

**VEGA PROGRAMME**

**QUALIFICATION AND ACCEPTANCE TEST OF EQUIPMENT**

Class : 2

Category : 1

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**TITLE :** QUALIFICATION AND ACCEPTANCE TESTING OF EQUIPMENT

**AUTHOR'S ABSTRACT :**

This document defines the minimum acceptance and qualification test to be carried-out on equipment integrated on board the VEGA Launch Vehicle (LV). It also defines the test levels and methodology to be applied by each Equipment Supplier (ES) for conducting above mentioned testing activities.

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04/03	3	Compatibility with European standard ECSS; updating of shock and sinusoidal levels; introduction of applicability matrix; description of test levels, duration and tolerances specification.			
06/03	4	Updating to reflect the ESA FAX LAU-V/MB/2003-109 on safety equipment, and MOM VG-CR-M/392/03/SYS on pyro-component.			



13/11/06	5	<p>The following modifications close ESA reserves for approval:</p> <p>Page 19: Sentence added Page 24: Engine Plate zone added. Sentence modified for Severity 2 applicability. Page 32: Mass and Quantity columns removed from applicability matrix. Following positions better specified:</p> <ul style="list-style-type: none"><li>- Engine Plate instead of APM for Main Engine Assy,</li><li>- AVUM Skirt instead of APM for HP/LP fill &amp; vent valve,</li><li>- AVUM Skirt instead of APM for Gas Tanks (supported by struts)</li></ul> <p>Page 40, In Applicability Matrix for Qualification, Addition of High Shock (Pyrotechnic) level applicability to :</p> <ul style="list-style-type: none"><li>- Gas Tank (LPS and ACS), S3</li><li>- Oxidizer and Fuel Tank (LPS), S3</li></ul> <p>Page 41, applicability of High Shock (Pyrotechnic) addition of:</p> <ul style="list-style-type: none"><li>- HP/LP Pyrovalve, S3</li><li>- Pressure Regulator and Relief Valve, S3</li><li>- Non Return Valve, S3</li><li>- HP/LP fill &amp; drain valve, S3</li><li>- HPO Pyrovalve, S3</li></ul> <p>Removal of redundant lines for Pressure regulator and relief valve and HP/LP Fill and vent valve</p> <p>Page 43, modification of High Shock Severity:</p> <ul style="list-style-type: none"><li>- Reaction Control Thruster, from S3 to S4,</li><li>- Main Engine Assy, from S3 to S2</li></ul> <p>Page 7: new ref. Doc. ECS-Q-20-07 Page 9 : introduction of sentence on clean room conditions as per fax LAU-V2003/184</p>			
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		<p><b><u>The following modifications are presented in VG-CP-SYS-0013 R2 :</u></b></p> <p><u>Addition of paragraph §4.1.14: requirements concerning verifications (adapted from A5-SG-1-40)</u></p> <p><u>The modification of the launcher configuration</u> (implementation of RACS instead of ACS) induces a change of equipments studied. Besides the specification concerning RACS is now presented in the document VG-SG-1-12</p> <p><u>Applicability of SG 1-40</u></p> <ul style="list-style-type: none"><li>- Removing of some big equipments (MEA, fuel tank, oxyder tank, gas tank) §7 from this document. Their specifications are now presented in VG-SG 1-12.</li><li>- Precision of applicability of SG 1-40 p6</li></ul> <p><u>The exploitation of the vibration test UCMEC (acoustic)</u> allows to modify the random specification §5.3 of the equipment mounted in the upper part of the launcher : addition of the severities 3 (AVUM skirt) and 4 (lower shear panel)</p> <p>§5.4.2 duration of “medium shock” test 11ms (idem Ariane 5)</p> <p><u>Shock evaluation</u> : addition of the new document in reference (VG-NT-C-135-SYS 1/1 Assessment on VEGA LV shock environment) and updating of levels specified in upper part (antennas S4-&gt; S5 shock, etc.)</p>		VG-CP-SYS-0013 R2	
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## 1. INTRODUCTION AND SCOPE/ APPLICABILITY

This document defines the minimum acceptance and qualification test to be carried-out on equipment integrated on board the VEGA Launch Vehicle (LV). It also defines the test levels and methodology to be applied by each Equipment Supplier (ES) for conducting above mentioned testing activities.

This document is based on European standard methodology (A.D. [2]) and on the correspondent A5 General Specification (A.D. [1]) and, as consequence, most of the requirements defined for equipment used on previous Ariane programs remain fully applicable, but some modifications have been introduced to better fit the Vega program specificity.

In case a Supplier of equipment could achieve a significant cost reduction in basing its testing on other standards (i.e. Mil standard A.D. [3], R.D.[1]), this shall be investigated with Prime Contractor since considered important to achieve the low cost objective of the Vega program.

In this case such standards shall be presented to Prime Contractor together with the relevant compliance matrix with respect to the requirement of this document, and shall be submitted, as Waiver, for Approval.

### ***Notes on applicability of this document***

This specification is applicable to:

- all the on board equipment used on LV (i.e. each equipment with small dimensions and a local behaviour such as electronic “boxes” of avionic, functional sensors and equipment, batteries, antennas)
- Pyro-chains
- Pressure vessels
- SRMs igniters and RR motors
- Propulsion components (LPS, ACS, MEA)
- TVC

This document is not applicable to:

- assembled stages or structural assemblies
- Solid rocket motors
- Elements and/or assemblies of the LV primary structure
- Non functional sensors (i.e. add-on sensors): a minimum set of test is required and defined in Technical Specification to guaranty the sensor integrity during flight
- Sub-items constituting a functional assembly of an electronic or mechanical equipment (i.e. Power electronic board inside a power amplifier; regulation spring inside a pressure regulator etc.)
- Distributed elements like thermal protections, harness
- Payload
- Bolts/ nuts/ washers
- Raw materials

Any case of non compliance with respect to this specification will be processed through a Waiver request from the Supplier.

In case the Equipment specification asks for additional testing, such testing shall be added to the testing specified herein.

## 2. DOCUMENTS

### 2.1 APPLICABLE DOCUMENTS

- A.D. [1] A5-SG-1-X-40-ASAI  
Specification of the equipment qualification and reception environmental tests
- A.D. [2] ECSS-E-10-03A rev.1  
Space engineering testing
- A.D. [3] MIL-STD-1540C  
Test requirements for Launch, Upper stage, and Space vehicles
- A.D. [4] VG-SG-1-C-022-SYS  
General Specification for Loads
- A.D. [5] VG-SG-1-C-023-SYS  
Dynamic Environment
- A.D. [6] VG-SG-1-C-30-SYS  
General EMC specification
- A.D. [7] VG-SG-1-C-31-SYS  
Pyrotechnic Sub-Systems General Specification
- A.D. [8] VG-SG-1-C-51-SYS  
General Specifications for Liquid Propellant Motors
- A.D. [9] VG-SG-1-C-010-SYS  
Structural design; dimensioning and test specifications specificities for Vega LV
- A.D. [10] VG-ST-1-C-001-SYS  
Launch Vehicle System Specification
- A.D. [11] VG-SG-1-C-12-SYS  
Specification for Dimensioning and Qualification of Subsystems

## 2.2 REFERENCE DOCUMENTS

- R.D.[1] MIL-STD-810E  
Test method standard for environmental engineering considerations and laboratory test
- R.D.[2] VG-BI-1-C-001-SYS  
Launch Vehicle Mass Budget
- R.D.[3] VG-BI-1-C-002-SYS  
Launch Vehicle Thermal Characteristic Budget
- R.D.[4] A5-NT-1-X-3159-ASAI ed.2 rev.1  
Synthese des demandes d'essais de qualification et de reception en environnement des equipements electriques
- R.D.[5] ECSS-Q-20-07  
Quality Assurance for Test Centre
- R.D.[6] VG-NT-C-135-SYS 1/1  
Assessment on VEGA LV shock environment
- R.D.[7] VG-RE-1Z05-C-0004-SYS  
UCMEC Acoustic test report

### 3. ACRONYMS

ACRONYM	LEGEND
AAM	AVUM Avionics Module
ACS	Attitude Control System
AD	Applicable Document
APM	AVUM Propulsion Module
BMV	Boite de Multi Vie
COG	Center of gravity
EMA	Electro Magnetic Actuator
EMC	Electro Magnetic Compatibility
ES	Equipment Supplier
ESD	Electro-Static Discharge
ICD	Interface Control Document
IFOC	Initiateur Foncionnant par Onde de Choc
INS	Inertial Navigation System
IPDU	Integrated PDU
IS	Inter-Stage
LPS	Liquid Propulsion System
LV	Launch Vehicle
MEA	Main Engine Assembly
MFU	Multi Functional Unit
MOI	Moment of Inertia
N/A	Not Applicable
OBB	On Board Battery
OBC	On Board Computer
PDU	Power Drive Unit
P/L	Pay Load
RD	Reference Document
RR	Retro Rocket
RTX	Radar Tracking
SAD	Safe and Arm Device
SMU	Safeguard Master Unit
SRS	Shock Response Spectrum
SRM	Solid Rocket Motor
SRU	Safeguard Remote Unite
Tamax	Maximum acceptance temperature (from equipment specification)
Tamb	Ambient temperature
Tamin	Minimum acceptance temperature (from equipment specification)
Tqmax	Maximum qualification temperature (from equipment specification)
Tqmin	Minimum qualification temperature (from equipment specification)
TLM	Telemetry
TR	Telecommand Receiver
TVC	Thrust Vector Control
UCTM	Unité Centrale de Telemesure

## 4. TEST REQUIREMENTS

### 4.1 GENERAL REQUIREMENTS

#### 4.1.1 TEST CATEGORIES AND EQUIPMENT TO BE TESTED

The test categories are defined in the table below:

Test category Name/ par.	Test purpose	Test article	NOTES
Development testing Par. 4.4	To increase confidence on preliminary equipment design	Engineering representative model (generally not deliverable)	The need for development testing shall be assessed by the equipment supplier. Testing under the control of Supplier and based on Supplier internal procedures not subject to Customer approval.
Acceptance testing Par. 4.3	To verify the compliance of the equipment under test with the minimum functional requirement of specification and under environmental conditions that are "equal or slightly worst" than the worst case defined for the flight envelope. To filter-out equipment infant mortality. To consent the use for flight.	EACH Flight Equipment (and spares)	Contractual milestone; full visibility and approval by Customer. As a general rule each individual equipment delivered to the Customer (i.e. structural-thermal, electrical model etc.) shall be subject to acceptance testing whose content is specified in the equipment specification.
Qualification testing Par. 4.2	To verify the minimum margins of the equipment design w.r.t. the maximum expected environmental level in flight	ONE flight equipment previously accepted. Deliverable.	As Acceptance
Proto-flight testing Par. 4.5	To verify the minimum margins of the equipment design and To be utilised for the first flight	ONE flight equipment previously accepted	Not considered for Vega. If considered as suitable by Supplier it shall be handled via waiver subject to Prime Contractor approval.

