NOTICE OF CHANGE

METRIC

MIL-STD-1540B (USAF)
NOTICE 2
08 FEB 91

MILITARY STANDARD

TEST REQUIREMENTS FOR SPACE VEHICLES

TO ALL HOLDERS OF MIL-STD-1540B (USAF)

1. This change notice incorporates a minimum random vibration spectrum for component qualification and acceptance tests. THE FOLLOWING PAGES OF MIL-STD-1540B (USAF) HAVE BEEN REVISED AND SUPERSEDE THE PAGES LISTED:

NEW PAGE	DATE	SUPERSEDED PAGE	DATE
vii	10 OCTOBER 1982	vii	REPRINTED WITHOUT CHANGE
viii	08 FEB 91	viii	10 OCTOBER 1982
49	08 FEB 91	49	10 OCTOBER 1982
49a	08 FEB 91	-	(NEW PAGE)
49b	08 FEB 91	-	(NEW PAGE)
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76b	08 FEB 91	-	(NEW PAGE)

2. RETAIN THIS NOTICE AND INSERT BEFORE TABLE OF CONTENTS.

3. Holders of MIL-STD-1540B (USAF) will verify that page changes indicated above have been entered. This notice page will be retained as a check sheet. This issuance, together with appended pages, is a separate publication. Each notice is to be retained by stocking points until the Military Standard is completely revised or cancelled.

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FIGURES

TABLES

shall be slow enough to allow identification of significant resonances. Tests conducted to demonstrate the degree of ruggedness (purpose "a" above) shall use two (2) minutes per octave unless the sweep rates and dwell times can be based on the persistence of the environment in service use. The vibration levels shall be sufficient to cover the severity of the maximum design levels.

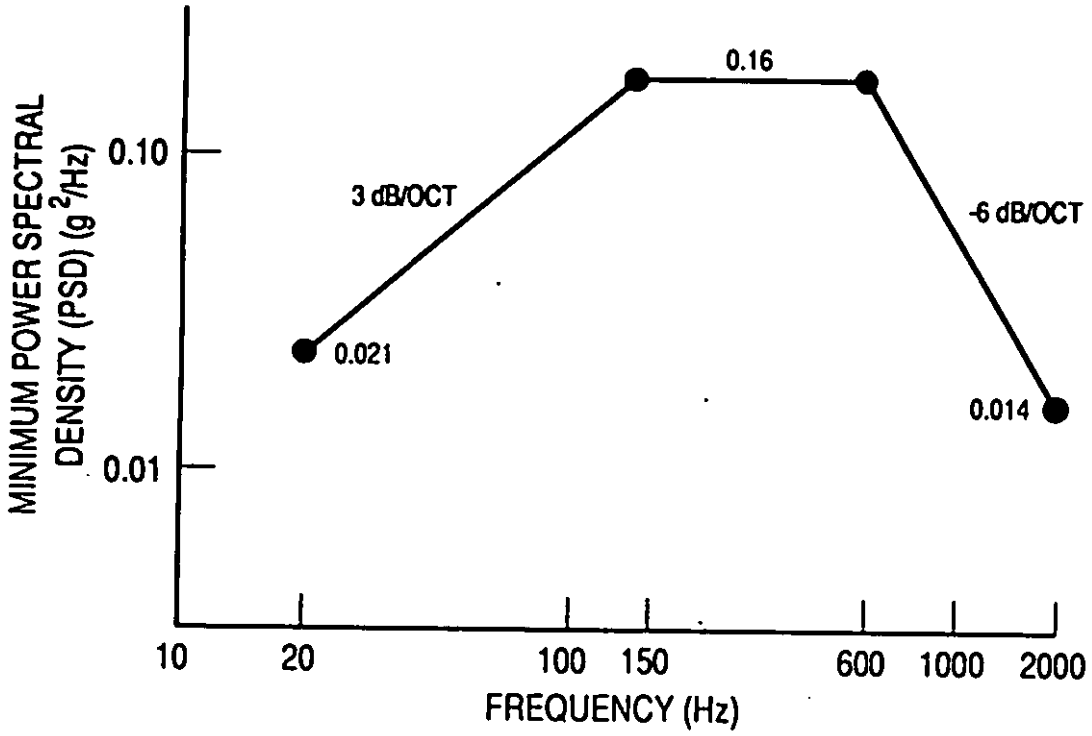
6.4.4.4 Supplementary Requirements. Sinusoidal vibration tests to demonstrate the degree of ruggedness (purpose "a" above) shall be considered a required test where significant sinusoidal vibration is expected in service usage. A functional test shall be conducted before the sinusoidal vibration test and after its completion. Electrical components shall be powered during the test and perceptive parameters monitored for failures or intermittents. When monitoring during the test is not practical, a limited functional test shall be performed after the vibration test for each axis is completed. If the component is to be mounted on dynamic isolators in the space vehicle, the component shall be mounted on these isolators during the qualification test.

