and adjust the chamber air pressure at a rate not to exceed 3°C/min (to the cabin altitude (2,438m (8,000 ft)
2. Reduce the chamber air pressure to 18.8 kPa (2.73 psi) corresponding to 12,192m (40,000 ft) in not more than 15 seconds. Maintain this stabilized reduced pressure for at least 10 minutes.
3. Adjust the chamber air to standard ambient conditions using a pressure change rate not greater than 10m/s, and a temperature change rate not to exceed 3°C/min
4. Verify and record parameters in test sheets *<Refer test sheets>*

7.19 Combined Temperature Altitude And Humidity (CATH) Test

Severity:

Operational temperature: -40˚C to +54˚C
Altitude: ..... Km
Humidity: 95% RH
No. of cycles: 10
Test profile: As per Table 4

Test Procedure*:*

1. The UUT is installed in the temperature chamber with Unit OFF condition.
2. The temperature of the chamber then shall be ramped from ambient to –40°C in 15 minutes

and then maintained at -40°C for 4 hours. After 4 hrs, equipment shall be switched ON at minimum operating voltage for 20 minutes and performance check shall be carried out in the last 5 minutes.

3. With the UUT operating, the chamber pressure shall be ramped up to the maximum cruise Altitude ....km in 10 minutes.This condition shall be maintained for 30 minutes.
4. Then chamber temperature shall be raised to +32°C, Humidity raised to 95% RH and altitude lowered to ambient. The time duration for ramping of temperature, humidity and pressure shall be 10 minutes.
5. This condition is maintained for 30 minutes.
6. Chamber Temperature shall be increased to +54°C, humidity reduced to less than 30% RH and equipment power supply is increased to maximum operating voltage. The ramping of temperature and humidity shall be done in 15 minutes.
7. The equipment shall be under this condition for further period of 2 hours and after 2 hrs, performance check shall be carried out for 5 minutes.
8. The chamber pressure is ramped to maximum altitude … km in 10 minutes time.
9. This condition is maintained for a period of 4 hours. At the end of 4 hrs, performance check is carried out for 5 minutes.
10. Chamber temperature, humidity and altitude are ramped to ambient conditions.

This constitutes one cycle.
Remaining nine cycles will be carried out in the same manner as in steps 1 to 10.

COMBINED ALTITUDE TEMPERATURE HUMIDITY (CATH) Table 520.3-I Table 520.3 -II Fig 520.3-I	15 min ramp to temperature OFF 4 Hr -40 °C OFF 20 min -40 °C 22V* 10 min ramp to altitude 22V 30 Min -40 °C *<Alt>* Km 22V* 10 min ramp to humidity, temp & alt 22V 30 Min +32 °C 95%RH 22V 15 min ramp to temp and humidity 29V 2 Hr +54 °C <30% RH 29V* 15 min ramp to altitude 29V 4 Hr +54 °C *<Alt>* Km <30% RH 29V *	10 cycles	*Parameter check.

Table 4 : CATH test profile

7.20 Rain Drip Test

Severity:

Height of rain drip : Approx. 1 m above the equipment.
Duration : 15 min. The Unit should be ON.
Temp. Difference : > 10˚C between UUT and water used for rain test

Test Procedure*:*

1. Use a test setup that provides a volume of water greater than 280 L/m2/hr (7 gal/ft2 /hr) dripping from a dispenser with drip holes on a 20 to 25.4mm pattern, without coalescence of the drips into a stream.
2. The drip height that ensures terminal velocity of the droplets (approximately 9 m/s) has to be applied
3. Use a dispenser with a drip area large enough to cover the entire top surface of the UUT. For known conditions where a 280 L/ m2/hr drip rate cannot occur, test the item by reducing the drip rate and increasing the test duration.
4. Measure water found inside the UUT. Water penetration should not be more than 4 cm^3 per cubic feet of UUT.

