



IPC-D-640A

Design and Critical Process Requirements for Optical Fiber, Optical Cable and Hybrid Wiring Harness Assemblies

Developed by the Fiber Optic Cable Acceptability Task Group (7-31m)
of the Acceptability Subcommittee (7-31) of IPC

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Users of this publication are encouraged to participate in the
development of future revisions.

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Table of Contents

1	GENERAL	1	2.12	Telecommunications Industry Association	7
1.1	Scope	1	2.13	UL	7
1.2	Purpose	1	2.14	United States Department of Defense (DoD)	7
1.3	Performance / Product Classification	1	2.15	Reference	7
1.4	Definition of Requirements	2	3	DESIGN PHILOSOPHY	8
1.4.1	Design Requirement Format (A/N)	2	3.1	General Design Requirements	9
1.4.2	Requirements Flowdown	2	3.2	System Requirements Specification (SyRS)	10
1.4.3	Note(s) / Italicized Text	2	3.2.1	Interface Control Document (ICD)	10
1.4.4	Commercial Off-the-Shelf (COTS)	2	3.2.2	System Power Budget (Link Loss Budget + Unallocated Margin)	16
1.4.5	Existing or Previously Approved Designs	2	3.2.3	Performance and Reliability	18
1.4.6	Line Drawings and Illustrations		3.2.4	Environmental Requirements	19
1.5	Measurement Units and Applications	3	3.2.5	Packaging, Handling, Shipping and Transportation (PHS&T)	19
1.6	Acronyms, Abbreviations, and Terms	3	3.2.6	Documentation Requirements	19
1.6.1	Use of "Lead"	3	3.2.7	Intellectual Property (IP) Control Requirements	19
1.6.2	Periodic Table Elements	3	3.2.8	Physical Security	19
1.7	Engineering Documentation	3	3.2.9	Supply Chain Traceability	19
1.8	Order of Precedence	3	3.2.10	Fiber/Cable Storage	19
1.8.1	Conflict	3	4	SELECTION OF PARTS, MATERIALS AND PROCESSES	19
1.8.2	Clause References	4	4.1	Commonality	20
1.9	Appendices A and B	4	4.3	Outgassing	20
1.10	Approval of Departures From Standards and Requirements	4	4.4	Materials Requiring Cure	20
1.11	Foreign Object Debris (FOD) Control Plan	4	4.5	Dissimilar Metals	20
1.12	Safety	4	4.6	Optical Fiber and Cable	20
1.12.1	Chemicals	4	4.6.1	Strength Member	21
1.13	Electrostatic Discharge (ESD) Protection	5	4.6.2	External Jacket(s)	21
2	APPLICABLE DOCUMENTS	6	4.6.3	Cable Types	21
2.1	IPC	6	4.7	Connectors	24
2.2	Joint Industry Standards	6	4.7.1	Mating Provisions	24
2.3	American Society of Mechanical Engineers (ASME)	6	4.8	Attenuators, Couplers, Splices, and Other Interconnecting Components	26
2.4	ASTM International	6	4.8.1	Attenuators	26
2.5	EOS/ESD Association	6	4.8.2	Couplers	26
2.6	Institute of Electrical and Electronics Engineers (IEEE)	6	4.8.3	Isolators	27
2.7	International Electrotechnical Commission (IEC)	6	4.8.4	Pigtailed Component	27
2.8	International Organization for Standardization (ISO)	6	4.8.5	Splices	27
2.9	Laser Institute of America (LIA)	6	4.8.6	Identification and Marking	28
2.10	National Fire Protection Association (NFPA)	6	4.9	Prohibited/Restricted Usage Parts, Materials, Processes (PMP)	30
2.11	SAE International	7			

