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MASTER ENVIRONMENTAL TEST SPECIFICATION
for <LRU/SYSTEM Name>
for
<Platform Name>

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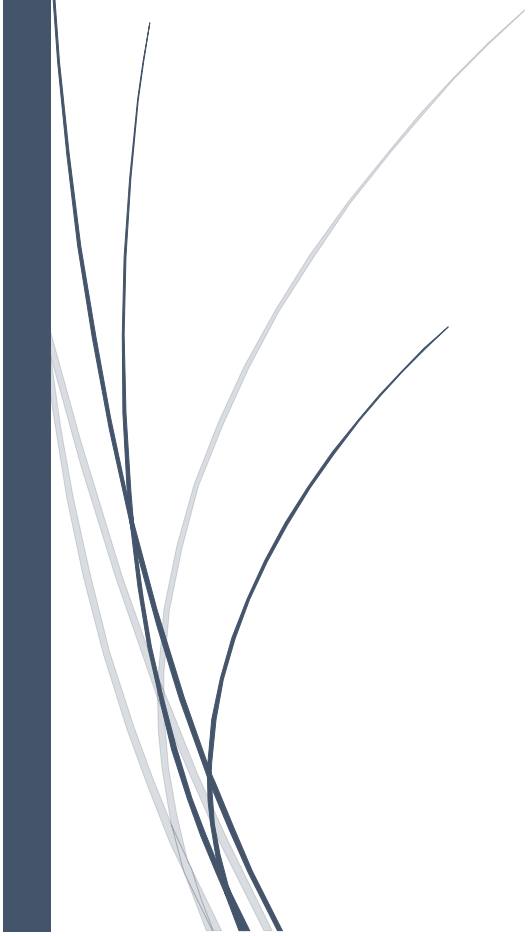

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MASTER ENVIRONMENTAL TEST SPECIFICATION for <LRU/SYSTEM Name>for <Platform name>	< Project/System Name>
	LRU/System Part No.
	<No.>
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Disclaimer:

This document is a guidance document. Applicable section / table rows may be considered. Any additional details may be added. Any not applicable section/ table rows may be deleted. The template is very general and vary with process to process followed by Development Agency. The document may be fine-tuned with the TAA for finalization.

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1 INTRODUCTION

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1.1 System Overview

1.2 Purpose

1.3 Scope

1.4 Applicable Documents

1.5 Platform Characteristics

Table 1-1: Aircraft Characteristics

Sl. No.	Parameter	Value
i.	Length	
ii.	Wingspan	
iii.	Maximum speed	
iv.	Maximum roll rate	
v.	Maximum altitude of operation	
vi.	Aircraft Structural frequencies	
vii.	Total Technical Life (in Hrs)	
viii.	Total Calendar Life (in years)	
ix.	Number of Landings	

1.6 Classification of Aircraft Zone

From Mission systems environmental testing perspective, the aircraft is divided into zones based on Induced Climatic Environment and Electro Magnetic (EM) Environment.

1.6.1 Induced Climatic Environment

Table 1-2: Zones for Induced Climatic Environment

SL. No	Climatic Zone Name	Climatic Zone Identifier	Zone Description

1	Internal Controlled Zone	CIC	
2	Internal Uncontrolled Zone	CUC	
3	External Zone	CEX	

Note 1-1 : The above classification of zones is generic and may be different for different types of platforms.

Table 1-3: Zones for External Store (Like Weapons/ pods)*

SL. No	Climatic Zone Name	Climatic Zone Identifier	Zone Description
1	Nose Section	SNS	
2	Tail Section	STS	
3	Mid Section	SMS	
4	Warhead section	SWH	
5	Skin	SSK	

***Depending on the type of store, the number and type of zones may be different**

1.6.2 Electromagnetic (EM) Environment

Table 1-5: Zones for Electromagnetic Environment

SL. No	EM Zone Name	EM Zone Identifier	Zone Description
1	External Zone	EEX	An equipment location on a platform which is exposed to the external electromagnetic environment (EME). i.e. outside electrically conductive structure or regions which does not use electrically conductive treatments like radome and windscreen.
2	Internal Zone	EIN	An equipment location on a platform which is totally inside an electrically conductive structure.

