INCH-POUND

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28 June 2013
(see 6.1)

DEPARTMENT OF DEFENSE

TEST METHOD STANDARD

METHOD 213, SHOCK (SPECIFIED PULSE)

AMSC N/A

FSC 59GP

FOREWORD

1. This standard is approved for use by all Departments and Agencies of the Department of Defense.

2. This entire standard has been revised. This revision has resulted in many changes to the format, but the most significant one is the splitting the document into test methods. See MIL-STD-202 for the change summary.

3. Comments, suggestions, or questions on this document should be emailed to std202@dla.mil or addressed to: Commander, Defense Logistics Agency, DLA Land and Maritime, ATTN: VAT, P.O. Box 3990, Columbus, OH 43218–3990. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.dla.mil.

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METHOD 213
SHOCK (SPECIFIED PULSE)

1. SCOPE

1.1 Purpose. This test is conducted for the purpose of determining the suitability of component parts and subassemblies of electrical and electronic components when subjected to shocks such as those which may be expected as a result of rough handling, transportation and military operations. This test differs from other shock tests in this standard in that the design of the shock machine is not specified, but the half-sine and sawtooth shock pulse waveforms are specified with tolerances. The frequency response of the measuring system is also specified with tolerances.

2. APPLICABLE DOCUMENTS

2.1 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

ACOUSTICAL SOCIETY OF AMERICA (ASA)

ASA S2.2 - Methods for the Calibration of Shock and Vibration Pickups

(Copies of this document are available online at http://asa.aip.org)

3. DEFINTIONS

This section not applicable to this standard.

4. GENERAL REQUIREMENTS

4.1. Apparatus.

4.1.1 Shock machine. The shock machine utilized shall be capable of producing the specified input shock pulse as shown on figures 1 or 2, as applicable. The shock machine may be of the free fall, resilient rebound, nonresilient, hydraulic, compressed gas, or other activating types.

4.1.1.1 Shock machine calibration. The actual test item, or a dummy load which may be either a rejected item or a rigid dummy mass, may be used to calibrate the shock machine. (When a rigid dummy mass is used, it shall have the same center of gravity and the same mass as that of the test item and shall be installed in a manner similar to that intended for the test item.) The shock machine shall then be calibrated for conformance with the specified waveform. Two consecutive shock applications to the calibration load shall produce waveforms which fall within the tolerance envelope given on figures 1 or 2. The calibration load shall then be removed and the shock test performed on the actual test item. If all conditions remain the same, other than the substitution of the test item for the calibration load, the calibration shall then be considered to have met the requirements of the waveform.

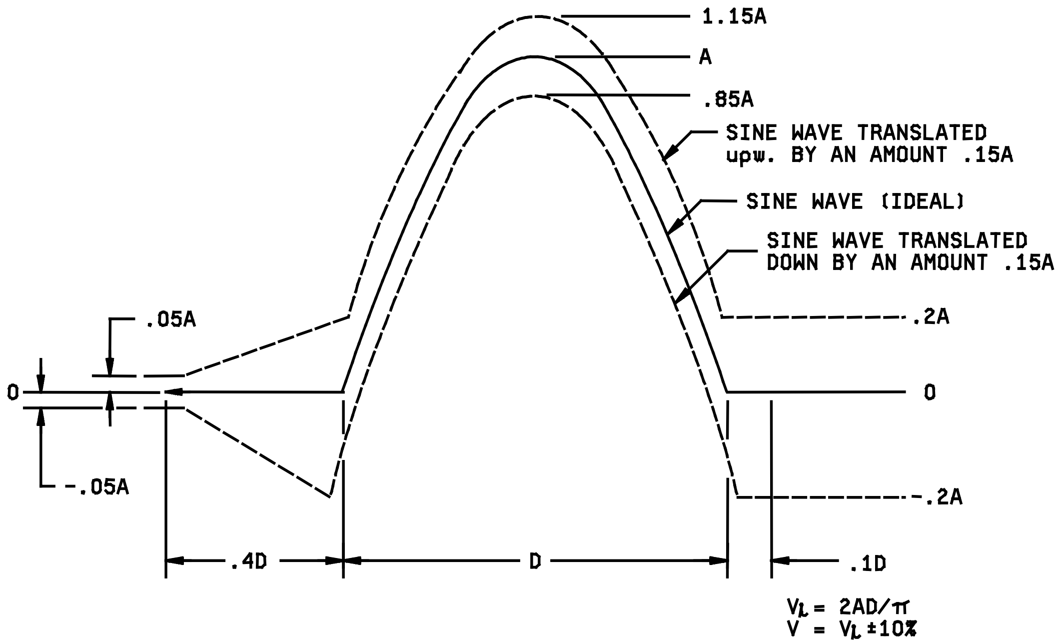
NOTE: It is not implied that the waveform generated by the shock machine will be the same when the actual test item is used instead of the calibration load. However, the resulting waveform is considered satisfactory if the waveform with the calibration load was satisfactory.

