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Sys Specs

T3-6-002
Formerly [redacted]
Rev. A
April 20, 1966

GENERAL SPECIFICATION

FOR

PAYLOAD QUALIFICATION

AND ACCEPTANCE

[redacted]

Prepared by [redacted] 4/27/66
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Resident Officer

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1.0 SCOPE

This specification defines the environments which the [redacted] Payload will encounter during ascent, orbital, and recovery operations; further it establishes qualification and acceptance test requirements based on these criteria. Boost phase environments are based on the use of the Thorad. This document shall be used as an intrinsic part of detail equipment specifications.

1.1 Purpose

a. To consolidate all pertinent environmental and test criteria.

b. To establish qualification and acceptance test levels.

c. To provide design reference to be used in optimizing reliability.

d. To standardize requirements and tolerances such that repeatability may be achieved.

1.2 Use

This document may be used in conjunction with detail specification to specify requirements against which the payload shall be designed, qualified, and accepted.

1.3 Application

Detail specifications may be combined with this document to specify design or test requirements. In these instances the following additional specific requirements shall be specified as applicable.

a. Sequence of testing or a statement that such a sequence is unnecessary.

b. Acceptable performance limits before and after the test.

c. Standards of acceptance for qualification.

d. Arrangement and mode of operation.

e. A statement as to whom should receive records and data.

f. Specific locations of test instrumentation.

g. Special tests and unusual test conditions.

h. Location and orientation of components which are not to be qualified for the general payload usage.

i. Design Operating and shelf life.

j. Location of points of comparison to determine resonances.

k. Deviations to the general specification.

1.4 Deviations

a. Requirements may be modified if it is shown that installations protect equipments from existing environments.

b. Requirements may be modified if it can be shown that equipment performance is not sensitive to certain phases of operation.

c. Requirements may be modified if an increase in severity of requirement will not result in increased weight and power.

1.5 Severity of Qualification Tests

The qualification tests specified herein are for qualifying equipment designed for use in the payload only. They are not intended as production tests suitable for verifying manufacturing integrity. The test levels are therefore set sufficiently high to compensate for absence of combined environments during testing, normal variations in manufacture; and to verify design safety factors.

1.6 Definition.

1.6.1 Component

The lowest level of assembly of parts, arranged within one package that will permit performance of some prescribed function and which is easily removable as a self-contained functional unit. In general, items here defined as components are not disassembled to a lower level by payload personnel.

1.6.2 System

An assembly which integrates the outputs of various components into a final prescribed function or group of functions. For the purposes of this specification systems are divided into three groups by weight.

a. 75 lbs. or less

b. 76 lbs. to 250 lbs.

c. Above 250 lbs.

1.6.3 Structure

An assembly whose major function is the support of components and systems.

2.0 APPLICABLE DOCUMENTS

2.1 The intent of the following documents shall form the basis of this specification.

2.1.1 LMSC 6117D, General Environmental Specification

LMSC 675653, Satellite Encountered Radiation Doses from Trapped Particles

2.2 Precedence of Specifications

In the event of conflict between this specification and the detail specifications, the detail specifications shall take precedence.

2.3 Conflict

This document is not intended to conflict in any way with mandatory Federal Specifications.

3.0 ENVIRONMENTAL CRITERIA

Payload components, systems and structures shall be designed to fulfill operation objectives in all of the following phases under maximum stresses predicted for these phases:

a. Thorad Booster Launch
b. Agena D Launch
c. Orbital Flight
d. Re-entry

The following stresses to be here defined are actual loads either measured or predicted.

a. Shock
b. Vibration
c. Acceleration
d. Temperature
e. Pressure
f. Radiation
g. Humidity

Handling equipment shall be designed such that stresses encountered in storage and test shall in no case exceed those defined in operational phases.

3.1 Thorad Booster Phase

3.1.1 Sinusoidal Vibration

a. Complete Payload

Longitudinal

Freq. (cps)	Level (g's)
15 - 20	3.0

Lateral

Freq. (cps)	Level (g's)
15 - 20	0.25

Disturbance occurs at Thorad Burnout (T-200 seconds)

b. Systems

Systems receive inputs as shown in para. 3.1.1.a. Resonances in the 15-20 cps range must be avoided.

c. Components - See 3.1.1 b. - Components may have any orientation.

3.1.2 Random Vibration

a. Complete payload - 6 g's rms overall - all axes at Thorad Ignition and in transonic region.

b. System resonances at all frequencies are excited sinusoidally.

c. Components (see. 3.1.2 b.)

3.1.3 Steady State Acceleration

a. Complete Payload

6 g's axial

1 g lateral

At Thorad Burnout

Components may have any orientation. See 3.1.1.a.

3.1.4 Shock

a. Complete Payload

1. Thorad Ignition Phase 16g's longitudinal
   2g's lateral

2. Separation pyro event
   g's - all axes

3.1.5 Temperature

a. Complete Payload

The following correlation curves based upon predicted skin temperatures for ten design trajectories shall be used as a basis for ascent thermal design. These data are based on the assumption that the payload skin outer surface has the emissivity of gold. Higher ascent temperatures are found in the +Z side of the payload during ascent.

b. Internal Systems

$70^{o}F \pm 30^{o}F$

c. Components

See 3.1.5 b.

3.1.6 Pressure Static

a. Complete Payload

1. 0.4 - 0.8 psi differential at the payload Agena interface at launch.

