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APPENDIX S - DoD CONTRACTS
ELECTROMAGNETIC INTERFERENCE REQUIREMENTS
(May 2011)

I. GENERAL

This appendix is applicable when invoked by the purchase order. This appendix sets forth requirements for the submittal of electromagnetic interference control procedure, test procedures, and test reports.

The Electromagnetic Interference Control Procedures (EMICP) provides data to evaluate the contractor's design procedures and techniques for subsystems and equipment used to meet electromagnetic interference (EMI) control requirements based on MIL-STD-461.

The Electromagnetic Interference Test Procedures (EMITP) describes the measurement procedures that will be used to demonstrate that an equipment or subsystem complies with its contractual electromagnetic interference (EMI) requirements based on MIL-STD-461, including how the general test procedures in the standard will be applied to the specific equipment or subsystem.

Electromagnetic Interference Test Procedures should also be in accordance with DOD-STD-1399B, “Interface Standard for Shipboard Systems”, standard interface characteristics and constraints applicable to the design of ships and of shipboard equipment need to be defined to ensure interface compatibility within the shipboard environment. Section 1.4 of the standard states in part: “Circumstances may arise where the incorporation of requirements and constraints is considered impractical, or the expected shipboard environment will be less stringent than the postulated “worst case”. In such a situation, it may be desirable to tailor the section requirements to be cost-effective.”

The Electromagnetic Interference Test Report (EMITR) provides the data and information necessary to evaluate compliance of an equipment or subsystem with its electromagnetic interference (EMI) control requirements based on MIL-STD-461, including the discussion of recommended corrective actions, if needed.

This appendix contains the format and content preparation instructions for all EMICP’s, EMITP’s, and EMITR’s required by Section 5 of MIL-STD-461 (Series), as well as instructions for preparing these documents.

II. Electromagnetic Interference Control Procedures (EMICP)

The EMICP provides data to evaluate the contractor's design procedures and techniques for subsystems and equipment used to meet electromagnetic interference (EMI) control requirements based on MIL-STD-461.

This Data Item Description (DID) contains the format and content preparation instructions for the EMICP required by 5.1 of MIL-STD-461.

Requirements:

1. Format. Contractor format is acceptable.

2. Content. The EMICP shall contain the following:

2.1. Management. The EMICP shall address the following management areas:

a. Specific organizational responsibilities, lines of authority and control, and program planning, including milestones and schedules.

b. Detailed EMI requirements imposed on subcontractors.

c. Role in program of Government Furnished Equipment and subcontractor items.

d. Description of the equipment or subsystem, its function, characteristics, and intended installation.

e. Plans and procedures for identifying and resolving potential EMI problems, implementing solutions, and verifying solutions through analysis and testing.

f. Point of contact for EMI technical issues.

2.2. Design techniques and procedures. The EMICP shall describe the specific design techniques and procedures used to meet each emission and susceptibility requirement, including the following:

a. Spectrum management techniques.

b. EMI mechanical design, including the following:

(1) Type of metals, casting, finishes, and hardware employed in the design.

(2) Construction techniques, such as isolated compartments; filter mounting, isolation of other parts; treatment of openings (ventilation ports, access hatches, windows, metal faces and control shafts), and attenuation characteristics of Radio Frequency (RF) gaskets used on mating surfaces.

(3) Shielding provisions and techniques used for determining shielding effectiveness.

(4) Corrosion control procedures.

(5) Methods of bonding mating surfaces, such as surface preparation and gaskets.

c. Electrical wiring design, including cable types or characteristics, cable routing, cable separation, grounding philosophy, and cable shielding types and termination methods.

d. Electrical and electronic circuit design, including the following:

(1) Filtering techniques, technical reasons for selecting types of filters, and associated filter characteristics, including attenuation and line-to-ground capacitance values of AC and DC power line filters.

(2) Part location and separation for reducing EMI.

(3) Location, shielding, and isolation of critical circuits.

2.3. Analysis. The EMICP shall provide analysis results demonstrating how each applicable requirement is going to be met.

2.4 Developmental testing. The EMICP shall include a discussion of testing to be performed during development (such as evaluations of breadboards, prototypes, and engineering models).

III. ELECTROMAGNETIC INTERFERENCE TEST PROCEDURES (EMITP)

Requirements:

1. Format. A format that presents the EMITP in a clear and understandable manner with at least the required content of this appendix is acceptable.

