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Technical Note

MIL-STD 188-125

Referencing MIL-STD 188-125 for Commercial Applications

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05/2012 | 1474-006 RevB

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Electromagnetic Pulse (EMP) is an intense electromagnetic field that can instantly overload electrical circuits and damage microelectronics, electrical control and communications systems as well as electric power distribution networks. Produced in the atmosphere by the gamma ray pulse of a nuclear explosion, it is referred to as High-Altitude Electromagnetic Pulse (HEMP) or Nuclear Electromagnetic Pulse (NEMP), which affects electronic equipment over a wide area. Other sources of EMP include nuclear explosions on the ground, man-made weapons like High Power Microwave (HPM) or Directed Energy Weapons (DEW) as well as natural causes like solar storms and lightning.

The widespread, detrimental effects of an EMP/HEMP event are well understood and recognized within military theaters. To protect critical systems, the US military established a comprehensive set of standards. MIL-STD 188-125-1 and -2 in particular describe the threat environment, test methods and minimum protection requirements for high-altitude electromagnetic pulse (HEMP) hardening of fixed and transportable ground-based facilities which perform critical, time-urgent command, control, communications, computer, and intelligence (C4I) functions.

Since any environmental effects of an EMP/HEMP event would also expand to the civilian infrastructure, the International Electrotechnical Commission attempted to establish a civilian set of standards resulting in IEC61000-1. While the military standard provides definitive limits for electric free field shielding and pulse current injection testing, the IEC standards generally use electric system disruption as a pass fail criteria.

Due to the extensive detail, highest performance requirements and credibility of the originating authority, MIL-STD 188-125 has become the most widely respected and referenced EMP/HEMP protection standard around the world. Nevertheless, proper application of this standard for non-US military applications is severely misunderstood. This paper emphasizes the purpose of MIL-STD 188-125 and explains its correct use for commercial or non-US military applications in an economically feasible way.

MIL-STD 188-125 – Purpose

MIL-STD 188-125-1 and -2 describe the threat environment and protection requirements for absolute critical command and control applications with no margin for disruption of command chain communications. These tests are severe and the pass requirements are conservative in the extreme. After all, this standard is intended to preserve the executive chain of command of the US armed forces. While the standards are under the responsibility of the US Defense Threat Reduction Agency (DTRA), the actual implementation falls within the governance of the US Strategic Command - operational and survivability branch of the US Armed Forces. Facilities regarded as critical command and control assets required to comply with the provisions are identified by the Joint Chiefs of Staff, Military Department Headquarters, or a Major Command.

US military suppliers of equipment classified as critical per MIL-STD 188-125 have to comply with all provisions as applicable.

MIL-STD 188-125 – Application to Non-US Military Situations

The complexity of the provisions of MIL-STD 188-125 requires considerable investment in time and resources to understand and apply each one. Achieving full protection can quickly become an expensive endeavor. To keep financial expenses in check, many businesses and organizations referencing

MIL-STD 188-125 thus consider not applying it in its entirety but attempt to extract the most important aspects. However, MIL-STD 188-125 is not a pick-and-choose menu. To effectively protect a system from EMP induced damages, the complete standard must be applied. Skipping critical shielding or filter investments could compromise the entire shelter environment.

Despite the stipulation of having to apply the standard in its entirety, it is possible to do so in an economically feasible way. As discussed earlier, MIL-STD 188-125 is designed for facilities that perform critical, time-urgent functions. This is an important aspect as it allows for scalability. For a business, the entire facility may not be critical, but instead only specific systems or servers that may fit into a room or even box. In addition, it needs to be determined whether the system needs to operate through an EMP/HEMP event or if it can accept brief disruptions as long as it can return to normal service after the event. System designers are encouraged to identify the core service or key asset that must be protected and build it into a fully compliant EMP vault at a small scale.

Conclusion

MIL-STD 188-125 has been designed to protect critical communications systems from HEMP damage in the most extreme environments under the most severe conditions. As such, it is an authoritative reference for any agency or organization looking to safeguard its communication structure and assets. To effectively protect a system, the standard has to be applied in its entirety. Despite its complexity, doing so can be accomplished in an economically feasible way by scaling the protection efforts down to the most critical assets of a system.

Appendix

Summary of Sections

The MIL-STD 188-125 -1 and -2 documents for fixed and transportable ground-based facilities are divided into three main parts: definitions, requirements and test procedures.

The definitions in part one provide a solid base of terms and descriptions to support further discussion, design and construction. Part two, General and Detailed requirements, provides a foundation to build an understanding of shielding and filter principles upon which to execute the actual construction of the HEMP facility. The Test section establishes baseline requirements that allow pass/fail conclusions and unbiased decisions to determine whether or not the system is adequately shielded. Three test procedures are documented: A-Shielding Effectiveness, B-Pulse Current Injection and C-Continuous Wave Immersion.

The differences between MIL-STD 188-125-1 and -2 manifest in grounding and Pulse Current Injection limits. While the necessity of bonding all metallic construction does not change, mobile applications are not always connected to Earth. With fewer connections to fixed AC power and long haul land lines, the pulse current injection severity is reduced by approximately half for mobile applications. Test requirements and residual let-through limits are summarized in the appendix. Note that the difference in Pulse Current Injection limits for MIL-STD 188-125-1 versus -2 demonstrates the lower injection requirements for mobile applications.

MIL-STD 188-125 does not include any references towards conducted insertion loss testing. These tests are necessary to properly characterize a filter and can be found in MIL-STD 461 and MIL-STD 220. Engineers are reminded that MIL-STD 188–125–1 and -2 are based on free field EMP environments produced from the gamma rays and Compton effects from high-altitude nuclear detonation. These free fields, which can reach strengths of up to 50 kV/m, induce currents and voltages into electrical systems but tests described in the standard do not measure conducted insertion loss.

MIL-STD 188-125 also offers the option of installing special protective measures in place of complete adherence to the shielding effectiveness and pulse current injection testing protocol. This means alternative protection solutions are acceptable if they meet test requirements and offer enough protection to maintain system operation.

Please contact us for questions or further information on this topic.

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