2. The absolute pressure during ascent is reduced from sea level to 25 mm Hg. in 90 seconds. A maximum pressure reduction rate of 15 mm Hg. per second occurs in the transonic region for a maximum duration of 30 seconds.

b. Internal Systems

See 3.1.6 b.

c. Components

See 3.1.6 b.

3.1.7 Dynamic Pressure

a. Complete Payload

Maximum dynamic pressure is 800 p.s.f.

b. Internal Systems

Not applicable

c. Components

No applicable

3.1.8 Radiation (Negligible)

3.1.9 Humidity

a. Payload Complete

External Surface

b. Exposure to relative humidity up to 100%

b. Internal Systems

50% Humidity maximum

c. Components

See 3.1.9 b)

3.2 Agena Boost Phase

3.2.1 Sinusoidal Vibration

Negligible

3.2.2 Random Vibration

Negligible

3.2.3 Acceleration

a. Complete Payload

5 g's axial

1 g lateral

at Agena Shut Off

3.2.4 Shock

a. Payload Separation

Pyrotechnic Event

all axes

[redacted]

3.2.5 Pressure

10^{-2} - 10^{-13} mm Hg.

3.2.6 Temperature

Note: All temperatures are decreasing after the Thorad Phase and are not critical.

3.2.7 Radiation

Negligible

3.3 Orbital Flight

All environmental stresses except temperature pressure and radiation are negligible.

3.3.1 Temperature

a. Complete Payload

Maximum orbital skin temperatures are uniform longitudinally varying overall between 140°F and 220°F. Differentials on opposite ends of lateral axes are 150°F maximum. The temperatures are cyclic and a function of the orbit.

b. Internal Systems

The heat sink for internal systems shall be maintained at $70^{\circ} \pm 40^{\circ}$F.

c. Components

See 3.3.1 b.

3.3.2 Pressure

a. Complete Payload

10^{-13} mm Hg external

b. Systems

40 - 100 microns internally

c. See 3.2.6 b.

3.3.3 Radiation

a. Complete Payload System

Electron dose of 1.6×10^{-3} rads per day.

Trapped particle dose of 2×10^{-1} rad per day.

3.4 Re-entry (Recovery System only)

3.4.1 Vibration

Negligible

3.4.2 Acceleration

12.5 g's axial) concurrently for 35 seconds duration
5 g's lateral)

3.4.3 Shock

a. Air Recovery

18 g's longitudinal

5 g's lateral

b. Separation pyrotechnic events

all axes

3.4.4 Temperature

100°F max. inside recovery capsule skin

3.4.5 Pressure

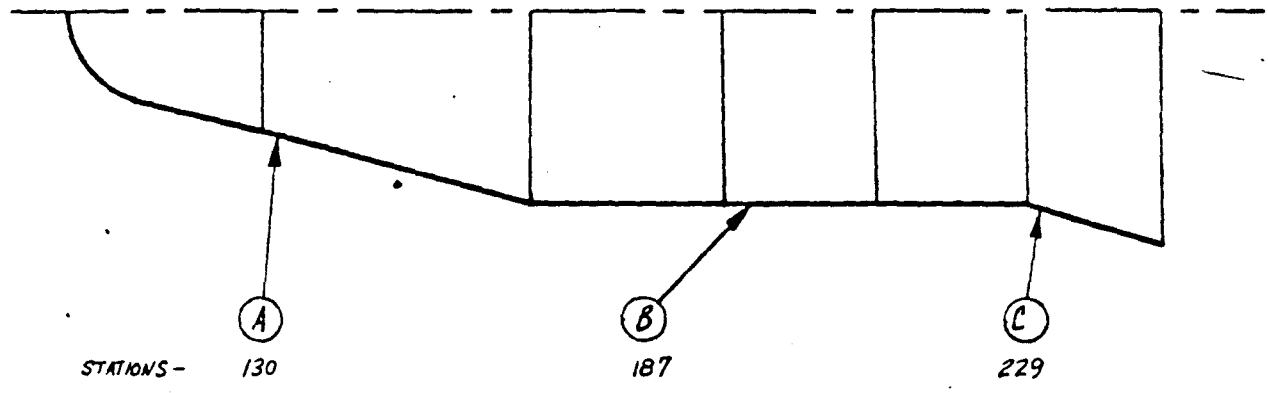
a. De-orbit & separation - 10^{-31} mm Hg - 5×10^{-7} mm Hg