7.21 Icing/Freezing Rain

Test Procedure:

1. Perform the operational check of the unit at ambient condition and Stabilize the UUT temperature at 0°C (-0/+2°C).
2. Deliver water spray with water temperature of 5°C and a water delivery rate of 25 mm/h for 1 hour to allow water penetration into the UUT crevices/openings.
3. Adjust the chamber air temperature to -10°C maintain the water spray rate until the 6 mm thickness of ice has accumulated on the surfaces.
4. Maintain the chamber air temperature for a minimum of 4 hours to allow the ice to harden. Examine for safety hazards and attempt to operate the UUT. Document the results.
5. If Step 4 has resulted in failure, or if the specification requires or allows ice removal, remove the ice. If the UUT fails to operate as intended, restart from Step 1.
6. Attempt to operate the UUT at the specified low operating temperature of the material. If the UUT fails to operate as intended, restart from Step1 for UUT failure.
7. Repeat Steps 3 through 6 to produce 13 mm thickness of ice.
8. Stabilize the UUT at standard ambient conditions and perform a post-test operational check.
9. Document the results for comparison with pretest data.
10.

7.22 Immersion

Test Procedure*:*

1. Measure and record the immersion water temperature.
2. Condition the UUT (Powered OFF) to 10 deg C above the water temperature and record the conditioning temperature and duration.
3. Immerse the UUT in water so that the uppermost point of the UUT is 1 ± 0.1m below the surface of the water.
4. Following a 30-minute immersion period, remove the UUT from the water.
5. Open the UUT and examine the interior and contents for evidence of and quantity of any leakage and, if leakage occurred, for probable areas of entry.
6. If appropriate, conduct an operational check of the UUT and record results.

7.23 Fungus (Mould Growth):

Test Procedure*:*

Preparation for incubation:

1. Install the UUT in the chamber or cabinet on suitable fixtures, and remove any covers.
2. Hold the UUT in the test chamber at 30 ±1°C and RH >= 90 % but < 100% for at least four hours immediately before inoculation.
3. Inoculate the UUT and the cotton fabric strips (control items) with the mixed fungus spore suspension by spraying the suspension on the control items and on and into the UUT (if not permanently or hermetically sealed) in the form of a fine mist from an atomizer or nebulizer.
4. Replace the covers of the UUTs without tightening the fasteners.
5. Start incubation immediately following the inoculation.

   NOTE: In spraying the test and control strips with composite spore suspension, cover all external and internal surfaces that are exposed during use or maintenance. If the surfaces are non-wetting, spray until drops begin to form on them.

Incubation of the UUT :

1. Except as noted in Step 2 below, incubate the UUTs at constant temperature and humidity conditions of 30 ±1°C and RH >= 90 % but < 100% for 28 days.
2. After 7 days, inspect the growth on the control cotton strips to verify the environmental conditions in the chamber are suitable for growth. At this time, verify that at least 90 percent of the surface area of each test strip located at the level of the UUT is covered by

fungus. If it is not, repeat the entire test with the adjustments of the chamber required to produce conditions suitable for growth. Leave the control strips in the chamber for the duration of the test.

3. If the cotton strips show satisfactory fungus growth after 7 days, continue the test for the required period from the time of inoculation as specified in the test plan. If there is no increase in fungus growth on the cotton strips at the end of the test as compared to the 7-day results, the test is invalid .

7.24 Humidity Test

Severity :

Temperature humidity profile : 24 hrs cycle as in Fig.5

No. of cycles : 10

Test setup

The UUT to be placed inside the chamber in its normal operating configuration.

Test Procedure*:*

- Check the UUT for performance.
- Place the UUT in the humidity chamber and run the humidity test profile as per the table given below. (1 cycle of 24 hours)
- Repeat the above step for 10 cycles. Perform the operational checks near the end of fifth and tenth cycles
- UUT shall be kept off during the test except during performance check.
- The results shall be tabulated.

Humidity Test profile

SL No.		UUT
1	30°C to 60°C in 2 Hrs	95%RH
2	Soak at 60°C for 6 Hrs	95%RH
3	60°C to 30°C in 8Hrs	85-95%RH
4	Soak at 30°C for 8 Hrs	95%RH

This constitutes one cycle of 24 Hrs. 10 such are cycles to be carried out.