4.9.1	Acetic Acid Cure RTV Silicone Sealants, Adhesives and Coatings	30	7	CLEANING	38
4.9.2	Beeswax / Wax (All Types) Lacing Tape	30	7.1	General Requirements	38
4.9.3	Beryllium (Be)	31	7.1.1	Solvents	38
4.9.4	Cadmium (Cd)	31	7.1.2	Wipes/Swabs	39
4.9.5	Cuprous Oxide Corrosion (Red Plague)	31	7.1.3	Drying	39
4.9.6	Fluorine Attack (White Plague)	31	8	DOCUMENTATION	39
4.9.7	FN/HN Grade Polyimide	32	8.1	General	39
4.9.8	Glass / Glass-Like Materials	32	8.2	Data	39
4.9.9	Use of Lead-Free Tin (Sn) Materials and/or Processes	32	8.3	Connector Orientation (Clocking)	40
4.9.10	Lock Washers (Star/Tooth Type)	33	8.4	Connector Pin-Out	40
4.9.11	Magnesium (Mg)	33	8.5	Dimensioning and Tolerance	40
4.9.12	Mercury (Hg)	33	8.6	Documentation for Maintenance / Emergency Restoration	41
4.9.13	Micro-D Connectors	33	9	TAILORING	41
4.9.14	Natural Rubber Materials	33	9.1	Alternate Technological Applications – Fiber Optic Sensor (FOS)	41
4.9.15	Polyvinyl Chloride (PVC / Vinyl)	34	10	DEFINITIONS AND ACRONYMS	42
4.9.16	Silver (Ag)	34	11	TABLES	55
4.9.17	Splices	34	APPENDIX A	SPACE / MILITARY / HAZARDOUS APPLICATIONS REQUIREMENTS	62
4.9.18	Zinc (Zn)	34	APPENDIX B	TEST METHODS FOR THE VERIFICATION OF OPTICAL FIBER FABRICATION PROCESSES	64
4.10	Time-Critical or Limited-Life	34		Tables	
4.11	Moisture Protection	34	Table 11-1	Bend Radius	55
5	ASSEMBLY	35	Table 11-2	Optical Fiber / Cable Length Measurement Tolerance	56
5.1	Optical Fiber End Preparation	35	Table 11-3	Optical Power (Absolute Power and Power Loss)	56
5.2	Optical Fiber – Connector Termination	35	Table 11-4	Typical Transmitter Specifications	56
5.3	Adhesives	35	Table 11-5	Comparison of LED and LD Transmitter Parameters	57
5.3.1	Adhesives Selection	35	Table 11-6	Comparison of Optical Cable Types	57
5.3.2	Process Controls	35	Table 11-7	Typical Optical Fiber Specifications	58
6	INSTALLATION	36	Table 11-8	Standard Test Conditions	59
6.1	General Installation Requirements	36	Table 11-9	Extended Test Conditions	59
6.1.1	Bundling (Fiber in the Wiring Harness)	36	Table A-1	Space / Military / Hazardous Applications Requirements	62
6.1.2	Conduits	36	Table B-1	Test Methods for the Verification of Optical Fiber Fabrication Processes	64
6.1.3	Cable Alignment and Bend Radius	36			
6.1.4	Fiber Alignment and Bend Radius	36			
6.1.5	Tensile Load	37			
6.1.6	Mating	37			
6.1.7	Torquing	37			
6.1.8	CTE Issues	37			
6.2	Routing	37			
6.3	Protection and Support	37			

Figures

Figure 1-1	Optical Fiber Assemblies, Cables And	1	Figure 4-11	Crashed Endface	25
Figure 3-1	Basic Types of Optical Cables	8	Figure 4-12	Attenuator	26
Figure 3-2	Design Process Flowchart.	11	Figure 4-13	T-Coupler/Splitter.	26
Figure 3-3	Physical Contact (PC) Connector (X-Section)	12	Figure 4-14	Isolator	27
Figure 3-4	Common Commercial Single-Channel PC Connectors	13	Figure 4-15	Pigttailed Component (Cover removed).	27
Figure 3-5	Optical Fiber Contact (M29504/4 & M29504/5)	14	Figure 4-16	Mechanical Splice.	27
Figure 3-6	Multi-channel Optical Connector (ARINC 801)	13	Figure 4-17	Waxed Lacing Tape.	30
Figure 3-7	Expanded Beam (EB) Connector (X-Section)	14	Figure 4-18	Red Plague (Cuprous Oxide Corrosion)	31
Figure 3-8	EB Single-Channel Contact	14	Figure 4-19	White Plague (Fluorine Attack)	31
Figure 3-9	EB Multi-channel Connector	14	Figure 4-20	FN/HN Grade Polyimide	32
Figure 4-1	Simplex / Duplex Detail	21	Figure 4-21	Glass / Glass-Like Materials.	32
Figure 4-2	Distribution Cable Detail	21	Figure 4-22	Tin Whiskers on Cardguide	32
Figure 4-3	Breakout Cable Detail.	21	Figure 4-23	Lock Washer	33
Figure 4-4	Loose Tube Cable Detail	22	Figure 4-24	Serrated-Face / Wedge-Lock Washer (Paired Set)	33
Figure 4-5	Ribbon Cable Detail	22	Figure 6-1	Improper Axial Alignment	36
Figure 4-6	Armored Cable Detail.	22	Figure 8-1a	Connector Orientation (Clocking) and Mating Face View	40
Figure 4-7	Armored Cable, Rodent-Deterrent Variant.	23	Figure 8-1b	Connector Orientation (Clocking), Example - APC Connector without Dust Cap	40
Figure 4-8	Aerial Armored Cable Detail	23	Figure 8-1c	Connector Orientation (Clocking), Example - LC Connector without Dust Cap	40
Figure 4-9	Blown Optical Fiber Tube (BOFT).	23	Figure 8-1d	Connector Orientation (Clocking), Example - MPO Connector without Dust Cap	40
Figure 4-10	Hybrid Connector	24			

