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SERIES G: TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

Optical fibre and cable Recommendations and standards guideline

ITU-T G-series Recommendations – Supplement 40

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Supplement 40 to ITU-T G-series Recommendations

Optical fibre and cable Recommendations and standards guideline

Summary

This Supplement provides information on the background and specifications used in the development of optical fibre and cable ITU-T Recommendations such as G.651, G.652, G.653, G.654, G.655, G.656 and the L series. It also contains information used in the development of test method Recommendations such as G.650.1 and G.650.2. Moreover, this Supplement maps ITU-T Recommendations to optical fibre and cable standards developed under IEC.

Source

Supplement 40 to ITU-T G-series Recommendations was agreed on 30 April 2004 by ITU-T Study Group 15 (2001-2004).

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this publication, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this publication is voluntary. However, the publication may contain certain mandatory provisions (to ensure e.g. interoperability or applicability) and compliance with the publication is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the publication is required of any party.

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Optical fibre and cable Recommendations and standards guideline

1 Scope

This fibre guideline aims at providing a road map with regard to the specifications of various kinds of fibres and their test methods, as well as the most important fibre optics hardware which will be very useful for engineers reading the ITU-T Recommendations and other documents to design an optical fibre network. This guideline should also make it easier for readers to correlate the specifications found in the fibre, component, terrestrial system interface, and submarine system Recommendations currently being developed in ITU-T Study Group 15, Questions 15, 16, 17 and 18, respectively. Moreover, this guideline provides important information for system designs and optical fibre cable installations in relation to, for example, high power limitations and reliability, which is available to optical fibre cable installation suppliers and system designers. This guideline contains:

– Definitions of fibre parameters not specified in current ITU-T fibre Recommendations but very important for practical use.

– Features of existing optical fibre categories and their application areas.

– The relationship between fibre parameters and interface parameters.

– Optical fibre properties for operation and maintenance.

In the appendices, the following items are described for reference.

– Standardization rules for optical fibres in ITU-T SG 15.

– Optical fibre cable structures and constructions.

– Fibre optics hardware and passive components mostly used in the construction of an optical network.

– Comparison of ITU-T Recommendations and IEC documents related to optical fibre specifications and test methods.

In particular, this guideline is prepared concisely by quoting document numbers so as to avoid any overlap with existing ITU-T Recommendations and Handbooks or IEC documents. This guideline would be a very useful desk book for engineers dealing with optical transmission systems.

2 References

– ITU-T Recommendation G.650.1 (2002), *Definitions and test methods for linear, deterministic attributes of single-mode fibre and cable*.

– ITU-T Recommendation G.650.2 (2002), *Definitions and test methods for statistical and non-linear attributes of single-mode fibre and cable*.

– ITU-T Recommendation G.651 (1998), *Characteristics of a 50/125 µm multimode graded index optical fibre cable*.

– ITU-T Recommendation G.652 (2003), *Characteristics of a single-mode optical fibre cable*.

– ITU-T Recommendation G.653 (2003), *Characteristics of dispersion-shifted single-mode optical fibre and cable*.

– ITU-T Recommendation G.654 (2004), *Characteristics of a cut-off shifted single-mode optical fibre and cable*.

– ITU-T Recommendation G.655 (2003), *Characteristics of a non-zero dispersion-shifted single-mode optical fibre and cable*.

– ITU-T Recommendation G.656 (2004), *Characteristics of a fibre and cable with non-zero dispersion for wideband optical transport*.

– ITU-T G-series Recommendations – Supplement 39 (2003), *Optical system design and engineering considerations*.

– ITU-T Recommendation L.10 (2002), *Optical fibre cables for duct and tunnel application.*

– ITU-T Recommendation L.12 (2000), *Optical fibre joints*.

– ITU-T Recommendation L.13 (2003), *Performance requirements for passive optical nodes: Sealed closures for outdoor environments*.

– ITU-T Recommendation L.14 (1992), *Measurement method to determine the tensile performance of optical fibre cables under load.*

– ITU-T Recommendation L.25 (1996), *Optical fibre cable network maintenance.*

– ITU-T Recommendation L.26 (2002), *Optical fibre cables for aerial application.*

– ITU-T Recommendation L.27 (1996), *Method for estimating the concentration of hydrogen in optical fibre cables*.

– ITU-T Recommendation L.28 (2002), *External additional protection for marinized terrestrial cables*.

– ITU-T Recommendation L.29 (2002), *As-laid report and maintenance/repair log for marinized terrestrial cable installation.*

– ITU-T Recommendation L.30 (1996), *Markers on marinized terrestrial cables*.

– ITU-T Recommendation L.31 (1996), *Optical fibre attenuators*.

– ITU-T Recommendation L.36 (1998), *Single mode fibre optic connectors*.

– ITU-T Recommendation L.37 (1998), *Fibre optic (non-wavelength selective) branching devices*.

