

---

# Generic Requirements for Fiber Optic Dispersion Compensators

## Contents

1.	Introduction .....	1-1
1.1	Purpose and Scope of Document .....	1-1
1.2	Requirements Terminology .....	1-2
1.3	Requirement Labeling Conventions .....	1-3
1.3.1	Numbering of Requirement and Related Objects .....	1-3
1.3.2	Requirement, Conditional Requirement, and Objective Object Identification .....	1-3
1.4	Organization .....	1-3
1.5	Changes from Previous Issue .....	1-4
2.	General Information .....	2-1
2.1	Components in Scope of Document .....	2-1
2.2	Chromatic Dispersion Limitations .....	2-2
2.2.1	Chromatic Dispersion of Dispersion-Unshifted Fiber .....	2-2
2.2.2	Pulse Broadening .....	2-3
2.2.3	Dispersion-Limited Length .....	2-4
2.2.4	Types of Dispersion Compensation .....	2-6
2.2.4.1	Compensation by the Transmitter or Receiver .....	2-6
2.2.4.2	Active Compensation Along the Optical Path .....	2-7
2.2.4.3	Passive Compensation Along the Optical Path .....	2-7
2.3	Passive Dispersion Compensator Parameters .....	2-10
2.3.1	Operating Wavelength Range .....	2-11
2.3.2	Chromatic Dispersion .....	2-11
2.3.3	Dispersion Compensation Rate .....	2-13
2.3.4	Insertion Loss .....	2-14
2.3.5	Reflectance .....	2-14
2.3.6	Polarization .....	2-15
2.3.6.1	Polarization-Dependent Loss .....	2-15
2.3.6.2	Polarization-Mode Dispersion .....	2-15
2.3.7	Optical Non-Linearity .....	2-16
2.4	Dispersion Compensator Applications .....	2-16
2.4.1	Higher Bit-Rates .....	2-16
2.4.2	Longer Unrepeated Spans .....	2-17
2.4.3	Multiwavelength Transmission .....	2-18
2.5	Environmental Conditions .....	2-19
3.	General and Design Criteria .....	3-1
3.1	Documentation .....	3-1

---

3.1.1	General Documentation .....	3-1
3.1.2	Workcenter Information Package .....	3-3
3.2	Marking, Packaging and Shipping .....	3-3
3.3	Physical Design Criteria.....	3-3
3.3.1	Optical Fiber .....	3-3
3.3.2	Optical Connectors .....	3-5
3.3.3	Materials .....	3-5
3.3.3.1	Toxicity.....	3-5
3.3.3.2	Corrosion Resistance .....	3-5
3.3.3.3	Dissimilar Metals.....	3-6
3.3.3.4	Fungus Resistance .....	3-6
3.3.3.5	Flammability.....	3-6
3.3.4	Safety .....	3-6
3.3.5	Mounting .....	3-7
3.3.5.1	Central Office Location .....	3-7
3.3.5.2	Outside Plant Location .....	3-9
4.	Performance Criteria.....	4-1
4.1	Optical Criteria.....	4-2
4.1.1	Optical Bandpass .....	4-2
4.1.2	Nominal Central Operating Frequencies for FBG-Based PDCs. ....	4-2
4.1.3	Insertion Loss .....	4-4
4.1.4	Dispersion .....	4-4
4.1.5	Dispersion Compensation Rate .....	4-5
4.1.6	Figure of Merit .....	4-5
4.1.7	Reflectance .....	4-6
4.1.7.1	Digital Transmission Systems .....	4-6
4.1.7.2	AM-VSB Applications .....	4-6
4.1.8	Polarization-Dependent Loss (PDL) .....	4-7
4.1.9	Polarization-Mode Dispersion (PMD) Coefficient .....	4-7
4.2	Environmental Criteria.....	4-7
4.2.1	Operating Environment .....	4-8
4.2.2	Non-Operating Environment .....	4-9
4.2.3	Shock Criteria .....	4-10
4.2.3.1	Shipment from Manufacturer .....	4-10
4.2.3.2	Local Transportation.....	4-10
4.2.3.3	During Use.....	4-10
4.2.4	Vibration Test .....	4-10
4.2.5	Airborne Contaminants .....	4-10
4.2.6	Flex Test .....	4-11
4.2.7	Twist Test .....	4-11
4.2.8	Side Pull .....	4-11
4.2.9	Cable Retention .....	4-11
5.	Performance Verification/Test Procedures .....	5-1

