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TECHNICAL REPORT

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Guideline for combining different single-mode fibres types

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

GUIDELINE FOR COMBINING DIFFERENT SINGLE-MODE FIBRES TYPES

FOREWORD

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IEC 62000, which is a technical report, has been prepared by subcommittee 86A: Fibres and cables, of IEC technical committee 86:Fibre optics.

This second edition cancels and replaces the first edition (2005) and constitutes a technical revision.

The major technical changes with respect to the previous edition are considerations concerning B6 fibres.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
86A/1276/DTR	86A/1283/RVC

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
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GUIDELINE FOR COMBINING DIFFERENT SINGLE-MODE FIBRES TYPES

1 Scope

This technical report provides guidelines concerning single-mode fibre compatibility.

A given type of single-mode fibre, for example B4, may have different implementations by suitably optimising several of the following parameters: mode field diameter (hence effective area), chromatic dispersion coefficient, slope of the chromatic dispersion curve, cable cut-off wavelength.

This guideline indicates the items that should be taken into account when planning to connect: (1) different implementations of single-mode fibres of the same type, e.g. different implementations of type B single-mode fibres, and (2) single-mode fibres of different types, e.g. B1.1 with B4. See IEC 60793-2-50 for the attributes and definitions of single-mode fibre. The attributes and definitions of fibres covered in this technical report are given in Table 1.

Table 1 – Correspondence table of various single-mode fibres

Common name	*Use (IEC 6079-2-50)*	*IEC Class*	*ITU-T Recommendation*
Dispersion unshifted single-mode fibre	Optimised for use in the 1 310 nm region but can be used in the 1 550 nm region	B1.1	G.652 A, B
Cut-off shifted single-mode fibre	Optimised for low loss in the 1 550 nm region, with cut off wavelength shifted above the 1 310 nm region	B1.2	G.654
Extended band dispersion unshifted single-mode fibre	Optimised for use in the 1 310 nm region but can be used in the O, E, S, C and L-band (i.e. throughout the 1 260 nm to 1 625 nm range).	B1.3	G.652 C, D
Dispersion shifted single-mode fibre	Optimised for single channel transmission in the 1 550 nm region. Multiple channels can only be transmitted if care is taken to avoid the effects of four wave mixing by, for example, moderating the power levels or appropriate spacing or placement of the channels	B.2	G.653
Non-zero dispersion-shifted single-mode fibre	Optimised for multiple channel transmission in the 1 550 nm region with a cut off wavelength that may be shifted above the 1 310 nm region	B4	G.655
Wideband non-zero dispersion-shifted single-mode fibre	Optimised for multiple channel transmission in the wavelength range of 1 460 to 1 625 nm with the positive value of the chromatic dispersion coefficient that is greater than some non-zero value over the same wavelength range.	B5	G.656
Bend loss optimised	Bending loss insensitive single-mode fibre suitable for use in the access networks, including inside buildings at the end of these networks. B6_a fibres are suitable to be used in the O, E, S, C and L-band (i.e. throughout the 1 260 nm to 1 625 nm range) and meet the requirements of B1.3 fibres.	B6_a	G.657.A
	Bending loss insensitive single-mode fibre suitable for use in the access networks, including inside buildings at the end of these networks.	B6_b	G.657.B

Common name	*Use (IEC 6079-2-50)*	*IEC Class*	*ITU-T Recommendation*
	B6_b fibres are suitable for transmission at 1 310 nm, 1 550 nm, and 1 625 nm for restricted distances that are associated with in-building transport of signals.		

This guide does not consider the connection of fibres with the same implementation from different manufacturers, which is already considered by the standardisation procedure.

2 Abbreviations

OTDR: Optical Time Domain Reflectometre

PMD: Polarization Mode Dispersion

DWDM: Dense Wavelength Division Multiplexing

NRZ: Non Return to Zero

RZ: Return to Zero

3 System issues

The different characteristics of B type fibres can be explicitly combined to optimise system performance in terms of the dispersion characteristic (global dispersion coefficients, slope) of the link. It is in fact possible to combine fibres with opposite signs of the dispersion coefficient in a given wavelength range to bring the total link dispersion to near-zero in that range. The final result will however depend on the accuracy of individual fibre dispersion measurements and the ability to match lengths.

The process of combining fibres with different dispersion coefficient characteristics can be one of the ways to make dispersion management in a transmission line (the most common one being the periodical insertion of dispersion compensating modules).

Combining fibres with different effective area is also a possible way to minimise the overall impact of non-linear effects. For instance, it is possible to place large effective area fibres in the initial section of a link, where the propagating power is relatively large. In this case, the large core reduces the associated non-linear effects. For link sections away from the source, where power levels are reduced, fibres with smaller effective area may be used, to take advantage of a possible reduction of the dispersion slope or to increase the efficiency of Raman amplification. The relative size and placement of fibres with large effective area versus fibres with smaller effective area are critical issues in system design.

Splice loss considerations (see section 4.3) should also be taken into account when fibres with different effective area or mode field diameter are combined.

4 Fibre issues

4.1 General

Most fibre characteristics are wavelength dependent: the actual operating wavelengths of the system shall therefore be taken into account when considering the following comments and suggestions.

The compatibility between the fibre specified characteristics (e.g. attenuation and dispersion) and the system operating wavelength must be considered.