

MIL-STD-461B

MIL-STD-461B, dated 1 April 1980, has been in effect for nearly four years. Entitled *Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference*, this standard is to be used on all applicable military procurements. However, many procurements still lack the proper application of MIL-STD-461B or still refer to the predecessor, MIL-STD-461A.

MIL-STD-461A is no longer available through the Government Printing Office. Thus, when a procurement specification refers to MIL-STD-461A, it should include a copy with the procurement package. Government agencies may procure equipment using MIL-STD-461A as the EMI control requirement, especially for reprocurments.

Applications

The proper way for the government to apply MIL-STD-461A or earlier EMI control standards and specifications is to excerpt the specific requirements and include them in the procurement specification. This practice is frequently used by Army personnel and by other government agencies outside of the military establishment. Although it is not required when

applying MIL-STD-461B, it is still a good practice for the procurement agencies to follow. If a procurement specification simply refers to MIL-STD-461B as the EMI control requirement, it is requiring that the contractor interpret the applicable requirements or applicable portions of the standard. Many contractors are not equipped technically to perform this function and, thus, the requirements are subject to misinterpretation.

MIL-STD-461B is intended to be a universal standard for all U.S. military and governmental organizations, although it is used by many foreign military establishments. It has been structured into ten parts for ease of application. Whereas Part 1 applies to all procurements, the other parts have limited applicability depending upon the type of equipment procured, its end use, and/or its end location. For instance, Part 2 applies for aircraft, air launch missiles, aerospace ground equipment, and other aerospace related items. Part 3 applies to spacecraft and launch vehicles whereas Part 4 applies to ground facilities and includes vehicles. Table 1 shows the ten parts of the standard and their general applicability.

Class	Description	Applicable Part
A	Equipments and subsystems which must operate compatibly when installed in critical areas, such as the following platforms or installations:	
A1	Aircraft (including associated ground support equipment)	2
A2	Spacecraft and Launch Vehicles (including associated ground support equipment)	3
A3	Ground facilities (fixed and mobile, including tracked and wheeled vehicles)	4
A4	Surface Ships	5
A5	Submarines	6
B	Equipments and subsystems which support the Class A equipments and subsystems but which will not be physically located in critical ground areas. Examples are electronic shop maintenance and test equipment used in non-critical areas; aerospace ground equipment used away from flightlines; theodolites, navals and similar equipments used in isolated areas.	7
C	Miscellaneous, general purpose equipments and subsystems not usually associated with a specific platform or installation. Specific items in this class are:	
C1	Tactical and special purpose vehicles and engine-driven equipment	8
C2	Engine generators and associated components, uninterruptible power sets (UPS) and mobile electric power (MEP) equipment supplying power to or used in critical areas	9
C3	Commercial electrical or electromechanical equipment	10

Table 1. Equipment and Subsystem Classes vs. Applicable Part of MIL-STD-461 for Emission and Susceptibility Requirements and Limits.

Although MIL-STD-461B's organization into ten parts has enhanced its application, Parts 2 through 6 require additional interpretation depending upon the procuring activity. For instance, the Air Force and Navy may agree in the application of one requirement whereas the Army may have a different application and/or specification limit. In other cases, the Navy has a unique interpretation or limit whereas the Army and Air Force requirements may be similar. Thus, if the procuring activity fails to tailor the standard for their particular procurement, the contractor must do so by meticulously reading the applicability paragraph under each requirement.

Reprocurements

Reprocurements or procurements of equipment and systems having met other EMI requirements should have the original EMI requirements imposed. Such procurements are sometimes referred to as "built per drawing" and are electrically and mechanically identical to those previously procured. For such procurements, research and development is normally not required. However, if MIL-STD-461B is applied, the original design may not be adequate for compliance to the standard. Litigation is known to have occurred between a contractor and a government agency on a "built per drawing" contract when the government applied MIL-STD-461B and the equipment was originally designed to meet MIL-I-6181D. The drawings did not include provisions for meeting MIL-STD-461B and the contract did not include any engineering development work. Thus, the contractor proved in court that the government applied the wrong EMI control requirement. The government agencies have been advised that they should not change the EMI requirements in a reprocurement unless they fear or anticipate an EMI problem, or the equipment has experienced EMI problems. When they do upgrade to the latest standard, they should advise the contractor that this is a change so that the contractor may plan and budget design modifications. This is often overlooked since the involvement of design modifications requires additional engineering expense which the government is attempting to avoid in a reprocurement package.