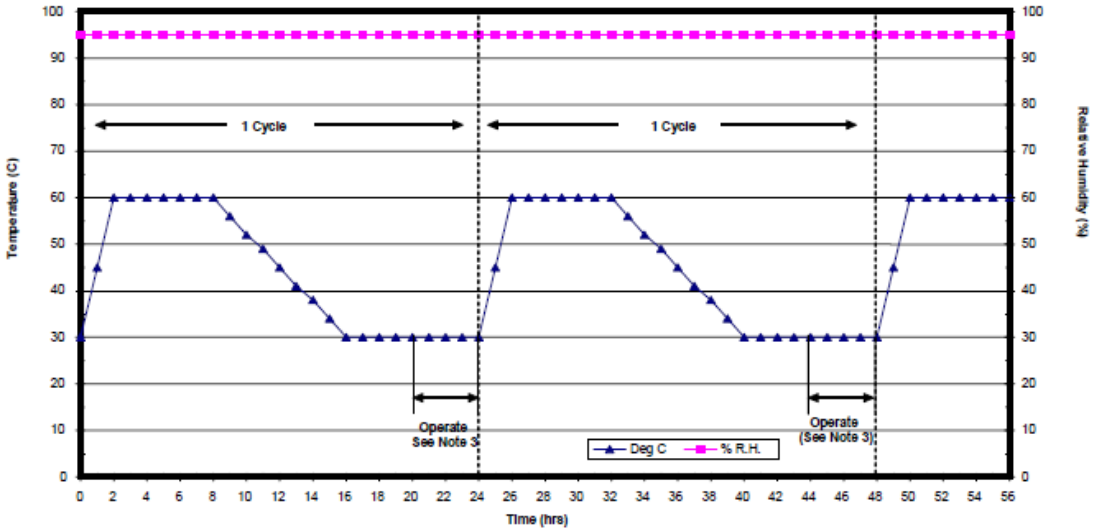

Fig 5 Humidity Test Profile

7.25 Salt Fog Test

Severity:

Salt solution concentration	: 5 ±1%
Composition of salt solution	: Sodium Chloride containing not more than 0.1% Sodium Iodide and not more than 0.5% impurities.
Exposure to salt mist	: 24 hours 35±2˚C
Drying	: 24 Hours at and <50% RH@23 ˚C
No. of cycles	: 2

Test setup: The UUT to be placed inside the salt spray setup. The salt spray shall be produced by an atomizer employing compressed air, which is free from all impurities.

Test Procedure :

1. With the UUT in the chamber, adjust the test chamber temperature to 35°C and condition the UUT for at least two hours before introducing the salt fog.
2. Continuously atomize a salt solution of a composition into the test chamber for a period of 24 hours. During the entire exposure period, measure the salt fog fallout rate and pH of the fallout solution. Ensure the fallout is between 1 and 3 ml/80cm /hr.
3. Dry the UUT at standard ambient temperature and a relative humidity of < 50 %, for 24 hours. Minimize handling of the UUT or adjusting any mechanical features during the drying period.
4. Repeat the step 2 and 3 to complete 2nd cycle.
5. After completing the physical and electrical checkouts, document the results.

7.26 Explosive Atmosphere Test :

Test setup:

For UUT thermal stabilization measurements, install thermocouples on the most massive functional part of the UUT, and two thermocouples attached to the inside the of test chamber to detect any temperature increase due to burning of the mixture.

Test Procedure*:*

1. With the UUT installed, seal the chamber and stabilize the UUT and chamber inner walls to the +71°C (±2 °C).
2. Adjust the chamber air pressure to simulate the highest operating altitude of the UUT (not to exceed 40,000 ft) plus 2000 meters (6600 ft) to allow for introducing, vaporizing, and mixing the fuel with the air.
3. Slowly introduce the required volume of n-hexane into the test chamber as the simulated altitude begins to drop.
4. Circulate the test atmosphere and continue to reduce the simulated chamber altitude for at least three minutes to allow for complete vaporization of fuel and the development of a homogeneous mixture, and for the chamber pressure to reach the test altitude.
5. At a pressure equivalent to 1000 m (3300 ft) above the test altitude, verify the potential explosiveness of the fuel-air vapor by attempting to ignite a sample of the mixture taken from the test chamber using a spark-gap device or glow plug ignition source with sufficient energy to ignite a 3.82 percent hexane mixture. If ignition does not occur, purge the chamber of the fuel vapor and repeat Steps 1-4 . An alternative method of determining the explosive characteristics of the vapor is by using a calibrated explosive gas meter that verifies the degree of explosiveness and the concentration of the fuel-air mixture.
6. Although above the maximum operational altitude of the UUT, attempt to operate the UUT and continue operation from this step until completion of Step 8. Note the altitude at which the UUT begins proper operation
7. To ensure adequate mixing of the fuel and air, slowly decrease the simulated chamber altitude at a rate no faster than 100 meters per minute by bleeding air into the chamber.
8. Stop decreasing the altitude at 1000 m below the test altitude or ground level, whichever is reached first, and perform operational check and switch off power to the UUT.
9. Verify the potential explosiveness of the air-vapor mixture as in Step 5 above. If ignition does not occur, purge the chamber of the fuel vapor, and repeat the test from Step 1.
10. Adjust the simulated chamber altitude to the equivalent of 2000 m above site pressure.
11. Repeat Steps 3-7 at site pressure, perform operational check and switch-off power to the test item.