4.1.2 Instrumentation. In order to meet the tolerance requirements of the test procedure, the instrumentation used to measure the input shock shall have the characteristics specified in the following paragraphs.

4.1.2.1 Frequency response. The frequency response of the complete measuring system, including the transducer through the readout instrument, shall be as specified by figure 3.

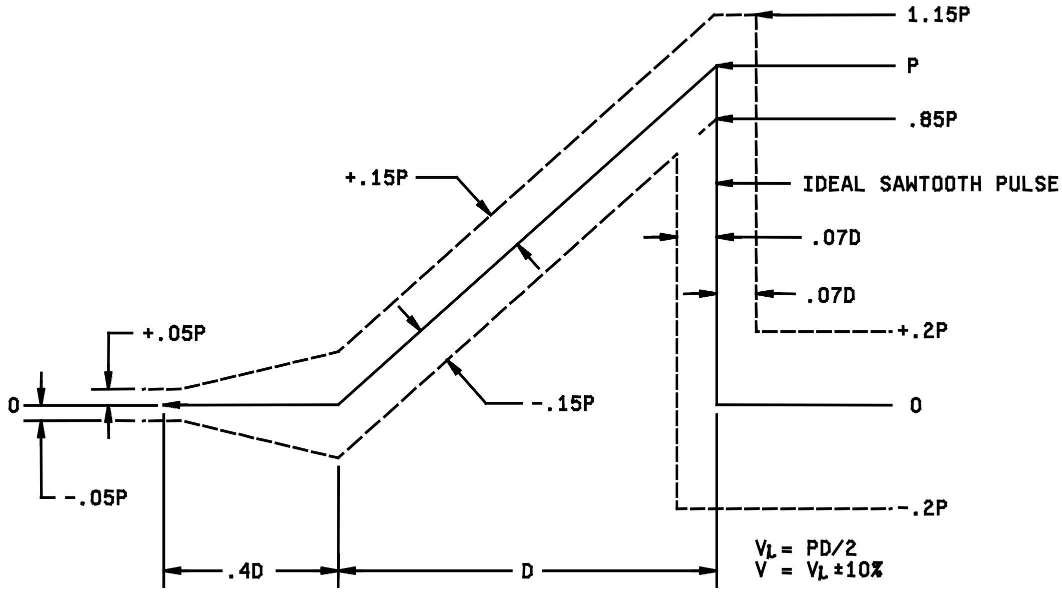
4.1.2.1.1 Frequency response measurement of the complete instrumentation. The transducer-amplifier-recording system can be calibrated by subjecting the transducer to sinusoidal vibrations of known frequencies and amplitudes for the required ranges so that the overall sensitivity curve can be obtained. The sensitivity curve, normalized to be equal to unity at 100 Hz, should then fall within the limits given on figure 3.

