

---

# Generic Requirements for Fiber Optic Attenuators

## Contents

Preface .....	Preface-1
1. Introduction .....	1-1
1.1 Document Description .....	1-1
1.2 Requirements Terminology .....	1-1
1.3 Requirement Labeling Conventions.....	1-2
1.3.1 Numbering of Requirement and Related Objects .....	1-2
1.3.2 Requirement, Conditional Requirement, and Objective Object Identification .....	1-3
1.4 Changes from GR-910-CORE, Issue 1 .....	1-3
1.5 Organization .....	1-4
2. General Information .....	2-1
2.1 General Product Description .....	2-1
2.2 Attenuator Technology.....	2-1
2.3 Attenuator Applications .....	2-3
2.3.1 Environmental Conditions .....	2-4
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.....	3-4
3.3.1 Optical Fiber .....	3-4
3.3.2 Optical Connectors.....	3-5
3.3.3 Cleanability .....	3-5
3.3.4 Intermateability .....	3-5
3.3.5 Materials.....	3-6
3.3.5.1 Toxicity .....	3-6
3.3.5.2 Corrosion Resistance .....	3-6
3.3.5.3 Dissimilar Metals.....	3-6
3.3.5.4 Fungus Resistance .....	3-6
3.3.5.5 Flammability.....	3-6
3.3.6 Safety .....	3-7
3.3.7 Mounting .....	3-8
3.3.7.1 Outside Plant Location .....	3-8
3.3.8 Index Matching .....	3-8
3.3.9 Change of Attenuation .....	3-9

---

---

4.	Performance Criteria .....	4-1
4.1	Environmental and Mechanical Criteria .....	4-2
4.1.1	Controlled Operating Environment.....	4-3
4.1.2	Uncontrolled Operating Environment.....	4-3
4.1.3	Non-Operating Environment.....	4-4
4.1.4	Humidity/Condensation Cycling Test.....	4-4
4.1.5	Water Immersion.....	4-4
4.1.6	Vibration .....	4-5
4.1.7	Flex Test.....	4-5
4.1.8	Twist Test.....	4-5
4.1.9	Side Pull Load.....	4-6
4.1.10	Cable Retention.....	4-6
4.1.11	Durability .....	4-6
4.1.12	Impact Test.....	4-7
4.2	Optical Criteria.....	4-7
4.2.1	Optical Bandpass.....	4-8
4.2.2	Change in Attenuation .....	4-9
4.2.3	Attenuation Tolerance.....	4-9
4.2.4	Attenuation Increments and Range .....	4-10
4.2.5	Reflectance.....	4-10
4.2.6	Polarization-Dependent Loss (PDL).....	4-11
4.2.7	Polarization-Mode Dispersion (PMD).....	4-12
4.2.8	Damage Criteria .....	4-12
5.	Performance Verification/Test Procedures .....	5-1
5.1	Environmental and Mechanical Testing.....	5-2
5.1.1	Controlled Operating Environment.....	5-3
5.1.2	Uncontrolled Operating Environment.....	5-3
5.1.3	Non-Operating Environment.....	5-5
5.1.4	Humidity/Condensation Cycling Test.....	5-5
5.1.5	Water Immersion.....	5-5
5.1.6	Vibration Test .....	5-6
5.1.7	Flex Test.....	5-6
5.1.8	Twist Test.....	5-7
5.1.9	Side Pull .....	5-7
5.1.10	Cable Retention.....	5-8
5.1.11	Durability .....	5-9
5.1.12	Impact Test.....	5-9
5.2	Optical Testing .....	5-10
5.2.1	Optical Bandpass.....	5-10
5.2.2	Change in Attenuation .....	5-11
5.2.3	Attenuation Tolerance.....	5-13
5.2.4	Attenuation Increments and Range .....	5-13
5.2.5	Reflectance.....	5-14
5.2.6	Polarization-Dependent Loss (PDL).....	5-14