6.4.5 Random Vibration Test, Component Qualification

6.4.5.1 Purpose. This test demonstrates the ability of the component to withstand the design level random vibration environment.

6.4.5.2 Test Description. The component shall be mounted to a rigid fixture through the normal mounting points of the component. The component shall be tested in each of three mutually perpendicular axes. Propulsion system valves shall be pressurized to operating pressure for this test and monitored for internal pressure decay if pressurized during ascent.

6.4.5.3 Test Levels and Duration. The random vibration shall be the design level for the component. The minimum overall test level for components weighing 22.7 kg (50 lb) or less shall be 12.2 grms with a spectrum as shown in Figure 1. The minimum test level for components weighing more than 22.7 kg (50 lb) shall be evaluated on an individual basis. The test duration in each of the three orthogonal axes shall be three times the expected flight exposure time to the maximum predicted environment or three times the component random vibration acceptance test time if that is greater, but not less than 3 minutes per axis. Where insufficient time is available at the full test level to test all redundant circuits, all functions, and all modes, extended testing at a level 6 dB lower shall be conducted as necessary to complete functional testing.



NOTES:

The minimum test level is 6 dB above the maximum flight envelope, but not less than the minimum power spectral density shown for each frequency.

The minimum overall test level is 12.2 grms.

The minimum test duration is 3 minutes per axis.

Curve values:

Frequency Range (Hz)	Minimum Power Spectral Density (PSD)
20	$0.021g^2$/Hz
20 to 150	3dB/octave slope
150 to 600	$0.16g^2$/Hz
600 to 2000	-6dB/octave slope
2000	$0.014g^2$/Hz

FIGURE 1. Component Vibration Qualification Test Requirements

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6.4.5.4 Supplementary Requirements. A functional test shall be conducted before and after the completion of the random vibration test. During the test, electrical and electronic components, including all redundant circuits, shall be electrically energized and functionally sequenced through various operational modes to the maximum extent possible. Several perceptive parameters shall be monitored for failures or intermittents during the test. If the component is to be mounted on dynamic isolators in the space vehicle, the component shall be mounted on these isolators during the qualification test and vibration test levels controlled at the input to the isolators.

6.4.6 Acoustic Test, Component Qualification

6.4.6.1 Purpose. This test demonstrates the ability of the component to withstand the design level acoustic environment. Acoustic tests shall be conducted only on components with large surfaces which are likely to be susceptible to acoustic noise excitations.

6.4.6.2 Test Description. The component shall be installed in a reverberant acoustic cell capable of generating desired sound pressure levels. A uniform sound energy density throughout the chamber is desired. The configuration of the component, such as deployed or stowed, shall be as it is during subjection to the flight dynamic environment. The preferred method of testing shall be with the component mounted on flight-type support structure and with ground handling equipment removed. Electrical components shall be operating.

6.4.6.3 Test Levels and Duration. The sound pressure level shall be at least the design level, but not less than 144 dB overall. The duration shall be three times the expected flight exposure time to the maximum predicted environment or three times the acoustic acceptance test duration, whichever is greater, but not less than three minutes. Where insufficient time is available at the full test level to test all redundant circuits, all functions, and all modes, extended testing at a level 6 dB lower shall be conducted as necessary to complete functional testing.

6.4.6.4 Supplementary Requirements. A functional test shall be conducted before and following the acoustic test. During the test, electrical and electronic components, including all redundant circuits, shall be electrically energized and functionally sequenced through various operational modes to the maximum extent possible. Several perceptive parameters shall be monitored for failures or intermittents during the test.

7.3.3.1 Purpose. This test detects material and workmanship defects prior to installation of the component into a space vehicle, by subjecting the component to thermal cycling.

