

NOTICE OF
CHANGE

METRIC

MIL-STD-462D
NOTICE 1
10 April 1995

MILITARY STANDARD
MEASUREMENT OF
ELECTROMAGNETIC INTERFERENCE
CHARACTERISTICS

TO ALL HOLDERS OF MIL-STD-462D:

1. THE FOLLOWING PAGES OF MIL-STD-462D HAVE BEEN REVISED AND SUPERSEDE THE PAGES LISTED:

NEW PAGE	DATE	SUPERSEDED PAGE	DATE
1	11 January 1993	-	REPRINTED WITHOUT CHANGE
2	10 April 1995	2	11 January 1993
3	10 April 1995	3	11 January 1993
4	10 April 1995	4	11 January 1993
15	10 April 1995	15	11 January 1993
16	11 January 1993	-	REPRINTED WITHOUT CHANGE
A-5	11 January 1993	-	REPRINTED WITHOUT CHANGE
A-6	10 April 1995	A-6	11 January 1993
A-7	10 April 1995	A-7	11 January 1993
A-8	10 April 1995	A-8	11 January 1993
A-41	11 January 1993	-	REPRINTED WITHOUT CHANGE
A-42	10 April 1995	A-42	11 January 1993

2. This change notice removes MIL-STD-45662 from this standard.

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

4. Holders of MIL-STD-462D will verify that page changes and additions 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.

Custodians:
Army - CR
Navy - EC

Preparing activity:
Air Force - 11

Project Nr. EMCS-0134

AMSC: N/A

AREA: EMCS

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

1. SCOPE

1.1 Purpose. This standard establishes general techniques for use in the measurement and determination of the electromagnetic emission and susceptibility characteristics of electronic, electrical, and electromechanical equipment and subsystems designed or procured for use by activities and agencies of the Department of the Defense.

1.2 Application. The testing techniques of this standard are used to obtain data for determination of compliance with the specified MIL-STD-461 requirements. The test methods contained in this document shall be adapted by the testing activity for each application. The adapted test methods shall be documented in the Electromagnetic Interference Test Procedures (EMITP) required by MIL-STD-461.

1.3 Emission and susceptibility designations. The test methods contained in this standard are designated in accordance with an alpha-numeric coding system. Each method is identified by a two letter combination followed by a three digit number. The number is for reference purposes only. The meaning of the individual letters are as follows:

C = Conducted
R = Radiated
E = Emissions
S = Susceptibility

- a. Conducted emissions tests are designated by "CE---".
- b. Radiated emissions tests are designated by "RE---".
- c. Conducted susceptibility tests are designated by "CS---".
- d. Radiated susceptibility test are designated by "RS---".
- e. "---" = numerical order of test from 101 to 199.

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2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.2 Specifications, standards, and handbooks. The following document forms a part of this document to the extent specified herein. Unless otherwise specified, the issue of this document is the one listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement(s) thereto, cited in the solicitation.

STANDARDS

MILITARY

MIL-STD-461 - Requirements for the Control
of Electromagnetic
Interference Emissions and
Susceptibility

(Copies of federal and military specifications, standards, and handbooks are available from the Department of Defense Single Source Stock Point, 700 Robbins Avenue, Building 4D, Philadelphia, Pennsylvania 19111-5094.)

2.2 Non-Government documents. The following non-government documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents which are DoD adopted are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/IEEE 268 - Standard Metric Practice
(DoD Adopted)

ANSI C63.2 - Standard for Instrumentation -
Electromagnetic Noise and Field
Strength, 10 kHz to 40 GHz -
Specifications

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AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) - Continued

- ANSI C63.4 - Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
- ANSI C63.14 - Standard Dictionary for Technologies of Electromagnetic Compatibility (EMC), Electromagnetic Pulse (EMP), and Electrostatic Discharge (ESD)
- ANSI C95.1 - Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 300 kHz - 100 GHz
- ANSI/NCSL Z540-1- General Requirements for Calibration Laboratories and Measuring and Test Equipment
- ISO 10012-1 - Quality Assurance Requirements for Measuring Equipment

(DoD activities may obtain copies from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia PA 19111-5094. Other Government agencies and the private sector may address application for copies to the American National Standards Institute, 11 West 42nd Street, New York, New York 10036 [Telephone: 212-642-4900 or FAX: 212-398-0023]; or the Institute of Electrical and Electronics Engineers, Incorporated (IEEE), 445 Hoes Lane, Piscataway, New Jersey 08855-1331 [Telephone: 1-800-701-4333 or FAX: 908-981-9667].)