Design and Critical Process Requirements for Optical Fiber, Optical Cable and Hybrid Wiring Harness Assemblies

1 GENERAL

1.1 Scope This document provides design and critical process requirements and technical insight for cable and wire harness assemblies incorporating optical fiber, optical cable and hybrid wiring technology. Reference materials listed in this text are among those considered as required reading. The User is encouraged to obtain all relevant referenced materials, as this document cannot (nor can any single document) cover every material, process, environment, performance, or safety aspect, that impact a given design.

1.2 Purpose This standard is intended to provide information on the general design requirements for optical fiber, optical cable, hybrid wiring harness assemblies, and Fiber Optic Communications Systems (FOCS) to the extent that they can be applied to the broad spectrum of optical cable and wiring harness design.

This document is intended for use by the design engineer, manufacturing engineer, quality engineer, or other individual, responsible for the tailoring of specific requirements of this document to the applicable performance class.

It is not the intent of this document to exclude any alternate documents or processes that meet or exceed the baseline requirements established by this document. Use of alternate documents or processes **shall [A1A2A3]** require review and prior approval of the User.

For purposes of this document:

- a. The Designer is the design agent for the User.
- b. The User is the individual, organization, company, contractually designated authority, or agency responsible for the procurement or design of electrical / electronic / electromechanical (EEE) hardware, and having the authority to define the class of product and any variation or restrictions to the requirements of this document (i.e., the originator / custodian of the contract detailing these requirements). The User is considered the Design Authority.
- c. The Supplier is considered the individual, organization or company which provides the Manufacturer (assembler) components (electrical, electronic, electromechanical, mechanical, printed boards) and/or materials (solder, flux, cleaning agents).
- d. The Manufacturer is considered the entity that provides a service or product to the User.

1.3 Performance / Product Classification This document recognizes that optical wiring harnesses and cable assemblies are subject to performance / product classifications by intended end-item use. Three general end-product classes have been established to reflect differences in producibility, complexity, functional performance requirements, and verification (inspection/test) frequency. It should be recognized that there may be requirement overlaps between classes.

The User is responsible for defining the product class. The contract **shall [A1A2A3]** specify the performance class required, whether compliance to any of the Appendices is required, and indicate any exceptions to specific parameters where appropriate.

CLASS 1 – General Electronic Products

Includes products suitable for applications where the major requirement is function of the completed assembly.

CLASS 2 – Dedicated Service Electronic Products

Includes products where continued performance and extended life is required, and for which uninterrupted service is desired but not critical. Typically, the end-use environment would not cause failures.