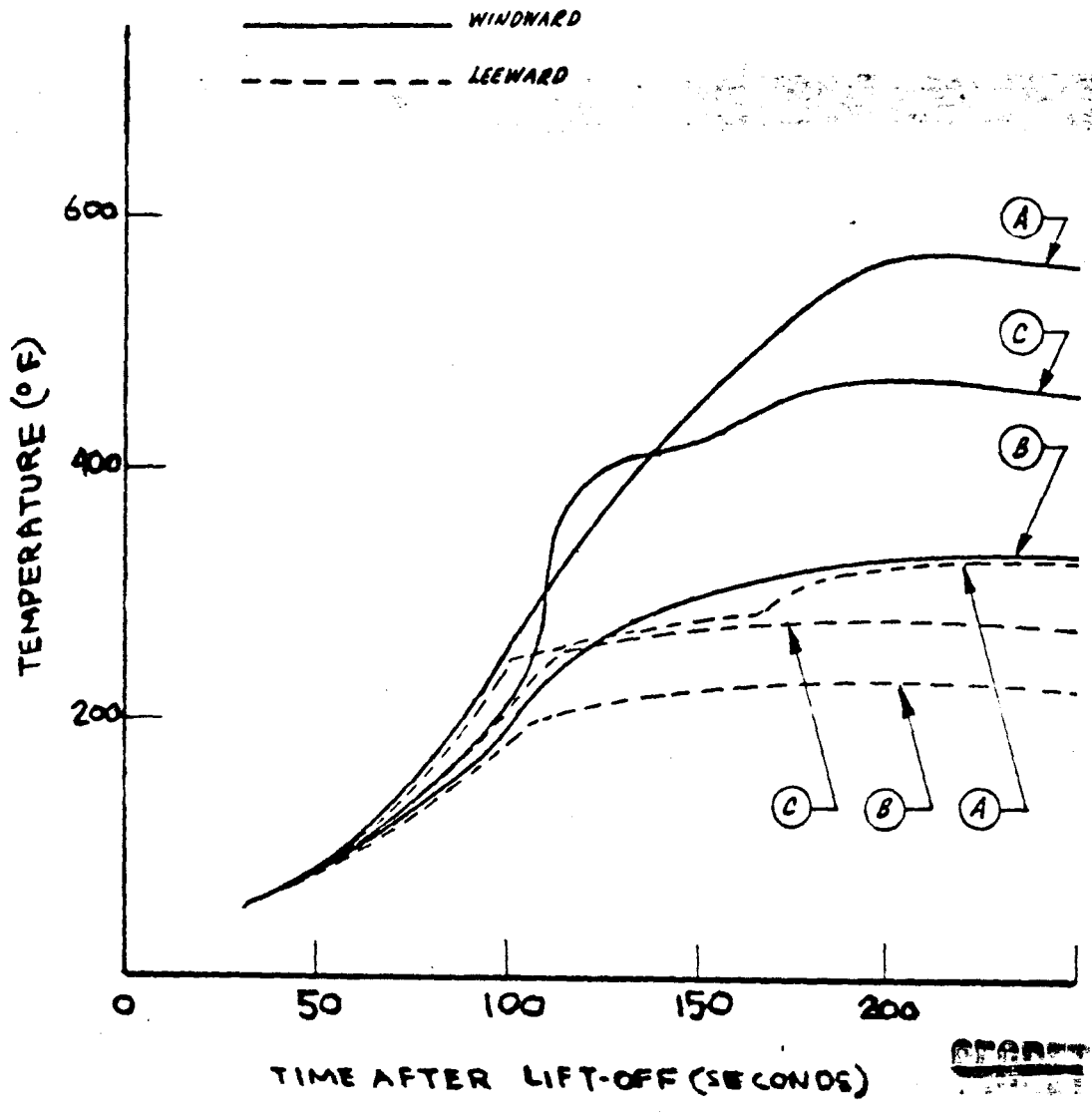
b. Re-entry - 5×10^{-7} - 5.6 in Hg.

c. Recovery - 5.6 in Hg - 30.5 in Hg.

TYPICAL SKIN TEMPERATURE HISTORIES FOR THE HOTTEST MISSION (PALC)

(90 NM / 65° INCL)





4.0 TEST REQUIREMENTS

4.1 Vibration Testing

a. The equipment shall be loaded and operated in accordance with the equipment qualification test specification prior and subsequent to testing. The specimen shall be inspected for damage and defects resulting from vibration at the conclusion of test periods as specified in the equipment qualification specification.

b. Resonances at frequencies other than those in the range from 10 - 20 cps shall be monitored and used to limit the input of the shaker to accelerations such that individual components shall not receive greater than their specified levels.

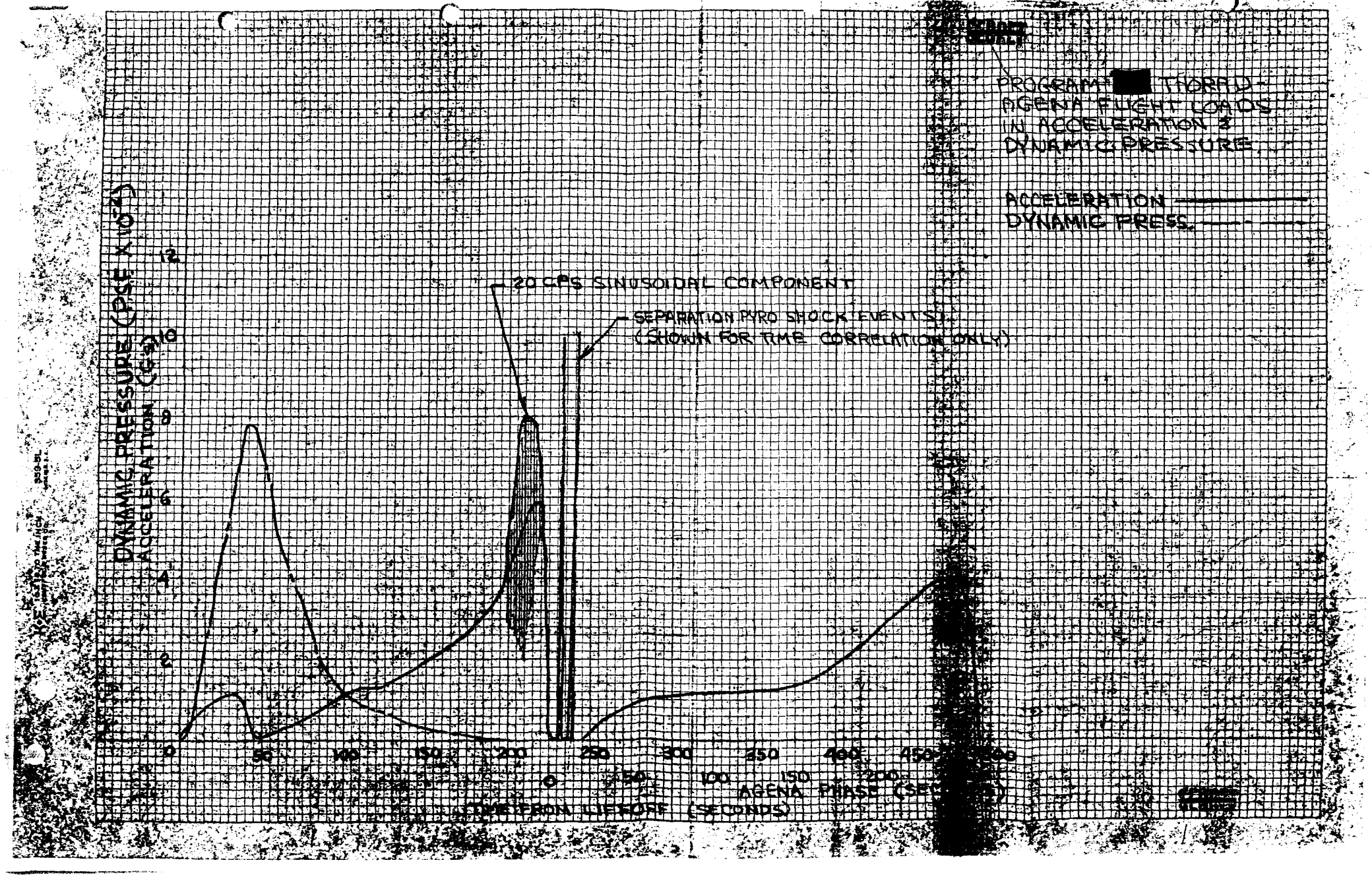
Resonances in the 10-20 cps range shall subject the equipment to further design review.