12. Verify the potential explosiveness of the air-vapor mixture as in Step 5 above. If ignition does not occur, purge the chamber of the fuel vapor, and repeat the test from Step 10.
13. Verify and record parameters in test sheets *<give test sheet reference>*

7.27 Blowing Dust Test :

During the test UUT shall be in OFF Condition

Relative Humidity	30 %
Dust materials	Red china clay or Silica flour with 97 to 99% by weight with silicon dioxide
Dust concentration	10.6 ± 7 gm/ m^3

Test Procedure:

1. With the test item in the chamber and stabilized at standard ambient temperature, adjust the air velocity to 8.9+1.3m/s (1750+250ft/min), or as otherwise determined from the test plan.
2. Adjust the dust feed control for a dust concentration of 10.6 ± 7 g/m (0.3 ± 0.2 g/ft)
3. Unless otherwise specified, maintain the conditions of Steps 1 and 2 for at least 6 hours. If required, periodically reorient the test item to expose other vulnerable faces to the dust stream. Check the above warning note regarding health hazards.
4. Stop the dust feed. Reduce the test section air velocity to approximately 1.5 ±1 m/s (300 + 200 ft/min) and adjust the temperature to the required high operational temperature
5. Maintain the Step 4 conditions for a minimum of 1 hour following UUT temperature stabilization.
6. Adjust the air velocity to that used in Step 1 and restart the dust feed to maintain the dust concentration as in Step 2.
7. Continue the exposure for at least 6 hours
8. Stop the dust feed and allow the test item to return to standard ambient conditions at a rate not to exceed 3°C/min. Stop any air flow and allow the dust to settle (12 hours).
9. Remove accumulated dust from the test item by brushing, wiping, or shaking, taking care to avoid introduction of additional dust or disturbing any that may have already entered the UUT. Do NOT remove dust by either air blast or vacuum cleaning unless these methods are likely to be used in service.
10. Perform an operational check in accordance with the approved test plan, and document the results
11. Inspect the UUT for dust penetration, giving special attention to bearings, grease seals, lubricants, filters, ventilation points, etc.
12. Verify and record parameters in test sheets *<give test sheet reference>*

7.28 Blowing Sand Test :

Test Procedure:

1. Increase the chamber temperature (at a rate not to exceed 3°C/min (5°F/min)) and stabilize the UUT at its high operating temperature.
2. Adjust the air velocity according to test plan (18 to 29 m/s).
3. Adjust the sand feeder to obtain the sand mass flow rate determined.
4. Maintain the conditions of Steps 1 to 3 for the duration specified in the test plan. If required, re- orient the UUT at 90-minute intervals to expose all vulnerable faces to blowing sand, repeat Steps 1-3.
5. If operation of the UUT during the test is required, perform an operational test during the last hour of the test, and document the results.
6. Stop the sand feed. Allow the UUT to return to standard ambient conditions at a rate not to exceed 3°C/min. Stop any air flow and allow the sand to settle. Remove accumulated sand from the UUT by using the methods anticipated to be used in service such as brushing, wiping, shaking, etc., taking care to avoid introduction of additional sand into the UUT.
7. Conduct an operational check of the UUT as per *<give test sheet reference>*.
8. Visually inspect the test item looking for abrasion and clogging effects, and any evidence of sand penetration. Document the results.