4.1.2.1.2 Frequency response measurement of auxiliary equipment. If calibration factors given for the accelerometer are such that when used with the associated equipment it will not affect the overall frequency response, then the frequency response of only the amplifier-recording system may be determined. This shall be determined in the following manner: Disconnect the accelerometer from the input terminals of its amplifier. Connect a signal voltage source to these terminals. The impedance of the signal voltage source as seen by the amplifier shall be made as the impedance of the accelerometer and associated circuitry as seen by the amplifier. With the frequency of the signal voltage set at 100 Hz, adjust the magnitude of the voltage to be equal to the product of the accelerometer sensitivity and the acceleration magnitude expected during test conditions. Adjust the system gain to a convenient value. Maintain a constant input voltage and sweep the input frequency over the range from 1.0 to 9,000 Hz, or 4 to 25,000 Hz, as applicable, depending on duration of pulse. The frequency response in terms of dB shall be within the limits given on figure 3.



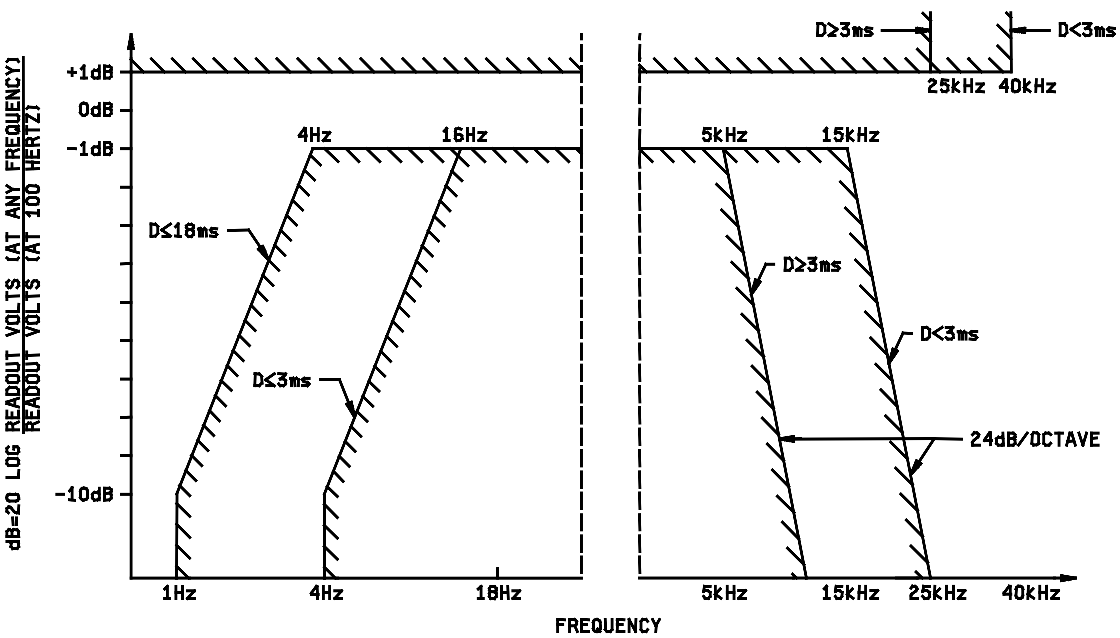
NOTE: The oscillogram should include a time about 3D long with the pulse located approximately in the center. The integration to determine velocity change should extend from .4D before the pulse to .1D beyond the pulse. The acceleration amplitude of the ideal half sine pulse is A and its duration is D. Any measured acceleration pulse which can be contained between the broken line boundaries is a nominal half sine pulse of nominal amplitude A and nominal duration D. The velocity change associated with the measured acceleration pulse is V.

FIGURE 1. Tolerances for half sine shock pulse.



NOTE: The oscillogram should include a time about 3D long with the pulse approximately in the center. The integration to determine the velocity change should extend from .4D before the pulse to .1D beyond the pulse. The peak acceleration magnitude of the sawtooth pulse is P and its duration is D. Any measured acceleration pulse which can be contained between the broken line boundaries is a nominal terminal-peak sawtooth pulse of nominal peak value, P, and nominal duration, D. The velocity change associated with the measured acceleration pulse is V.

FIGURE 2. Tolerances for terminal-peak sawtooth shock pulse.



