

MIL-STD-1678
DEPARTMENT OF DEFENSE STANDARD PRACTICE
FIBER OPTIC CABLING SYSTEMS REQUIREMENTS
AND MEASUREMENTS

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Introduction

MIL-STD-1678-DEPARTMENT OF DEFENSE STANDARD PRACTICE FIBER OPTIC CABLING SYSTEMS REQUIREMENTS AND MEASUREMENTS is an outgrowth of a decade of lessons learned from airborne platform maintenance and training personnel, defense acquisition program office professionals, and defense civilian and contractor subject matter expert professionals.¹ Requirements and methods specified in MIL-STD-1678 are intended to standardize and minimize variations in requirements, parts, test setups, test measurement procedures, test sample fabrication configurations, support equipment, and other aspects that must be addressed for completeness.

MIL-STD-1678 also aims to reduce airborne fiber optic system total ownership cost by addressing performance, cost, supportability, maintainability, reliability, durability, producibility, quality, and safety.² MIL-STD-1678 complements aerospace fiber (MIL-PRF-49291), fiber optic cable (MIL-PRF-85054), fiber optic termini (MIL-PRF-29504), fiber optic connector (MIL-PRF-64266) and splice (MIL-PRF-24623) performance specifications. MIL standards and specifications are published and maintained by Defense Logistics Agency, and are available on the Internet via downloaded files.³

Part 1: Design and Installation Requirements

Part 1 provides detailed design requirements for aerospace platforms that use cable harnesses to transport data through optical fiber among communication network and end use equipment such as weapons replaceable assemblies, line replaceable units/modules, and air transport racks. Part 1 emphasizes the benefits of specifying a consistent design approach throughout the fiber optic system engineering process to assure that the fiber optic system will perform as designed for the life of the system. Part 1 encompasses fiber optic cabling routing, placement and other specific design practices, cabling components, cable repair, cable and equipment labeling, equipment interfaces, built-in-test, loss budget calculation, optical measurements and inspection, endface geometry inspection, post-cable installation inspection, cabling quality conformance inspection, and cabling documentation requirements.

Part 2: Optical Measurements

Part 2 bounds the performance of each optical test measurement addressed in a qualification test, and augments other test methods to ensure consistency with setup and measurement procedures. Part 2 specifies optical measurements (insertion loss, change in optical transmittance, optical crosstalk, optical signal discontinuity, optical return loss and attenuation rate) and support processes for optical measurements (test procedures, optical test instrumentation and launch conditions).

Part 3: Physical, Mechanical, Environmental and Material Measurements

Part 3 provides performance limits for each physical, mechanical, environmental and material test measurement or inspection addressed in a qualification test. Part 3 specifies physical measurements (size, weight, workmanship, marking, visual and mechanical), mechanical (vibration, shock, cable scraping resistance), environmental (temperature cycling, temperature-humidity cycling, temperature life, thermal shock, altitude immersion, weathering, freezing water immersion, electromagnetic effects), and material

measurements (fungus resistance, salt spray and SO₂/salt spray, ozone exposure, smoke generation and flame propagation, toxicity index, shell-to-shell conductivity, fluid immersion and cable jacket strength and elongation).

Part 4: Test Sample Configuration and Fabrication Requirements

Part 4 constrains the configuration and fabrication of test samples for the fiber optic components addressed in a qualification test, and augments the fabrication method to ensure consistency with use of the same components (such as cable types) and processes. Part 4 also augments the component specification to ensure consistency of the test sample configuration. Part 4 addresses fiber, terminus, connector, cable and mechanical splice components.

Part 5: Design Phase and Legacy Measurements

Part 5 addresses some test methods cited in the former DOD-STD-1678. Although the test methods cited on DOD-STD-1678 are considered obsolete, a few military specifications and commercial standards still refer to some of the test methods. This residual DOD-STD-1678 content is provided under the restrictions cited in MIL-STD-1678.

Part 6: Parts and Support Equipment Commonality and Standardization Requirements, Cable Harness Configurations

MIL-STD-1678, Part 6 addresses component part and support equipment standardization requirements for platforms. Part 6 was prepared primarily to ensure commonality and standardization (consistency) by listing those fiber optic parts and support equipment found suitable for use and specified in the General Series Technical Manual NAVAIR 01-1A-505-4/T.O. 1-1A-14-4/TM 1-1500-323-24-4. Part 6 requires fiber optic design requirements to be based on total ownership cost. Total ownership cost criteria specified in MIL-STD-1678, Part 6 are:

- Use of standard processes and practices as specified in MIL-STD-1678-1.
- Use of standard parts as specified in MIL-STD-1678-1 and MIL-STD-1678, Part 6.
- Use of standard support equipment as specified in MIL-STD-1678, Part 6.
- Reducing training costs by applying standard processes, practices and parts selection into system designs as specified in MIL-STD-1678-1 and by applying commonality in use of the parts and support equipment as specified in MIL-STD-1678, Part 6.
- Reducing logistic support costs by implementing standard processes, practices and parts selection into system designs as specified in MIL-STD-1678-1 and by implementing standardization of parts and support equipment as specified in MIL-STD-1678, Part 6.
- Use practices that improve reliability, maintainability, durability, performance, producibility, quality, and safety over the entire expected service life of the platform.

Conclusion

MIL-STD-1678 specifies requirements that address airborne platform fiber optic system total ownership cost factors including performance, cost, supportability, maintainability, reliability, durability, producibility, quality, and safety.

References

- [1] M.J. Hackert and O. Muja, "Activities of the Joint Fiber Optic Working Group," Proc. IEEE Avionics Fiber Optics and Photonics Conference, pp. 7-9, 2006.
- [2] M.W. Beranek, A.R. Avak and R.L. VanDeven, "Military digital avionics fiber optic network design for maintainability and supportability," IEEE Aerospace and Electronic Systems Magazine, vol. 21, no. 9, pp. 18-24, 2006.
- [3] M. Beranek, M. Hackert, B. McDermott, J. Cotterill, E. Ebert, L. Feix and D. Martinec, "Military and aerospace standards for digital avionics fiber optic systems," Proc. 30th AIAA/IEEE Digital Avionics Systems Conference, pp. 7B2-1 - 7B2-12, 2011.