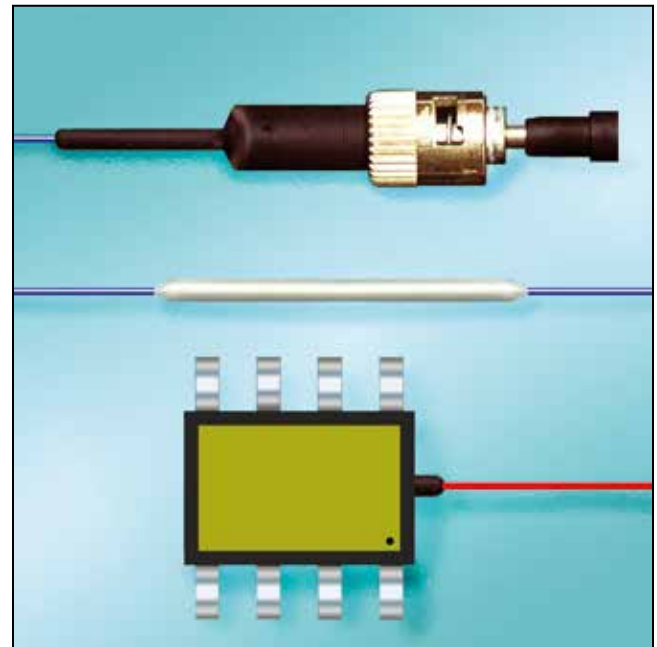


Figure 1-1 Optical Fiber Assemblies, Cables And Wiring Harnesses Connector, Splice and Transmitter
Image credit: NASA

CLASS 3 – High-Performance Electronic Products

Includes products where continued high performance or performance-on-demand is critical, equipment downtime cannot be tolerated, end-use environment may be uncommonly harsh, and the equipment must function when required, such as life support or other critical systems.

Space / Military / Hazardous Applications

Includes products from Class 3, with additional considerations for unique materials requirements (e.g., flammability, outgassing), exposure to extreme operational conditions (e.g., vibration and thermal cycling, shock, gravitational-loading), and extreme or sensitive operational environments (e.g., oil and gas exploration, petrochemical, food, pharmaceutical). Space / Military / Hazardous classification deviations to IPC-D-640A requirements are defined and listed in Appendix A.

1.4 Definition of Requirements The imperative form of action verbs are used throughout this document to identify acceptance requirements that may require compliance, depending upon the Performance Classification of the hardware.

- a. **SHALL / SHALL NOT** – The words **shall** or **shall not** are used whenever a requirement is intended to express a provision that is mandatory.
 - 1) To assist the users of this standard (e.g., User, Manufacturer, Designer), the action verbs **shall** and **shall not** are displayed in **bolded text**.
 - 2) Deviation from a **shall** or **shall not** requirement for a particular Performance Class may be considered if sufficient technical rationale/objective evidence (OE) is supplied to the User to justify the exception.
- b. **SHOULD / SHOULD NOT** – The words “should” or “should not” are used whenever a requirement is intended to express a provision that is nonmandatory, and which reflects general industry practice and/or procedure. The words “should” or “should not” are displayed in unbolded text.

1.4.1 Design Requirement Format (A/N) This is a design document, and the requirements are formatted to allow verification and validation (V&V). As such, there are no quality acceptance conditions specified in the document. To assist the User, each requirement in the design section of the document is identified by its Performance Classification (x1x2x3) and applicability, where “x” represents:

N = Not Applicable
A = Applicable

Examples:

[N1N2A3] = Not Applicable for Class 1 or Class 2; Applicable for Class 3

[N1A2A3] = Not Applicable for Class 1; Applicable for Class 2 and Class 3

[A1A2A3] = Applicable for all Classes

1.4.2 Requirements Flowdown This document **shall not [A1A2A3]** be binding, unless separately and specifically included by the applicable contract, approved drawing(s), or purchase order.

- a. When invoked, the applicable requirements of this document **shall [A1A2A3]** be imposed on all applicable subcontracts, assembly drawing(s), documentation, and purchase orders.

1.4.3 Note(s) / Italicized Text Information provided in Notes or presented as italicized text is for informational purposes only.

1.4.4 Commercial Off-the-Shelf (COTS) The requirements of this document **shall not [A1A2A3]** apply to Commercial-Off-the-Shelf (COTS) or catalog items (e.g., components, assemblies, sub-assemblies and/or hardware).

- a. The design and workmanship of COTS items should be evaluated and modified as required to ensure that the use of COTS in wiring harnesses and cable assemblies meets contract performance and reliability requirements.
- b. Modifications of COTS **shall [A1A2A3]** be documented.
- c. All modifications **shall [A1A2A3]** meet the applicable requirements of this document for the specified Product Class, and be completed, inspected, and tested in accordance with this document, unless otherwise specified by the User.

1.4.5 Existing or Previously Approved Designs The requirements of this document **shall not [A1A2A3]** constitute the sole cause for the redesign of previously approved designs.

- a. When drawings for existing or previously approved designs undergo revision, they should be reviewed and changes made that allow for compliance with the requirements of this document.