MIL-STD-907B MODIFIES MIL-STD-285 EMI TEST PROCEDURES

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Abstract

MIL-STD-285 provides a method of measuring the attenuation characteristics of electromagnetically shielded enclosures. Because of the well-known inadequacies of this standard, first published in 1956, several organizations have unsuccessfully attempted to revise it. However, an interim measure has been approved to reduce some of the deficiencies. The changes will be included in MIL-STD-907B, engineering and design criteria for shelters, expandable and non-expandable.

I. Introduction

The MIL-STD-285 electromagnetic interference (EMI) test procedure [1] has been around since 1956 and is one of the most widely used and well-known test procedures in the United States for measuring attenuation of electromagnetically shielded enclosures. It is also known to have some deficiencies, prompting several organizations to try to revise MIL-STD-285 or to write other standard test methods, such as the proposed IEEE recommended practice for measurement of shielding effectiveness of high-performance shielding enclosures [2] and proposed MIL-STD-285A [3]. However, since these proposed standards have not been approved, many organizations have created their own standards for measuring the shielding effectiveness of shielded enclosures.

The Department of Defense (DoD) Joint Committee on Tactical Shelters (JOCOTAS) had tried in vain to revise the MIL-STD-285 for the past several years. Finally, JOCOTAS decided to make the urgently need changes by modifying the EMI section in MIL-STD-907B [4], which is controlled by JOCOTAS. MIL-STD-907B gives the military standard engineering and design criteria for shelters, expandable and non-expandable.

The revised EMI provision's test parameters for MIL-STD-907B will be published within a year and are summarized in the following paragraphs.

II. EMI Test Provisions

The shelter will be tested in accordance with MIL-STD-285 with the following modifications:

A. Magnetic Field Test.

A magnetic field test will be performed at a frequency of 150 kHz, using the basic procedure for low-impedance testing in MIL-STD-285, at the test points and with the antenna orientations specified as follows:

(1) Corners and Edges.

(a) *Test Point Assignment.* A corner where three adjacent panels converge, three test points shall be assigned. These three corner test points shall be located at a distance of 12 inches from the interior corner or apex along the three edges where two panels converge as shown in figure 1. Along edges where corners are less than 24 inches apart, a single test point shall be assigned at the center along the edge.

At each edge where two adjacent panels merge, test points shall be assigned along the edge. The length of the edge (measured from one end of the corner test points to the other end of the corner test points) shall be measured in inches. Edge test points shall be assigned to be uniformly spaced along this span at a spacing not to exceed 36 inches (see fig. 2).

(b) *Antenna Orientation.* The transmitting and receiving loop antennas shall lie in the same plane and be perpendicular to the edge containing the test point. The antennas shall be

Figure 1. Corner test point locations.

Figure 2. Edge test point locations.

D = diameter of loop antenna

Dimensions shown are measured from the interior shelter surfaces.

Figure 3. Loop antenna test position for edge and corner measurements [2].

positioned at the required distance from the shelter's edge as shown in figure 3 [2].

(2) Sections and Seams.

(a) *Test Point Assignment.* A shelter is usually comprised of one or more integrally fabricated sections such as a roof panel or a formed knee-wall panel. Generally shelter sections are attached together directly or to a supporting frame. Seams formed as a result of the sections shall be tested.

A test point shall be assigned to the geometric center of each section (such as the center of a roof panel). If a center test point is within 18 inches of a previously assigned test point, that center test point may be eliminated.

A seam is usually formed when a wall is constructed of more than one sheet metal. Seam test points shall be assigned to be uniformly spaced along each seam at a spacing not to exceed 36 inches. A seam for which the measured length is less than 36 inches need not be measured. If one seam test point is within 18 inches of a test point already assigned to another section, the seam test point may be eliminated.

(b) *Antenna Orientation.* Attenuation measurements shall be made at each test point for two antenna orientations, each of which will be perpendicular to each other. The plane containing the antenna shall be perpendicular to the panel, and the transmitting and receiving antenna shall lie in the same plane (coplanar). The plane containing the antennas

shall be perpendicular to the seams being tested if the panel is rectangular or square.

A test point shall be assigned to the geometric center of each of the roofs, floors and each of the four walls. Attenuation measurements shall be made at these test points for the two aforementioned antenna orientations (coplanar). If a center test point is within 18 inches of a previously assigned test point, that center test point may be eliminated.

(3) Doors.

