

# Testing of Installed Cabling



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**AGENDA**

Introduction

Test Parameters

Test Approaches

LSPM

OTDR

Measurement Error



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e-Ready Building

## Standards Activities



**Member:**

**ISO/IEC JTC1 SC25 WG3: Generic Cabling**

**ISO/IEC JTC1 SC25 Project Team: SOHO**

**Convenor:**

**ISO/IEC JTC1 SC25 WG3 IPTG: Industrial Premises Cabling**



**Convenor: CENELEC TC215 WG1: IT Cabling**

**Convenor: CENELEC TC215 WG1 PT Industrial Premises Cabling**

**Secretary: CENELEC TC215 WG1 PT Data Centre Cabling**



**Chairman:**

**BSI TCT7/-/1: IT Cabling**

**BSI TCT7/-/3: IT Cabling Support Group**

**Technical and Standards Director:  
Fibreoptic Industry Association**

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# Agenda

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# FIA

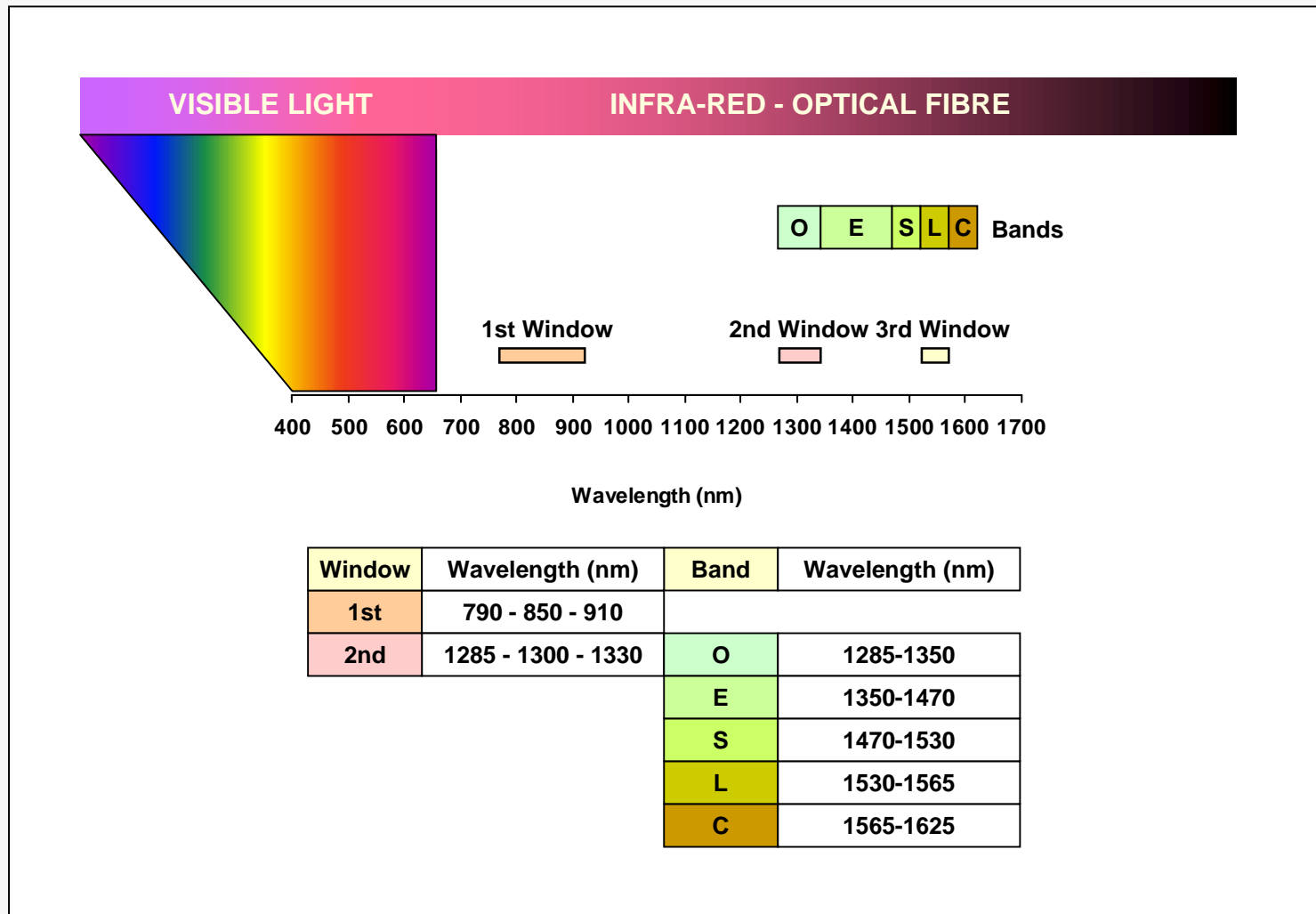
The Fibreoptic Industry Association

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# Transmission Wavelengths



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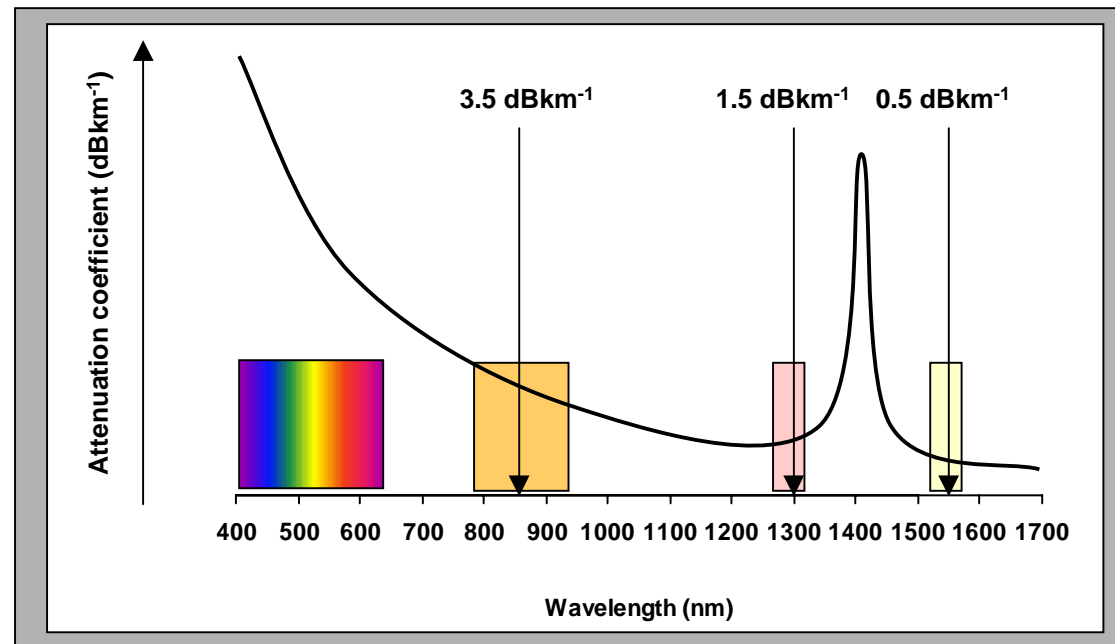
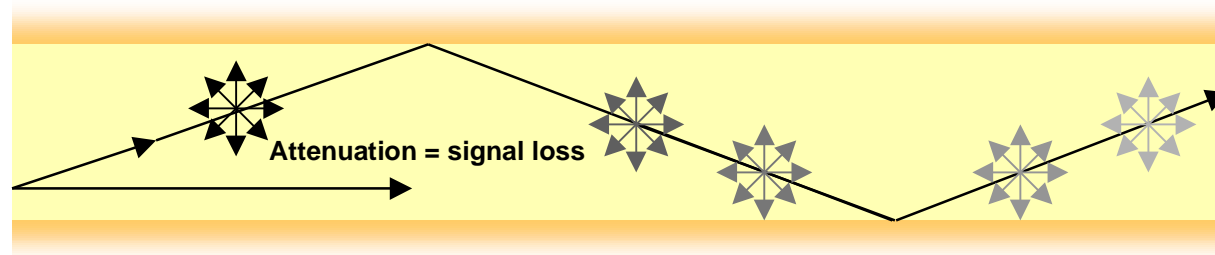
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## Attenuation