7.3.3.2 Test Description. Same as 6.4.3.2.

7.3.3.3 Test Levels and Duration

a. Pressure. Ambient pressure shall normally be used. When unsealed components are being tested, the chamber shall be flooded with dry air or nitrogen to preclude condensation on and within the component at low temperature. If convenient, this test may be performed in thermal vacuum and combined with the test of 7.3.2, provided that the temperature limits, number of cycles, rate of temperature change, and dwell times conform to this test.

b. Temperature. The high temperature shall be the maximum predicted but not less than +61 deg C, and the low temperature shall be the minimum predicted but not higher than -24 deg C, except where the temperature extreme would result in physical deterioration of the materials in the component such as in tape recorders and batteries.

c. Duration. The minimum number of temperature cycles shall be eight, of which the last four shall be failure free. Each cycle shall have a 1-hour minimum dwell at the high and at the low temperature levels during which the unit shall be turned off until the temperature stabilizes and then turned on. The dwell time at the high and low levels shall be long enough to obtain internal thermal equilibrium. The transitions between low and high temperatures shall be at an average rate of at least 1 deg C per minute.

7.3.3.4 Supplementary Requirements. Same as 6.4.3.4.

7.3.4 Random Vibration Test, Component Acceptance

7.3.4.1 Purpose. This test detects material and workmanship defects prior to installation of the component into a flight system, by subjecting the unit to a dynamic vibration environment.

7.3.4.2 Test Description. Same as 6.4.5.2.

7.3.4.3 Test Levels and Duration. The vibration test spectrum shall be equal to the maximum predicted environment as defined in 3.23. The minimum overall test level for components weighing 22.7 kilograms (50 pounds) or less shall be 6.1 grms with a spectrum as shown in Figure 2. The minimum test level for components weighing more than 22.7 kg (50 lb) shall be evaluated on an individual basis. The test duration in each of the three orthogonal axes shall equal or exceed the expected flight exposure time, but shall not be less than 1 minute per axis. Where insufficient time is available at the full test level to test all modes, extended testing at a level 6 dB lower shall be conducted as necessary to complete functional testing.

7.3.4.4 Supplementary Requirements. Same as 6.4.5.4.

7.3.5 Acoustic Test, Component Acceptance

7.3.5.1 Purpose. This test detects material and workmanship defects that might not be detected in a static test condition.

7.3.5.2 Test Description. Same as 6.4.6.2.

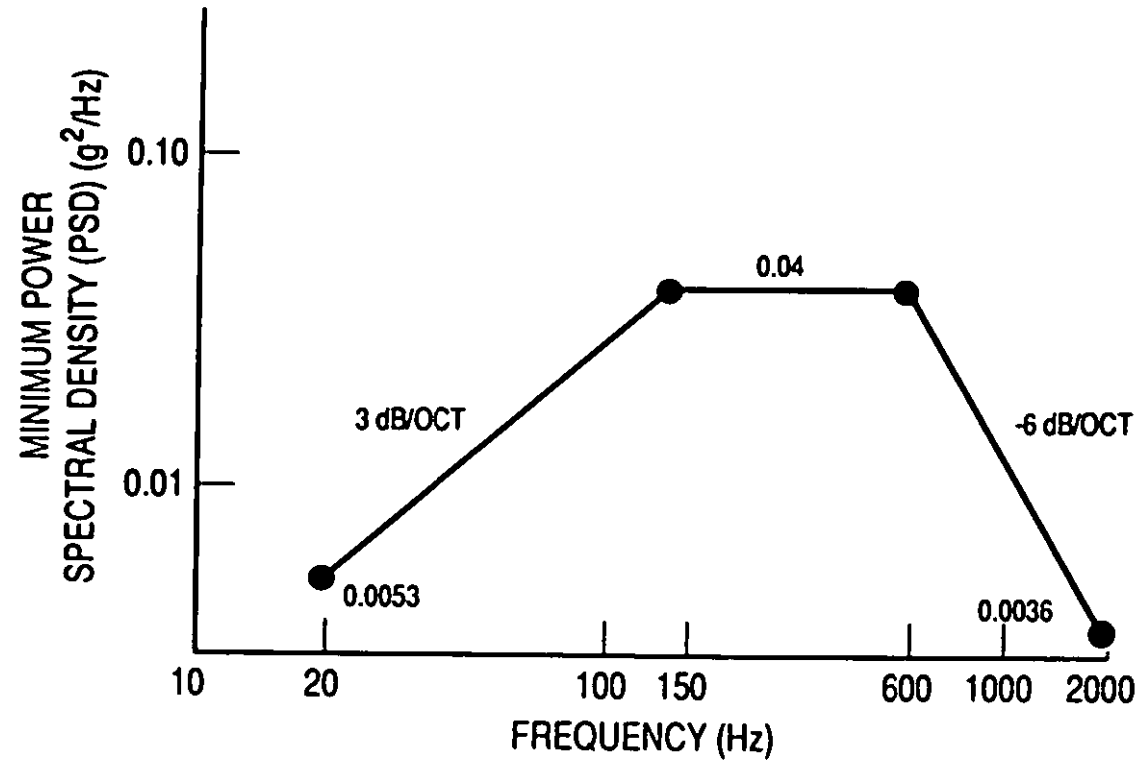
7.3.5.3 Test Levels and Duration. The component shall be exposed to sound pressure levels equal to the maximum predicted levels as defined in 3.21, but not less than 138 dB overall. The duration shall equal or exceed the expected flight exposure time to the maximum predicted environment but shall not be less than 1 minute.