#### 4.1.2 TEST CONDITIONS

Except otherwise specified, the test shall be conducted in a laboratory in the following ambient atmosphere (par. 4.7.1 of A.D. [1]):

Ambient temperature (°C)	15 - 30
Relative humidity (%)	45 - 75
Ambient pressure (mbar)	860 – 1060

For some sensitive equipments clean room conditions could be required (class 100000 or higher) in accordance with R.D.[5].

#### 4.1.3 ACCEPTABILITY OF TEST METHODOLOGIES BASED ON OTHER STANDARDS

The acceptability of other test standards (A.D. [3], R.D.[1]) can be evaluated (see par. 1) for already qualified equipment or for subcontractors used to work with them.

#### 4.1.4 TOLERANCES OF TEST PARAMETERS

Tolerances are specified for each type of test in the corresponding chapter, or according to par. 4.8.2.3 of A.D. [2].

#### 4.1.5 TEST PLAN AND PROCEDURES

As per par. 4.1 of A.D. [2].

#### 4.1.6 TEST INTERRUPTION AND RETEST

As per par 4.7 of A.D. [2].

#### 4.1.7 TEST SEQUENCE

The test sequence is the one specified in the following chapters, if not differently specified by the Equipment specification.

#### 4.1.8 ELECTRO-MAGNETIC COMPATIBILITY TEST

For EMC test refer to A.D. [6].

#### 4.1.9 INTERMEDIATE AND ADDITIONAL TESTING

The Supplier has the responsibility to add any intermediate test/verification, to the minimum specified testing presented in this document, in order to protect his equipment from re-testing risk, and to facilitate anomaly/failure investigations.

#### 4.1.10 EQUIPMENT MECHANICAL INTERFACE

The equipment subject to testing shall be in the complete configuration subject to the Supply. It is nevertheless the right of the Prime Contractor to ask for the implementation of specific bracketry expected for flight but not subject of the supply.

#### 4.1.11 EQUIPMENT ELECTRICAL INTERFACE

All environmental testing (except where differently specified) shall be executed with the equipment in full powered conditions. During all environmental testing, the equipment and its electrical interface shall be functionally active and continuously monitored by automatic recording devices in order to detect any out-of-spec conditions or any anomaly. Specific success criteria to be specified within the test spec and procedures.

#### 4.1.12 PYROTECHNIC COMPONENTS

This SG is applicable for any pyrotechnic component and for the pyro-chains. In some cases the document A.D. [7] may define in a more specific way the tests and levels. In any case, it prevails the most dimensioning test/level from this SG and A.D. [7]. The pyro-component may be qualified according this document either individually or as a part of the pyro-chain.

#### 4.1.13 SAFETY EQUIPMENT

Safety equipment are qualified at the maximum severity.

#### 4.1.14 REQUIREMENTS CONCERNING VERIFICATIONS

##### a) Verifications take place before, during and after the tests.

These verifications are intended to detect the effects of the test on the equipment.

Depending on the type of test, they can include:

- dimensional checks,
- visual inspections,
- grounding checks,
- insulation resistance checks,
- tightness checks.
- functional test,
- etc.

These checks and more particularly the processing of the recorded functional characteristics are performed after each type of tests according to paragraph 4.1.2.

It is necessary to check that an equipment works correctly during the test before undertaking the next test.

When between two successive tests a period of time longer than (TBD) has elapsed or such operations as transport, etc. have been carried out, the serviceability of the equipment will be checked prior to subjecting it to a new test. These checks and more particularly the processing of the recorded functional characteristics area performed after each type of tests according to paragraph 4.7.

At the end of a1 qualificat4on tests, the equipment will be investigated.

##### b) Technological inspection in the equipment

###### b1 - general

The specimen(s) of each item of equipment intended to undergo qualification tests is/are subjected to an internal technological inspection previously defined with the level 1 contractor and performed by the authority in charge of the item of equipment in the plant of the contractor on the latter's responsibility, as regards the operations on the equipment and the optical observation means (e.g. binocular magnifier).

A representative of ELV and/or ESA may attend the inspection as an observer.

The purpose of these technological inspections is to make an authoritative evaluation of assembling methods and component connections.

In no case the technological inspection can be destructive. It is visual inspection, facilitated if needed by traditional optical means. Photographs are often recommended.

#### b2 - Inspection before qualification tests

All the sub-assemblies which make up the equipment are inspected before final assembly. The assembled equipment is inspected before it is closed. It is subjected to the reception test.

The external aspect of the equipment is re-examined after the reception test, without re-opening it.

The purpose of these inspections is two-fold:

- to ascertain that the technological principles stated in this document seem to be complied with as well as the "state-of-the art" in the trade (compulsory consensus with the equipment manufacturer),
- to have an overview as accurate as possible on the layout and aspect of all the constituent elements (visual reference, hence the interest of photographs).

#### NOTE:

The fact of ascertaining that a layout should be improved does not thwart the execution of qualification tests. Generally speaking, these requirements are covered by key-points.

#### b3 - Inspection after qualification tests

Whatever the equipment behaviour during the tests, the inspections described in paragraph h2 are then repeated under the same conditions but in the reversed order, up to the constituent sub-assemblies. Unless it is exceptionally necessary to conduct an in-depth analysis, no assembly having a permanent character (brazing, crimping) shall be disassembled.

The expert appointed by the level 1 contractor also attends all disassemblies.

The purpose of these inspections is to compare the condition of the equipment with its condition before the tests, in order to check that the circuits, assemblies and wirings have not suffered any damage which may entail (or has entailed) a functional non-conformance, even if the test results seem satisfactory. Internal cleanliness is checked as well.

After the inspections, the equipment may be reassembled.

The favourable opinion of the expert is necessary for the qualification to be notified.

#### NOTE -

The fact that a degradation initiation has been observed in an equipment which has passed the tests may lead to postpone the qualification decision until the equipment manufacturer has taken the necessary corrective action and the expected effect has been demonstrated.



#### 4.2 ACCEPTANCE TESTING

TEST NAME	REFERENCE DOCUMENT	NOTES	LEVELS / DURATION
Inspection	4.5 of A.D. [3]	Or Supplier standard to be approved	
Mechanical & electrical I/F verification	Comparison of ICD and test item	Report compliance and actual data with respect to applicable ICD	
Mass properties verification (mass, dimension)	5.1.4 of A.D. [2]	No MOI and COG measurement (Already covered by qualification)	
Complete functional test (electrical, optical, and mechanical performance)	5.1.5 and 6.1.4 of A.D. [2]	This is the reference performance for evaluation of the intermediate and final functional testing.	
Leakage Test	6.1.5 of A.D. [2]	Only for pressurized or sealed equipment (see applicability matrix, par. 7.3)	
Pressure Test	6.1.6 of A.D. [2]	Only for pressure vessels or valves (see applicability matrix, par. 7.3)	
Random vibration	6.1.7 of A.D. [2]	It is required Severity 1 for acceptance.	Par. 5.3
Shock Screening	6.1.9 of A.D. [2]	To detect failures due to conducting particles in electronic equipment. It is like a medium level shock.	Par. 5.4.2
Leakage Test	6.1.5 of A.D. [2]	As above	



TEST NAME	REFERENCE DOCUMENT	NOTES	LEVELS / DURATION
Thermal Cycling		It is covered by Thermal Vacuum. Only Thermal Cycling instead of Thermal Vacuum test may be performed in agreement with the Prime Contractor (same temperatures and duration of vacuum test have to be used).	Par. 6.2
Thermal Vacuum	6.1.10 of A.D. [2]		Par. 6.1
Leakage Test	6.1.5 of A.D. [2]	As above	
Complete Functional Test	5.1.5 and 6.1.4 of A.D. [2]	This is the final functional verification	
Inspection			

General notes:

- (1) all environmental testing shall be executed on the full powered and functionally active & monitored equipment; success criteria shall be specified according to such equipment condition
- (2) other intermediate functional checks to be added by Supplier in order to minimise overtesting



### 4.3 QUALIFICATION TESTING

TEST NAME	REFERENCE DOCUMENT	NOTES	LEVELS / DURATION
Complete acceptance testing		As per par 4.2 of this document	
Visual inspection		Already covered by acceptance	
Mechanical & electrical I/F verification		Already covered by acceptance	
Mass properties verification (mass, dimension, MOI, COG)	5.1.4 of A.D. [2]	No MOI measurement for equipment below 15 Kg.	
Complete functional test (electrical, optical, and mechanical performance)	5.1.5 of A.D. [2]	This is the reference performance for evaluation of the intermediate and final functional testing.	
Humidity	5.4 of A.D. [1]		Par. 6.3
Leakage Test	5.1.7 of A.D. [2]	Only for pressurized or sealed equipment (see applicability matrix, par. 7.2)	
Pressure Test	5.1.8 of A.D. [2]	Only for pressure vessels, pressure lines, fitting and valves (see applicability matrix, par. 7.2)	
Rain	5.10 of A.D. [1]	Only for external equipment or other selected equipment (see applicability matrix, par. 7.2).	Par. 6.5
Steady state acceleration	5.1.9 of A.D. [2]	Requested only for equipment sensitive to constant acceleration (see applicability matrix, par. 7.2)	Par. 5.5



TEST NAME	REFERENCE DOCUMENT	NOTES	LEVELS / DURATION
Sinusoidal Vibration	5.1.10 of A.D. [2]		
- <i>Low level (modal survey)</i>	5.1.10.3.1 of A.D. [2]		Par. 5.2.1
- <i>Transport</i>	6.2 of A.D. [1]	If required (see applicability matrix in par. 7.2). Level can be covered by high level sinusoidal test. It could be performed before or after the high level sinusoidal vibration.	Par. 5.2.3
- <i>High level (robustness)</i>	5.1.10.3.3 of A.D. [2]	Severity 2 is for equipped support with natural frequency in the range 35-60 Hz (see applicability matrix in par. 7.2).	Par. 5.2.2
- <i>Low level (modal survey)</i>	5.1.10.3.2 of A.D. [2]	To reveal eventual degradation or failure	Par. 5.2.1



TEST NAME	REFERENCE DOCUMENT	NOTES	LEVELS / DURATION
Random vibration	5.1.11 of A.D. [2]	It is required Severity 2 for qualification.	Par. 5.3
Modal Survey	5.1.10.3.2 of A.D. [2]	To reveal eventual degradation or failure	Par. 5.2.1
High Shock	5.1.13 of A.D. [2]	Specific test level and duration must be applied, as reported in 5.1.13.3.b of A.D. [2]. At least 3 shock for each axis (5.1.13.3.c of A.D. [2]), or 3 shock for worst direction (in agreement with Prime Contractor, or imposed by Prime Contractor). Safety equipment must be qualified at the maximum severity level. Attenuation of level may be evaluated in agreement with the Prime Contractor on the basis of equipment location.	Par. 5.4.1 Shock Response Spectrum for qualification is divided in classes of Severity associated to equipment location.