2. Content. As a minimum, the EMITP shall contain the following:

2.1. Introduction. The introduction of the EMITP shall include the following:

- The purpose of the test
- Test Objectives
- Establish Total Susceptibility Test Times
- Establish Total Emission Test Times
- MIL-STD-461 Tailoring

a. A table describing all the tests to be performed, the applicable section within the EMITP, and the corresponding test procedure from MIL-STD-461.

b. Description of the Equipment Under Test (EUT), including its function, characteristics, intended installation, and power usage.

- The EUT shall be compared to the limit levels specified in MIL-STD-461 against the expected ship platform electromagnetic environment in order to determine which EMI standards are applicable and what, if any, modifications should be made to the limit levels in the standard.

c. Approved exceptions or deviations from contractual test requirements, if any.

2.2. Applicable documents. Applicable documents shall be listed as follows:

a. Military (such as standards and specifications).

b. Company (such as in-house documents used for calibration or quality assurance).

c. Other Government or industry standards, specifications, and documents.

d. Interface Control Documents

2.3. Test site. A description of the test site shall be provided covering the following:

a. Test facility and shielded enclosure or anechoic chamber, including size, characteristics, and placement of radio frequency (RF) absorbers.

b. Ground plane (size and type) and methods of grounding or bonding the EUT to the ground plane to simulate actual equipment installation.

c. Implementation of test precautions required by 4.3.7 of MIL-STD-461. Technicians will review test results on site with a *NNS* engineer (If attending) and will agree to any retests based on these results.

2.4. Test instrumentation. Test instrumentation to be used shall be described as follows:

a. Equipment nomenclature. Equipment Serial Number and Calibration Data can be referred to Interface Practices Subcommittee (IPS) test procedure EEB1-230-01, “Electromagnetic Compatibility Testing.”

b. Characteristics of coupling transformers and band-reject filters.

c. Antenna factors of specified antennas, transfer impedances of current probes, and impedance of Line Impedance Stabilization Networks (LISN).

d. Description of the operations being directed by computer programs/software for computer-controlled receivers, the verification techniques used to demonstrate proper performance of the software, and the specific versions of the software to be used.

e. Bandwidth (resolution and video) and scanning speeds of measurement receivers.

2.5. EUT setup. A description of the EUT test setup for each test shall cover the following:

a. Physical layout of the cables and EUT.

b. Cable types, characteristics, and construction details (see 4.3.8.6 of MIL-STD-461)

c. Position of the line impedance stabilization networks on the ground plane.

d. Use of bond straps and loads.

e. Test simulation and monitoring equipment.

f. EUTs are to be secured to mounting bases having shock or vibration isolators if such mounting bases are used in the installation. When mounting bases do not have bonding straps, bonding straps will not be used in the test setup. Hard mounting of the equipment enclosures to the ground plane can produce a low impedance path across the bonding interface over most of the frequency range of interest. The bonding straps associated with isolators will typically represent significant impedances at frequencies as low as tens of kilohertz. The common mode voltages associated with these impedances will generally be greater than the hard mounted situation. Therefore, care will be taken with common mode voltages so that they do not substantially influence the recorded test results.

g. Tailoring of DOD-STD-1399B shall be discussed in detail. Technical justification shall be provided. The deviation process detailed in Section 6 of DOD-STD-1399 shall be completed prior to qualification testing.

2.6. EUT operation. A description of the EUT operation shall cover the following:

a. Modes of operation for each test, including operating frequencies (where applicable), and rationale for selection.

b. Control settings on the EUT.

c. Control settings on any test stimulation and monitoring equipment and characteristics of input signals.

d. Operating frequencies (such as oscillator and clock frequencies) which may be expected to approach limits. An oscilloscope is also necessary in checking the system to ensure that the actual applied voltage is measured accurately and maintains a sinusoidal shape.

e. Performance checks initiated to designate the equipment as meeting minimal working standard requirements.

f. Enumeration of circuits, outputs, or displays to be monitored during susceptibility testing, as well as the criteria for determining degradation of performance.

g. During testing it would be reasonable to hypothesize that running the system at full power will give the maximum EMI readings.

