

# Handbook of Optical Fibers and Cables

***Hiroshi Murata***

Optics System Development Division  
The Furukawa Electric Co., Ltd.  
Tokyo, Japan

**Physikalische Bibliothek**  
Fachbereich 5  
Technische Hochschule Darmstadt  
Hochschulstraße 2  
**D-6100 Darmstadt**

*I/3928*

**MARCEL DEKKER, INC.**

**New York and Basel**

# Contents

Preface	iii
1. INTRODUCTION	1
1.1 History of Optical Communications	1
1.2 History of Optical Fibers	2
1.3 History of Optical Fiber Cables	6
1.4 Features of Optical Fiber and Comparison with Other Transmission Media	8
References	14
2. OPTICAL FIBERS	15
2.1 Introduction	15
2.2 Optical Fiber Materials	19
2.3 Transmission Bandwidth of the Fiber	37
2.4 Mechanical Properties of the Fiber	59
2.5 Reliability of Fibers	67
2.6 Manufacturing of Optical Fiber	88
2.7 Single-Mode Fibers	139
2.8 1.55 $\mu\text{m}$ Zero Dispersion SM Fibers	151
References	169

3.	OPTICAL FIBER CABLE	179
3.1	Introduction	179
3.2	Basic Conditions of Optical Fiber Cable Design	181
3.3	Design, Construction, and Properties of Optical Fiber Cable	237
	References	315
4.	SPLICING OF FIBERS	321
4.1	Introduction	321
4.2	General Concepts	322
4.3	Fiber Splicing Loss	323
4.4	Fiber Splicing	337
4.5	Examples of Fusion Splicing Machines	361
4.6	Fiber Splicing Accessories	268
	References	372
5.	CONNECTORS	375
5.1	Single-Fiber Connectors	377
5.2	Precision Ferrule Connectors	377
5.3	Lens Connector	382
5.4	Biconic Connector	383
5.5	Ball Connector	385
5.6	Multifiber Connector	386
5.7	V-Groove Round Connector	386
5.8	Fiber Ribbon Connector	388
5.9	Plastic Connectors (Single and Multifiber Connectors)	394
	References	394
6.	JOINING OF OPTICAL FIBER CABLES	397
6.1	General Concepts	397
6.2	Basic Conditions	397
6.3	Optical Fiber Cable Joining	398
6.4	Test Conditions for the Cable Joint	406
	References	406

7.	MEASUREMENT OF OPTICAL FIBER	407
7.1	Measurement of Structural Parameters of the Fiber	408
7.2	Measurement of Transmission Characteristics	428
7.3	Profile Measurement of the Preform	441
	References	444
8.	INSTALLATION OF OPTICAL FIBER CABLE	447
	References	459
	Index	461