TEST NAME	REFERENCE DOCUMENT	NOTES	LEVELS / DURATION
Leakage Test	5.1.7 of A.D. [2]	As above	
Complete functional test	5.1.5 of A.D. [2]	This is the intermediate functional verification	
Thermal Cycling	5.1.16 of A.D. [2]	It is a temperature shock test. It can be covered by Thermal Vacuum (Supplier will propose to include it or not, in agreement with Prime Contractor)	Par. 6.2
Thermal Vacuum	5.1.15 of A.D. [2]		Par. 6.1
Leakage Test	5.1.7 of A.D. [2]	As above	
EMC/ESD test	A.D. [1] and A.D. [6]	For electrical equipment	
Cycle life test	5.1.18 of A.D. [2]	If required. Cycling characteristics to be defined in the Equipment specification	



TEST NAME	REFERENCE DOCUMENT	NOTES	LEVELS / DURATION
Salt Fog	5.9 of A.D. [1]	Only for external equipment or other selected equipment (see applicability matrix, par. 7.2).	Par. 6.4
Complete Functional Test	5.1.5 of A.D. [2]	This is the final functional verification	
Destructive testing		To be specified on case by case basis as per equipment	



#### **4.4 DEVELOPMENT TEST**

This is under the responsibility and control of the Equipment Supplier.

#### **4.5 PROTOFLIGHT TEST**

Not considered in the Vega Launch vehicle equipment baseline.

## 5. TEST IN MECHANICAL ENVIRONMENT

### 5.1 GENERAL

General aspect for what concerns tests in mechanical environment are exposed in 6.1 of A.D. [1].

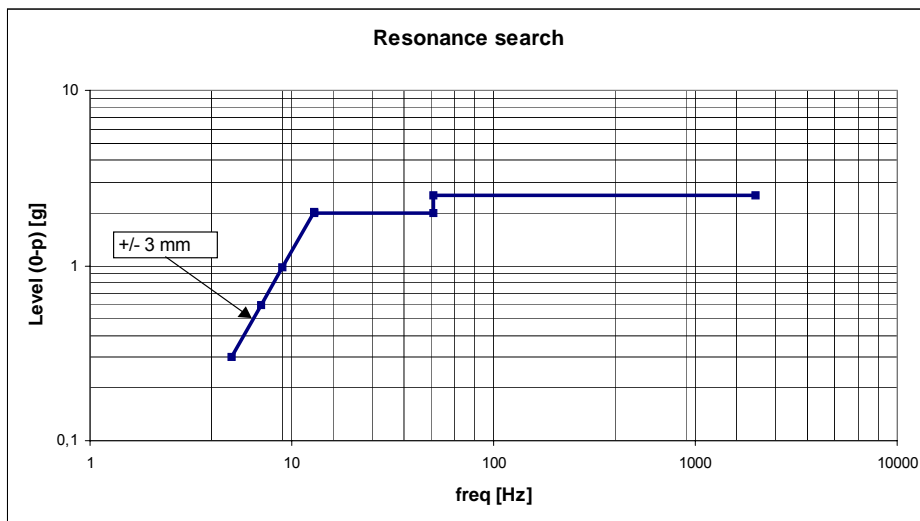
### 5.2 SINUSOIDAL VIBRATION

See 5.1.10 of A.D. [2] for methodology.

#### 5.2.1 Low Level (Sinusoidal modal survey)

The level must be applied along each of 3 axes, one sweep-up and one sweep-down.

Freq [Hz]	Level (0-peak)	Sweep rate
5-13	3 mm	2 oct / min
13-50	2 g	i.e.
50-2000	2.5 g	$T \cong 4'$



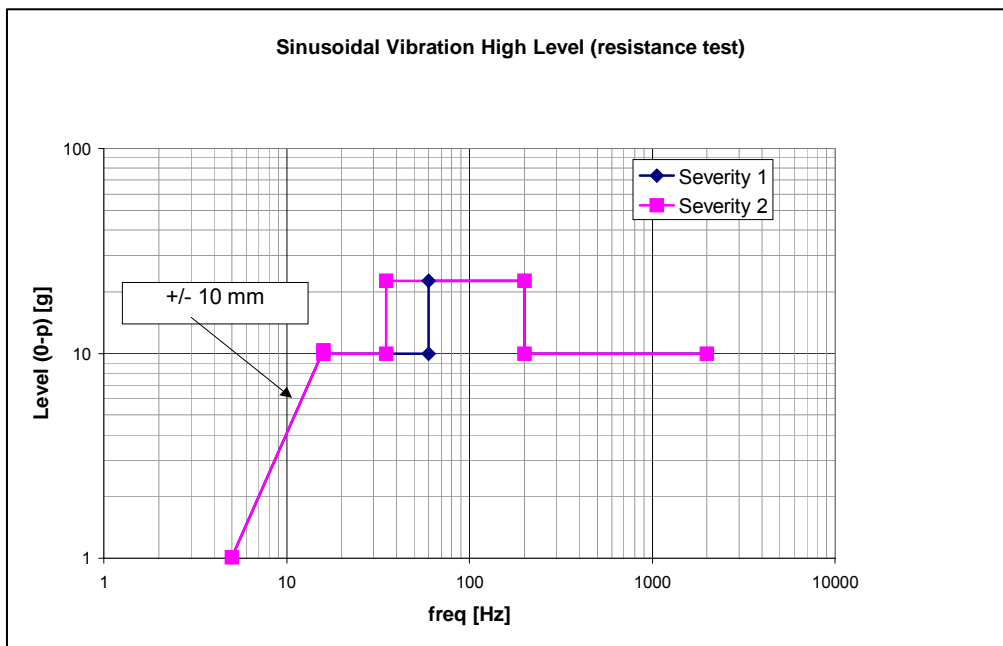
5.2.2 High level (Robustness vibration test)

Test to be executed along each of 3 axes.

Freq [Hz]	Level (0-peak)		Sweep rate
	Sev.1	Sev.2	
5-16	10 mm	10 mm	1/3 oct /min i.e. T $\cong$ 11.4'
16-35	10 g	10 g	
35-60	10 g	22.5 g	
60-70	22.5 g	22.5 g	2 oct / min i.e. T $\cong$ 2.4'
70-200	22.5 g	22.5 g	
200-2000	10 g	10 g	

Severity 2 is for heavy equipment for which natural frequency (support+equipment) could be in the range 35-60 Hz. The AVUM Secondary Structures (panels) are also intended as supports.

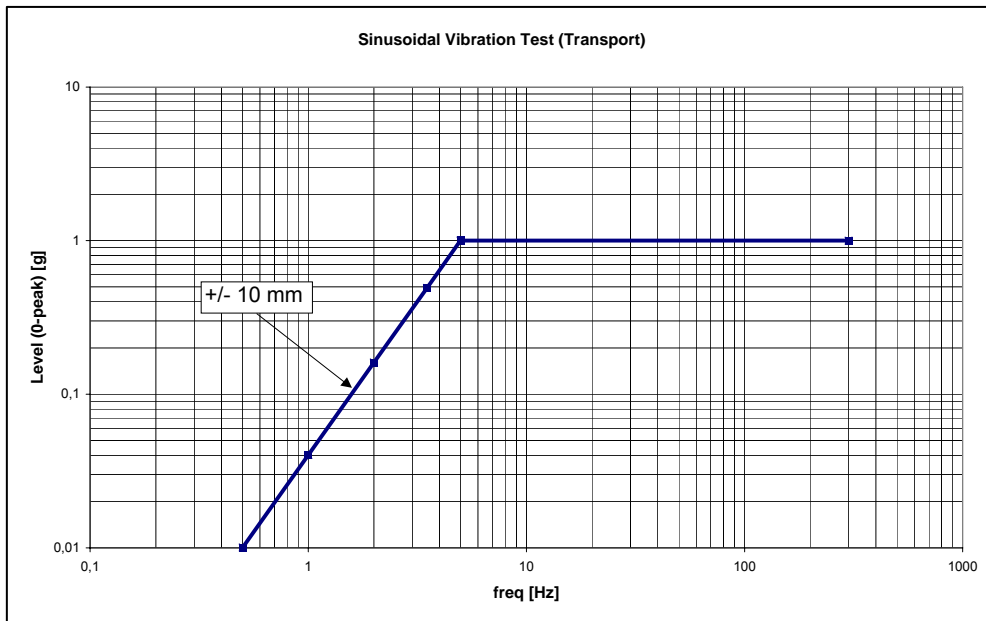
It is not required for acceptance.



### 5.2.3 Transport vibrations

These level must be applied 26 times along each of the 3 axes (i.e. 4 h per axis):

Freq [Hz]	Level (0-peak)	Sweep rate
0.5 - 5	10 mm	1 oct / min i.e. $T \cong 9'$
5 - 300	1 g	



It could be covered by high level sinusoidal test.

### 5.2.4 Sinusoidal Vibration tolerances

Frequency	± 0.05 Hz ± 20 % ± 1 Hz ± 2 %	[0-0.25] Hz [0.25-5] Hz [5-50] Hz [50-2000] Hz
Sweep rate	-0 / +10 %	
Amplitude of vibration (motion, speed, acceleration)	± 10 % (control signal) ± 25 % (attachment point)	
Differences Overall-Filtered signal	± 5 %	

The equipment attachment points will move in phase and parallel to the stressing axis within the tolerances specified.

For tolerances on adapting facilities refer to 6.2.6.4 of A.D. [1].