7.29 Contamination By Fluids

Severity: Test temp 65 ± 3°C, test fluids

Test fluids (As applicable)

1. Aviation fuel
2. Hydraulic oil
3. Lubricating oil
4. Solvent/ cleaning fluid
5. De-icing fluid
6. Coolant fluid

Duration: 3 cycles of 24 hours each/test fluid

Test Procedure :

1. Apply the specified fluid(s) (e.g., immerse, dip, spray, etc.) to the entire surface of the UUT that is likely to be exposed.
2. Allow the UUT to drain naturally for 5 to 10 minutes.
3. Maintain the wet for eight hours.

4. Drying of 16Hrs at soaking temperature 65 ± 3°C.
5. Ramp the chamber to standard ambient temperature (avoiding temperature shock) prior to removal of UUT(s).
6. Visually examine the UUT for degradation of materials, protective finishes, and record any physical characteristics for comparison with previous results or if appropriate, conduct an operational check of the UUT as per *<give test sheet reference>* .
7. Clean the UUT with a known fluid that will not cause any changes to the UUT. If testing sequentially, repeat steps a (1) through (4) for each specified fluid without cleaning between each chemical application.

7.30 Functional Shock

Severity:

Shock level	:	20g
Duration Pulse	:	11ms
Shape	:	Saw tooth
No. of shocks	:	3 shocks in each of the 6 directions

Test Procedure:

1. Mount he UUT shall be on the shock table in its normal mounting configuration..
2. UUT shall be powered ON during the test.
3. Perform the shock test with 20g, 11 ms sawtooth pulses, 3 shocks in each of the 6 directions.
4. Performance test on the UUT as per *<give test sheet reference>*

7.31 Bench Handling

Severity :

Height	: 45° or 10 cm above bench top (whichever is less).
No of drops	: 4 on each face
Condition	: On solid wooden bench top.

Test procedure :

1. With UUT powered OFF, subject the UUT to 4 drops on each face.
2. After completion, visual examination and record the impact point and damage if any
3. Carryout Performance tests as per *<give test sheet reference>*

7.32 Crash Hazard Test :

Shock Level	40 g
Pulse duration	11ms

Shape	Saw tooth
No of shocks (2 shocks/direction)	12 shocks

Test Procedure:

1. Mount the UUT in power OFF condition, on the shock apparatus by its in-service mounting configuration
2. Perform two shocks in each of the six directions of the UUT for a maximum of 12 shocks
3. Perform a physical inspection.
4. Document the results of the physical inspection, including an assessment of potential hazards created by either material breakage or structural deformation or both.

7.33 Arrestor Hook Landing Test:

Severity:
Amplitude:…….g
Pulse duration:…..ms
Directions: 2 (vertical and longitudinal)
30 constant-amplitude-sine bursts, each of 2 sec duration, with resting period of 10 sec in between.
Wave frequency and amplitude to be decided based on aircraft structural analysis.
Wave damping Q=20.

Test Procedure:

1. Secure the UUT mount to the shock apparatus by its in-service mounting configuration.
2. Perform 15 shocks in each direction of vertical and longitudinal axes with a gap of 10 sec between the successive shocks.
3. After every 5 shocks, carryout performance check of the UUT as per *<give test sheet reference>* Document the results.
4. Perform a physical inspection of the UUT after completion of the Arrestor Landing Test.

7.34 Transit Drop Test

Severity:

Drop Height : 122cms
No. of drops : 26 [1 drop on each face (6), edge(12) and corner(8)]
Test condition: UUT shall be in its normal packed condition

Test procedure:

1. UUT shall be placed its normal packed condition prepared for field use.
2. Perform the drops free fall of the UUT.

3. UUT shall be visually checked periodically to observe failure.
4. After completion visual examination and record the impact point and damage if any.
5. Performance test on the UUT as per *<give test sheet reference>*

7.35 Final Ambient check:

This test is carried out after completion of all the environmental tests.

Test Procedure :

Switch on the UUT on the bench as per the Test Setup. Perform the complete parameter check at nominal power supply under ambient temperature as per FTP and record the values.

After completion of all the environmental and EMI/EMC tests, QTR in the given Test Report format shall be prepared.