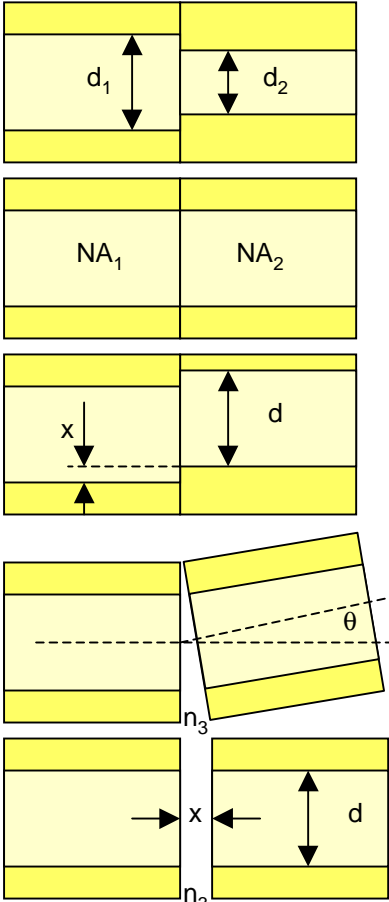


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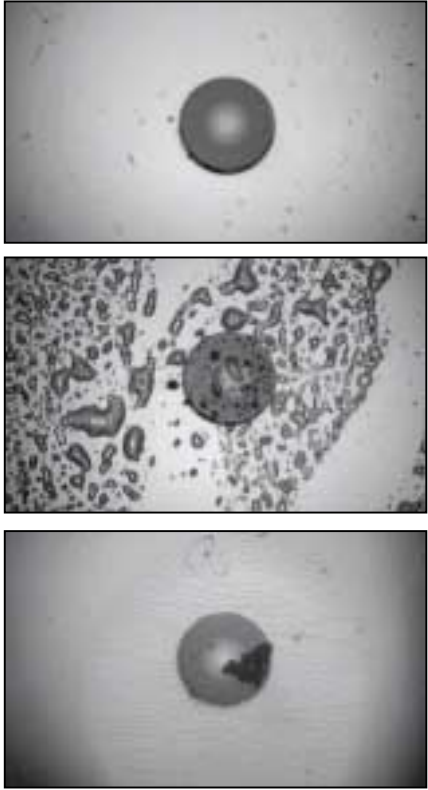


# Attenuation



The diagrams illustrate various fiber optic joint configurations and their parameters:

- Top diagram:** Shows two fibers with core diameters  $d_1$  and  $d_2$ .
- Second diagram:** Shows fibers with numerical apertures  $NA_1$  and  $NA_2$ .
- Third diagram:** Shows a core diameter  $d$  and an offset  $x$  between the fiber cores.
- Fourth diagram:** Shows a fiber with core diameter  $d$  and an angle  $\theta$  relative to the other fiber.
- Fifth diagram:** Shows a core diameter  $d$  and an offset  $x$  between the fiber cores.



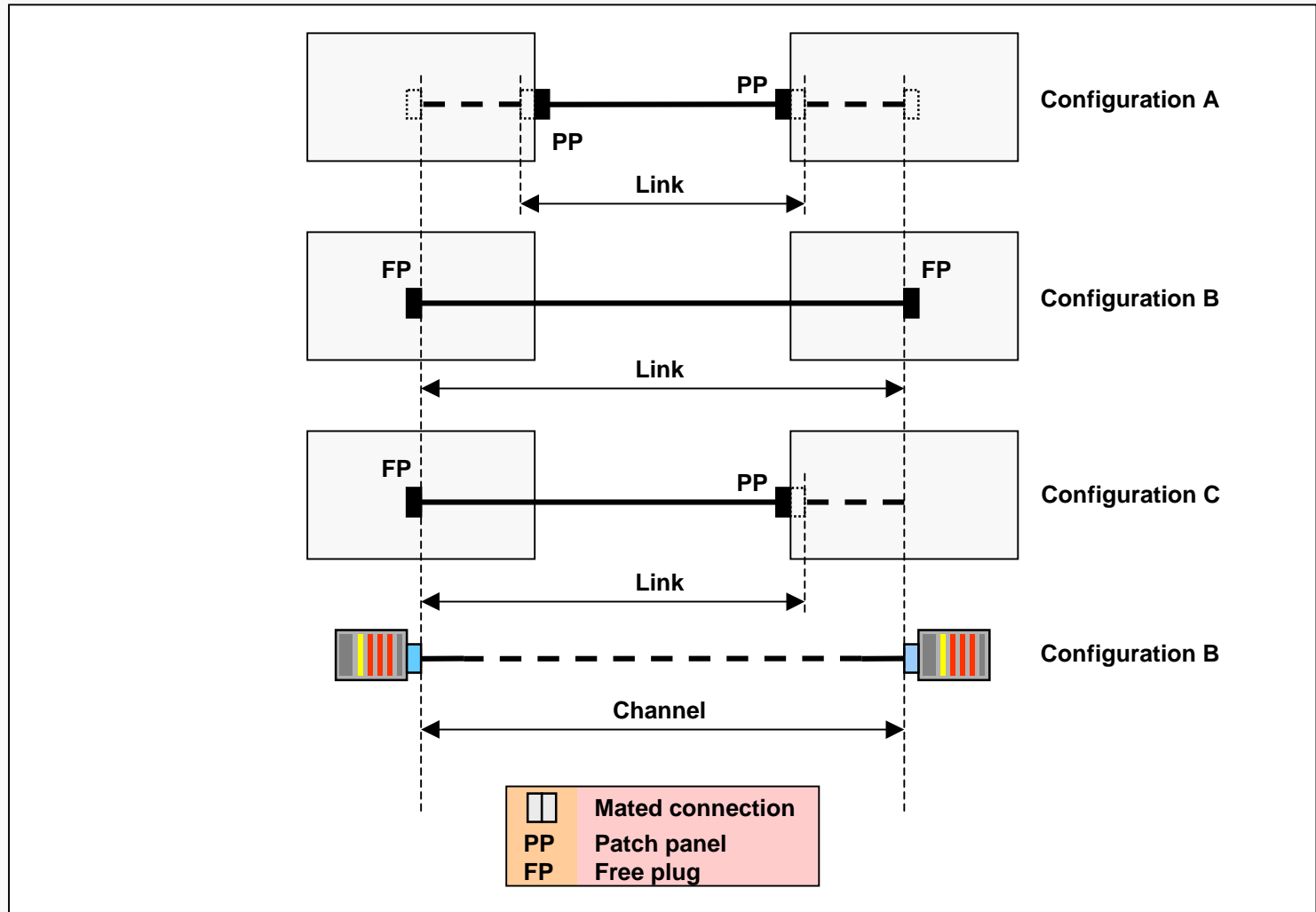
Photographs courtesy of Fluke Networks

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# Test Configurations



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# Acceptance Test Approaches