2.7 Measurements. The following shall be described for each test:

a. 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.

b. Laboratories and Measuring and Test Equipment, IS0 10012-1: "Qual Assurance Requirements for Measuring Equipment," or under an approved calibration program traceable to the National Institute of Standards & Technology (NIST). In particular, measurement antennas, current probes, field sensors, and other devices used in the measurement loop shall be calibrated unless otherwise specified by the impedances shall be determined on an individual basis for each device.

c. Block diagram depicting test setup, including all pertinent dimensions.

d. Step-by-step procedures.

e. Test equipment used in performance of the test and the methods of grounding, bonding, or achieving electrical isolation of the measurement instrumentation.

f. Selection of measurement frequencies.

g. Information to be recorded during the test, including frequency and units of recorded information. Sample data sheets, test logs and graphs,

including test limits, may be shown.

h. Modulation characteristics and scan rates of the susceptibility test signals, if applicable.

i. Test equipment and accessories required for measurement in accordance with this standard shall be calibrated in accordance with ANSI/NCSL Z540.1: "Calibration Laboratories and Measuring and Test Equipment - General Requirements".

IV. ELECTROMAGNETIC INTERFERENCE TEST REPORT (EMITR)

Requirements:

1. Format. A format that presents the EMITP in a clear and understandable manner with at least the required content of this appendix is acceptable.

2. Content. As a minimum, the EMITR shall contain the following:

2.1. Administrative data. The EMITR shall contain an administrative section covering the following:

a. Contract number.

b. Authentication and certification of performance of the tests by a qualified representative of the procuring activity.

c. Disposition of the Equipment Under Test (EUT).

d. Description of the EUT, including its function, characteristics, intended installation, actual cable types (characteristics and construction details - see 4.3.8.6 of MIL-STD-461), and electrical current usage on each power input line.

e. List of tests performed with pass/fail indications.

f. Any approved deviations from contractual test procedures or limits previously authorized.

g. Identification of Non-Developmental Items (NDI) and Government Furnished Equipment (GFE) that may be part of the EUT.

h. Traceability of test equipment calibration.

i. A reference to the approved EMI test procedure (EMITP).

2.2. Detailed results. A separate appendix shall be prepared for each test. If deviations from an approved test procedure occurred during the test program, an additional appendix shall be provided with the as run procedures showing all red-lines and procuring activity concurrence. A separate appendix shall be provided for log sheets. Each test appendix shall contain the following factual data:

a. Test equipment nomenclature, serial numbers, version of software used (if any), and calibration due date.

b. Photographs or diagrams of the actual test set up and EUT, with identification.

c. Transfer impedance of current probes.

d. Antenna factors.

e. Impedance values of Line Impedance Stabilization Networks (LISN).

f. Identification of any suppression devices used to meet the contractual requirements, including schematics, performance data, and drawings.

g. Sample calculations, such as conversions of measured levels for comparison against the applicable limit.

h. The ambient radiated and conducted electromagnetic emission profile of the test facility, when necessary.

i. Data, and data presentation, as specified in the “data presentation” sections of the individual test procedures of MIL-STD-461.

j. Scan speeds (Time Durations of the Frequency Sweeps).

k. Measurement receiver bandwidths.

l. Antenna polarization.

m. Power line voltages, frequencies, and power factor.

n. Low-noise amplifiers (LNA) compression points.

o. Any thresholds of susceptibility that was determined.

2.3. Post Test reporting. Inspection data will be reviewed and analyzed. Measurements will be compared to calculated and tailored values. The post analysis team will perform the following upon completion of the test scenario.

a. At the testing conclusion for each day, a review will be conducted to verify that all the required test data was obtained, as defined in the test procedure. Test data will be compared to predicted values. Test anomalies (test failures or incidents) that occurred during a test, along with recommended corrective action, will be noted in the final test report.

b. The post test data will determine whether each test requirement/objective was realized, and whether the test was adequately fulfilled. The data analysis will be performed in a timely manner to minimize the lag time from test completion to final test report.

c. Other activities concern analyses and documentation of follow-up activities, such as post-test equipment calibrations and detailed data analysis. A standard library and database could be used to store post-test data.

d. All emissions test data could be recorded in a swept spectrum analog format at specified receiver bandwidths. The data will then be converted to logarithmic amplitude versus frequency printout, including a specification limit when applicable, by an ISO 9000-compliant software package. The measurement and analysis system can be used for both radiated and conducted emissions measurements. All susceptibility data can be acquired manually during the injection or radiation sweep. During testing, if the experimenter notes frequencies at which the test item is susceptible, these frequencies and threshold levels will be recorded manually on data log sheets. "

2.4. Conclusions and recommendations. Conclusions and recommendations shall be provided, including results of the tests in brief narrative form, a discussion of any remedial actions already initiated, and proposed corrective measures required (if necessary) to assure compliance of the equipment or subsystem with the contractual EMI requirements.