Supersedes page 3 dated 11 January 1993.

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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 380 - Standard for Metric Practice
(DoD Adopted)

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103-1187 [Telephone: 215-299-5585 or FAX: 215-977-9679].)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

ARP 958 - Electromagnetic Interference
Measurement Antennas; Standard
Calibration Requirements and
Methods

(Application for copies should be addressed to the Society of Automotive Engineers, Incorporated, 400 Commonwealth Drive, Warrendale, Pennsylvania 15096 [Telephone: 412-776-4841 or FAX: 412-776-5760].)

Supersedes page 4 dated 11 January 1993.

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- d. Record this level, frequency range of occurrence, frequency and level of greatest susceptibility, and other test parameters, as applicable.

4.11 Calibration of measuring equipment and antennas. Test equipment and accessories required for measurement in accordance with this standard shall be calibrated in accordance with ANSI/NCSL Z540-1: "General Requirements for Calibration Laboratories and Measuring and Test Equipment", ISO 10012-1: "Quality Assurance Requirements for Measuring Equipment", or under an approved calibration program traceable to the NIST. In particular, measurement antennas, current probes, field sensors, and other devices used in the measurement loop shall be calibrated at least every two years unless otherwise specified by the procuring activity, or when damage is apparent. Antenna factors and current probe transfer impedances shall be determined on an individual basis for each device.

4.11.1 Measurement of system test. At the start of each emission test, the complete test system (including measurement receivers, cables, attenuators, couplers, and so forth) shall be verified by injecting a known signal, as stated in the individual test method, while monitoring system output for the proper indication.

4.12 Antenna factors. Factors for electric field test antennas shall be determined in accordance with SAE ARP-958: "Electromagnetic Interference Measurement Antennas; Standard Calibration Requirements and Methods".

5. MEASUREMENT PROCEDURES

This section contains the measurement procedures to be used in determining compliance with the emission and susceptibility requirements of MIL-STD-461. The test procedures are applicable for the entire specified frequency range; however, certain equipment or classes of equipment may not require testing throughout the complete measurement frequency range. These modifications are specified in MIL-STD-461. Table IV is an index of measurement procedures by method number and title.

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APPENDIX

10. GENERAL

10.1 Scope. This appendix provides background information for each requirement in the main body of the standard. The information includes rationale for the test requirements and guidance for application of the requirements. This information should help users understand the intent behind the test requirements and adapt them in the Electromagnetic Interference Test Procedures (EMITP) as necessary for particular applications. This appendix is provided for guidance purposes and, as such, should not be interpreted as providing contractual requirements.

10.2 Structure. This appendix follows the same general format as the main body of the standard. A "DISCUSSION" paragraph is provided for each requirement contained in the standard.

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20. APPLICABLE DOCUMENTS

20.1 Government documents.

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STANDARDS

MILITARY

- MIL-STD-220 - Method of Insertion Loss Measurement
- MIL-STD-285 - Attenuation measurements for Enclosures, Electromagnetic Shielding, for Electronic Test Purposes, Method of
- MIL-STD-461 - Requirements for the Control of Electromagnetic Interference Emissions and Susceptibility

(Copies of federal and military specifications, standards, and handbooks are available from the Department of Defense Single Source Stock Point, 700 Robbins Avenue, Building 4D, Philadelphia, Pennsylvania 19111-5094.)

20.2 Non-Government documents. The following non-government documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents which are DoD adopted are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation.

Supersedes page A-6 dated 11 January 1993.

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- ANSI C63.4 - Methods of Measurement of Radio-
Noise Emissions from Low-Voltage
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Equipment in the Range of
9 kHz to 40 GHz
- ANSI C63.14 - Standard Dictionary for
Technologies of Electromagnetic
Compatibility (EMC),
Electromagnetic Pulse (EMP),
and Electrostatic Discharge
(ESD)
- ANSI C95.1 - Safety Levels with Respect to Human
Exposure to Radio Frequency
Electromagnetic Fields,
300 kHz - 100 GHz
- ANSI/NCSL Z540-1- General Requirements for Calibration
Laboratories and Measuring and
Test Equipment
- ISO 10012-1 - Quality Assurance Requirements for
Measuring Equipment

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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

National Electrical Code

(Application for copies should be addressed to the National Fire Protection Association, One Batterymarch Park, P.O. Box 9101, Quincy MA 02269-9990 [Telephone: 617-770-3000 or FAX: 617-770-0700].)