– ITU-T Recommendation L.38 (1999), *Use of trenchless techniques for the construction of underground infrastructures for telecommunication cable installation.*

– ITU-T Recommendation L.40 (2000), *Optical fibre outside plant maintenance support, monitoring and testing system*.

– ITU-T Recommendation L.41 (2000), *Maintenance wavelength on fibres carrying signals*.

– ITU-T Recommendation L.43 (2002), *Optical fibre cables for buried application.*

– ITU-T Recommendation L.45 (2000), *Minimizing the effect on the environment from the outside plant in telecommunication networks*.

– ITU-T Recommendation L.46 (2000), *Protection of telecommunication cables and plant from biological attack.*

– ITU-T Recommendation L.48 (2003), *Mini-trench installation technique.*

– ITU-T Recommendation L.49 (2003), *Micro-trench installation technique*.

– ITU-T Recommendation L.50 (2003), *Requirements for passive optical nodes: Optical distribution frames in central office environments*.

– ITU-T Recommendation L.51 (2003), *Passive node elements for fibre optic networks – General principles and definitions for characterization and performance evaluation.*

– ITU-T Recommendation L.52 (2003), *Deployment of Passive Optical Networks (PON)*.

– ITU-T Recommendation L.53 (2003), *Optical fibre maintenance criteria for access networks*.

– ITU-T Recommendation L.54 (2004), *Splice closure for marinized terrestrial cables (MTC)*.

– ITU-T Recommendation L.55 (2003), *Digital database for marine cables and pipelines*.

– ITU-T Recommendation L.56 (2003), *Installation of optical fibre cables along railways*.

– ITU-T Recommendation L.57 (2003), *Air-assisted installation of optical fibre cables*.

– ITU-T Recommendation L.58 (2004), *Optical fibre cables: Special needs for access network*.

– ITU-T Handbook, *Construction, Installation, Jointing and Protection of Optical Fibre Cables*.

A lot of IEC documents concerning optical fibre cables and test methods are quoted in this Supplement. The detailed information is omitted in this clause.

3 Defined terms

The following terms relevant to optical fibres are defined in ITU-T Recs G.650.1, G.650.2, G.651, G.652, G.653, G.654, G.655, and G.656.