### 5.3 RANDOM VIBRATION

#### 5.3.1 Random Vibration levels and duration

These levels must be applied along each of the 3 axes:

Severity 1	Frequency [Hz]	PSD [g <sup>2</sup> /Hz]	Slope [dB/Oct]	PSD [gRMS]	Duration
	20	0,0727		12	4'
	2000	0.0727			

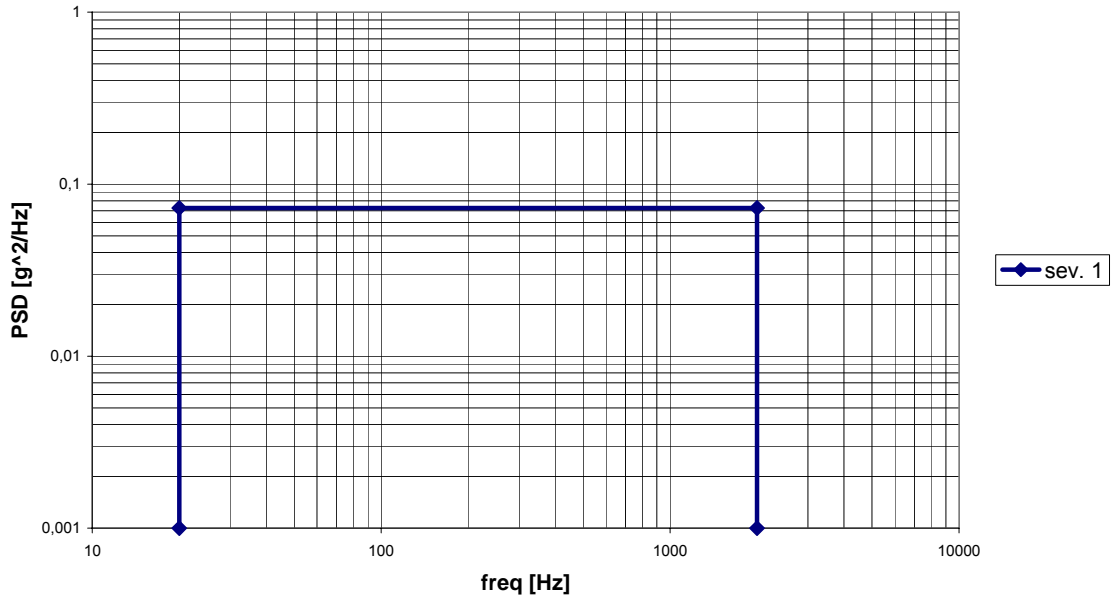
Severity 2	Frequency [Hz]	PSD [g <sup>2</sup> /Hz]	Slope [dB/Oct]	PSD [gRMS]	Duration
	20	0,0727	+3	20	4'
	60	0.273	-6		
	2000	0.0727			

Severity 3	Frequency [Hz]	PSD [g <sup>2</sup> /Hz]	Slope [dB/Oct]	PSD [gRMS]	Duration
	20	0,094	+3	30	4'
	150	0,70			
	600	0,70			
	2000	0,064	-6		

Severity 4	Frequency [Hz]	PSD [g <sup>2</sup> /Hz]	Slope [dB/Oct]	PSD [gRMS]	Duration
	20	0,01	+15.6	42.8	4'
	60	3,00			
	80	3,00			
	113	1,50	-6		
	360	1,50	-6		
	2000	0,05			

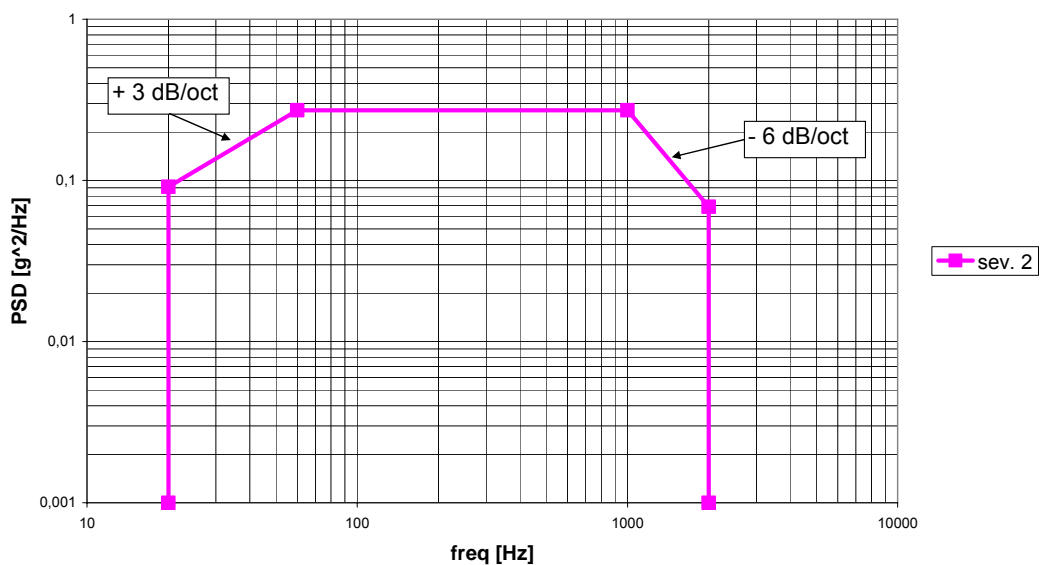
Severity 1 is requested for acceptance test of all equipment.

RANDOM VIBRATIONS SEVERITY 1



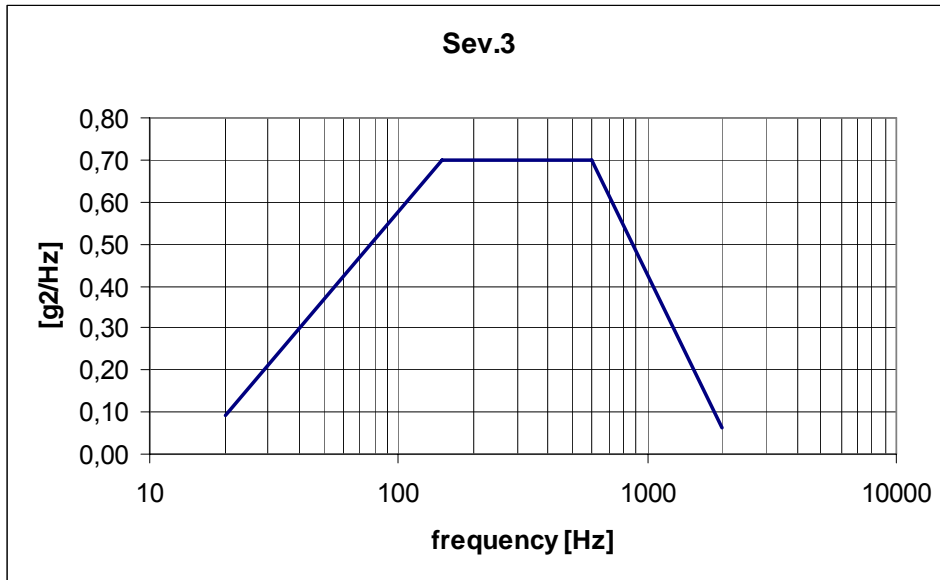
Severity 2 is requested for qualification test of most of the equipment.

RANDOM VIBRATIONS SEVERITY 2

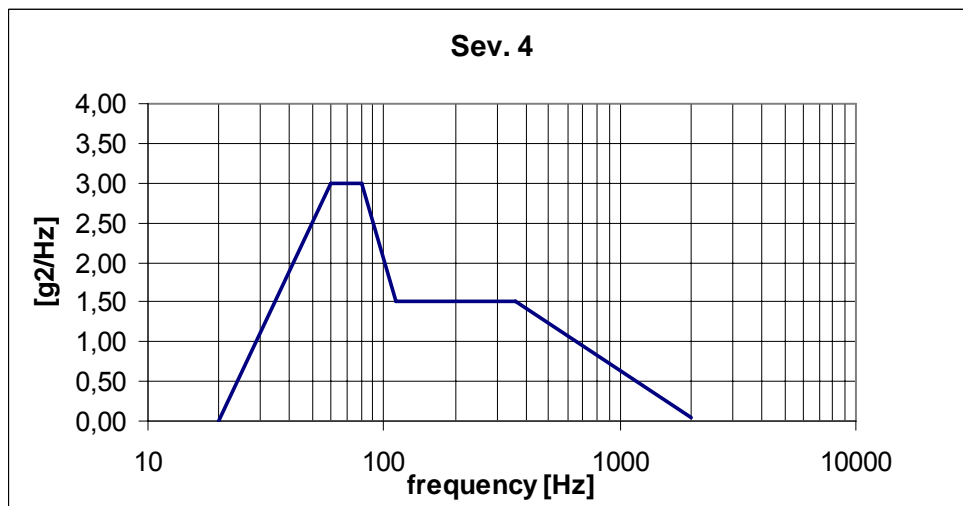


The exploitation of UCMEC acoustic tests (see in RD7) allows to define for the upper part (lower shear panel, AVUM skirt) two new severities : Severity 3 and 4.

**Severity 3** is requested for the qualification level of equipment fixed on AVUM skirt



**Severity 4** is requested for the qualification level of equipment fixed on AVUM structure



### 5.3.3 Random Vibration tolerances

Frequency	Hz	Max of $\pm 2 \%$ and $\pm 1$ Hz
PSD	$g^2/Hz$	$\pm 3$ dB
Overall	g RMS	$\pm 10 \%$ (control point) $\pm 25 \%$ (attachment point)
Test duration		$\pm 5 \%$

For tolerances on adapting facilities refer to 6.3.6 of A.D. [1].