Duration of pulse (ms)	Low frequency cut-off (Hz)		High frequency cut-off (kHz) -1 dB	Frequency beyond which the response may rise above +1 dB (kHz)
	-1dB	-10dB		
3				
<3	16	4	15	40
3	16	4	5	25
>3	4	1	5	25

FIGURE 3. Tolerance limits for measuring system frequency response.

4.1.2.2 Transducer. The fundamental resonant frequency of the accelerometer shall be greater than 30,000 Hz, when the accelerator is employed as the shock sensor.

4.1.2.3 Transducer calibration. Transducers shall be calibrated in accordance with ASA STD S2.2. The accuracy of the calibration method shall be at least ±5 percent over the frequency range of 2 to 5,000 Hz. The amplitude of the transducer being calibrated shall also be ±5 percent over the frequency range of 4 to 5,000 Hz.

4.1.2.4 Linearity. The signal level of the system shall be chosen so that the acceleration pulse operates over the linear portion of the system.

4.1.2.5 Transducer mounting. When conformance to 4.1.3 is required, the monitoring transducer shall be rigidly secured and located as near as possible to an attachment point of the specimen but not on the specimen itself.

4.1.3 Application of shock measuring instrumentation. Shock measuring instrumentation shall be utilized to determine that the correct input shock pulse is applied to the test specimen. This is particularly important where a multi-specimen test is made. Generally, the shock pulse should be monitored whenever there is a change in the test setup, such as a different test fixture, different component (change in physical characteristics), different weight, different shock pulse (change in pulse shape, intensity, or duration) or different shock machine characteristics. It is not mandatory that each individual shock be monitored, provided that the repeatability of the shock application as specified in 4.1.1.1 has been established.

4.2 Shock pulses. Two types of shock pulses, a half-sine shock pulse and a sawtooth shock pulse, are specified. The pulse shape and tolerances are shown on figures 1 and 2, respectively. For single degree of freedom systems, a sawtooth shock pulse can be assumed to have a damage potential at least as great as that of the half-sine pulse if the shock spectrum of the sawtooth pulse is everywhere at least as great as that of the half-sine pulse. This condition will exist for two such pulses of the same duration if over most of the spectrum the acceleration peak value of the sawtooth pulse is 1.4 times the acceleration peak value of the half-sine pulse.

4.2.1 Half-sine shock pulse. The half-sine shock pulse shall be as indicated on figure 1. The velocity change of the pulse shall be within ±10 percent of the velocity change of the desired shock pulse. The velocity change may be determined either by direct measurement, indirectly, or by integrating (graphically or electrically) the area (faired acceleration pulse may be used for the graphical representation) under the measured acceleration pulse. For half-sine acceleration pulses of less than 3 milliseconds duration the following tolerances should apply: The faired maximum value of the measured pulse shall be within ±20 percent of the specified ideal pulse amplitude, its duration shall be within ±15 percent of the specified ideal pulse duration, and the velocity change associated with the measured pulse shall be within ±10 percent of $V_i = 2AD/\pi$. See figure 1. The measured pulse will then be considered a nominal half-sine pulse with a nominal amplitude and duration equal to respective values of the corresponding ideal half-sine pulse. The duration of the measured pulse shall be taken as $D_m = D(.1A)/.94$; where D(.1A) is the time between points at .1A for the faired measured acceleration pulse.

4.2.1.1 The ideal half-sine pulse. An ideal half-sine acceleration pulse is given by the solid curve. See figure 1. The measured acceleration pulse must lie within the boundaries given by the broken lines. In addition, the actual velocity change of the shock must be within 10 percent of the ideal velocity change. The actual velocity change can be determined by direct measurements, or from the area under the measured acceleration curve. The ideal velocity change is equal to $V_i = 2AD/\pi$; where A is the acceleration amplitude and D is the pulse duration of the ideal pulse.

4.2.2 Sawtooth shock pulse. The sawtooth pulse shall be as indicated on figure 2. The velocity change of the faired measured pulse shall be within ±10 percent of the velocity change of the ideal pulse.