. Note 1-2 : **The technical specification and QTP of each LRU shall explicitly bring out climatic and EM environmental zone in which the equipment is mounted**

1.7 Applying the Master Environmental Test Specification

(i) The list of climatic, mechanical and EM tests given in the document are generic for XXXXX Platform. The following considerations are to be taken into account while tailoring:

a. The list of tests may be tailored suitably based on environmental exposure (as per Life-Cycle Environmental Profile (LCEP) derived in accordance with Part 1, Task 402 of Mil-Std-810G) derived from Operational Requirements Document (ORD), exact mounting location of the LRU and envisaged Total Technical Life/ Total Calendar life (TCL) /Total Storage Life and technology of implementation. Similarly, the EMI/EMC test specifications may be derived from EME requirements given from Mil-Std-464C/HIRF specification as per FAR-25 after tailoring based on platform shielding effectiveness.

b. The Technical Specification, the Qualification Test Plan/Procedure (QTP) document and ATP documents shall provide the details of the test specifications applicable to the LRU. The sub-system requirement specification, LRU Technical Specification and QTP of the LRU takes precedence over this document.

The order of precedence is given in the figure below.

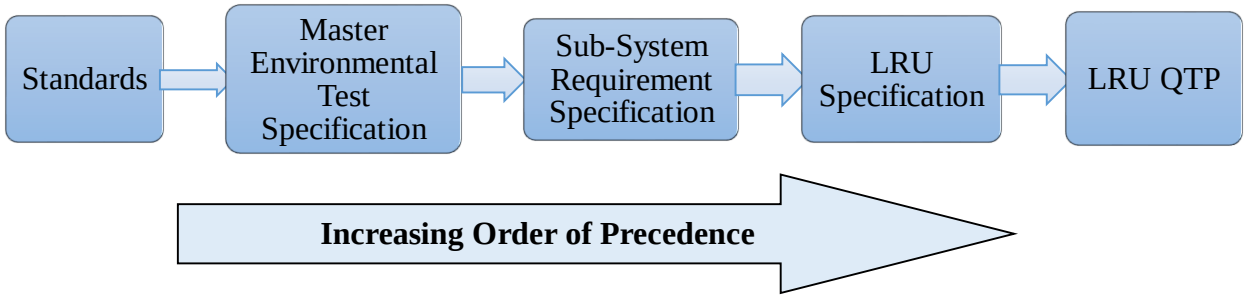

Figure 1-1: Order of Precedence

(ii) The Pass/Fail criteria during performance checks under different environmental and EM conditions shall be tailored based on the role and criticality of the equipment.

(iii) The following are the general guidelines from the procurement perspective

Table 1-6: General guidelines from the procurement perspective

SL. No	Type of procurement	Code	Applicability
1	New Development Items	Ab-Initio	The requirement specifications, technical specifications, QTP/ATP should derive the environmental test specification from this document. Tests shall be carried out as per the LRU specific test plan documents.

2	Previously Developed Items	NDI	The requirement specification of the Subsystem/LRU can be derived from this document. For selected NDI, the main contractor shall ensure that it meets the specification. If found inadequate, the delta qualification to be carried out.
3	Off the Shelf (LRUs selected based on vendor specification / catalogue)	COTS	➢ The sub-systems/LRU requirement specification shall be derived from this document. The main contractor shall select the COTS LRU that meets the environmental requirements given in the requirement specifications. Efforts should be made to acquire all test reports along with Declaration of Design Performance (DDP). ➢ This applies for both indigenous and Bought out COTS items. ➢ LRUs which holds a international TSO authorization from certification authorities from the country of origin, shall meet the environmental specification at its intended installation location. ➢ LRUs which are certified/ Qualified as per RTCA-DO-160 can also be considered if it meets the environmental specification at its intended installation location.
4	Customer Furnished and Customer Specified Equipment	CFE/CSE	User Service furnishing/nominating the sub-system/LRU shall ensure that the equipment meets all the environmental specification enumerated in this document.