### 5.4 SHOCK TEST

#### 5.4.1 High Shock levels

These level must be applied 3 times along each of the 3 axes (as in 5.1.13.3.c of A.D. [2]), or 3 times for worst direction of axes (in agreement with Prime Contractor or imposed by Prime Contractor):

Freq [Hz]	SRS Level (*) [g]				
	Sev.1	Sev.2	Sev.3	Sev.4	Sev.5
100	60	60	60	60	300
600	500	1400	2800	4000	5000
2000	1500	3550	7100	10000	15000
5000	2400	3550	7100	10000	24000
10000	2400	3550	7100	10000	24000

(\*): Shock Response Spectrum of a 1 d.o.f. system with Q=10 (i.e.  $\xi=0.05$ )

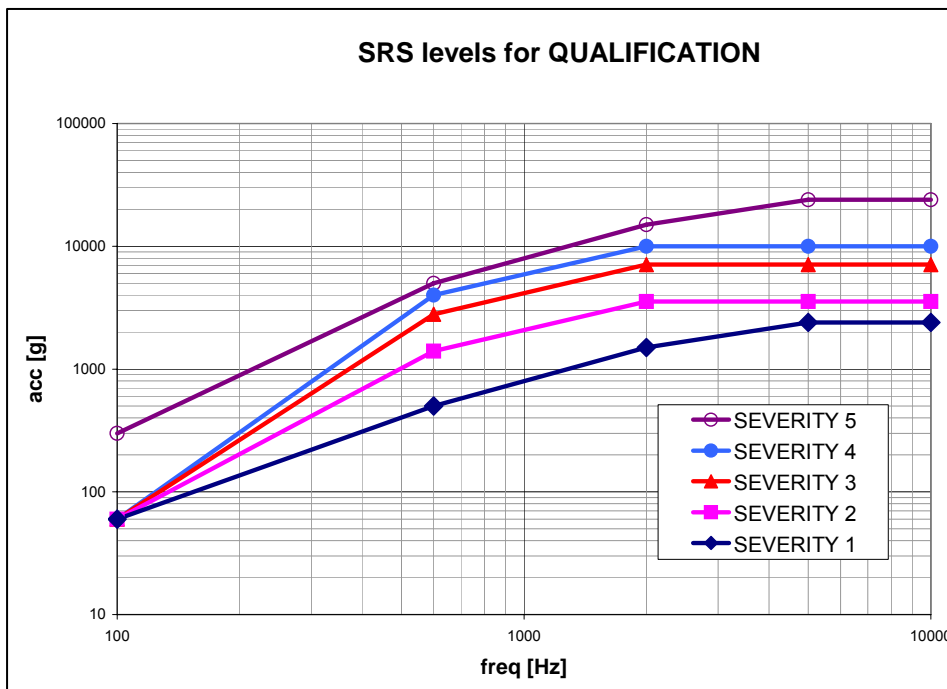
Severity 1 is required for equipment directly fixed on structure of IS01, and for SRMs igniters.

Severity 2 is required for equipment directly fixed on panel of Avum AAM.

Severity 3 is required for equipment directly fixed on panels of Avum APM and on Engine Plate.

Severity 4 is required for equipment directly fixed on structure in proximity of P/L adapter.

Severity 5 is required for equipment directly fixed on structure of IS1-2, IS2-3 and IS3-AV, Avum Skirt.





NOTA : the shock levels to be considered for the engine plate, IS3-AV and Avum Skirt have been enhanced (in edition 5) of one “severity level” for each one. It is due to the new consideration of the separation system between stages 3/Avum. This study is presented in [RD6].

An attenuation of shock may be selected in agreement with the Prime Contractor on the basis of equipment location.

This test is not required for acceptance.

#### 5.4.2 Medium Shock levels

Only for electrical and electronic equipment (see 6.1.9 of A.D. [2]).

It is a shock screening after random vibration test in acceptance: the purpose is to detect intermittent or persistent failures due to conducting particles in electronic equipment.

The medium shock test consists in applying an half-sinusoidal pulse of 11 ms duration and 50 g amplitude along each of three orthogonal axes.

This test is not required for qualification.

#### 5.4.3 Shock test tolerances

SRS amplitude	From -0 dB to +4 dB of spectrum specified
---------------	-------------------------------------------

## 5.5 STEADY STATE ACCELERATION TEST

### 5.5.1 Constant Acceleration levels

Only for equipment with any internal moving element or sensitive to static acceleration (i.e. batteries) shall be submitted to this test. The sinusoidal vibration test is considered to be demonstrative for other equipment.

Duration is 3 min and level is 7.5 g for each axes (corresponding to LV axes) in positive and negative direction.

This test is not required for acceptance.

### 5.5.2 Constant Acceleration tolerances

Acceleration	0 / +10 %
Test Time	0 / +10 %

## 6. TEST IN THERMAL AND CLIMATIC ENVIRONMENT

### 6.1 THERMAL VACUUM TEST

#### 6.1.1 Thermal Vacuum levels

	Acceptance	Qualification
Number of cycles	4	40 ( <i>electrical/electronic equip.</i> ) 10 ( <i>non electrical/electronic equip.</i> )
Temp. Min	$T_{AMIN} = -10\text{ °C}$	$T_{QMIN} = -20\text{ °C}$
Temp. Max	$T_{AMAX} = +60\text{ °C}$	$T_{QMAX} = +70\text{ °C}$
Duration at $T_{MIN}$	2 h	
Duration at $T_{MAX}$	2 h	
Temperature Rate (heating)	$<20\text{ °C/min}$ ( <i>internal equipment</i> ) $>20\text{ °C/min}$ ( <i>external equipment</i> )	
Temperature Rate (cooling)	$2\div3\text{ °C/min}$	
Pressure	1 milliPa	
Stabilization criterion	$1\text{ °C/1 h}$	

Severity classes are:

	SEVERITY	Equipment Type/Position	Cycles	Temp. Rate [°C/min]
Acceptance	1	<i>Internal</i>	4	$<20$
	2	<i>External</i>		$>20$
Qualification	3	<i>Internal</i>	10	$<20$
	4	<i>External</i>		$>20$
	5	Electrical	40	$<20$

For safety equipment the maximum severity together with a minimum temperature rate of  $20\text{ °C/min}$  is required.

#### 6.1.2 Thermal Vacuum tolerances

Pressure	Pa	$\pm 15\%$ , $p > 133\text{ Pa}$ ( $\cong 1\text{ Torr}$ ) $\pm 30\%$ , $p \in [0.133, 133]\text{ Pa}$ $\pm 80\%$ , $p < 0.133\text{ Pa}$ ( $\cong 10\text{E-3 Torr}$ )
Temperature	°C	$\pm 3\text{ °C}$

## 6.2 THERMAL CYCLING TEST

### 6.2.1 Thermal Cycling levels

	<b>Acceptance</b>	<b>Qualification</b>
Number of cycles	<i>Covered By Thermal Vacuum Test</i>	10
Temp. Min		$T_{AMB} = +20^{\circ} \text{C}$
Temp. Max		$T_{QMAX} = +70^{\circ} \text{C}$
Duration at $T_{MIN}$		2 h
Duration at $T_{MAX}$		2 h
Temperature Rate (heating)		>20 °C/min ( <i>external equipment</i> ) <20 °C/min ( <i>internal equipment</i> )
Temperature Rate (cooling)		2÷3 °C/min
Stabilization criterion		1 °C/1 h

Severity classes are:

<b>SEVERITY</b>	<b>Equipment Position</b>	<b>Cycles</b>	<b>Temp. Rate [°C/min]</b>
1	<i>Internal</i>	10	<20
2	<i>External</i>	10	>20

For safety equipment the maximum severity together with a minimum temperature rate of 20 °C/min is required.

It can be covered by thermal vacuum test for qualification.

It is not required for acceptance: only thermal cycling instead of thermal vacuum acceptance test may be performed in agreement with the Prime Contractor (same temperatures and duration of vacuum acceptance test have to be used).

### 6.2.2 Thermal Cycling tolerances

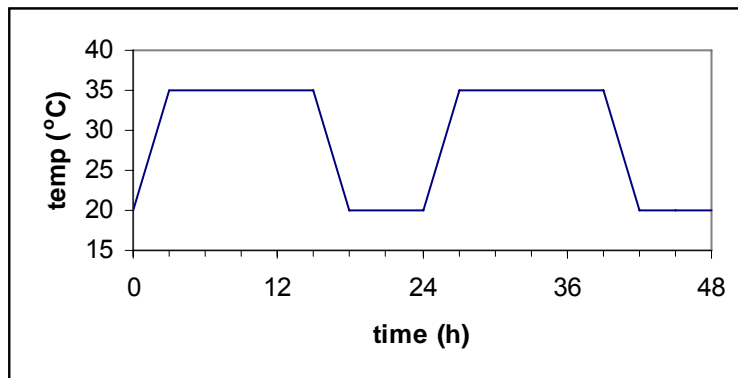
Temperature	°C	$\pm 3^{\circ} \text{C}$
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### 6.3 HUMIDITY TEST

#### 6.3.1 Humidity Test levels

		Qualification
Temperature MAX	°C	+35
Temperature MIN	°C	+20
Temp. Variation Rate	°C/min	< 3
Number of cycles	-	2
Cycle duration	(h)	24
Total duration	(h)	48
Humidity during constant levels	%	93

The test is not required for acceptance.



#### 6.3.2 Humidity Test tolerances

Temperature during constant level	°C	± 2
Humidity during constant level	%	-0 /+2

## 6.4 SALT FOG TEST

### 6.4.1 Salt Fog Test levels

It is required only for external equipment.

		<b>Qualification</b>
Temperature	°C	+35
Number of cycles (last cycle without fog)	-	2
Cycle duration	(h)	24
Total duration	(h)	48
Air compressor relative pressure	bar	+1
Salt solution concentration (density sol. 1035 kg/m <sup>3</sup> , 20 °C)	%	5
pH solution (at 35 °C)	pH	7
Humidity of compressed air	%	>85

See par. 5.9 of A.D. [1] for methodology and test facilities.  
The test is not required for acceptance.

### 6.4.2 Salt Fog Test tolerances

Temperature	°C	+/- 1
Salt solution concentration (density sol. 1030÷1040 kg/m <sup>3</sup> , 20 °C)	%	+/- 0.5
Air compressor pressure	bar	+/- 0.2
pH solution (at 35 °C)	pH	-0.5 / +0.2



## 6.5 RAIN TEST

### 6.5.1 Rain Test levels

		Qualification
Intensity	mm/h	50
Temperature	°C	+20
Time of exposure	min	30

Only external equipment or equipment subject to condensation shall be submitted to this test.

The test is not required for acceptance.

