# Master Environmental Test Specification FOR XXXXXXXXXX

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### **1 INTRODUCTION**

- 1.1 System Overview
- 1.2 Purpose
- 1.3 Scope
- **1.4 Applicable Documents**
- **1.5 Platform Characteristics**

SI. No.	Parameter	Value
i.	Length	
ii.	Wingspan	
iii.	Maximum speed	
iv.	Maximum roll rate	
٧.	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
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SL. No	Climatic Zone Name	Climatic Zone Identifier	Zone Description
1	Internal Controlled	CIC	
	Zone		
2	Internal Uncontrolled	CUC	
	Zone		
3	External Zone	CEX	

Note 1-1 : The above classification of zones is generic.

#### 1.6.2 Electromagnetic (EM) Environment

			5
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.

Table 1-3: Zones for Electromagnetic Environment

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 1-4: 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	Previsiosly 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	
3	Off the Shelf (LRUs selected based on vendor specification / catalogue)	COTS	<ul> <li>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).</li> <li>This applies for both indigenous and Bought out COTS items.</li> <li>LRUs which holds a international TSO authorization from certification authorities from the country of origin, shall meet the environmental specification.</li> <li>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.</li> </ul>	
4	Customer Furnished and Customer Nominated Equipment	CFE/CNE	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.

SI. No.	Test No	Test	Test Specification	Remarks
1.	ESS-01	Power Burn-in		
		Random		
2.	2. ESS-02	thermal cycling)		
		test		
		Thermal Cycling		
3	ESS-03	Test		
5.	3. E33-03		·	
			Add Figure	
4	ESS-04	Random	As per ESS Test -02	Same as ESS-02
- <b>-</b> .	4. 200-04	Vibration- 2		

### Table 2-1: List of ESS Test

### 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, atleast one system shall be subject to qualification testing. The list of qualification tests is categorized based on Zones (Climatic Zones & EM Zones).

### 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.

SI. Test		Test Nomenclature	Performance	EN	A Zone Specific	
No.	No.	rest nomenciature	Requirements	Zone-1	Zone-2	Zone-3
		Conducted Emissions, Power	Applicable to all			
1.	CE102	Leads, 10 kHz to	systems/sub-			
		10MHz	systems of Aircraft			
		Conducted	Applicable to			
	CE106		antenna ports of			
2.	CLIUU	nort 10 kHz to	transmitters,			
			receivers and			
		-00112.	amplifiers.			
			Applicable to			
		Conducted	equipment and			
3	CS101	Susceptibility,	subsystem that draws			
0.	00101	Power Leads, 30 Hz	AC or DS Power			
		to 150 kHz	Supply			
		Conducted	Applicable to			
		susceptibility,	equipment with			
	CS103*	antenna port,	receiving subsystems			
		intermodulation, 15	front ends connected			
		kHz to 10 GHz	to antenna			
		Conducted susceptibility,	Applicable to			
4.	CS104*	antenna port,	receiving subsystems			
		rejection of	front ends connected			
		undesired signals, 30Hz-20GHz	to antenna			
5.	CS105*	Conducted susceptibility, antenna port, cross modulation, 30 Hz	Applicable to equipment with receiving subsystems			