Chapter 2

2 ENVIRONMENTAL TEST SPECIFICATION

This chapter covers the following:

1. Screening Testing Specifications
2. Qualification Testing Specifications
3. Safety of Flight-Testing Specifications

2.1 Screening Test Specifications

Each and every airworthy LRU shall be subjected to screening tests. In addition, the prototype units which undergo SOFT and QT should also be subjected to screening tests.

The following are the types of screening tests:

(i) COTS Components Screening

(ii) Environmental Stress Screening

(iii) Highly Accelerated Stress Screening (HASS)

For each LRU, a QAP document shall be prepared and the approach for screening shall be included in the document. The QAP shall be approved by DGAQA.

2.1.1 COTS Component Screening

Any LRU which uses non-Mil Grade / non-Mil Screened components needs to be subjected to COTS Screening in accordance with CEMLAC Directive No 81/2003. Screening can be taken up at component level / board level in accordance with Part – A and Part – B of the directive respectively.

2.1.2 Environmental Stress Screening

All the equipment shall be subjected to ESS Test Specification. The ESS specification is based on:

1. DGAQA Quality Directive ESS Test Procedure No-04-03/2015.
2. MIL-STD -2164: - Environmental Stress Screening process for electronic equipment.

The list of ESS Tests and its specification is given in Table 2-1.

Table 2-1: List of ESS Tests

Sl. No.	Test No	Test	Test Specification	Remarks
1.	ESS-01	Power Burn-in		

2.	ESS-02	Random Vibration (Pre-thermal cycling) test		
3.	ESS-03	Thermal Cycling Test		
		Add Figure		
4.	ESS-04	Random Vibration- 2	As per ESS Test -02	Same as ESS-02

2.1.3 Highly Accelerated Stress Screening (HASS)

The design/production agency may adopt HASS for effective precipitation of latent defects. If HASS is planned, various limits may be arrived at based on HALT. The HALT shall be in accordance with Airworthiness Directive 09/2007 released by CEMILAC.

2.2 Qualification Testing Specifications

For every type of LRU, at least one system shall be subject to qualification testing. The list of qualification tests is categorized based on Zones (Table 1-3 and 1-4). All the applicable graphs and diagrams are included in Appendix – 1. Whether the test is destructive (DT)/ non-destructive (NDT) and whether test can be done on a sample/ test coupon is to be indicated. The items undergoing destructive test will be yellow banded.

Test Id	Test Name	Standard Reference	Test Specifications (Severity, duration, cycles, graph reference)	Applicability (Zone id)	NDT/ DT/ Sample
QT-01					
QT-02					

2.3 EMI/EMC Test Details

The UUT shall not exhibit any malfunction, degradation of performance, or deviation from specification. The list of EMI/EMC Tests and its specification is given in Table 2-2. The reference given are as per Mil-Std-461G.

Table 2-2 List of EMI EMC Tests

Sl. No.	Test No.	Test Nomenclature	Performance Requirements	Zone id as per Table 1-5
1.	CE102	Conducted Emissions, Power Leads, 10 kHz to 10MHz	Applicable to all systems/sub-systems of Aircraft	
2.	CE106	Conducted emission, antenna port, 10 kHz to 40GHz.	Applicable to antenna ports of transmitters, receivers and amplifiers.	
3.	CS101	Conducted Susceptibility, Power Leads, 30 Hz to 150 kHz	Applicable to equipment and subsystem that draws AC or DS Power Supply	
4.	CS103*	Conducted susceptibility, antenna port, intermodulation, 15 kHz to 10 GHz	Applicable to equipment with receiving subsystems front ends connected to antenna	
5.	CS104*	Conducted susceptibility, antenna port, rejection of undesired signals, 30Hz-20GHz	Applicable to equipment with receiving subsystems front ends connected to antenna	
6.	CS105*	Conducted susceptibility, antenna port, cross modulation, 30 Hz to 20 GHz	Applicable to equipment with receiving subsystems front ends connected to antenna	
7.	CS114	Conducted Susceptibility, Bulk Cable Injection, 10 kHz to 400 MHz	Applicable to all interconnecting cables, including power cables	
8.	CS115	Conducted Susceptibility, Bulk Cable Injection, Impulse Excitation	Applicable to all aircraft, interconnecting cables, including power cables.	
9.	CS116	Conducted Susceptibility, Damped Sinusoidal Transients, Cables and Power Leads, 10 kHz to 100 MHz	Applicable to all interconnecting cables, including power cables, and individual high side power leads.	
10.	RE102	Radiated Emissions, Electric Field, 2MHz to 18 GHz , Radiated emissions shall not exceed the applicable values.	Applicable to all LRUs of Aircraft	
11.	[3]RS103	Radiated Susceptibility, Electric	Applicable to all LRUs of Aircraft	