APPLICATION	Mb/s	Network	$\lambda$	Max. Attenuation/Insertion Loss (dB)		
				62.5/125 (OM1)	50/125 (OM2)	50/125 (OM3)
	4	Token Ring	850 nm	13.0	8.0	
	10	Ethernet		12.5	6.8	
	16	Token Ring		13.0	8.0	
	100	Ethernet	1300 nm	11.0	6.0	
	1000	Ethernet	850 nm	2.6	3.56	
	1000	Ethernet	1300 nm	2.35	2.35	
	10000	Ethernet	850 nm	1.60	1.80	2.59
	10000	Ethernet	CWDM/1300	1.96		

CABLING

Maximum values x dB    y dB    z dB

Actual value    Link < (x + y + z) dB

COMPONENT

Maximum values x dB    y dB    z dB

Actual value    < x dB    < y dB    < z dB

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# Acceptance Test Regimes

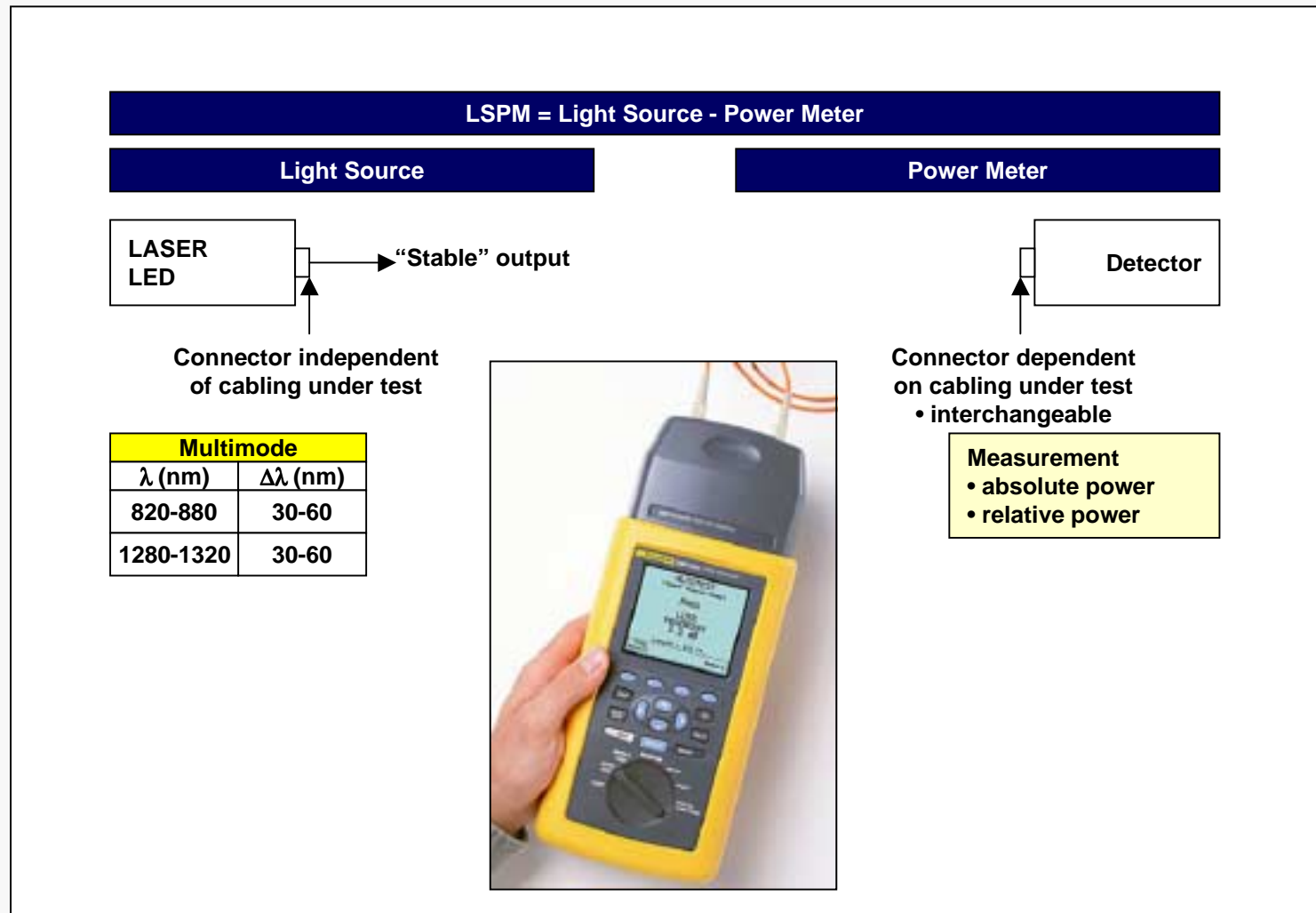
TEST REGIME	ITEM UNDER TEST	APPROACH	TEST TOOL
Component Acceptance	Cable	COMPONENT	OTDR
	Cord	CABLING	LSPM
COMPONENT		LSPM	
Legacy Cabling Acceptance	Link Channel	CABLING	LSPM
		COMPONENT	OTDR
Partial Completion Tests	Link	COMPONENT	OTDR
Installed Cabling Acceptance	Link Channel	CABLING	LSPM
		COMPONENT	OTDR
Fault Diagnosis	Channels	APPLICATION	OTDR
	Links and channels	COMPONENT	OTDR