### Table 2-2 List of EMI EMC Test

		to 20 GHz	front ends connected		
			to antenna		
		Conducted	Applicable to all		
6	00114	Susceptibility, Bulk	interconnecting		
0.	65114	Cable Injection, 10	cables, including		
		kHz to 400 MHz	power cables		
			Applicable to all		
		Conducted	aircraft,		
7	00115	Susceptibility, Bulk	interconnecting		
1.	03115	Cable Injection,	cables,		
		Impulse Excitation	including power		
			cables.		
		Conducted	Applicable to all		
		Susceptibility,	interconnecting		
Q	CS116	Damped Sinusoidal	cables, including		
0.	05116	Transients, Cables	power cables, and		
		and Power Leads,	individual high side		
		10 kHz to 100 MHz	power leads.		
		Radiated Emissions,			
		Electric Field, 2MHz	Applicable to all I RUs		
۹	RE102	to 18 GHz ,	of Aircraft		
0.	INC 102	Radiated emissions			
		shall not exceed the			
		applicable values.			
		Radiated			
10	<sup>3</sup> RS103	Susceptibility,	Applicable to all LRUs		
10.		Electric Field, 2	of Aircraft		
		MHz to 40 GHz			
11	*Sec	Lightning Test as	Applicable to		
	22	per RTCA DO-160	system/sub-system		
	*Sec	Electrostatic	Applicable to		
12.	23	Discharge (ESD) as	system/sub-system		
		per RTCA Do-160			

### 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

SI.No	Test No.	Test Nomenclature	Performance Requirements			
1.		Normal, Aircraft Electrical Operation				
	LDC101	Load Measurements	Applicability to be included in the TS			
	LDC102	Steady State Limits for Voltage	and/or QTP			
	LDC103	Voltage Distortion Spectrum				
	LDC104	Total Ripple				
	LDC105	Normal Voltage Transients				
2.		Transfer, Aircraft Electrica	I Operation			
	LDC201	Power Interrupt				
3.		Abnormal, Aircraft Electric	al Operation			
	LDC301	Abnormal Steady State Limits for Voltage	Applicable only for Aircraft			
	LDC302	Abnormal Voltage Transients (Overvoltage	systems /LRUs and MS LRUs			
		/Under voltage)	which are safety Critical.			
			Remaining not applicable			
4.		Emergency, Aircraft Electric	cal 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 Electr	ical Operation			
	LDC601	Power Failure	The UUT allowed to shut down			
	LDC602	Polarity Reversal	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.			

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

Table 2-4: 270V DC Utilization Equipment Compliance Tests HDC: High-Voltage DC (270V)

SI.	Test No.	Test Nomenclature	Performance Requirements
No.			
1.		Normal, Aircraft Electrical C	Dperation
	HDC101	Load Measurements	Applicability to be included in the TS
	HDC102	Steady State Limits for Voltage	and/or QTP
	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 Electrica	I Operation
4.	HDC401	Emergency Limits for Voltage	
5.		Starting, Aircraft Electrical	Operation
	HDC501	Starting Voltage Transients	
6.		Power Failure, Aircraft Electric	al Operation
	HDC601	Power Failure	The UUT allowed to shut down
	HDC602	Polarity Reversal	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.

Table 2-5:	Three-Phase,	400Hz, 7	115V (L-N)	Utilization	Equipment	Compliance <sup>-</sup>	Tests:

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

SI. No.	Test No.   Test Nomenclature   Performance Requirements				
1.		Normal, Aircraft E	lectrical Operation		
	TAC101	Three-Phase Load and Current	The airborne utilization equipment must		
		Harmonics Measurements	provide dc output power that is in accordance		
	TAC102	Steady State Limits for	with the MIL-STD-704F for the applicable		
		Voltage(Including Unbalance) and	power group under normal aircraft electrical		
		Frequency	operation. The equipment shall be supplying		
	TAC103	Voltage Phase Difference	full-rated load during MIL-STD-704 compliance		
	TAC104	Voltage Modulation	testing. The equipment shall not be damaged		
	TAC105	Frequency Modulation	or cause an unsafe condition.		
	TAC106	Voltage Distortion Spectrum			
	TAC107	Total Voltage Distortion			
	TAC108	DC Voltage Component			
	TAC109	Normal Voltage Transients			
	TAC110	Normal Frequency Transients			
2.		Transfer, Aircraft E	lectrical 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	The airborne utilization equipment must		
		Frequency	provide dc output power that is in accordance		
	TAC302	Abnormal Voltage Transients	with the MIL-STD-704F for the applicable		
		(overvoltage and undervoltage)	power group under abnormal aircraft electrical		
	TAC303	Abnormal Frequency Transients	operation. The equipment shall be supplying		
		(over-frequency and under-	full-rated load during MIL-STD-704 compliance		
		frequency)	testing. The equipment shall not be damaged		
			or cause an unsafe condition.		
4.		Emergency, Aircraft	Electrical Operation		
	TAC401	Emergency Limits for Voltage and	The airborne utilization equipment must		
		Frequency	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, Aircra	ft Electrical Operation
	TAC601	Power Failure (Three-Phase)	The airborne utilization equipment must
	TAC602	One Phase and Two-Phase Power	provide dc output power that is in accordance
		Failures	with the MIL-STD-704F for the applicable
	TAC603	Phase Reversal	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.