### 6.5.2 Rain Test tolerances

Intensity	%	+/- 20
Temperature	%	+/- 20

## 7. APPLICABILITY MATRIX

### 7.1 LIST AND LOCATION OF EQUIPMENT

The equipment used on LV and their location are (data are indicative, see R.D.[2]):

Position	Component Name/Description	Category
	<b>1ST STAGE</b>	
	<b>SRM P80FW</b>	
P80/IS 1-2	Igniter	PRO
	<b>TVC</b>	
IS 0-1	EMA	MMA/ELE
IS 0-1	Actuator battery	BAT
IS 0-1	IPDU	ELE
	<b>SAS</b>	
IS 1-2	Destruction battery	BAT
IS 1-2	SRU	ELE
IS 1-2	Destruction train	PYR
	SAD	
	Cutting chord 1.1/1.2	
	Pyro lines 1.1/1.2	
	<b>Loose parts</b>	
IS 1-2	Separation train	PYR
	SAD	
	Pyro lines 1.1&1.2	
	I/S cutting chord	
IS 1-2	SRM ignition train	PYR
	SAD	
	Pyro lines 1.1&1.2	
	IFOC	
IS 1-2	RR Motors	PRO
IS 1-2	RR ignition train	PYR
	SAD	
	Ignition pyro chain RR1/RR2	
	IFOC	
	BMV	

#### equipment category

ELE Electronic and electrical equipment  
 ANT Antennas  
 BAT Batterias  
 VAL valves  
 PRO propulsion components

PRE pressure vessels  
 THR Thrusters  
 MEC mechanical equipment  
 MMA mechanical movingg assembly  
 PYR Pyrochains



Position	Component Name/Description	Category
<b>2ND STAGE</b>		
<b>SRM Z23</b>		
Z23/IS 2-3	Igniter	PRO
<b>TVC</b>		
IS 1-2	EMA	MMA/ELE
IS 1-2	Actuator battery	BAT
IS 1-2	IPDU	ELE
<b>SAS</b>		
IS 2-3	Destruction battery	BAT
IS 2-3	SRU	ELE
IS 2-3	Destruction train	PYR
	SAD	
	Cutting chord 2.1/2.2	
	Pyro lines 2.1/2.2	
<b>Loose parts</b>		
IS 2-3	Separation train	PYR
	SAD	
	Pyro lines 2.1 & 2.2	
	I/S separation cutting chord	
IS 2-3	SRM ignition train	PYR
	SAD	
	Pyro lines 2.1 & 2.2	
	IFOC	

**equipment category**

ELE Electronic and electrical equipment  
 ANT Antennas  
 BAT Batterias  
 VAL valves  
 PRO propulsion components

PRE pressure vessels  
 THR Thrusters  
 MEC mechanical equipment  
 MMA mechanical movingg assembly  
 PYR Pyrochains



Position	Component Name/Description	Category
<b>3RD STAGE</b>		
<b>SRM Z9</b>		
Z9/IS 3-AV	Igniter	PRO
<b>TVC</b>		
IS 2-3	EMA	MMA/ELE
IS 2-3	Actuator battery	BAT
IS 2-3	IPDU	ELE
<b>SAS</b>		
IS 3-AV	Destruction battery	BAT
IS 3-AV	SMU	ELE
IS 3-AV	Destruction train	PYR
	SAD	
	Cutting chord 3.1&3.2	
	Pyro lines 3.1&3.2	
IS 3-AV	TR	ELE
IS 3-AV	RTX	ELE
IS 3-AV	TR antenna set	ANT
IS 3-AV	RTX antenna set	ANT
<b>Loose parts</b>		
IS 3-AV	SRM ignition train	PYR
	SAD	
	Pyro lines 3.1&3.2	
	IFOC	

**equipment category**

ELE Electronic and electrical equipment  
 ANT Antennas  
 BAT Batterias  
 VAL valves  
 PRO propulsion components

PRE pressure vessels  
 THR Thrusters  
 MEC mechanical equipment  
 MMA mechanical movingg assemmbly  
 PYR Pyrochains



Position	Component Name/Description	Category
	<b>AVUM</b>	
	<b>LPS</b>	
APM	HP/LP pyrovalve	PRO
APM	HP/LP transducer	ELE
APM	Pressure regulator & relief valve	PRO
APM	Non return valve	PRO
AVUM skirt	HP/LP fill & vent valve	PRO
	<b>GNC</b>	
AAM	OBC	ELE
AAM	INS	ELE
AAM	MFU	ELE
AAM	IPDU	ELE
AAM	OBB-A	BAT
AAM	Pyro battery	BAT
APM	EMA	MMA/ELE
AAM	Actuator battery	BAT
	<b>TLM</b>	
AAM	(*) UCTM	ELE
AAM	(*) TLM transmitter	ELE
AVUM skirt	(*) TLM antenna set	ANT
	<b>RACS</b>	
AVUM skirt	Thruster cluster module	THR
	Thruster	
	Filter branching manifold	
AVUM skirt	Propellant tank	PRE
APM	LV assy (+damper)	PRO
	High Flow Latch Valve	
	Pressure tansducer	
AVUM skirt	Liquid Fill/Drain Valve	PRO
AVUM skirt	Gas Fill/Vent Valve Assy	PRO
	Gas Fill/Vent Valve Assy	
APM	Piping Bracket Set	PRO
APM	Pipework	PRO
AVUM skirt	Aerothermal Cover	MEC

\* equipment positioned also on IS 3-AVUM during qualification flight\*\* Supported via struts

**equipment category**

ELE Electronic and electrical equipment  
 ANT Antennas  
 BAT Batterias  
 VAL valves  
 PRO propulsion components

PRE pressure vessels  
 THR Thrusters  
 MEC mechanical equipment  
 MMA mechanical movingg assembly  
 PYR Pyrochains



## ***7.2 QUALIFICATION TESTS APPLICABILITY MATRIX***



7.2.1 Electrical and Electronic Equipment

Equipment Name		Complete acceptance testing	Visual inspection	Mech. & elect. I/F verification	Mass properties verification	Complete functional test	Humidity	Leakage (4)	Pressure	Rain	Steady state acceleration	Sinusoidal Vibration (low level)	Sinusoidal Vibration (transport) (2)	Sinusoidal Vibration (high level)	Sinusoidal Vibration (low level)	Random Vibration	Sinusoidal Modal Survey	High Shock (Pyrotechnic)	Leakage (4)	Complete functional test	Thermal Cycling (3)	Thermal Vacuum	Leakage (4)	EMC/ESD test	Cycle life test	Salt Fog	Complete functional test	Destructive testing	
<b>IS01</b>	IPDU	R			R	R	R	R				R	R	S2	R	S2	R	S1	R	R	S1	S5	R	R				R	
<b>IS12</b>	SRU	R			R (1)	R	R	R				R	R	S1	R	S2	R	S5	R	R	S2	S5 (6)	R	R				R	
	IPDU (TVC)	R			R (1)	R	R	R				R	R	S1	R	S2	R	S5	R	R	S1	S5	R	R				R	
<b>IS23</b>	SRU	R			R (1)	R	R	R				R	R	S1	R	S2	R	S5	R	R	S2	S5 (6)	R	R				R	
	IPDU (TVC)	R			R (1)	R	R	R				R	R	S1	R	S2	R	S5	R	R	S1	S5	R	R				R	
<b>IS3AV</b>	SMU	R			R (1)	R	R	R				R	R	S1	R	S2	R	S5	R	R	S2	S5 (6)	R	R				R	
	TR	R			R (1)	R	R	R				R	R	S1	R	S2	R	S5	R	R	S1	S5	R	R				R	
	RTX	R			R (1)	R	R	R				R	R	S1	R	S2	R	S5	R	R	S1	S5	R	R				R	
<b>APM</b>	HP/LP transducer (LPS)	R			R (1)	R	R	R				R	R	S2	R	S2	R	S4	R	R	S1	S5	R	R				R	
<b>AAM</b>	OBC	R			R (1)	R	R	R				R	R	S1	R	S2	R	S2	R	R	S1	S5	R	R				R	
	INS	R			R (1)	R	R	R			R	R	R	S1	R	S2	R	S2	R	R	S1	S5	R	R				R	
	MFU	R			R (1)	R	R	R				R	R	S1	R	S2	R	S2	R	R	S1	S5	R	R				R	
	IPDU	R			R (1)	R	R	R				R	R	S1	R	S2	R	S2	R	R	S1	S5	R	R				R	
	UCTM (5)	R			R (1)	R	R	R				R	R	S1	R	S2	R	S4	R	R	S1	S5	R	R				R	
	TLM transmitter (5)	R			R (1)	R	R	R				R	R	S1	R	S2	R	S4	R	R	S1	S5	R	R				R	

- R = REQUIRED  
 S = SEVERITY CLASS
- (1) No MOI measurement
  - (2) It can be covered by high level of sinusoidal test
  - (3) It can be covered by thermal vacuum test
  - (4) Required only for sealed equipment
  - (5) equipment positioned also on IS3AV during qualification flight
  - (6) for safety equipment the maximum severity together with a temperature rate > 20 C/min is required



7.2.2 Antennas

Equipment Name		Complete acceptance testing	Visual inspection	Mech. & elect. I/F verification	Mass properties verification	Complete functional test	Humidity	Leakage	Pressure	Rain	Steady state acceleration	Sinusoidal Vibration (low level)	Sinusoidal Vibration (transport) (2)	Sinusoidal Vibration (high level)	Sinusoidal Vibration (low level)	Random Vibration	Sinusoidal Modal Survey	High Shock (Pyrotechnic)	Leakage	Complete functional test	Thermal Cycling (3)	Thermal Vacuum	Leakage	EMC/ESD test	Cycle life test	Salt Fog	Complete functional test	Destructive testing	
IS3AV	TR antenna set	R			R (1)	R	R			R	R	R	R	S1	R	S2	R	S5		R	S2	S4		R		R	R		
	RTX antenna set	R			R (1)	R	R			R	R	R	R	S1	R	S2	R	S5		R	S2	S4		R		R	R		
AVUM skirt	TLM antenna set	R			R (1)	R	R			R	R	R	R	S1	R	S3	R	S5		R	S2	S4		R		R	R		

R = REQUIRED (1) No MOI measurement  
 S = SEVERITY CLASS (2) It can be covered by high level of sinusoidal test  
 (3) It can be covered by thermal vacuum test