7.3.5.4 Supplementary Requirements. Same as 6.4.6.4.

7.3.6 Pyro Shock Screening Test, Component Acceptance

7.3.6.1 Purpose. This test is intended to detect intermittents due to conducting particles in electronic components. It is effective for particle detection since shock can dislodge the particle and the extended duration vibration allows the particle to move to a position where a short may occur and permit detection. It may also detect intermittents due to cracked or loose dies in electronic parts that would not be found in normal acceptance tests.

7.3.6.2 Test Description. The screening test consists of pyro shock followed by random vibration testing. The component shall be mounted to a rigid fixture through the normal mounting points of the component. The component shall be tested in each direction of each of three mutually perpendicular axes (6 tests).



NOTES:

The minimum test level is the maximum flight envelope, but not less than the minimum power spectral density shown for each frequency.

The minimum overall test level is 6.1 grms.

The minimum test duration is 1 minute per axis.

Curve values:

Frequency Range (Hz)	Minimum Power Spectral Density (PSD)
20	$0.0053g^2$/Hz
20 to 150	3dB/octave slope
150 to 600	$0.04g^2$/Hz
600 to 2000	-6dB/octave slope
2000	$0.0036g^2$/Hz

FIGURE 2. Component Vibration Acceptance Test Requirements

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SECTION 8

FLIGHT USE OF QUALIFICATION EQUIPMENT

Qualification tests are conducted to demonstrate that the design, manufacturing, and assembly have resulted in hardware conforming to specification requirements. The qualification tests required by this document incorporate the environmental design margin into the test levels to assure that flight units will meet the operational requirements for their service life. The vibration tests, acoustic tests, and thermal tests produce cyclic stresses that can encroach on the fatigue margins of interconnect wiring, solder joints, structural members and similar items in the qualification test units. If equipment that has been subjected to qualification testing is planned for subsequent flight use, it is possible that the remaining fatigue margins are so low as to present a high risk of failure during flight. This is primarily due to the use of high test levels and long test durations during the baseline qualification tests. Therefore, the actual vehicle used for the 6.2 vehicle qualification tests or the components used for the 6.4 component qualification tests may not be suitable for subsequent flight.

Nevertheless, initial program costs and schedule constraints may force the consideration of ways to make units used for qualification testing acceptable for flight. It should be recognized that the use of qualification items for flight always presents a higher risk than the use of standard acceptance tested items for flight. This risk may be reduced by various strategies such as reducing qualification test levels and durations to reduce the encroachment on fatigue and wearout margins. The strategy used should be based upon specific program considerations. One method has been to replace all components on the qualification vehicle with "new" components that have passed component acceptance tests (see 8.3). Another way was to lower the space vehicle qualification test levels and test duration to avoid excessive encroachment on margins (see 8.2). On some programs, one or more qualification components have been used as flight components (see 8.1). In such cases where program considerations are overriding, the contract may direct, or the contracting officer may approve, the use of qualification units for flight. Some of the strategies that have been used are presented in the following examples.

8.1 USE OF THE QUALIFICATION COMPONENTS FOR FLIGHT

When the qualification components are planned for flight

use, the component qualification test program shall be modified from that specified in Section 6 to reduce cyclic stress levels. In addition, the component qualification testing shall be conducted on flight spares so that flight use is delayed or possibly never required. The flight space vehicle in which these qualification components are installed shall be acceptance tested in accordance with the requirements of 7.1. This space vehicle qualification would be based on the requirements of 6.2.