		Field, 2 MHz to 40 GHz		
12.	*Sec 22	Lightning Test as per RTCA DO-160	Applicable to system/sub-system	
13.	*Sec 23	Electrostatic Discharge (ESD) as per RTCA Do-160	Applicable to system/sub-system	

2.4 Power Supply Test Details

The list of Power Supply Tests and its specification is given in Table 6,7 and 8. The utilization equipment connected to custom developed power supply should meets the Output specification of the power supply

Table 2-3: 28VDC Utilization Equipment Mil-Std-704 Compliance Tests

Sl.No	Test No.	Test Nomenclature	Performance Requirements
1.	**Normal, Aircraft Electrical Operation**		
	LDC101	Load Measurements	Applicability to be included in the TS and/or QTP
	LDC102	Steady State Limits for Voltage	
	LDC103	Voltage Distortion Spectrum	
	LDC104	Total Ripple	
	LDC105	Normal Voltage Transients	
2.	**Transfer, Aircraft Electrical Operation**		
	LDC201	Power Interrupt	
3.	**Abnormal, Aircraft Electrical Operation**		
	LDC301	Abnormal Steady State Limits for Voltage	**Applicable only for Aircraft systems /LRUs and MS LRUs which are safety Critical. Remaining not applicable**
	LDC302	Abnormal Voltage Transients (Overvoltage /Under voltage)	
4.	**Emergency, Aircraft Electrical Operation**		
	LDC401	Emergency Steady State Limits for Voltage	
5.	**Starting, Aircraft Electrical Operation**		
	LDC501	Starting Voltage Transients	The equipment shall not be damaged or cause an unsafe condition.
6.	**Power Failure, Aircraft Electrical Operation**		
	LDC601	Power Failure	The UUT allowed to shut down during power failure greater than 50 milli-second. For power failure of less than 7 seconds, the equipment shall automatically reboot within 5 seconds and return to 100% full performance
	LDC602	Polarity Reversal	

			within 2 minutes after power is restored. The equipment shall not be damaged or cause an unsafe condition.

Table 2-4: 270V DC Utilization Equipment Compliance Tests

HDC: High-Voltage DC (270V)

Sl. No.	Test No.	Test Nomenclature	Performance Requirements
1.	**Normal, Aircraft Electrical Operation**		
	HDC101	Load Measurements	Applicability to be included in the TS and/or QTP
	HDC102	Steady State Limits for Voltage	
	HDC103	Voltage Distortion Spectrum	
	HDC104	Total Ripple	
	HDC105	Normal Voltage Transients	
2.	**Transfer, Aircraft Electrical Operation**		
	HDC201	Power Interrupt	
3.	**Abnormal, Aircraft Electrical Operation**		
	HDC301	Abnormal Steady State Limits for Voltage	
	HDC302	Abnormal Voltage Transients (overvoltage and under voltage)	
	Emergency, Aircraft Electrical Operation		
4.	HDC401	Emergency Limits for Voltage	
5.	**Starting, Aircraft Electrical Operation**		
	HDC501	Starting Voltage Transients	
6.	**Power Failure, Aircraft Electrical Operation**		
	HDC601	Power Failure	The UUT allowed to shut down during power failure greater than 50 milli-second. For power failure of less than 7 seconds, the equipment shall automatically reboot within 5 seconds and return to 100% full performance within 2 minutes after power is restored. The equipment shall not be damaged or cause an unsafe condition.
	HDC602	Polarity Reversal	