7.2.3 Batteries

Equipment Name		Complete acceptance testing	Visual inspection	Mech. & elect. I/F verification	Mass properties verification	Complete functional test	Humidity	Leakage (4)	Pressure	Rain	Steady state acceleration	Sinusoidal Vibration (low level)	Sinusoidal Vibration (transport) (2)	Sinusoidal Vibration (high level)	Sinusoidal Vibration (low level)	Random Vibration	Sinusoidal Modal Survey	High Shock (Pyrotechnic)	Leakage (4)	Complete functional test	Thermal Cycling (3)	Thermal Vacuum	Leakage (4)	EMC/ESD test	Cycle life test	Salt Fog	Complete functional test	Destructive testing
<b>IS01</b>	Actuator battery	R			R	R	R	R			R	R	R	S2	R	S2	R	S1	R	R	S1	S3	R	R	R		R	
<b>IS12</b>	Destruction battery (5)	R			R (1)	R	R	R			R	R	R	S1	R	S2	R	S5	R	R	S2	S4	R	R	R		R	
	Actuator battery	R			R	R	R	R			R	R	R	S1	R	S2	R	S5	R	R	S1	S3	R	R	R		R	
<b>IS23</b>	Destruction battery (5)	R			R (1)	R	R	R			R	R	R	S1	R	S2	R	S5	R	R	S2	S4	R	R	R		R	
	Actuator battery	R			R (1)	R	R	R			R	R	R	S1	R	S2	R	S5	R	R	S1	S3	R	R	R		R	
<b>IS3AV</b>	Destruction battery (5)	R			R (1)	R	R	R			R	R	R	S1	R	S2	R	S5	R	R	S2	S4	R	R	R		R	
<b>AAM</b>	OBB-A	R			R	R	R	R			R	R	R	S1	R	S2	R	S2	R	R	S1	S3	R	R	R		R	
	Pyro battery	R			R (1)	R	R	R			R	R	R	S1	R	S2	R	S2	R	R	S1	S3	R	R	R		R	
	Actuator battery	R			R (1)	R	R	R			R	R	R	S1	R	S2	R	S2	R	R	S1	S3	R	R	R		R	

- R = REQUIRED
- S = SEVERITY CLASS
- (1) No MOI measurement
- (2) It can be covered by high level of sinusoidal test
- (3) It can be covered by thermal vacuum test
- (4) Required only for sealed battery
- (5) Same product tree



7.2.4 Pressure Vessels

Equipment Name		Complete acceptance testing	Visual inspection	Mech. & elect. I/F verification	Mass properties verification	Complete functional test	Humidity	Leakage	Pressure	Rain	Steady state acceleration	Sinusoidal Vibration (low level)	Sinusoidal Vibration (transport) (2)	Sinusoidal Vibration (high level)	Sinusoidal Vibration (low level)	Random Vibration	Sinusoidal Modal Survey	High Shock (Pyrotechnic)	Leakage	Complete functional test	Thermal Cycling	Thermal Vacuum	Leakage	EMC/ESD test	Cycle life test	Salt Fog	Complete functional test	Destructive testing	
<b>Avum skirt</b>	Gas tank (LPS)	R			R	R		R	R			R	R	S2	K	R	<b>S5</b>	R	R						R				
<b>APM</b>	Oxidizer tank (LPS)	R			R	R		R	R			R	R	S2			R	<b>S4</b>	R	R						R			
	Fuel tank (LPS)	R			R	R		R	R			R	R	S2			R	<b>S4</b>	R	R						R			
<b>Avum skirt</b>	Hydrazine Tank(RACS)	See § RACS																											

- R = REQUIRED (1) No MOI measurement
- S = SEVERITY CLASS (2) It can be covered by high level of sinusoidal test
- K = See AD11 SG 1 - 12



7.2.5 Propulsion Equipment

Equipment Name		Complete acceptance testing	Visual inspection	Mech. & elect. I/F verification	Mass properties verification	Complete functional test	Humidity	Leakage	Pressure	Rain	Steady state acceleration	Sinusoidal Vibration (low level)	Sinusoidal Vibration (transport) (2)	Sinusoidal Vibration (high level)	Sinusoidal Vibration (low level)	Random Vibration	Sinusoidal Modal Survey	High Shock (Pyrotechnic)	Leakage	Complete functional test	Thermal Cycling (3)	Thermal Vacuum	Leakage	EMC/ESD test	Cycle life test	Salt Fog	Complete functional test	Destructive testing	
<b>P80 / IS12</b>	Igniter (SRM P80FW)	R			R			R	R			R	R	S1	R	S2	R		R		S1	S3	R					R	
	RR motors	R			R			R	R	R		R	R	S1	R	S2	R	<b>S5</b>	R		S2	S4	R					R	
<b>Z23 / IS23</b>	Igniter (SRM Z23)	R			R			R	R			R	R	S1	R	S2	R		R		S1	S3	R					R	
<b>Z9 / IS3AV</b>	Igniter (SRM Z9)	R			R (1)			R	R			R	R	S1	R	S2	R		R		S1	S3	R					R	
<b>AVUM skirt</b>	Liquid Fill/Drain Valve	R			R (1)	R		R	R			R	R	S2	R	S2	R	<b>S5</b>	R	R	S1	S3	R					R	
<b>APM</b>	Non return valve	R			R (1)	R		R	R			R	R	S2	R	S2	R	<b>S4</b>	R	R	S1	S3	R					R	
	Gas Fill/Vent Valve Assy	R			R (1)	R		R	R			R	R	S2	R	S2	R	<b>S4</b>	R	R	S1	S3	R					R	
	HP pyrovalve	R			R (1)	R		R	R			R	R	S2	R	S2	R	<b>S4</b>	R	R	S1	S3	R					R	
	Pressure regulator & relief valve	R			R (1)	R		R	R			R	R	S2	R	S2	R	<b>S4</b>	R	R	S1	S3	R					R	
	HP/LP fill & vent valve	R			R (1)	R		R	R			R	R	S2	R	S2	R	<b>S4</b>	R	R	S1	S3	R					R	
	Evacuation valve	R			R (1)	R		R	R			R	R	S2	R	S2	R	<b>S4</b>	R	R	S1	S3	R					R	

R = REQUIRED (1) No MOI measurement  
 S = SEVERITY CLASS (2) It can be covered by high level of sinusoidal test  
 (3) It can be covered by thermal vacuum test



7.2.6 Mechanical Moving Assemblies (MMA)

Equipment Name		Complete acceptance testing	Visual inspection	Mech. & elect. I/F verification	Mass properties verification	Complete functional test	Humidity	Leakage	Pressure	Rain	Steady state acceleration	Sinusoidal Vibration (low level)	Sinusoidal Vibration (transport) (2)	Sinusoidal Vibration (high level)	Sinusoidal Vibration (low level)	Random Vibration	Sinusoidal Modal Survey	High Shock (Pyrotechnic)	Leakage	Complete functional test	Thermal Cycling (3)	Thermal Vacuum	Leakage	EMC/ESD test	Cycle life test	Salt Fog	Complete functional test	Destructive testing	
<b>IS01</b>	EMA	<b>SEE AD11 : SG 1-12</b>																											
<b>IS12</b>	EMA																												
<b>IS23</b>	EMA																												
<b>APM</b>	EMA																												

- R = REQUIRED
- S = SEVERITY CLASS
- (1) No MOI measurement
- (2) It can be covered by high level of sinusoidal test
- (3) It can be covered by thermal vacuum test



7.2.7 Thrusters

Equipment Name		Complete acceptance testing	Visual inspection	Mech. & elect. I/F verification	Mass properties verification	Complete functional test	Humidity	Leakage	Pressure	Rain	Steady state acceleration	Sinusoidal Vibration (low level)	Sinusoidal Vibration (transport) (2)	Sinusoidal Vibration (high level)	Sinusoidal Vibration (low level)	Random Vibration	Sinusoidal Modal Survey	High Shock (Pyrotechnic)	Leakage	Complete functional test	Thermal Cycling (3)	Thermal Vacuum	Leakage	EMC/ESD test	Cycle life test	Salt Fog	Complete functional test	Destructive testing	
AVUM skirt	Thruster Cluster Module	See § RACS																											
APM	Main Engine Assy	R			R (1)	R						R	R	S2	R	S2	R	S2		R	S2	S5			R			R	

- R = REQUIRED (1) No MOI measurement
- S = SEVERITY CLASS (2) It can be covered by high level of sinusoidal test  
(3) It can be covered by thermal vacuum test
- \* = FIRING TEST AT CLUSTER ASSEMBLY



7.2.8 Pyrochains

Equipment Name		Complete acceptance testing	Visual inspection	Mech. & elect. I/F verification	Mass properties verification	Complete functional test	Humidity	Leakage	Pressure	Rain	Steady state acceleration	Sinusoidal Vibration (low level)	Sinusoidal Vibration (transport) (2)	Sinusoidal Vibration (high level)	Sinusoidal Vibration (low level)	Random Vibration	Sinusoidal Modal Survey	High Shock (Pyrotechnic)	Leakage	Complete functional test	Thermal Cycling (3)	Thermal Vacuum	Leakage	EMC/ESD test	Cycle life test	Salt Fog	Complete functional test	Destructive testing	
IS12	Destruction train	R			R (1)		R					R	R	S1	R	S2	R	S5			S2	S4					R	R	(4)
	Separation train	R			R (1)		R					R	R	S1	R	S2	R	S5			S2	S4					R	R	(4)
	SRM ignition train	R			R (1)		R					R	R	S1	R	S2	R	S5			S2	S4					R	R	(4)
	RR ignition train	R			R (1)		R					R	R	S1	R	S2	R	S5			S2	S4					R	R	(4)
IS23	Destruction train	R			R (1)		R					R	R	S1	R	S2	R	S5			S2	S4					R	R	(4)
	Separation train	R			R (1)		R					R	R	S1	R	S2	R	S5			S2	S4					R	R	(4)
	SRM ignition train	R			R (1)		R					R	R	S1	R	S2	R	S5			S2	S4					R	R	(4)
IS3AV	Destruction train	R			R (1)		R					R	R	S1	R	S2	R	S5			S2	S4					R	R	(4)
	SRM ignition train	R			R (1)		R					R	R	S1	R	S2	R	S5			S2	S4					R	R	(4)

- R = REQUIRED
- S = SEVERITY CLASS
- (1) No MOI measurement
- (2) It can be covered by high level of sinusoidal test
- (3) It can be covered by thermal vacuum test
- (4) Functional test is also destructive test