c. The test fixture shall be vibrated alone and the resonant frequencies noted. The fixture shall be modified until all resonant frequencies are above 400 cps for small systems and components and 200 cps for assemblies over 75 lbs. The equipment shall be secured at its mounting points to the fixture and 1/4 - 1/2 g resonance searches of the fixture-equipment combination shall be conducted in all 3 axes.

d. All accelerometers specified shall be monitored for resonance.

Induced vibration along axes other than those being excited principally shall be measured.

e. Sinusoidal vibration shall be applied separately along each of three mutually perpendicular axes at the amplitude values specified. The test along each axis shall consist of a single sinusoidal sweep, starting at the lowest frequency limit and proceeding at a sweep rate of 3 minutes per octave to the highest frequency limit in not less than 25 minutes. All resonant frequencies shall be noted and recorded.


PROGRAM [redacted] THOR/D-AGENA FLIGHT LOADS
IN ACCELERATION & DYNAMIC PRESSURE.
ACCELERATION
DYNAMIC PRESS.
20 CPS SINUSOIDAL COMPONENT
SEPARATION PYRO SHOCK (EVENT 51)
(SHOWN FOR TIME CORRELATION ONLY)
DYNAMIC PRESSURE (PSF X 10^-3)
ACCELERATION (G's)
TIME FROM LIFTOFF (SECONDS)
AGENA PHASE (SEC

Resonant frequencies shall be determined by observation of increased acceleration amplitudes or displacements of equipment being tested. Specific dwell at resonance is not required.

f. Input cross talk in normal axes shall not exceed 100% of the specified input.

g. Input shall be applied as near as possible to the CG of the equipment being tested.

h. Axes refer to vehicle axes.

4.1.1 Sinusoidal Testing

4.1.1.1 System Vibration

a. Recoverable systems weighing 75 lbs or less

Longitudinal Axis

Frequency (cps)	Level
5 - 15	0.5 inches peak to peak
15 - 20	7.0 g's 0-peak
20 - 400	5.0 g's 0-peak
400 - 2000	10.5 g's 0-peak

Lateral Axes

Frequency (cps)	Level
11 - 2000	3.0

If specimen axis is not defined, longitudinal axis levels shall be used.

b. Non-recoverable systems weighing 75 lbs or less

Longitudinal Axis

Frequency (cps)	Level
5 - 15	0.5 inches peak to peak
15 - 20	7.0 g's 0 - peak
20 - 400	5.0 g's 0 - peak
400 - 2000	7.5 g's 0 - peak

Lateral Axes

Frequency (cps)	Level
11 - 2000	3.0

c. Recoverable Systems weighing from 76 lbs. through 250 lbs.

Longitudinal Axis

Frequency (cps)	Level
5 - 15	0.38 inches peak-peak
15 - 20	4.0 g's 0 - peak
20 - 400	3.0 g's 0 - peak
400 - 2000	5.0 g's 0 - peak

d. Non-recoverable systems weighing from 76 lbs. through 250 lbs.

Longitudinal Axis

Frequency (cps)	Level
5 - 15	0.38 inches peak - peak
15 - 20	4.0 g's 0 - peak
20 - 400	3.0 g's 0 - peak
400 - 2000	5.0 g's 0 - peak

e. Recoverable systems weighing more than 250 lbs.

Longitudinal Axis

Frequency (cps)	Level
5 - 15	0.38 inches peak-peak
15 - 20	4.0 g's 0 - peak
20 - 400	3.0 g's 0 - peak
400 - 2000	5.0 g's 0 - peak

f. Non-recoverable systems weighing more than 250 lbs.