4.2.2.1 The ideal terminal-peak sawtooth. An ideal terminal-peak sawtooth acceleration pulse is given by the solid line. See figure 2. The measured acceleration pulse must be within the boundaries given by the broken lines. In addition, the actual velocity change of the shock pulse must be within 10 percent of the ideal value. The actual velocity change can be determined from direct measurements, or from the area under the measured acceleration curve. The ideal velocity change is equal to $V_i = PD/2$; where P is the peak value of acceleration, and D is the pulse duration.

4.3. Procedure. The test specimen shall be mounted as specified in the component specification. Whenever possible, the test load shall be distributed uniformly on the test platform in order to minimize the effects of unbalanced loads.

4.3.1 Basic design test. Three shocks in each direction shall be applied along the three mutually perpendicular axes of the test specimen (18 shocks). If the test specimen is normally mounted on vibration isolators, the isolators shall be functional during the test. The specified test pulse (half-sine or sawtooth pulse) shall be in accordance with figures 1 and 2, respectively, and shall have a duration and peak value in accordance with one of the test conditions of table 1.

TABLE 1. Test condition values.

Test condition	Peak value (g's)	Normal duration (D) (ms)	Waveform	Velocity change (V_i) ft/sec
A	50	11	Half-sine	11.3
B	75	6	Half-sine	9.2
C	100	6	Half-sine	12.3
D	500	1	Half-sine 1/ 2/ 3/	10.2
E	1,000	0.5	Half-sine 1/ 2/ 3/	10.2
F	1,500	0.5	Half-sine 1/ 2/ 3/	15.4
G	50	11	Sawtooth 2/	8.8
H	75	6	Sawtooth 2/	7.2
I	100	6	Sawtooth 2/	9.7
J	30	11	Half-sine	6.8
K	30	11	Sawtooth	5.3

1/ For half-sine shock pulses of less than 3 milliseconds duration, it is not required that the envelope fall within the tolerances specified on figure 1. The faired amplitude of the measured pulse shall be within ±20 percent of the ideal amplitude. The measured duration shall be within ±15 percent of the specified amplitude duration. The velocity change of the faired measured pulse shall be within ±10 percent of the ideal pulse. The duration of the pulse shall be measured at the 0.1A point on the pulse. The duration of the pulse shall be the duration measured at the 0.1A point divided by .94. Test conditions D, E, and F are principally applicable to semiconductors.

2/ Test conditions G, H, and I (sawtooth) waveforms are preferred, except for semi- conductors, for which test conditions D, E, and F (half-sine) are preferred.

3/ For test condition D. Where the weight of multi-specimen and fixtures exceeds 150 pounds, there is a question as to whether the shock pulse is properly transmitted to all specimens. Due consideration should be given to the design of the test fixture to assure the proper shock input to each specimen. This also applies to test conditions E and F except that where the weight of the multi-specimen and fixtures exceeds 25 pounds.

5. DETAILED REQUIREMENTS

5.1 Measurements. Measurements are to be made before and after the required number of shocks unless otherwise specified, and during the test if specified.

5.2 Summary. The following details are to be specified in the individual specification:

a. Mounting method and accessories (see 4.1.2.5 and 4.3).

b. Test condition letter (see 4.3.1).

c. Measurements before, during, and after the test (see 5.1).

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Supersession data. The main body and 38 parts of this revision of MIL-STD-202 replace superseded MIL-STD-202.

6.2 Cancelled Method. Methods 202 (Shock, specimens weighing not more than 4 pounds) and 205 (Medium Impact) are cancelled, when specified use Method 213.

202 or 205 test condition		213 test condition	
A	15g (pk)	K	30g (sawtooth)
B	30g (pk)	H	75g (sawtooth)
C	50g (pk)	I	100g (sawtooth)

Custodians:
Army - CR
Navy - EC
Air Force - 85
DLA - CC

Preparing activity:
DLA – CC

(Project 59GP-2015-027)

Review activities:
Army - AR, AT, AV, CR4, MI, SM, TE
Navy - AS, OS, SH
Air Force - 19, 99
NSA - NS

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