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# LSPM



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# Test Standard References

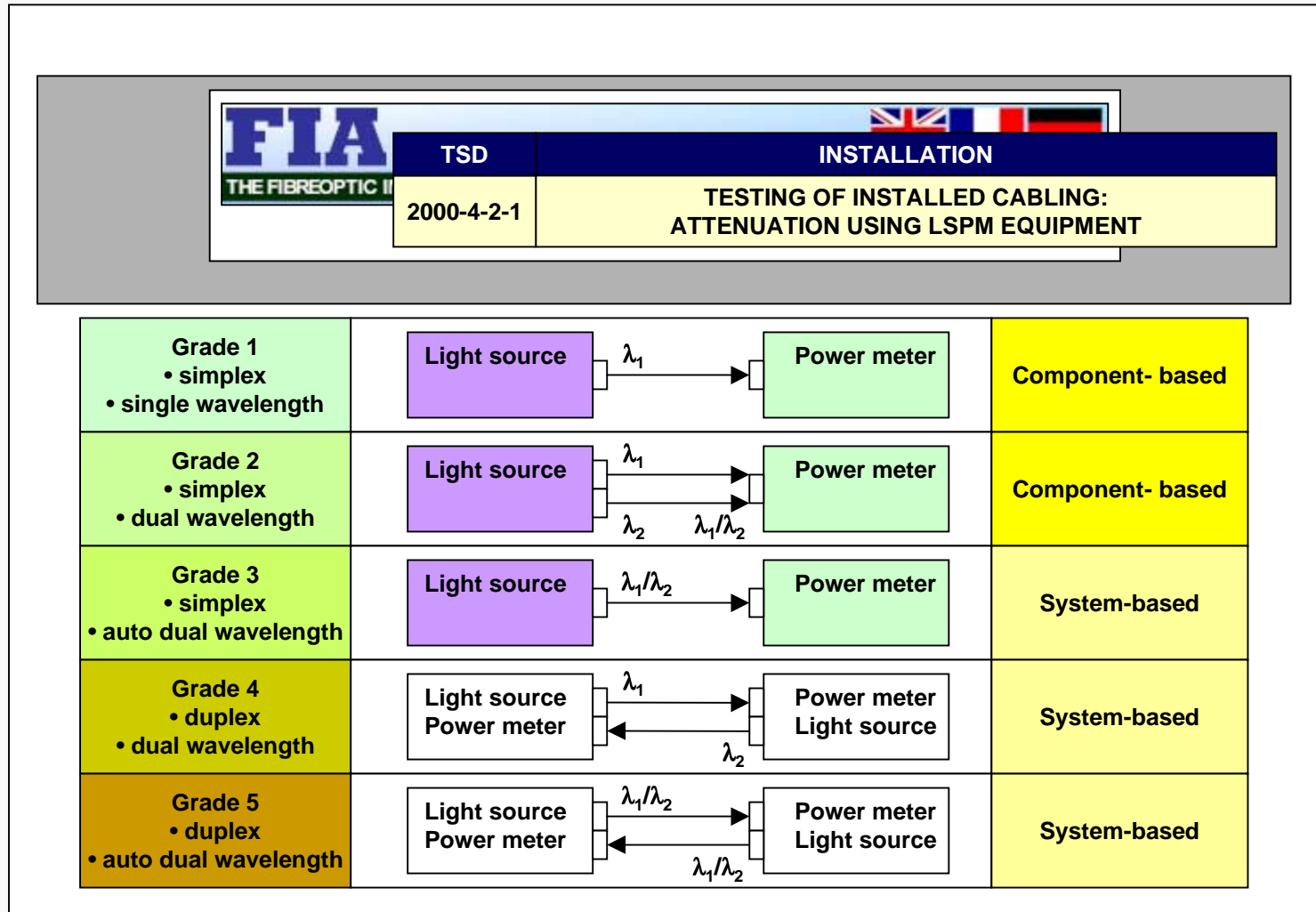
ARENA	REFERENCE	TITLE
IEC	61280-4-1	Fibre optic communication subsystem basic test procedures - Part 4-1: Fibre optic cable plant - Multimode fibre optic cable plant
IEC	61280-4-2	Fibre optic communication subsystem basic test procedures - Part 4-2: Fibre optic cable plant - Single-mode fibre optic cable plant
EN	50346	Information Technology - Testing of installed cabling
TIA/EIA	526-14-A	OFSTP-14A Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant (ANSI/TIA/EIA-526-14A-98)
TIA/EIA	526-7	OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant (ANSI/TIA/EIA-526-7-98)

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# Equipment Options





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# FIA Technical Support Documents