Longitudinal Axis

Frequency (cps)	Level
5 - 15	0.18 inches peak - peak
15 - 20	3.0 g's 0 - peak
20 - 400	1.5 g's 0 - peak
400 - 2000	3.0 g's 0 - peak

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Lateral Axis

Frequency (cps)	Level (g's 0 - peak)
11 - 2000	1.0

4.1.1.2 Structures Vibration

a. Recoverable structures

Longitudinal Axis

Frequency (cps)	Level
5 - 15	0.5 inches peak
15 - 400	5 g's 0 - peak
400 - 2000	10 g's 0 - peak

Lateral Axis

Frequency (cps)	Level
15 - 2000	3.0

b. Non-recoverable Structures

Longitudinal Axis

Frequency (cps)	Level
5 - 15	0.5 inches peak to pe
15 - 400	5 g's 0 - peak
400 - 2000	10 g's 0 - peak

Lateral Axis

Frequency (cps)	Level
15 - 2000	3.0

4.1.1.3 Components Vibration

The component shall be hard mounted on the vibration exciter.

a. Recoverable Components - all axes

Frequency (cps)	Level
5 - 20	0.5 inches peak to peak
15 - 20	7.0 g's 0 - peak
20 - 400	5.0 g's 0 - peak
400 - 2000	10.0 g's 0 - peak

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b. Non-recoverable components - all axes

Frequency (cps)	Level
5 - 20	0.5 inches peak to peak
15 - 20	7.0 g's 0 - peak
20 - 400	5.0 g's 0 - peak
400 - 200	10.0 g's 0 - peak

4.1.2 Random Vibration

The random vibration shall be conducted in the frequency range of 20 - 2000cps. The method may be either broad or narrow band. The equipment shall be vibrated for 180 seconds in each of the three mutually perpendicular axes at maximum level specified. Paragraphs 4.1 a, c, d, f, g and h shall apply.

4.1.2.1 System Vibration

a. Recoverable systems weighing 75 lbs or less.

Frequency Range (cps)	Density (g^2/cps)	Overall Acceleration (g's RMS)
20 - 400	0.5	14.5
400 - 2000	0.12	

b. Non-recoverable systems weighing 75 lbs or less

Frequency Range (cps)	Density (g^2/cps)	Overall Acceleration (g's RMS)
20 - 400	0.05	
400 - 2000	0.12	14.5

c. Recoverable systems weighing from 76 lbs. to 250 lbs.

Frequency Range (cps)	Density (g^2/cps)	Overall Acceleration (g's RMS)
20 - 400	0.5	
400 - 2000	0.12	14.5

d. Non-recoverable systems weighing from 76 lbs. to 250 lbs.

Frequency Range (cps)	Density (g^2/cps)	Overall Acceleration (g's RMS)
20 - 400	0.05	
400 - 2000	0.12	14.5

e. Recoverable systems weighing more than 250 lbs.

No requirement.

f. Non-recoverable systems weighing more than 250 lbs

No requirement.

4.1.2.2 Structures Vibration

a. Recoverable Structures

No requirement

b. Non-recoverable structures

No requirement

4.1.2.3 Components Vibration

a. Recoverable Components

Frequency Range (cps)	Density (g^2/cps)	Overall Acceleration (g's RMS)
20 - 400	0.05	
400 - 2000	0.18	17.5

b. Non-recoverable Components

Frequency Range (cps)	Density (g^2/cps)	Overall Acceleration (g's RMS)
20 - 400	0.05	
400 - 200	0.18	17.5

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4.2 Acceleration Testing

4.2.1 System Acceleration *

a. Recoverable Systems weighing 250 lbs. or less

Longitudinal Axis

Level (g's)	Direction
15.0	Minus only *

Lateral Axis

Level (g's)	Direction
6.5	±

b. Non-recoverable system weighing 250 lbs. or less

Longitudinal Axis

Level (g's)	Direction
15.0	±

Lateral Axis

Level (g's)	Direction
2.5	±

4.2.2 Structures Acceleration

a. Recoverable Structures

Longitudinal Axis

Level (g's)	Direction
20	+

Lateral Axis

Level (g's)	Direction
8	±

b. Non-recoverable Structures

Longitudinal Axis

Level (g's)	Direction
20	+

Lateral Axis

Level (g's)	Direction
3	±

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* Systems weighing over 250 lbs. shall be tested by static load application with loads shown in Para. 4.2.1.

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4.2.3 Component Acceleration

a. Recoverable Components

Longitudinal Axis

Level (g's)	Direction
20	±

Lateral Axis

Level (g's)	Direction
20	±

b. Non-recoverable Components

Longitudinal Axis

Level (g's)	Direction
20	±

Lateral Axis

Level (g's)	Direction
20	±

4.3 Load Application as a Substitute for Dynamic Acceleration Testing

4.3.1 Recoverable and Non-recoverable Acceleration Load Testing

Tests shall be conducted to limit loads. The load level at ultimate load shall be held for a period of 1 minute. The component shall be operated during the acceleration test if it is to be operated during the acceleration phases of flight.

4.3.2 Recoverable and Non-recoverable Structure Load Testing

Tests shall be conducted to limit and ultimate dloads. The load level at both limit without yield and ultimate load shall be held from 5 to 10 seconds. The test may be conducted in either of 2 methods:

a. Incremental Loading. Up to limit load, the test loading shall be applied in increments of not more than 20% of limit load. After application of 100% limit load, all loads shall be reduced to zero. The specimen and data shall be carefully examined and any evidence of yielding documented and evaluated prior to continuing tests. The test load increments from limit to ultimate load shall not exceed

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10% of limit load. The load shall be applied for a maximum of 10 seconds at each load increment.