8.1.1 Component Qualification Tests. When the component qualification tests are conducted on a component intended for subsequent flight, the component acceptance tests required by this standard are waived, except for the burn-in acceptance test of 7.3.9, and only the qualification test baseline specified in 6.4 is required with the following exceptions:

a. For the component thermal vacuum test (6.4.2), the temperature extremes shall be 5 deg C beyond the minimum and maximum predicted temperatures.

b. For the component thermal cycling test (6.4.3), the temperature cycles shall be conducted at 5 deg C beyond the acceptance temperature extremes (7.3.3.b)

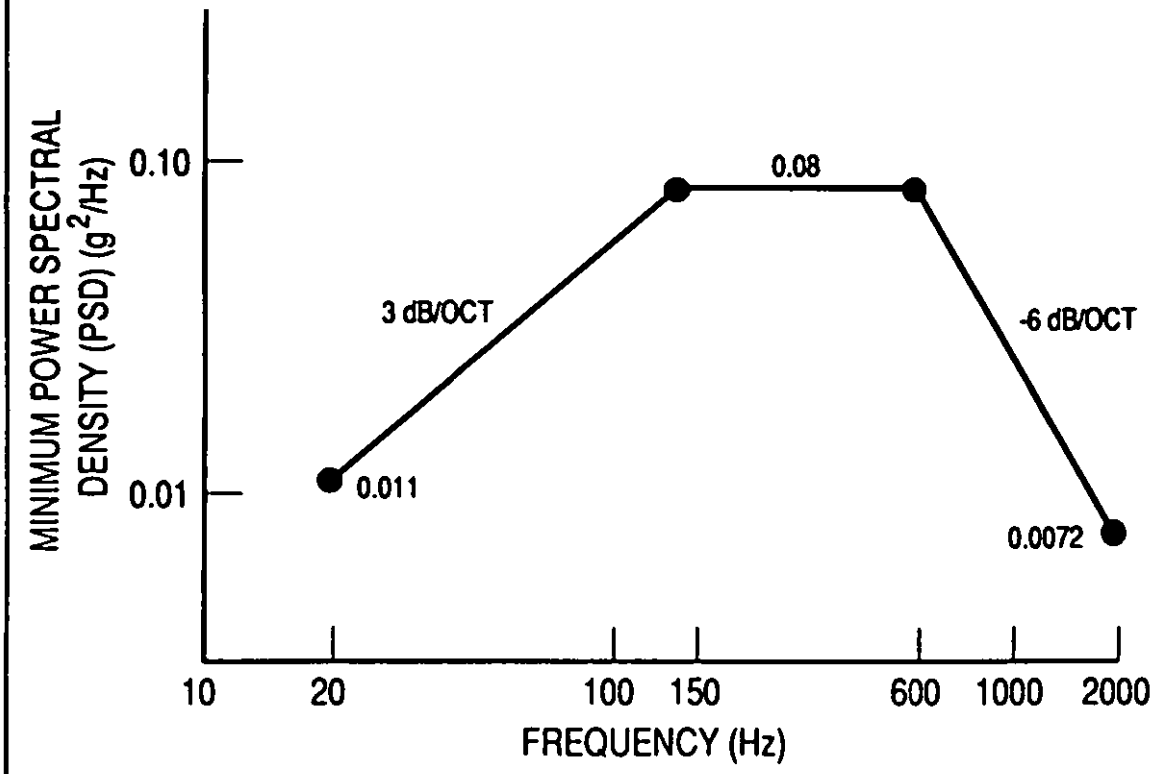
c. For the component random vibration test (6.4.5), the level should be a spectrum which is 3 decibels above the maximum flight envelope, but not less than a minimum spectrum of 8.6 grms with a spectrum as shown in Figure 3, for a minimum duration of 3 minutes per axis.

d. For the component acoustic qualification test (6.4.6), the test level shall be 3 dB greater than the maximum predicted level but not less than 141 dB overall.

e. For the component pyro shock test (6.4.7), the shock spectrum shall be 3 dB greater than the maximum predicted level.

f. For the component pressure test (6.4.10) only proof pressure tests per 6.4.10.3 a and b shall be conducted.

8.1.2 Component Certification for Flight. Upon completion of the modified qualification test program, the component test history shall be reviewed for excessive test time and potential fatigue type failures to determine if the unit is acceptable for flight or if refurbishment is required. Mission and safety critical qualification components should not be used for flight



NOTES:

The minimum test level is 3 dB above the maximum flight envelope, but not less than the minimum power spectral density shown for each frequency.

The minimum overall test level is 8.6 grms.

The minimum test duration is 3 minutes per axis.

Curve values:	Frequency Range (Hz)	Minimum Power Spectral Density (PSD)
	20	$0.011g^2$/Hz
	20 to 150	3dB/octave slope
	150 to 600	$0.08g^2$/Hz
	600 to 2000	-6dB/octave slope
	2000	$0.0072g^2$/Hz

FIGURE 3. Protoflight Component Vibration Test Requirements

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