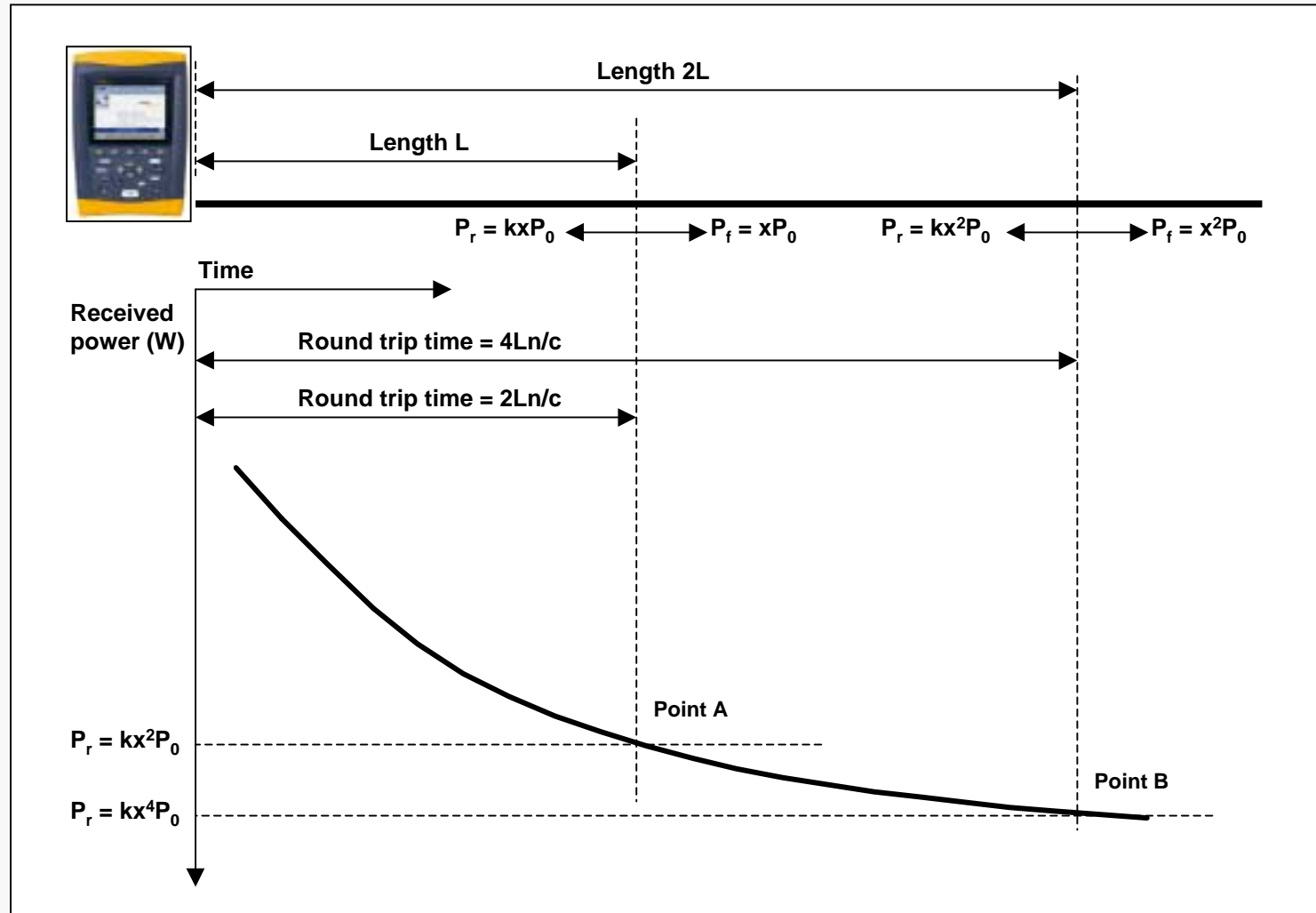
 	
THE FIBREOPTIC INDUSTRY ASSOCIATION <a href="http://www.fibreoptic.org.uk">www.fibreoptic.org.uk</a>	
<b>TSD</b>	<b>DESIGN</b>
2000-1-1	OPTICAL FIBRE CABLING: LAN APPLICATION SUPPORT GUIDE
2000-1-3	OPTICAL FIBRE CABLING: DARK FIBRE SUPPORT GUIDE
<b>TSD</b>	<b>OPERATION</b>
2000-3-3	POLARITY MAINTENANCE
<b>TSD</b>	<b>INSTALLATION</b>
2000-4-2-1	TESTING OF INSTALLED CABLING: ATTENUATION USING LSPM EQUIPMENT
2000-4-2-2	TESTING OF INSTALLED CABLING: ATTENUATION USING OTDR EQUIPMENT
<b>TSD</b>	<b>SAFETY</b>
2000-5-1	OPTICAL POWER: SAFETY LEVELS
2000-5-2	OPTICAL FIBRE: HANDLING OF PROCESSING CHEMICALS
2000-5-3	OPTICAL FIBRE: DISPOSAL OF WASTE
<b>MODELLING TOOLS</b>	
CABLING STRUCTURES COST MODEL	

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# OTDR Theory - Linear Plot

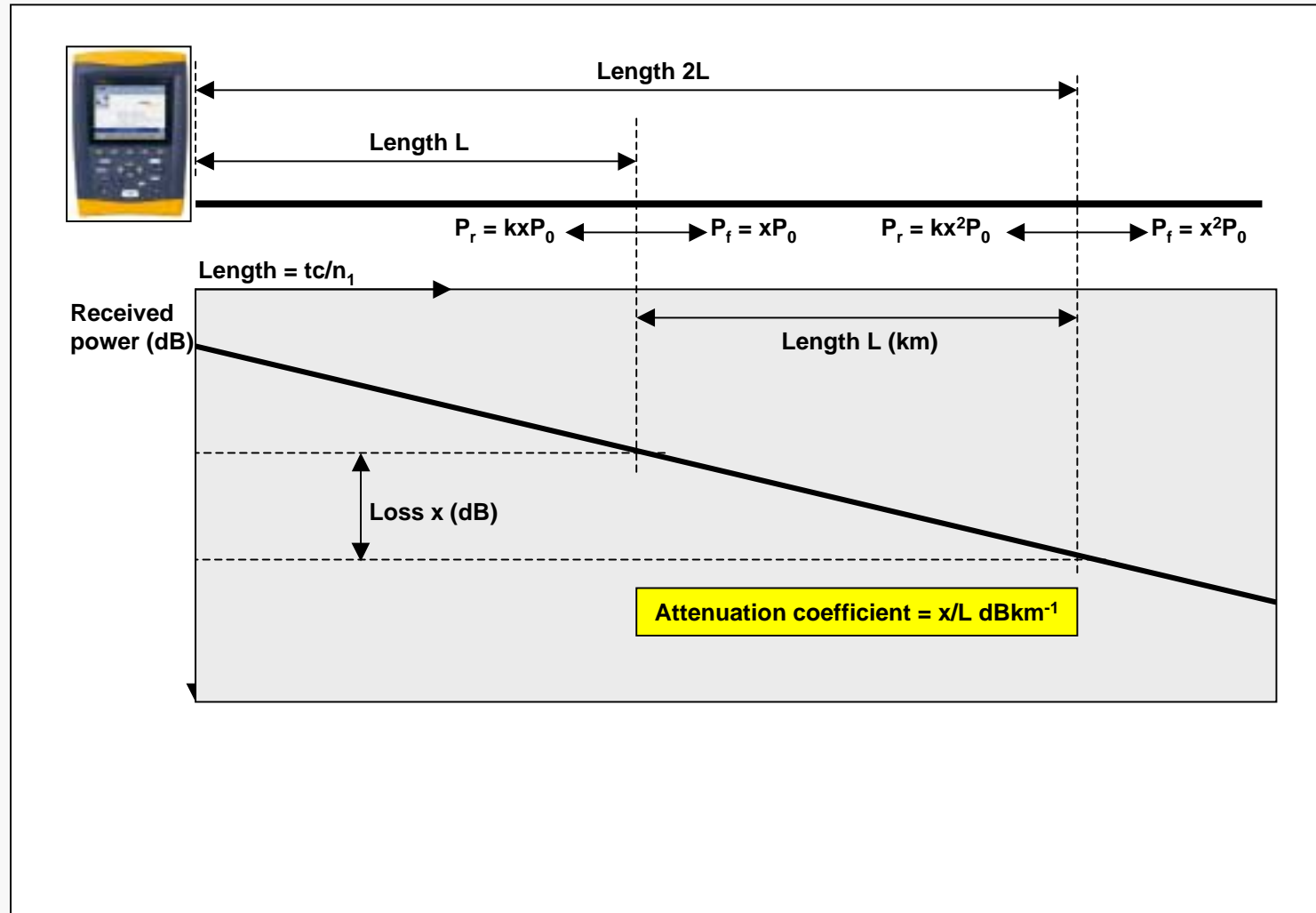


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# OTDR Theory - Log (dB) Plot



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# Interface Loss

The diagram illustrates the setup for measuring interface loss. It shows an OTDR connected to a launch cord, which is then connected to the cabling under test. The OTDR trace below shows a peak for the launch cord, a dip representing the interface loss, and a peak for the cabling under test. The link length is indicated by a double-headed arrow between the launch cord and the cabling under test. The interface loss is indicated by a vertical double-headed arrow between the baseline of the launch cord and the baseline of the cabling under test.

The attenuation of the local interface is shown as the interface loss (dB).

However, this is not a true measurement since the scattering fraction ( $k$ ) may be different in the launch cord and the cabling under test.

If the scattering fraction of the launch cord is higher than that of the cabling under test then the result will be overstated.

If the scattering fraction of the cabling under test is higher than that of the launch cord then the result will be understated (sometimes, but very rarely, producing an apparent amplification).