* Loads shall be equivalent to limit dynamic acceleration loads specified in Para. 4.3. with ultimate load being 1.5 x limit load.

b. Continuous Loading. Up to limit load the test loading shall be applied at a constant rate of 2% of limit load per second.

After application of 100% limit load, all loads shall be reduced to zero. The specimen and data shall be carefully examined and any evidence of yielding documented and evaluated prior to continuing tests. The test load to ultimate load shall be applied at a constant rate of 2% of limit load per second. The tests shall be conducted at elevated temperatures if applicable.

4.4 Thermal Altitude Testing

The equipment shall be loaded, instrumented, and operated as specified in the applicable detail qualification test specification during all phases of testing.

4.4.1 System Orbital Simulation

The complete payload system shall be subjected to an orbital simulation in which dynamic thermal programming shall reproduce the effects of various orbit solar incidence angles (Beta) at vacuum equivalent to those found in typical orbits. Temperature and pressure at all critical areas, both internal and external, shall be measured. Payload external surface patterns shall be correct for the orbits being simulated. If contingencies make this impossible, the thermal programming shall be adjusted to compensate for such lack of patterns.

All payload thermal masses such as parachutes and retro rockets shall be installed or simulated.

The payload shall be in orbital configuration.

a. After installation of the payload in the thermal altitude chamber, an interval vacuum of at least 10^{-4} mm Hg shall be achieved. During pump down, all equipment normally operated during ascent and injection shall be energized.

b. The duration of the test shall equal the maximum planned mission of the payload.

c. During the course of the test orbital solar incidence angles of 0°, $\pm 30^{\circ}$, $\pm 60^{\circ}$, and $\pm 90^{\circ}$ shall be programmed.

d. The system shall be operated in all modes as specified in the applicable detail qualification specification.

e. At the conclusion of the programmed thermal test, the entire payload temperature shall be stabilized at 50°F and the system operated continuously for its maximum design continuous duty cycle period.

f. The test specified in paragraph e. shall be repeated with the payload temperature stabilized at 90°F.

g. The chamber shall be returned to room ambient conditions (Para. 5.1) and tests made as specified in the detail specification.

4.4.2 Non-Recoverable System Thermal Altitude Testing

These tests shall apply to systems subsidiary to the complete payload.

a. After the system is installed in the chamber, a vacuum of at least 10^{-5} mm Hg shall be achieved. The temperature of the system shall be stabilized at 100°F.

b. The system shall be operated continuously for its maximum design duty cycle period. (See Note 1)

c. The temperature shall be elevated to 110° and the system soaked non-operating for 8 hours.

d. The equipment shall be returned to ambient conditions (See Para. 5.0) and tests performed as specified in the detail qualification specification (see Para. 1.3).

c. The test shall be repeated using a temperature of 40°F for the operational test of Para. 4.4.2 b and 20°F for the non-operational test of Para. 4.4.2 c.

4.4.3 Recoverable System Thermal Altitude Testing

The tests specified in Para. 4.4.2 shall be performed with the following exceptions.

a. The high temperature operational test shall be performed at 110°F (Para. 4.4.2 a and b)

b. The high temperature non-operational test shall be performed at 140°F. (Para. 4.4.2 c)

c. The low temperature operational test shall be performed at 20°F. (Para. 4.4.2 e)

d. The low temperature non-operational test shall be performed at 0°F. (Para. 4.4.2. e)

4.4.4 Non-Recoverable Component Thermal Altitude Testing

a. After installation of the component in the thermal vacuum chamber, a vacuum of at least 10^{-3} mm Hg shall be achieved in 180 seconds. During this period, the maximum pressure reduction rate shall be 15 mm Hg per second for a maximum period of 30 seconds. Pressure reduction shall continue until a pressure of 10^{-5} mm Hg or less is achieved.

b. Temperature elevation shall be started at approximately the same time as evacuation.

c. The temperature of the component stabilized at 125°F.

d. The component shall be operating normally during evacuation and temperature change. Ascent equipment shall be de-energized when 10^{-3} mm Hg pressure level has been reached. Orbital equipment shall be soaked inoperative for 4 hours and operated for 1.25 times the orbital mission duty cycle. (See Note 1)

Note 1: For duty cycles longer than 1 hr., operation periods for each test shall be 50% of the time specified.

e. The chamber shall be returned to room donditions and the equipment shall be tested according to applicable component specifications.

f. The test specified in Para. 4.4.4 a,-4.4.4 e shall be re-performed with the exception that the temperature shall be $0^{\circ}F$.

4.4.5 Recoverable Component Thermal Altitude Testing

4.4.5.1 All components, except those mounted on the thrust cone, rocket assembly, and forebody.

The component shall be placed in the test chamber and the pressure reduced to 10^{-5} mm Hg or lower. While maintaining the reduced pressure, the temperature shall be cycled as follows:

Cycle	Temperature	Time
1	$85^{\circ}F$	5 days
2	$20^{\circ}F$	20 days
3	$85^{\circ}F$	5 days

At the end of the second cycle, while at $0^{\circ}F$ and 10^{-5} mm Hg or lower, the component shall be subjected to a performance test in accordance with the requirements of the applicable component specification.

At the end of the third cycle, while at $85^{\circ}F$ and 10^{-5} mm Hg or lower, the component shall be subjected to a performance test in accordance with the requirements of the applicable component specification.

4.4.5.2 Components Mounted on the Forebody

Tests shall be the same as under 4.4.5.1 except that the high temperature limit shall be $100^{\circ}F$ for cycles 1 and 3.