7.2.9 RACS

	Quantity	Complete Acceptance Testing	Visual Inspection	Mech & Electrical I/F Verification	Mass Properties verification	Complete Functional Tests	Humidity	Leakage	Pressure	Rain	Steady State Acceleration	Sinusoidal Vibration (low level)	Sinusoidal Vibration (transport)	Sinusoidal Vibration (high level)	Sinusoidal Vibration (low level)	Random Vibration	Sinusoidal Modal Survey	High Shock (Pyrotechnic)	Leakage	Complete Functional tests	Thermal Cycling	Thermal Vacuum	Leakage	EMC/ESD test	Cycle Life Test	Salt Fog	Complete Functional tests	Destructive testing
<b>RACS equipment</b>																												
Thruster	3	R			R	R		R	R			R	R	S1		S2	R	S5					R				R	
Filter & Branching Manifold	1	R			R	R		R	R			R	R	S1		S2	R	S5					R				R	
Propellant Tank	1	R			R	R		R	R			R	R	S1	R	K	R	S5	R				R			R		R
High Flow Latch Valve	1	R			R	R		R	R			R	R	S1	R	S2	R	S4			S1	S3	R			R		R
Pressure Transducer	1	R			R	R		R	R			R	R	S2	R	S3	R	S4			S1	S3	R				R	R
Liquid Fill/Drain Valve	1	R			R	R		R	R			R	R	S2	R	S3	R	S5	R		S1	S3	R				R	R
Gas Fill/Vent Valve	1	R			R	R		R	R			R	R	S2	R	S2	R	S5	R		S1	S3	R				R	R
Piping Bracket Set	1	R						R										S4				R						R
Pipework	1	R																S4										R
Aerothermal Cover	2	R																S5										R

R = REQUIRED  
 K = specificities SEE AD11 SG 1-12



### ***7.3 ACCEPTANCE TESTS APPLICABILITY MATRIX***



7.3.1 Electrical and Electronic Equipment

Equipment name		Inspection	Mechanical & electrical I/F verification	Mass properties verification (1)	Complete functional test	Leakage (4)	Pressure	Random vibration	Shock Screening (2)	Leakage (4)	Thermal Cycling (3)	Thermal Vacuum	Leakage (4)	Complete Functional Test	Inspection
IS01	IPDU	R	R	R	R	R		S1	R	R		S1	R	R	R
IS12	SRU	R	R	R	R	R		S1	R	R		S1	R	R	R
	IPDU (TVC)	R	R	R	R	R		S1	R	R		S1	R	R	R
IS23	SRU	R	R	R	R	R		S1	R	R		S1	R	R	R
	IPDU (TVC)	R	R	R	R	R		S1	R	R		S1	R	R	R
IS3AV	SMU	R	R	R	R	R		S1	R	R		S1	R	R	R
	TR	R	R	R	R	R		S1	R	R		S1	R	R	R
	RTX	R	R	R	R	R		S1	R	R		S1	R	R	R
APM	HP/LP transducer (LPS)	R	R	R	R	R		S1	R	R		S1	R	R	R
	HP/LP pressure transducer (ACS)	R	R	R	R	R		S1	R	R		S1	R	R	R
AAM	OBC	R	R	R	R	R		S1	R	R		S1	R	R	R
	INS	R	R	R	R	R		S1	R	R		S1	R	R	R
	MFU	R	R	R	R	R		S1	R	R		S1	R	R	R
	IPDU	R	R	R	R	R		S1	R	R		S1	R	R	R
	UCTM	R	R	R	R	R		S1	R	R		S1	R	R	R
	TLM transmitter	R	R	R	R	R		S1	R	R		S1	R	R	R

R = REQUIRED  
S = SEVERITY CLASS

- (1) no MOI and COG verification (already covered by qualification)
- (2) shock screening to reveal failure or rupture after random test
- (3) covered by thermal vacuum test
- (4) Required only for sealed equipment



7.3.2 Antennas

Inspection	Mechanical & electrical I/F verification	Mass properties verification (1)	Complete functional test	Leakage	Pressure	Random vibration	Shock Screening (2)	Leakage	Thermal Cycling (3)	Thermal Vacuum	Leakage	Complete Functional Test	Inspection
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**Equipment name**

IS3AV	TR antenna set	R	R	R	R			S1			S2		R	R
	RTX antenna set	R	R	R	R			S1			S2		R	R
AVUM SKIT (APM)	TLM antenna set	R	R	R	R			S1			S2		R	R

R = REQUIRED  
S = SEVERITY CLASS

(1) no MOI and COG verification (already covered by qualification)  
(2) shock screening to reveal failure or rupture after random test  
(3) covered by thermal vacuum test



7.3.3 Batteries

Equipment name		Inspection	Mechanical & electrical I/F verification	Mass properties verification (1)	Complete functional test	Leakage (4)	Pressure	Random vibration	Shock Screening (2)	Leakage (4)	Thermal Cycling (3)	Thermal Vacuum	Leakage (4)	Complete Functional Test	Inspection
IS01	Actuator battery	R	R	R	R	R		S1		R		S1	R	R	R
IS12	Destruction battery	R	R	R	R	R		S1		R		S1	R	R	R
	Actuator battery	R	R	R	R	R		S1		R		S1	R	R	R
IS23	Destruction battery	R	R	R	R	R		S1		R		S1	R	R	R
	Actuator battery	R	R	R	R	R		S1		R		S1	R	R	R
IS3AV	Destruction battery	R	R	R	R	R		S1		R		S1	R	R	R
AAM	OBB-A	R	R	R	R	R		S1		R		S1	R	R	R
	Pyro battery	R	R	R	R	R		S1		R		S1	R	R	R
	Actuator battery	R	R	R	R	R		S1		R		S1	R	R	R

R = REQUIRED

S = SEVERITY CLASS

(1) no MOI and COG verification (already covered by qualification)

(2) shock screening to reveal failure or rupture after random test

(3) covered by thermal vacuum test

(4) Required only for sealed battery



7.3.4 Pressure Vessels

Inspection	Mechanical & electrical I/F verification	Mass properties verification (1)	Complete functional test	Leakage	Pressure	Random vibration	Shock Screening (2)	Leakage	Thermal Cycling	Thermal Vacuum	Leakage	Complete Functional Test	Inspection
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**Equipment name**

APM	Equipment name	Inspection	Mechanical & electrical I/F verification	Mass properties verification (1)	Complete functional test	Leakage	Pressure	Random vibration	Shock Screening (2)	Leakage	Thermal Cycling	Thermal Vacuum	Leakage	Complete Functional Test	Inspection
	Gas tank (LPS)	R	R	R	R	R	R	S1		R				R	R
	Oxidizer tank (LPS)	R	R	R	R	R	R	S1		R				R	R
	Fuel tank (LPS)	R	R	R	R	R	R	S1		R				R	R
	Gas tank (ACS)	R	R	R	R	R	R	S1		R				R	R

R = REQUIRED

S = SEVERITY CLASS

(1) no MOI and COG verification (already covered by qualification)

(2) shock screening to reveal failure or rupture after random test



7.3.5 Propulsion Equipment

Equipment name		Inspection	Mechanical & electrical I/F verification	Mass properties verification (1)	Complete functional test	Leakage	Pressure	Random vibration	Shock Screening (2)	Leakage	Thermal Cycling (3)	Thermal Vacuum	Leakage	Complete Functional Test	Inspection
<b>P80 / IS12</b>	Igniter (SRM P80FW)	R	R	R		R	R	S1		R		S1	R		R
	RR motors	R	R	R		R	R	S1		R		S2	R		R
<b>Z23 / IS23</b>	Igniter (SRM Z23)	R	R	R		R	R	S1		R		S1	R		R
<b>Z9 / IS3AV</b>	Igniter (SRM Z9)	R	R	R		R	R	S1		R		S1	R		R
<b>APM</b>	HP/LP pyrovalve	R	R	R	R	R	R	S1		R		S1	R	R	R
	Pressure regulator & relief valve	R	R	R	R	R	R	S1		R		S1	R	R	R
	Non return valve	R	R	R	R	R	R	S1		R		S1	R	R	R
	HP/LP fill & vent valve	R	R	R	R	R	R	S1		R		S1	R	R	R
	HP pyrovalve	R	R	R	R	R	R	S1		R		S1	R	R	R
	Pressure regulator & relief valve	R	R	R	R	R	R	S1		R		S1	R	R	R
	HP/LP fill & vent valve	R	R	R	R	R	R	S1		R		S1	R	R	R

R = REQUIRED  
S = SEVERITY CLASS

(1) no MOI and COG verification (already covered by qualification)  
(2) shock screening to reveal failure or rupture after random test  
(3) covered by thermal vacuum test



7.3.6 Mechanical Moving Assemblies (MMA)

Equipment name		Inspection	Mechanical & electrical I/F verification	Mass properties verification (1)	Complete functional test	Leakage	Pressure	Random vibration	Shock Screening (2)	Leakage	Thermal Cycling (3)	Thermal Vacuum	Leakage	Complete Functional Test	Inspection
IS01	EMA	R	R	R	R			S1				S1		R	R
IS12	EMA	R	R	R	R			S1				S1		R	R
IS23	EMA	R	R	R	R			S1				S1		R	R
AAM	EMA (GNC)	R	R	R	R			S1				S1		R	R

R = REQUIRED  
S = SEVERITY CLASS

(1) no MOI and COG verification (already covered by qualification)  
(2) shock screening to reveal failure or rupture after random test  
(3) covered by thermal vacuum test



7.3.7 Thrusters

Equipment name		Inspection	Mechanical & electrical I/F verification	Mass properties verification (1)	Complete functional test	Leakage	Pressure	Random vibration	Shock Screening (2)	Leakage	Thermal Cycling (3)	Thermal Vacuum	Leakage	Complete Functional Test	Inspection
<b>APM</b>	Reaction control thruster	R	R	R	R			S1				S1		R	R
	Main Engine Assy	R	R	R	R			S1				S1		R	R

R = REQUIRED

S = SEVERITY CLASS

(1) no MOI and COG verification (already covered by qualification)

(2) shock screening to reveal failure or rupture after random test

(3) covered by thermal vacuum test



7.3.8 Pyrochains

Equipment name		Inspection	Mechanical & electrical I/F verification	Mass properties verification (1)	Complete functional test	Leakage	Pressure	Random vibration	Shock Screening (2)	Leakage	Thermal Cycling (3)	Thermal Vacuum	Leakage	Complete Functional Test	Inspection
<b>IS12</b>	Destruction train	R	R	R				S1				S2			R
	Separation train	R	R	R				S1				S2			R
	SRM ignition train	R	R	R				S1				S2			R
	RR ignition train	R	R	R				S1				S2			R
<b>IS23</b>	Destruction train	R	R	R				S1				S2			R
	Separation train	R	R	R				S1				S2			R
	SRM ignition train	R	R	R				S1				S2			R
<b>IS3AV</b>	Destruction train	R	R	R				S1				S2			R
	SRM ignition train	R	R	R				S1				S2			R

R = REQUIRED  
S = SEVERITY CLASS

- (1) no MOI and COG verification (already covered by qualification)
- (2) shock screening to reveal failure or rupture after random test
- (3) covered by thermal vacuum test