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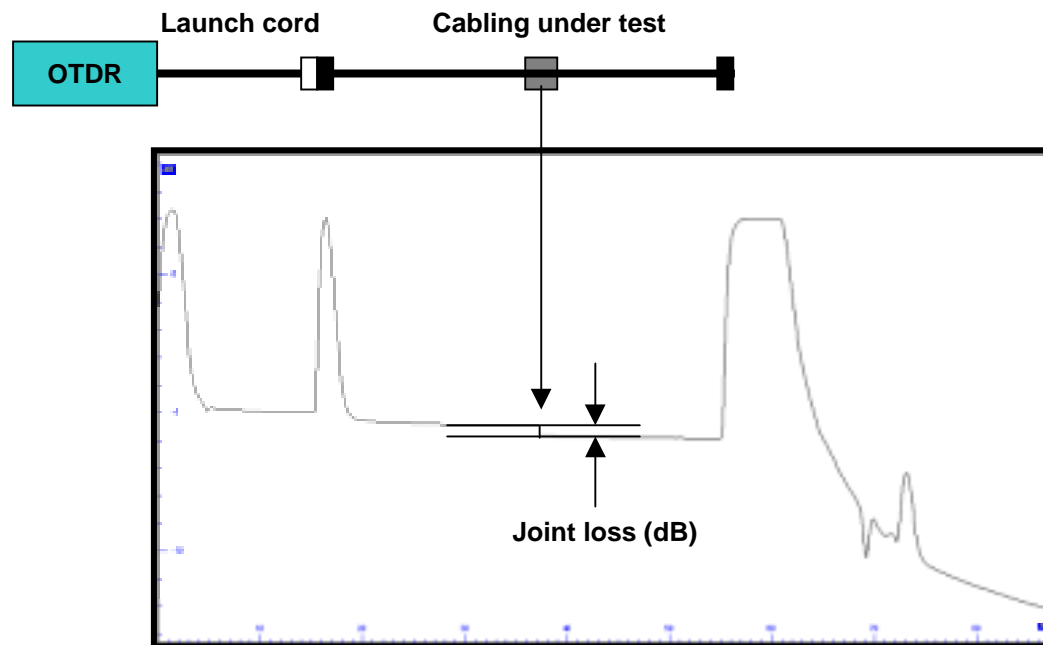
LSPM

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## Joint Loss



The attenuation of the joint is shown as the joint loss (dB).

However, this is not a true measurement since the scattering fraction ( $k$ ) may be different in the launch cord and the cabling under test.

If the scattering fraction of the launch cord is higher than that of the cabling under test then the result will be overstated.

If the scattering fraction of the cabling under test is higher than that of the launch cord then the result will be understated (sometimes producing an apparent amplification).

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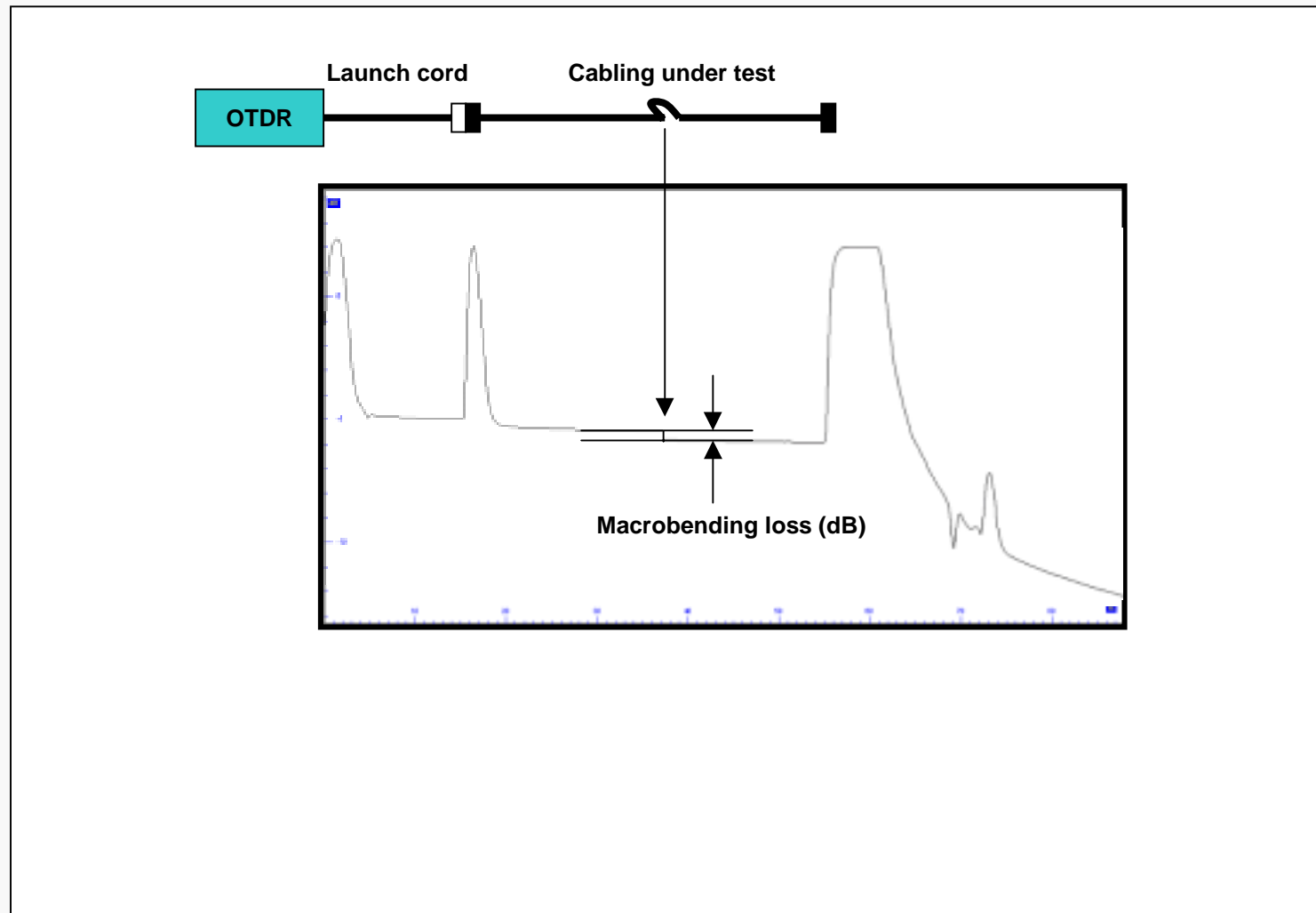
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# Macrobending Loss