4.4.5.3 Components Mounted on the Thrust Cone and Rocket Assembly

The component shall be placed in the test chamber and the pressure reduced to 10^{-5} mm Hg or lower. While maintaining the reduced pressure, the temperature shall be cycles as follows:

Cycle	Temperature	Time
1	110°F	5 days
2	0°F	20 days
3	+10°F	Equilibrium *
4	110°F	5 days
5	100°F	Equilibrium *

At the end of the third cycle, while at +10°F and 10^{-5} mm Hg or lower, the component shall be subjected to a performance test in accordance with the requirements of the applicable component specification.

At the end of the fifty cycle, while at 100°F and 10^{-5} mm Hg or lower, the component shall be subjected to a performance test in accordance with the requirements of the applicable component specification.

* Component temperature, as measured with a thermocouple, has been stabilized for 1 hour.

4.4.6 Recoverable and Non-Recoverable System and Component Leakage Testing

The container shall be purged with helium and then charged to the required pressure before being sealed. The sealed container shall then be placed in a suitable high-vacuum test chamber and elevated ot its maximum operating temperature. The chamber shall then be evacuated to 10^{-3} mm Hg as quickly as possible. A suitable helium leakage detector shall be used for measurements. For containers with equipment that must be operational for more than a one day period in orbit, the test chamber shall be maintained below 10^{-3} mm Hg for a minimum of 4 hours. The test item shall be maintained at its maximum specified operating temperature during this 4-hour period. The leakage rate shall not exceed that amount specified in each respective detailed equipment specification.

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4.5 Shock Testing

a. The equipment shall be operated prior and subsequent to the following shock tests, and a performance record made in accordance with the applicable qualification specification. Equipment shall be operative in test if it is operative during the launch or recovery phases of the mission. Shocks shall be applied thru the normal mounting points of the equipment in each direction along 3 mutually perpendicular axes. The shock wave form for ascent shall approximate a half sine wave with a duration of 8 ms. The shock wave for recovery shall approximate a half sine wave with a duration of 1 second. The magnitude of the shock shall be measured at the interface of the equipment and the test fixture. Induced secondary accelerations shall be measured along the two transverse axes.

The deceleration rate shall be no greater than one half the initial input acceleration when the velocity is maximum at the end of the input shock.

b. Tests shall be performed on equipment susceptible to pyrotechnic shock environments. The test shall be capable of providing a pyrotechnic environment that simulates payload pyrotechnic events. The environment shall originate from the detonation of pyrotechnic devices equivalent in a manner to that found in the payload.

4.5.1 Systems Shock Testing

4.5.1.1 Recoverable System Weighing 75 lbs. or less

Longitudinal Axis		
Level (g's)	Duration (ms)	Number (each)
25	8	3
Lateral Axis		
Level (g's)	Duration (ms)	Number (each)
6	8	3

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4.5.1.2 Non-recoverable Systems weighing 75 lbs. or less

Longitudinal Axis

Level (g's)	Duration (ms)	Number (each)
20	8	3

Lateral Axis

Level (g's)	Duration (ms)	Number (each)
3	8	3

4.5.1.3 Recoverable Systems Weighing 76 lbs. to 250 lbs.

Longitudinal Axis

Level (g's)	Duration (ms)	Number (each)
20	8	3

Lateral Axis

Level (g's)	Duration (ms)	Number (each)
4	8	3

4.5.1.4 Non-recoverable Systems weighing 76 lbs. to 250 lbs.

Longitudinal Axis

Level (g's)	Duration (ms)	Number (each)
14	8	3

Lateral Axis

Level (g's)	Duration (ms)	Number (each)
12	8	3

4.5.1.5 Recoverable Systems Weighing over 250 lbs.

Longitudinal Axis

Level (g's)	Duration (ms)	Number (each)
15	8	3

Lateral Axis

Level (g's)	Duration (ms)	Number (each)
3	8	3

4.5.1.6 Non-recoverable System Weighing over 250 lbs.

No requirement

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4.5.2 Structures Shock Testing

4.5.2.1 Recoverable Structure

Longitudinal Axis

Level (g's)	Duration (ms)	Number (each)
25	8	3

Lateral Axis

Level (g's)	Duration (ms)	Number (each)
6	8	3

4.5.2.2 Non-recoverable Structure

No requirement

4.5.3 Component Shock Testing

4.5.3.1 Recoverable Components

All Axes

Level (g's)	Duration (ms)	Number (each)
35	8	3

4.5.3.2 Non-recoverable Components

Level (g's)	Duration (ms)	Number (each)
20	8	3

4.5.4 Pyrotechnic Shock Testing

Due to the difficulty of specifying pyrotechnic loads, pyrotechnic shock tests shall consist of the firing of actual pyrotechnic devices with the equipment in design configuration. Special pyrotechnic devices with 1.25 times normal charge shall be used.

4.5.4.1 System Pyrotechnic Shock Testing

a. Pyrotechnic devices as specified in Para. 4.6.2 shall be fired in system configuration for a total of 3 shocks.

4.5.4.2 Structures Pyrotechnic Shock Testing

No requirement

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4.5.4.3 Component Pyrotechnic Shock Testing

No requirement.