---

---

5.1	Optical Testing .....	5-1
5.1.1	Optical Bandpass .....	5-2
5.1.2	Insertion Loss .....	5-2
5.1.3	Dispersion .....	5-3
5.1.4	Figure of Merit .....	5-3
5.1.5	Reflectance and Optical Return Loss .....	5-3
5.1.6	Polarization-Dependent Loss (PDL) .....	5-4
5.1.7	Polarization-Mode Dispersion .....	5-4
5.2	Environmental Performance Testing.....	5-4
5.2.1	Operating Environment .....	5-4
5.2.2	Non-Operating Environment .....	5-4
5.2.3	Shock Tests .....	5-5
5.2.3.1	Shipment from Manufacturer .....	5-5
5.2.3.2	Local Transportation.....	5-5
5.2.3.3	In Use.....	5-5
5.2.4	Vibration Test .....	5-5
5.2.5	Airborne Contaminants Test .....	5-6
5.2.6	Flex Test .....	5-6
5.2.7	Twist Test .....	5-6
5.2.8	Side Pull .....	5-6
5.2.9	Cable Retention .....	5-6
6.	Reliability and Quality Assurance Program.....	6-1
6.1	Reliability Assurance Requirements Philosophy .....	6-1
6.2	Overview of Reliability Assurance .....	6-2
6.3	Dispersion Compensator Qualification Criteria.....	6-3
6.3.1	Characterization .....	6-4
6.3.2	Reliability Tests .....	6-5
6.4	DCF Lot-To-Lot Controls .....	6-5
6.4.1	Visual Inspection .....	6-5
6.4.2	Optical Testing .....	6-5
6.4.3	Screening .....	6-6
6.5	General Components.....	6-6
6.6	Quality and Reliability Criteria.....	6-6
6.6.1	Reliability Assurance .....	6-7
6.6.2	Quality Technology Program .....	6-8
References	.....	References-1
Acronyms.....	.....	Acronyms-1
Glossary.....	.....	Glossary-1

---



## List of Figures

Figure 2-1. ....	Extremes of the Dispersion Coefficient for Dispersion-Unshifted Fiber (C-SMF).....	2-2
Figure 2-2. ....	Dispersion Characteristics of C-SMF and DCF.....	2-8
Figure 2-3. ....	Schematic Sum of the C-SMF and DCF-Based PDC Dispersions Over the EDFA Window .....	2-9
Figure 2-4. ...	Reflectivity and Delay Characteristics of an FBG-Based PDC (Dispersion is the wavelength derivative of the time delay.) .....	2-10
Figure 2-5. ....	Dispersion Compensation Using an Optical Circulator.....	2-11
Figure 2-6. .	Passive Dispersion Compensators Placed at One Location.....	2-17
Figure 2-7. ....	Dispersion Compensators (DCs) Placed Before Transmitter Booster Amplifier EDFAs .....	2-18
Figure 2-8. ...	Two-Band WDM with an EDFA and PDC in the Upper Band.....	2-18
Figure 2-9. ....	Multichannel WDM in the EDFA Band.....	2-19
Figure 3-1. ....	Generic Frame Mountable Dispersion Compensator.....	3-7
Figure 3-2. ..	Possible Dispersion Compensator Location in a Central Office.....	3-8
Figure 3-3. ....	Example of a Dispersion Compensator Mounted in an OSP Closure .....	3-9
Figure 6-1.	Elements of a Comprehensive Reliability Assurance Program.....	6-3



## List of Tables

Table 2-1.	Transmission Length Limits Determined by Attenuation and Dispersion .....	2-5
Table 2-2.	Transmission Length Ranges With a Dispersion Compensator Designed to Compensate Typical Lengths of Conventional Fiber .....	2-13
Table 4-1.	Summary of Dispersion Compensator Performance Criteria and Test Sequence .....	4-1
Table 4-2.	Grid Central Frequencies .....	4-3
Table 4-3.	Tensile Loads for Mechanical Tests .....	4-8
Table 4-4.	Fiber Retention Loads .....	4-12
Table 6-1.	Characterization Tests for Dispersion Compensators .....	6-4
Table 6-2.	Required Characterization Tests for DCF .....	6-6