---

---

5.2.7	Polarization-Mode Dispersion (PMD) .....	5-15
6.	Passive Optical Component Code (POCC).....	6-1
6.1	Structure and Format .....	6-1
6.2	Component Type Character .....	6-3
6.3	Fiber Type and Operating Wavelength Region Character .....	6-4
6.4	Cable Type Character.....	6-4
6.5	Attenuation Value Characters .....	6-5
6.6	Application Character .....	6-5
6.7	Configuration Characters .....	6-5
6.8	Example.....	6-6
7.	Reliability and Quality Assurance Program.....	7-1
7.1	Reliability Assurance Requirements Philosophy .....	7-1
7.2	Overview of Reliability Assurance .....	7-1
7.3	Qualification Criteria .....	7-3
7.3.1	Characterization .....	7-3
7.3.2	Reliability Tests .....	7-4
7.3.3	Failure Rate Prediction.....	7-7
7.3.4	Optical Adhesives .....	7-11
7.3.5	Quality Assurance and Lot Controls .....	7-11
7.3.5.1	Visual Inspection .....	7-11
7.3.5.2	Optical Testing.....	7-11
7.3.5.3	Stress Screening.....	7-12
7.3.6	Optical Adhesives .....	7-13
7.3.7	Optical Connectors.....	7-13
7.3.8	Optical Fiber .....	7-13
7.4	Quality and Reliability Criteria.....	7-13
7.4.1	Reliability Assurance .....	7-14
7.4.2	Quality Technology Program.....	7-14
References .....	References-1	
Ref.1 Bellcore Documents .....	References-1	
Ref.2 External References .....	References-2	
References .....	References-7	
Glossary .....	Glossary-1	
Acronyms.....	Glossary-4	

---



## List of Figures

Figure 2-1.	The a) Fixed and b) Variable Attenuator Components.....	2-1
Figure 2-2.	Attenuator Types a) Connector Receptacle, b) Optical Pad, c) Patchcord.	2-3
Figure 2-3.	Optical Transmission Using a Variable Attenuator.....	2-4
Figure 2-4.	Central Wavelength Variation of Uncontrolled Optical Source.....	2-5
Figure 5-1.	Transmission Measurement Facility.....	5-2
Figure 5-2.	Controlled Operating Environment Temperature Profile.....	5-4
Figure 5-3.	Uncontrolled Environment Temperature Profile.....	5-4
Figure 5-4.	Humidity/Condensation Temperature Profile .....	5-5
Figure 5-5.	5 dB Attenuator Optical Bandpass Spectra .....	5-11
Figure 5-6.	Attenuation Loss Measurement .....	5-12
Figure 5-7.	Configuration for Measuring Polarization Dependent Loss.....	5-15
Figure 5-8.	Mechanical Test Facility for Flex, Twist, Side Pull and Cable Retention Tests.....	5-16
Figure 7-1.	Elements of a Comprehensive Reliability Assurance Program.....	7-2



## List of Tables

Table 4-1.	Summary of Attenuator Performance Criteria and Test Sequence.....	4-1
Table 4-2.	Tensile Loads for Mechanical Tests .....	4-3
Table 4-3.	Optical Bandpass Criteria.....	4-8
Table 5-1.	Number of Turns for Twist Test.....	5-7
Table 5-2.	Side Pull Tensile Loading.....	5-8
Table 6-1.	Passive Optical Component Manufacturer Code POCC .....	6-1
Table 6-2.	POCC Character Description.....	6-2
Table 6-3.	POCC Character $S_1$ .....	6-3
Table 6-4.	POCC Character $S_2$ .....	6-4
Table 6-5.	POCC Character $S_3$ .....	6-4
Table 6-6.	POCC Character $S_8$ .....	6-5
Table 6-7.	POCC Interpretation .....	6-6
Table 7-1.	Test Matrix for Demonstrating Acceleration Factors [Relative Humidity as a Function of Temperature and Absolute Humidity].	7-6