4.6 System Acceptance Testing

4.6.1 Vibration

A low level vibration environment shall be imposed during the acceptance testing of all systems. The specified vibration may be utilized for the purpose of detecting possible manufacturing and assembly defects, such as loose fasteners and cold solder joints. This test will not reflect the qualification environment. The equipment should be operating during testing if operative during launch*, and as many functional checks may be performed as required in the detail acceptance specification. Either random or sinusoidal vibration should be imposed along the longitudinal axis as follows:

a. Random Vibration: The system shall be subjected to random vibration for a period of 2 minutes per axis at one-half the applicable qualification test level within the frequency band 20 to 2000 cps.

b. Sinusoidal Vibration: The system shall be subjected to a single sweep of sinusoidal vibration. A sweep rate equivalent to 30 seconds per octave shall be employed. The time for a single sweep from 15 to 2000 cps will be approximately 3.5 minutes.

15 - 400 cps	1 g zero-to-peak acceleration
400 - 2000 cps	2.5 g zero-to-peak acceleration

4.6.2 Thermal Altitude

An acceptance thermal altitude test to be performed on the system shall simulate the thermal vacuum conditions to which the system is expected to operate.

* Pyrotechnics and other one shot devices excluded.

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The chamber walls shall be programmed between minus 120°F and plus 230°F in a thermal simulation of a 75° orbit. The chamber pressure shall be maintained at 10^{-5} mm Hg.

5.0 TOLERANCES AND CONDITIONS (Unless otherwise specified)

5.1 Atmospheric Conditions (Ambient)

a. Temperature	60°F - 95°F
b. Pressure	710 - 810 mm Hg
c. Relative Humidity	Not more than 50%

5.2 Tolerances

a. Temperature °F	± 5°F or 3% whichever is greater
b. Barometric Pressure	± 5%
c. Relative Humidity	5% of R_H
d. Vibration Amplitude (g or inches), sinusoidal and random	± 10%
e. Vibration Frequency (cycles)	± 2% or 1 cycle whichever is greater
f. Shock (g or sec) Ascent and Recovery	± 10%
g. Acceleration (g)	± 5% (at ref. point)
h. Regulated 28 VDC (positive)	+27.85 VDC to +28.9 VDC
i. Unregulated 28 VDC	+21.5 VDC to +29.5 VDC
k. 115V 400 cycle VAC (1-Phase or) (3-Phase)	113.7 - 117.3 VAC

l. 115V 400 cycle frequency may vary between 399.996 and 400.004 cps

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6.0 RECORDING AND REPORTING REQUIREMENTS

6.1 Performance Records

The equipment shall be operated under the conditions of 5.1 and a record made of all data necessary to determine compliance with qualification requirements in detail equipment specifications prior to conducting any of the tests specified herein. A comparison shall be made between data obtained under 5.1 and those obtained during and after testing. This comparison shall determine compliance with criteria for qualification. Variations from performance requirements shall be within limits acceptable to the Contractor, but shall not be in conflict with the contractual agreements between the Procuring Agency and the Contractor.

6.1.1 Detailed log books, test data, failure data, calibrations, and supporting analyses shall be provided in documented form accompanying the deliverable hardware. After acceptance, the payload equipment and SRV's shall be provided as government furnished equipment (GFE) to the payload contractor for integration into the payload section of the satellite vehicle. Assembly of the integrated payload shall be in accordance with the requirements of the payload specification including all applicable interface requirements. The payload section of the satellite vehicle shall then be acceptance tested as a complete unit, and offered for delivery to the procuring agency. Specifications, test plans and procedures shall be subject to review and approval by the procuring agency. A/P will agree to having all test data, calibrations, etc. accompany the delivered hardware to the procuring agency. The payload test philosophy shall be documented in a test matrix by the payload contractor. The test matrix shall minimize unnecessary redundant testing, disassembly and handling of the payload section components at the factory areas and at the launch base. The test matrix shall provide the basis for approval modifications to implement changes to optimize the payload test plan.

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6.2 Failure During Test

The test shall be stopped if a part or component fails during testing. No replacement, adjustment, maintenance, or repairs are authorized during tests. This requirement does not prevent the replacement or adjustment of equipment that has exceeded its design operating life during tests, provided that after such replacement the equipment is then given as many tests as are necessary to assure its proper operation. A complete record of any exception taken to this requirement shall be included in the test report.

6.3 Test Reports

Preparation of test reports shall be the responsibility of the testing agency. Each report shall document the test arrangement and test conditions in detail. The description shall include sufficient detail so that the test can be repeated independently of other information sources. Photographs of the test arrangement [illegible] ambient conditions. The sequence of testing shall be recorded. Degradation of equipment performance during testing shall be recorded even though still within tolerance limits at the conclusion of testing. Any failures experienced during testing shall be reported together with action taken to correct the deficiency.

6.4 Test Facilities

The test facilities and apparatus used in conducting the environmental tests shall be capable of producing and maintaining the test conditions required.

6.4.1 Volume

The volume of the test facilities shall be such that the bulk of the equipment under test shall not interfere with the generation and maintenance of test conditions.

6.4.2 Heat Source

The heat source of the test facilities shall be so located that intense radiant heat shall not fall directly on the equipment under test, except where application of radiant heat is a test requirement.

6.5 Measurement

All measurements shall be made with laboratory instrument whose accuracy has been certified. The accuracy of these instruments should be such that their tolerances are better than 0.1 times those tolerances specified in 5.2.

6.6 Equipment Operation

Equipment shall be operated during testing if this equipment will also be operated under similar environmental conditions in its actual application.

6.7 Controlled Environmental Equipment

Controlled-environment equipment shall be subjected to the environmental tests while installed in its associated container, when applicable.

6.8 Sequence of Tests

The environmental tests shall be conducted in the order specified in the applicable detail equipment specification.