Testing Requirements

Whereas MIL-STD-461 describes the requirement, MIL-STD-462 describes the test procedures. Unfortunately, MIL-STD-462 has not been fully revised to be consistent with MIL-STD-461B and some requirements do not have a stated test procedure. In order to compensate for this loophole, MIL-STD-461B states that the tests shall be performed in accordance with MIL-STD-462 or by a government approved EMI test plan. This gives the contractor considerable latitude in designing the tests to demonstrate that the equipment or subsystem is compliant with the requirements. For some of the new requirements imposed by the Navy, separate notices to MIL-STD-462 have been issued. For the new CE07 requirement, which addresses conducted emissions in the time domain measured on power lines, there is no test method specified. For the CS09 requirement pertaining to conducted susceptibility by injecting currents into the chassis of equipment, the Navy has issued Notice 4 to MIL-STD-462. Furthermore, in Part 5, addressing above-deck shipboard equipment, the Navy has specifically stated that modifications to the procedures of MIL-STD-462 may be required when radiation susceptibility testing (RS03) higher than 50V/m is required.

Future Modifications

In the Fall of 1983, a draft or proposed Notice 1 to MIL-STD-461B was circulated for review within the government. Comments have been received by the Navy and a revision to MIL-STD-461B can be expected within the next 9-12 months. The following are some of the more significant changes to MIL-STD-461B which are expected to be approved.

1. Paragraph 4.3.1, Part 1, addresses the maximum line-to-ground capacitance for EMI filters employed in prime power lines. This paragraph limits the maximum capacitance to $0.1 \mu\text{f}$ for 60 Hz equipment and $0.02 \mu\text{f}$ for 400 Hz equipment. Furthermore, it states that the filtering employed shall be fully described in the equipment or subsystem technical manual as well as the EMI test report. This requirement is consistent with the requirements of MIL-STD-454 and MIL-E-16400 which limits leakage current in primary power lines to 5 ma. It is intended to avoid a personnel shock hazard situation and to limit the amount of power line harmonic current conducted through the chassis, fuselage, or ship's hull. It is expected that this requirement will be deleted for equipment under Parts 2 and 3 of MIL-STD-461B which are procured solely for Air Force use.

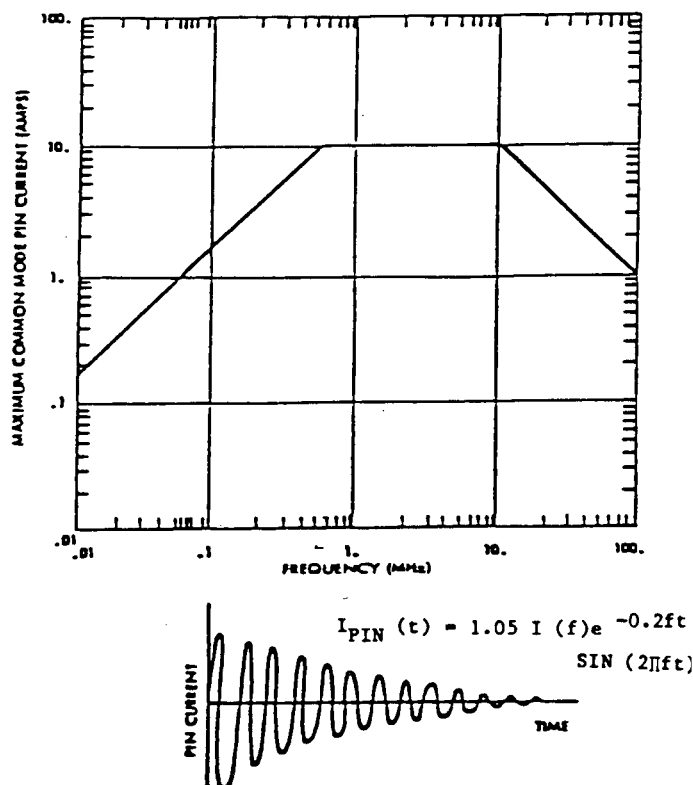


Figure 1. Limit for CS10.
Interface PIN Current.