Table 2-5**:** Three-Phase, 400Hz, 115V (L-N) Utilization Equipment Compliance Tests:

TAC: Three-Phase, fixed frequency (400Hz), AC

Sl. No.	Test No.	Test Nomenclature	Performance Requirements
1.	**Normal, Aircraft Electrical Operation**		
	TAC101	Three-Phase Load and Current Harmonics Measurements	The airborne utilization equipment must provide dc output power that is in accordance with the MIL-STD-704F for the applicable power group under normal aircraft electrical operation. The equipment shall be supplying full-rated load during MIL-STD-704 compliance testing. The equipment shall not be damaged or cause an unsafe condition.
	TAC102	Steady State Limits for Voltage(Including Unbalance) and Frequency	
	TAC103	Voltage Phase Difference	
	TAC104	Voltage Modulation	
	TAC105	Frequency Modulation	
	TAC106	Voltage Distortion Spectrum	
	TAC107	Total Voltage Distortion	
	TAC108	DC Voltage Component	
	TAC109	Normal Voltage Transients	
	TAC110	Normal Frequency Transients	
2.	**Transfer, Aircraft Electrical Operation**		
	TAC201	Power Interrupt	The airborne utilization equipment must provide dc output power that is in accordance with the MIL-STD-704F for the applicable power group under transfer aircraft electrical operation. The equipment shall be supplying full-rated load during MIL-STD-704 compliance testing. The equipment shall not be damaged or cause an unsafe condition.
3.	**Abnormal, Aircraft Electrical Operation**		
	TAC301	Abnormal Limits for Voltage and Frequency	The airborne utilization equipment must provide dc output power that is in accordance with the MIL-STD-704F for the applicable power group under abnormal aircraft electrical operation. The equipment shall be supplying full-rated load during MIL-STD-704 compliance testing. The equipment shall not be damaged or cause an unsafe condition.
	TAC302	Abnormal Voltage Transients (overvoltage and undervoltage)	
	TAC303	Abnormal Frequency Transients (over-frequency and under-frequency)	
4.	**Emergency, Aircraft Electrical Operation**		
	TAC401	Emergency Limits for Voltage and Frequency	The airborne utilization equipment must provide dc output power that is in accordance with the MIL-STD-704F for the applicable power group under emergency aircraft electrical operation. The equipment shall be supplying full-rated load during MIL-STD-704 compliance testing. The equipment shall not be damaged or cause an unsafe condition.

5.	**Power Failure, Aircraft Electrical Operation**		
	TAC601	Power Failure (Three-Phase)	The airborne utilization equipment must provide dc output power that is in accordance with the MIL-STD-704F for the applicable power group under power failure operation. The equipment shall be supplying full-rated load during MIL-STD-704 compliance testing. The equipment shall not be damaged or cause an unsafe condition.
	TAC602	One Phase and Two-Phase Power Failures	
	TAC603	Phase Reversal	

2.5 SOF Test Details

The SOF test will be preceded by ESS as per CEMIIAC Airworthiness directive 14/2015 Safety of Flight Tests dated 13 Feb 2015. The list of SOF Tests and its specification is given in Table 2-6 which is applicable only to all zones.

Table 2-6: List of SOF Test

Test No	Test	Reference Standard	Remarks
SOFT-01	Initial Visual Examination (VE) and Performance Check (PC)	Confirm that Unit is sealed condition. Verify Part No and Serial No as per SoP. Check for finishes, workman ship, FOD, Surface Finish including dents and scratches, availability of all Fasteners, gaskets, pin damage in all connectors.	Zone wise applicability
SOFT-03	ESS	As per MIL-STD-2164A	
SOFT-04	Power Supply Compatibility Test	As per MIL-STD-704	
SOFT-05	EMI/EMC Tests	As per MIL-STD 461G	
SOFT-06	Vibration	**a)** Initial Resonance Search **0.5g from 5Hz to 2000Hz.** Test will be conducted with test item hard mounted. **Equipment in "OFF" Condition**	
	For Internal Controlled (CIC), Internal Uncontrolled (CUC)	b) Endurance by Minimum Integrity Test As per MIL-STD-810G, Method 514.6 Procedure – I General Vibration, Category 24 – General minimum integrity exposure. **Severity: Refer Profile Figure 2-3** **Duration: 15 Min / axis for all 3 axes**.	
		c) Final Resonance Search **0.5g from 5Hz to 500Hz.** Test will be conducted with test item hard mounted. Equipment in "OFF" Condition.	