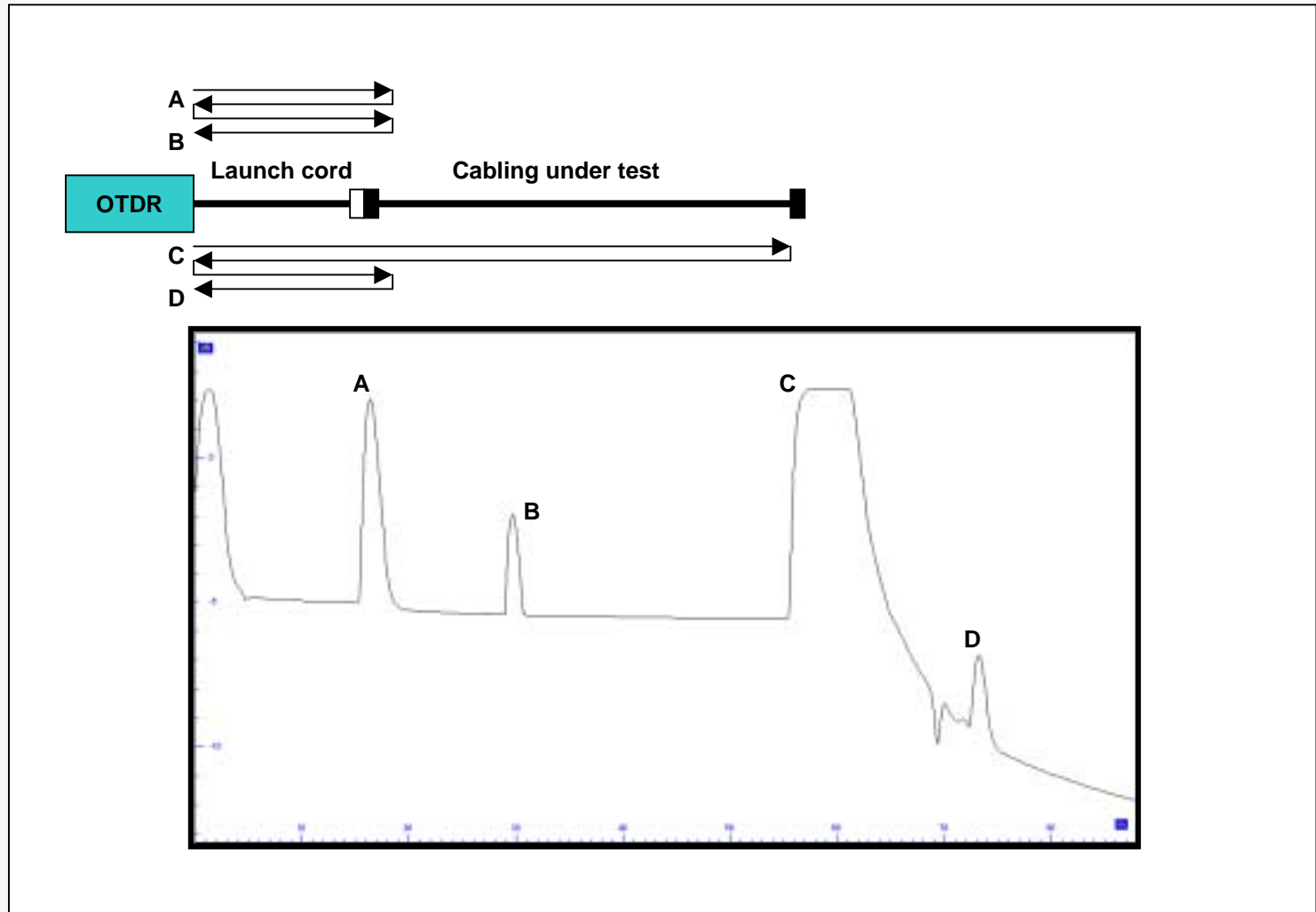


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# The Presence of Ghosts



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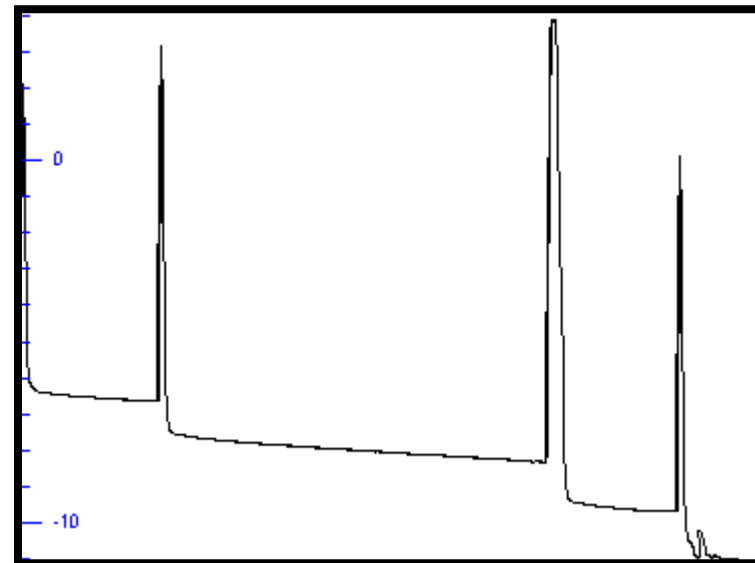
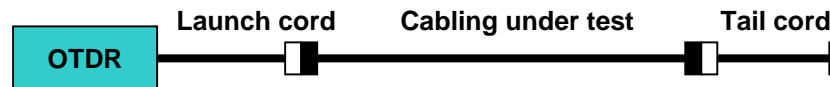
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# Tail Cords



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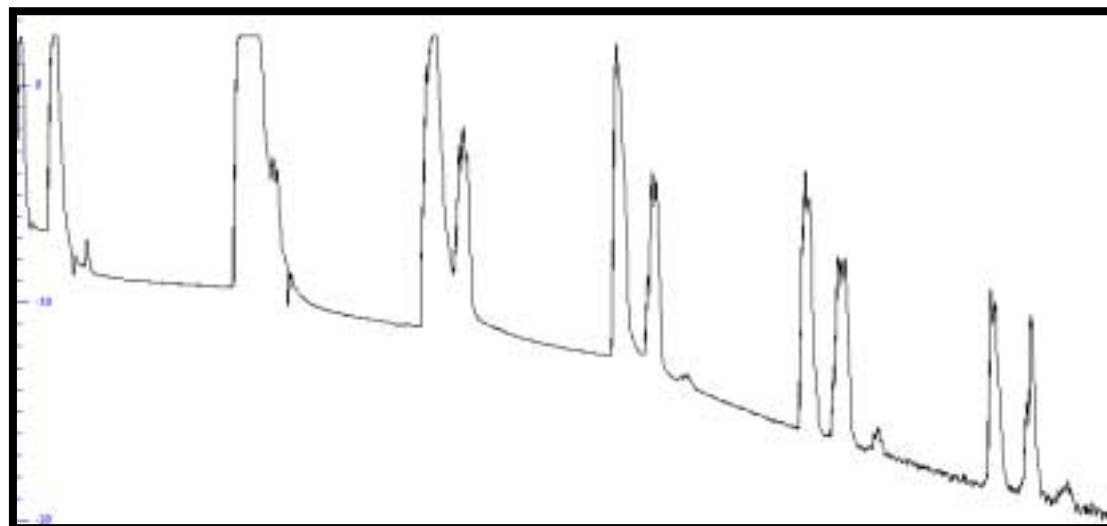
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# The Impact of Over-Ghosting



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# Optical Power Budgets

Application			Optical Fibre			
			50/125 (OM2)		62.5/125 (OM1)	
Mb/s	Network	$\lambda$	Max. length (m)	OPB max. (dB)	Max. length (m)	OPB max. (dB)
4	Token Ring	850 nm	1857 <sup>1</sup>	8.0	2000	13.0
10	Ethernet		1514 <sup>1</sup>	6.8	2000	12.5
16	Token Ring		1857 <sup>1</sup>	8.0	2000	13.0
100	Ethernet	1300 nm	2000	6.0	2000	11.0
1000	Ethernet	850 nm	550	3.56	275	2.6
1000	Ethernet	1300 nm	550	2.35	550	2.35
10000	Ethernet	850 nm	82	1.80	33	1.60
10000	Ethernet	CWDM/1300	300	2.46	300	2.46
			50/125 (OM3)			
10000	Ethernet	850 nm	300	2.59		