#### 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.

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	
	Vibration	<ul> <li>a) Initial Resonance Search</li> <li>0.5g from 5Hz to 2000Hz.</li> <li>Test will be conducted with test item hard</li> <li>mounted.</li> <li>Equipment in "OFF" Condition</li> </ul>	
SOFT-06	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.	
		<b>0.5g from 5Hz to 500Hz.</b> Test will be conducted with test item hard mounted. Equipment in "OFF" Condition.	

Table 2-6 <sup>.</sup>	List of SOF Test

	СТАН		
SOFT-07	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	
	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	
	Humidity	Refer Profile Figure 2-7 Number of cycles: 3	

		Altitu	ıde: 3000m @	-10ºC		
		Altitude change rate: 10m /sec				
	Altitude	Dura	tion: 02 Hours			
		Refe	r Profile Figur			
		Temp	perature: Ambi	ent Temp a	t lab altitude	e
				OG Method	516.6	
		Proc	edure – I: Fun	ctional Sh	ock	
		Shoc	k Pulse Shane	· Saw Tool	h shock	
		nulse	Roth nositiv	e and Neo	in Shock iative)	
SOFT-08	Shock Test	Shoc	k Pulse Level	20 a	junivoj	
		Pulse	Puration: <b>11n</b>	ns		
		Num	ber of Shocks	3 Shocks/	face	
		(18 S	shocks total)			
		As pe	er MIL-STD-81	0G. Method	513.6	
		Proc	edure I – Stru	ctural Test		
			Directions		Duratio	
				Severity	n	
		-	Fore	9g*	1 min /	
SOFT-09	Acceleration	_	Aft	1.5g*	direction	
		-	Up	3g*		
			Down	6g*		
			Lateral left	3g*		
			Lateral Right	3g*		
		*As p	per FAR part 2	5.561, Para	a b3	
		As pe	er MIL-STD-81	0G Method	516.6	
		Procedure -V: Crash Hazard Shock				
		Shoc	k Pulse Shaj	pe: <b>Saw</b> '	Tooth sho	ock
SOFT-10	Shock Test	pulse	e (Both positiv			
	(Crash Safety)	Shoc	k Pulse Level:	40 g		
		Pulse	e Duration: <b>11n</b>	ns		
		Num	ber of Shocks:	1 Shocks/	face	
(6 Shocks total)						
		As per MIL-STD-810G				
		Method 500.5, Procedure-III				
	Rapid	The	test is to be	carried ou	t at reduce	ed
SOFT-11	Decompression	equiv	alent altitude	of 11,000 r	m (36,000 f	t).
		The reduction to this test altitude (36,000 ft)			ft)	
		should not be more than 15 seconds. This is				is
to be stabilized for at least 10 minutes.						

		Pressure change rate - 10m/s	
		Confirm that Unit is sealed condition	
	Final Visual	Verify Part No and Serial No as per SoP.	
	Examination (VE)	Check for finishes, workman ship, FOD,	
50F1-12	and Performance	Surface Finish including dents and	
	Check (PC)	scratches, availability of all Fasteners,	
		gaskets, pin damage in all connectors.	