SOFT-07	CATH		
	High Temperature Storage cum Operation	**Internal Controlled (CIC): Refer Profile Figure 4** TOH : 55°C, TSH : 71°C **Internal Uncontrolled (CIUC), Refer Profile Figure 2-10** TOH : 71°C TSH: 85°C **Number of cycles: 3**	Applicable if CATH is not done
	Low Temperature Storage cum Operation	**Internal Controlled (CIC): Refer Profile Figure 2-5** Temperature Operating Low (TOL): -10°C Temperature Storage Low(TSL): -54°C **Internal Uncontrolled (CUC): Refer Profile Figure 2-11** Temperature Operating Low (TOL): -54°C Temperature Storage Low(TSL): -54°C **Number of cycles: 1**	Applicable if CATH is not done
	Humidity	**Refer Profile Figure 2-7** **Number of cycles: 3**	Applicable if CATH is not done
	Altitude	**Altitude: 3000m @** -10ºC **Altitude change rate: 10m /sec** **Duration: 02 Hours.** **Refer Profile Figure 2-6** Temperature: Ambient Temp at lab altitude	Applicable if CATH is not done
SOFT-08	Shock Test	As per MIL-STD-810G Method 516.6 **<u>Procedure – I: Functional Shock</u>** Shock Pulse Shape: **Saw Tooth shock pulse (Both positive and Negative)** Shock Pulse Level: **20 g** Pulse Duration: **11ms** Number of Shocks: **3 Shocks/face** (18 Shocks total)	

<table>
<tr>
<td>SOFT-09</td>
<td>Acceleration</td>
<td>As per MIL-STD-810G, Method 513.6
<u>Procedure I – Structural Test</u>
<table>
<tr><th>Directions</th><th>Severity</th><th>Duration</th></tr>
<tr><td>Fore</td><td>9g*</td><td rowspan="6">1 min / direction</td></tr>
<tr><td>Aft</td><td>1.5g*</td></tr>
<tr><td>Up</td><td>3g*</td></tr>
<tr><td>Down</td><td>6g*</td></tr>
<tr><td>Lateral left</td><td>3g*</td></tr>
<tr><td>Lateral Right</td><td>3g*</td></tr>
</table>
*As per FAR part 25.561, Para b3</td>
<td></td>
</tr>
<tr>
<td>SOFT-10</td>
<td>Shock Test (Crash Safety)</td>
<td>As per MIL-STD-810G Method 516.6
<u>Procedure -V: Crash Hazard Shock</u>
Shock Pulse Shape: Saw Tooth shock pulse (Both positive and Negative)
Shock Pulse Level: 40 g
Pulse Duration: 11ms
Number of Shocks: 1 Shocks/face
(6 Shocks total)</td>
<td></td>
</tr>
<tr>
<td>SOFT-11</td>
<td>Rapid Decompression</td>
<td>As per MIL-STD-810G
<u>Method 500.5, Procedure-III</u>
The test is to be carried out at reduced equivalent altitude of 11,000 m (36,000 ft). The reduction to this test altitude (36,000 ft) should not be more than 15 seconds. This is to be stabilized for at least 10 minutes.
Pressure change rate - 10m/s</td>
<td></td>
</tr>
<tr>
<td>SOFT-12</td>
<td>Final Visual Examination (VE) and Performance Check (PC)</td>
<td>Confirm that Unit is sealed condition
Verify Part No and Serial No as per SoP.
Check for finishes, workman ship, FOD, Surface Finish including dents and scratches, availability of all Fasteners, gaskets, pin damage in all connectors.</td>
<td></td>
</tr>
</table>

Appendix – 1

1. ESS tests graphs

2. EMI/EMC Test graphs

3. Power supply variation test graphs

4. SOF Test graphs

5. QT graphs