(a) *Test Point Assignment.* For personnel and cargo doors, two test points are required along each vertical seam and one test point along each horizontal seam.

(b) *Antenna Orientation.* For the horizontal door seams, antennas shall be located at the center of the seam coplanar. For vertical door seams, two measurements per seam will be taken at locations one-third the distance from the top and one-third the distance from the bottom (see fig. 4) [2]. Attenuation measurements shall be made using coplanar orientation. The plane containing the antennas shall be perpendicular to a seam.

(4) Hatches, Windows, Power/Signal Entry Panels, Ventilation and/or Environmental Control Unit (ECU) Openings and Similar Openings.

(a) *Test Point Assignment.* Each opening shall be tested at the test point located at the geometric center of the opening.

For each opening larger than 24 inches wide by 24 inches high, there shall be additional test points around the opening. These opening test points shall be assigned along the perimeter of each opening. Opening test points shall be assigned to be uniformly spaced along each seam at a spacing not to exceed 36 inches. If one test point is within 18 inches of a previously assigned test point, the test point may be eliminated.

(b) *Antenna Orientation.* Attenuation measurements shall be made at the geometric center test point for two antenna orientations, each of which will be perpendicular to each other. For additional test points, attenuation measurement shall be made by positioning the plane of the antenna

Figure 4. Loop antenna test positions for doors: (a) front view and (b) side view [2].

perpendicular to a seam (perimeter of opening) being tested. Antenna orientation shall be coplanar. The plane containing the antenna shall be perpendicular to seam(s) being tested if the opening is rectangular or square.

(5) Isolated Penetrations.

(a) *Test Point Assignment.* Isolated penetrations are openings for hardware items such as drain holes, pressure relief valves, electrical and other connectors, door handles and hinges which penetrate the EMI shield. A test point shall be assigned to the geometric center of each isolated penetration.

If one test point is within 18 inches of a previously assigned test point, the isolated penetration test may be eliminated.

(b) *Antenna Orientation.* Attenuation measurements shall be made at each test point for two antenna orientations, each of which will be perpendicular to each other. Antenna orientation shall be coplanar. The plane containing the antenna shall be perpendicular to seam(s) being tested, if the opening is rectangular or square.

B. Electric Field and Plane Wave Test.

The electric field test shall be used for specific developmental items only. The electric field test is optional to be determined by the government for each shelter. Electric field and plane wave measurements shall be made at the following frequencies:

Electric field: 200 kHz, 1.0 MHz, 18 MHz
Plane wave: 400 MHz, 1 GHz, 10 GHz

(1) Test Point Assignment. Test point assignment is the same as the magnetic field test point assignment.

(2) Antenna Orientation. Antennas shall be orientated in accordance with MIL-STD-285.

C. Test Equipment Range.

For each test, the dynamic range of the test equipment shall be a minimum of 10 dB greater than the largest shielding effectiveness value required for the test. The dynamic range measurement for each test setup shall be recorded in the test report.

D. Recorded Data.

Diagrams shall be made indicating the location of each test point for each frequency tested in the magnetic field, electric field (if required), and plane wave. A matrix indicating the test points, frequency, and the level of EMI attenuation found shall be generated. The diagrams indicating test point locations and the matrix shall be included in the test report. The production test will be the same as above.

Note: Any adjustable or variable components of the shelter shall be set to the operating configuration for the above testing.

III. Conclusion

The revised EMI test parameter is aimed at reducing the variations of measurement technique and improving measurement repeatability and reliability in magnetic field (low-impedance) tests. The electric field measurement is optional, and therefore can be eliminated. Plane wave and electric field test procedure is the same as MIL-STD-285. As stated in the abstract, this provision is interim and is not complete by any means; however, if one follows the procedures specified in this provision, reliability of the test results can be improved substantially.

References

- [1] "MIL-STD-285, Method of Attenuation Measurements for Enclosures, Electromagnetic Shielding, for Electronic Test Purposes," Department of Defense, 25 June 1956.
- [2] "Proposed IEEE Recommended Practice for Measurement of Shielding Effectiveness of High Performance Shielding Enclosures," IEEE No. 299, June 1969.
- [3] Richard B.Schulz, "MIL-STD-285 Revision," ECAC-CR-83-052, IIT Research Institute, July 1983.
- [4] "MIL-STD-907B, Military Standard Engineering and Design Criteria for Shelters, Expandable and Non-expandable," Department of Defense, 9 September 1985.