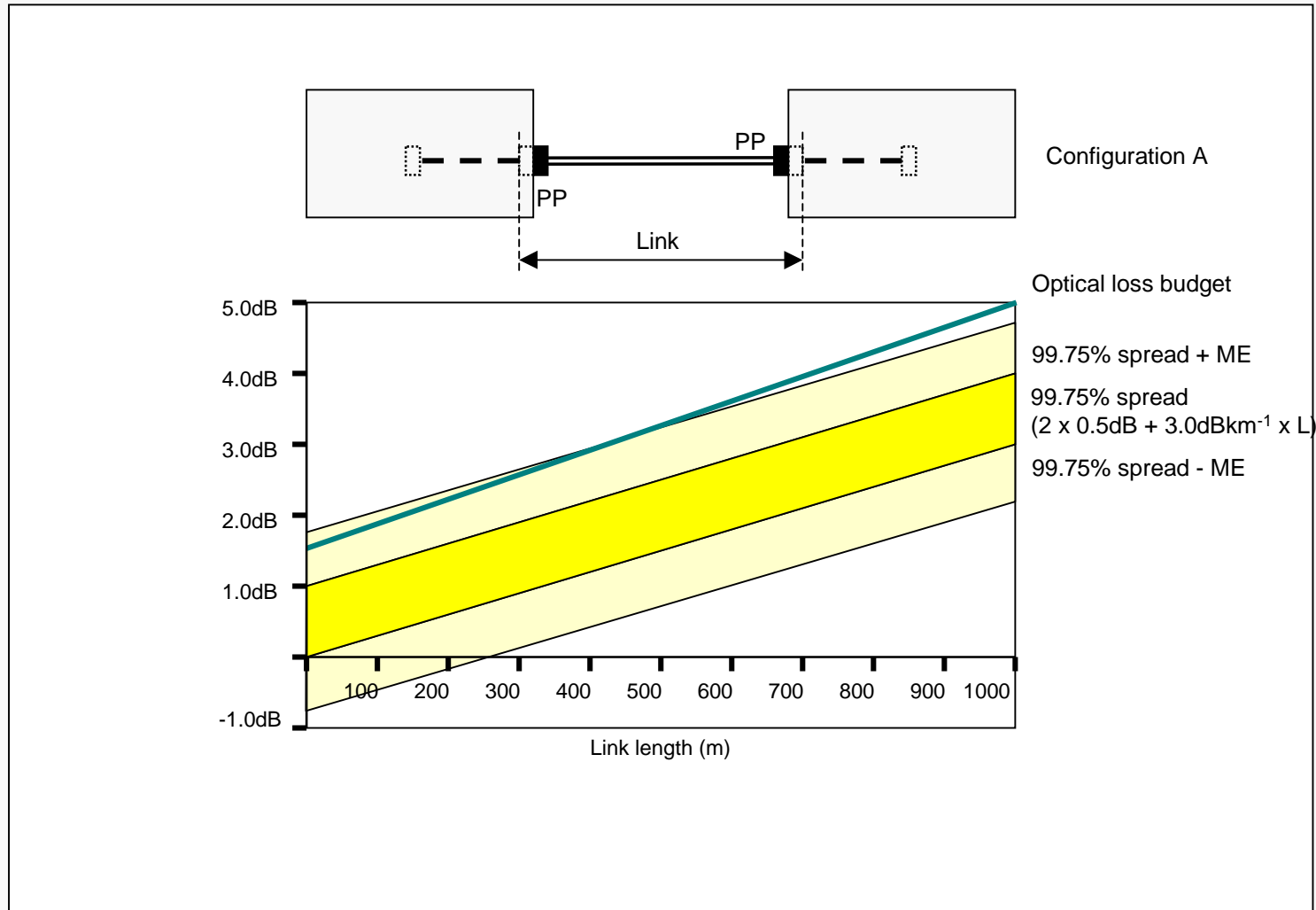
<sup>1</sup> Calculated values using 1.5dB of connecting hardware losses

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# Measurement Error



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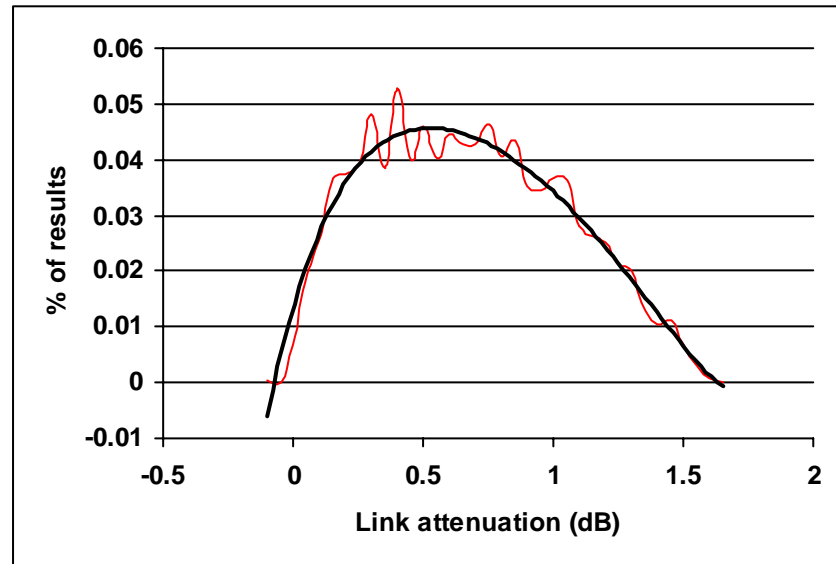
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## Typical Results



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# Prepare for Failure

CORDS

**E** = label indicating equipment connection

TEST CONFIGURATION RECORD

How is each test configuration identified?

- test equipment ID?
- local (launch) test cord ID?
- remote (tail) test cord ID?
  - dummy cord ID?
- channel adaption cords ID?

TEST RECORD

How is each test result identified?

- operator?
- date and time?
- test ID?

TEST CORD CONNECTION RULES	
Local	End E to equipment
Remote	End E to equipment
Dummy	End A to local
CA	End A to test cords

↑  
MG-a-b-c-d

Operator	Initials
ID	Port ID/cable ID?

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# Test Result Management

## TEST SYSTEM CONTAMINATION



Fluke FiberInspector (free-standing or fitted to OTDR OF-500)



Priorscope (200x or 400 x) Fitted with appropriate filters for Class 1M Hazard



Priorscope II (200x or 400 x) Fitted with appropriate filters for Class 1M Hazard

## TEST SYSTEM MANAGEMENT

- test cord usage?
- test equipment calibration status?



## TREATMENT OF MARGINAL/FAILED RESULTS

- re-testing with different test leads?
- the use of a statistical approach?
- simple acceptance?

2 test leads = 2 tests  
3 test leads = 6 tests  
4 test leads = 12 tests

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# OTDR vs. LSPM

**SHORT LENGTH SYNDROME**  
calls LSPM measurements into question

(unless measurement error is “allowed for” in adjudication)

OTDRs can be used to assess and measure individual components  
(subject to appropriate techniques)

**COMPONENT UP VERIFICATION MAY BECOME MORE COMMON**

THE END