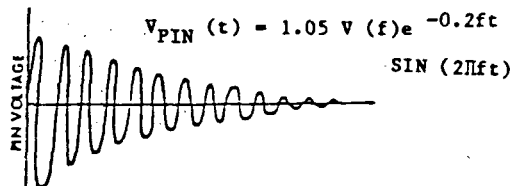
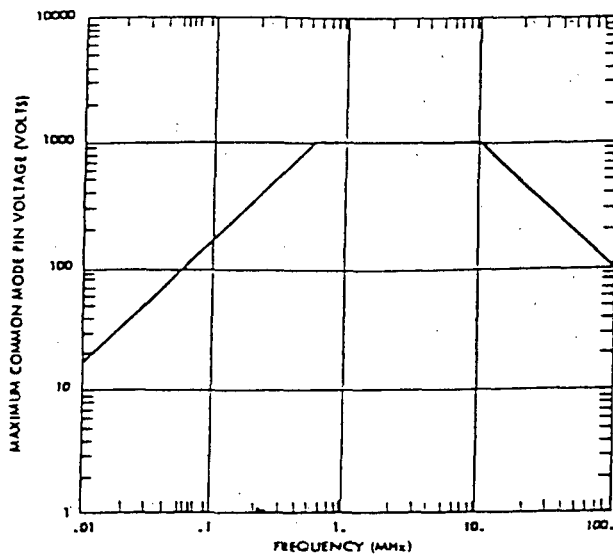


Figure 2. Limit for CS10.
Interface PIN Voltage.

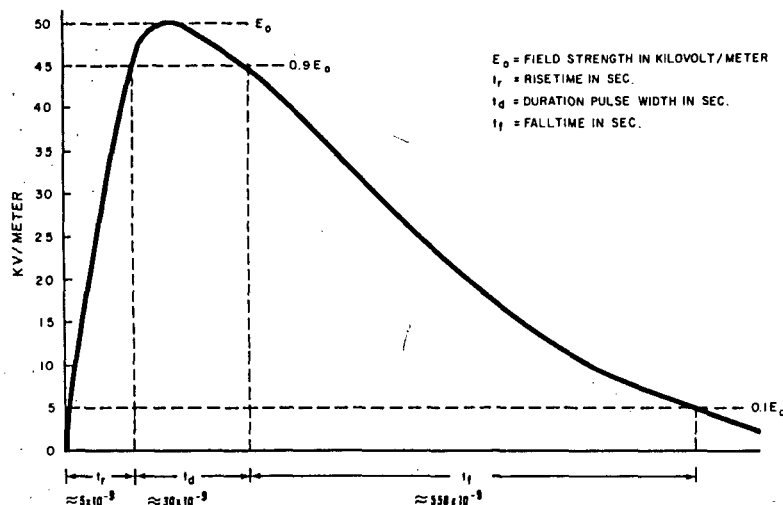


Figure 3. Limit for RS05.

2. MIL-STD-461B contains five different transient characteristics as susceptibility criteria under CS06, "Conducted Power Line Susceptibility" and RS02, "Radiated Magnetic Field Susceptibility." For all these transient definitions, the time base is given as equal to or less than the value shown. This is expected to be modified with the time base equal to the value shown, *plus or minus 20 percent*. Solar Electronics now offers a transient generator which meets this criteria.
3. Two new requirements are expected to be added. These are CS10, "Conducted Susceptibility, Damped Sinusoidal Transients" and RS05, "Radiated Susceptibility, Damped Sinusoidal Electromagnetic Field Transients." Figures 1, 2, and 3 illustrate the requirements.

These requirements are added in order to address the electromagnetic pulse (EMP) threat. The government has apparently performed sufficient analysis to estimate the current and voltage characteristics of an EMP transient that will be induced into cable and harnesses. This represents the first introduction of EMP requirements into an EMI document, thus converting MIL-STD-461B into an E³ (Electromagnetic Environmental Effects) document. If these new requirements are in fact included in future revisions of MIL-STD-461B, an additional notice to MIL-STD-462 will be issued to describe the test methods. Notice 5 to MIL-STD-462, containing the proposed test methods was distributed in draft form for review. Although the final and official version is likely to change, it is interesting to note that the compliance to the RS05 requirement is to be verified through analysis. Testing was not required in the review draft that was circulated.

Summary

It is important that all users of MIL-STD-461B fully recognize and appreciate the document's intent. The purpose of the document is to help provide assurance that the equipment or subsystem will be compatible in its end environment and adjacent to other equipment and subsystems. It is not a means unto itself. Thus, the end environment must be considered in order to properly apply MIL-STD-461B. In most cases, it is not practical to assume that the contractor has the ability to make this definition. The standard refers to MIL-HDBK-235 which defines specific classified environments. Unfortunately, some procurement specifications simply state to use MIL-STD-461B and MIL-HDBK-235 without further definition. This usually results in much confusion and ultimately the deletion of the application of MIL-HDBK-235. A one day seminar entitled, "The Interpretation and Application of MIL-STD-461B," is offered by R & B Enterprises. Although this seminar is offered on a regularly scheduled basis, it is also available on a dedicated basis as an in-house seminar for both contractors and government activities.

This article was prepared by Robert D. Goldblum, Publisher of ITEM and the principal instructor of R & B Enterprises MIL-STD-461B training seminar and course program.