RADIO TECHNICAL COMMISSION FOR AERONAUTICS (NFPA)

DO-160 - Environmental Conditions and
Test Conditions for Airborne
Equipment

(Application for copies should be addressed to the Radio Technical Commission for Aeronautics Secretariat, One McPherson Square, Suite 500, 1425 K Street, NW, Washington DC 20005.)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

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at 1 GHz with a bandwidth of 100 kHz has a Q of 1 GHz/100 kHz or 10,000.

Automatic leveling used to stabilize the amplitude of a test signal for stepped scans may require longer dwell times than one second at discrete frequencies. The signal will take time to settle and any EUT responses during the leveling process should be ignored.

40.10.4.2 (4.10.4.2.) Modulation of susceptibility signals. Susceptibility test signals above 10 kHz shall be pulse modulated at a 1 kHz rate with a 50% duty cycle unless otherwise specified in an individual test method of this standard.

DISCUSSION: Modulation is usually the effect which degrades EUT performance. The wavelengths of the RF signal cause efficient coupling to electrical cables and through apertures (at higher frequencies). Nonlinearities in the circuit elements detect the modulation on the carrier. The circuits may then respond to the modulation depending upon detected levels, circuit bandpass characteristics, and processing features.

Pulse modulation at a 1 kHz rate, 50% duty cycle, (alternately termed 1 kHz square wave modulation) is specified for several reasons. One kHz is within the bandpass of most analog circuits such as audio or video. The fast rise and fall times of the pulse causes the signal to have significant harmonic content high in frequency and can be detrimental to digital circuits. Response of electronics has been associated with energy present and a square wave results in high average power. The modulation encompasses many signal modulations encountered in actual use. The square wave is a severe form of amplitude modulation used in communications and broadcasting. It also is a high duty cycle form of pulse modulation representative of radars.

Previous versions of MIL-STD-461 required that the worst case modulation for the EUT be used. Worst case modulation usually was not known or determined. Also, worst case modulation may not be related to modulations seen in actual use or may be very specialized. The most typical modulations used below approximately 400 MHz have been amplitude modulation at either 400 or 1000 Hz (30 to 80%) or pulse modulation, 50% duty cycle, at 400 or 1000 Hz. These same modulations have been used above 400 MHz together with pulse modulation at various pulse widths and pulse repetition frequencies. Continuous wave (CW - no modulation) has also occasionally been used. CW typically produces a detected DC level in the circuitry and affects certain types of circuits. In general, experience has shown that modulation is more likely to cause degradation. CW should be included as an additional requirement when assessing circuits

which respond only to heat such as electroexplosive devices. CW should not normally be used as the only condition.

40.10.4.3 (4.10.4.3) Thresholds of susceptibility. When susceptibility indications are noted in EUT operation, a threshold level shall be determined where the susceptible condition is no longer present. Thresholds of susceptibility shall be determined as follows:

- a. When a susceptibility condition exists, reduce the interference signal until the EUT recovers.
- b. Reduce the interference signal by an additional 6 dB.
- c. Gradually increase the interference signal until the susceptibility condition reoccurs. The resulting level is the threshold of susceptibility.
- d. Record this level, frequency range of occurrence, frequency and test level of greatest susceptibility, and other test parameters, as applicable.

DISCUSSION: It is usually necessary to test at levels above MIL-STD-461 requirements to ensure that the test signal is at least at the required level. Determination of a threshold of susceptibility is necessary when degradation is present to assess whether requirements are met. This information should be included in the EMITR. Threshold levels below MIL-STD-461 requirements are unacceptable.

The specified steps to determine thresholds of susceptibility standardize a particular technique. An alternative method sometimes utilized in the past was to use the value of the applied signal where the EUT recovers (step a above) as the threshold. Hysteresis type effects are often present where different values are obtained for the two methods.

40.11 (4.11) Calibration of measuring equipment and antennas. Test equipment and accessories required for measurement in accordance with this standard shall be calibrated in accordance with ANSI/NCSL Z540-1: "General Requirements for Calibration Laboratories and Measuring and Test Equipment", ISO 10012-1: "Quality Assurance Requirements for Measuring Equipment", or under an approved calibration program traceable to the NIST. In particular, measurement antennas, current probes, field sensors, and other devices used in the measurement loop shall be calibrated at least every 2 years unless otherwise specified by the procuring activity, or when damage is apparent. Antenna factors and current probe transfer impedances shall be determined on an individual basis for each device.

DISCUSSION: Calibration is typically required for any measurement device whose characteristics are not verified through