– alternative test method (ATM) defined in ITU-T Rec. G.650.1

– attenuation coefficient defined in ITU-T Rec. G.651

– attenuation defined in ITU-T Rec. G.650.1

– bandwidth defined in ITU-T Rec. G.651

– baseband response defined in ITU-T Rec. G.651

– cable cut-off wavelength defined in ITU-T Rec. G.650.1

– chromatic dispersion coefficient defined in ITU-T Rec. G.650.1

– chromatic dispersion defined in ITU-T Rec. G.650.1

– chromatic dispersion slope defined in ITU-T Rec. G.650.1

– cladding centre defined in ITU-T Rec. G.650.1

– cladding defined in ITU-T Recs G.650.1 and G.651

– cladding diameter defined in ITU-T Rec. G.650.1

– cladding diameter deviation defined in ITU-T Rec. G.650.1

– cladding mode stripper defined in ITU-T Recs G.650.1 and G.651

– cladding non-circularity defined in ITU-T Rec. G.650.1

– cladding tolerance field defined in ITU-T Rec. G.650.1

– core (cladding) centre defined in ITU-T Rec. G.651

– core (cladding) diameter defined in ITU-T Rec. G.651

– core (cladding) non-circularity defined in ITU-T Rec. G.651

– core (cladding) tolerance field defined in ITU-T Rec. G.651

– core area defined in ITU-T Rec. G.651

– core centre defined in ITU-T Rec. G.650.1

– core concentricity error defined in ITU-T Rec. G.650.1

– core defined in ITU-T Rec. G.651
– (core/cladding) concentricity error defined in ITU-T Rec. G.651
– cut-off wavelength defined in ITU-T Rec. G.650.1
– differential group delay (DGD) defined in ITU-T Rec. G.650.2
– dispersion offset defined in ITU-T Rec. G.650.1
– elementary cable sections defined in ITU-T Rec. G.651
– fibre cut-off wavelength defined in ITU-T Rec. G.650.1
– fibre materials defined in ITU-T Rec. G.651
– jumper cable cut-off wavelength defined in ITU-T Rec. G.650.1
– maximum theoretical numerical aperture defined in ITU-T Rec. G.651
– modal distortion bandwidth defined in ITU-T Rec. G.651
– mode field centre defined in ITU-T Rec. G.650.1
– mode field concentricity error defined in ITU-T Rec. G.650.1
– mode field defined in ITU-T Rec. G.650.1
– mode field diameter defined in ITU-T Rec. G.650.1
– mode field non-circularity defined in ITU-T Rec. G.650.1
– mode filter defined in ITU-T Rec. G.650.1
– mode scrambler defined in ITU-T Rec. G.651
– numerical aperture defined in ITU-T Rec. G.651
– PMD coefficient defined in ITU-T Rec. G.650.2
– PMD delay defined in ITU-T Rec. G.650.2
– polarization mode dispersion (PMD) defined in ITU-T Rec. G.650.2
– primary coating defined in ITU-T Rec. G.650.1
– principal states of polarization (PSP) defined in ITU-T Rec. G.650.2
– prooftest level defined in ITU-T Rec. G.650.1
– protective materials defined in ITU-T Rec. G.651
– reference surface defined in ITU-T Rec. G.651
– reference test method (RTM) defined in ITU-T Rec. G.650.1
– (refractive) index profile defined in ITU-T Rec. G.651
– secondary coating defined in ITU-T Rec. G.650.1
– source wavelength offset defined in ITU-T Rec. G.650.1
– stress corrosion parameter defined in ITU-T Rec. G.650.1
– zero-dispersion slope defined in ITU-T Rec. G.650.1
– zero-dispersion wavelength defined in ITU-T Rec. G.650.1

4 Abbreviations and acronyms

This Supplement uses the following abbreviations:

ATM Alternative Test Method

DC Dispersion Curvature

DCF Dispersion Compensating Fibre

DGD Differential Group Delay

PMD Polarization Mode Dispersion

PSP Principal States of Polarization

RDC Relative Dispersion Curvature

RDS Relative Dispersion Slope

RTM Reference Test Method

SBS Stimulated Brillouin Scattering

5 Definitions

5.1 passive (chromatic) dispersion compensator: A passive component used to compensate the chromatic dispersion of an optical path.

5.2 dispersion compensating fibre (DCF): A fibre used to compensate the chromatic dispersion of an optical path.

5.3 dispersion curvature (DC): The dispersion curvature is defined as $C(\lambda) = dS(\lambda)/d\lambda$. $S(\lambda)$ denotes the dispersion slope at the wavelength λ.

5.4 relative dispersion slope (RDS): The relative dispersion slope is defined as $RDS = S(\lambda)/D(\lambda)$. $D(\lambda)$ denotes the chromatic dispersion at the wavelength λ.

5.5 relative dispersion curvature (RDC): The relative dispersion curvature is defined as $RDC = C(\lambda)/D(\lambda)$.

6 Features of existing optical fibre categories and their application areas

6.1 Attenuation properties

Typical attenuation spectrum of G.652 fibre with and without OH absorption loss is given in Appendix I/G.695.

6.2 Dispersion properties

The dispersion properties of G.652 and G.653 fibres are given in 10.3 of Supplement 39 of the G.600 series.

6.3 Bending properties

For further study.

7 Relationship between fibre parameters and interface parameters

7.1 Relationship between PMD and DGD

Relationship between PMD and DGD is given in IEC/TR 61282-3, *Fibre optic communication system design guides – Part 3: Calculation of polarization mode dispersion*.

7.2 Transmission limitation due to dispersion properties

Transmission limitation due to dispersion properties is given in clauses 9.2 and 10.3 of Supplement 39 to G.600 series.

8 Unspecified fibre parameters and their test methods

The unspecified fibre parameters are defined in Appendix II/G.650.2 and Appendix II/G.663.

8.1 Non-linear coefficient

Information of Non-linear coefficient is given in Appendix II/G.650.2 and IEC/TR 62285, *Non-linear coefficient measuring methods – Application guide*.

8.2 Effective area A_{eff}

Information on effective area is given in Appendix II/G.650.2 and IEC/TR 62284, *Effective area measurements of single-mode optical fibres – Guidance*.

8.3 Stimulated Brillouin Scattering (SBS) threshold

Information on stimulated Brillouin scattering threshold is given in Appendix II/G.650.2 and Appendix II/G.663.

8.4 Raman gain coefficient

Information on Raman gain coefficient is given in Appendix II/G.663 and IEC/TR 62324, *Single-mode optical fibres – Raman gain efficiency measurement using continuous wave method – Guidance*.

8.5 Microbending loss

Measurement methods of microbending loss are given in IEC 62221, *Optical fibres – Measurement methods – Microbending sensitivity*.

9 Optical fibre properties for operation and maintenance

IEC/TR 62xxx, *Guidance for inter-fibre compatibility*.

9.1 Properties of cut-off wavelength under the deployment conditions

This clause contains length dependence of cut-off wavelength and loop diameter dependence of cut-off wavelength.

9.2 Properties of chromatic dispersion and polarization mode dispersion

The statistical design of chromatic dispersion is given in clause 10.3 of Sup. 39 to G.600 series.

NOTE – This clause contains the temperature dependence of chromatic and polarization mode dispersions.

9.3 Splice loss

Information on splice loss is given in ITU-T Recs G.651, *Characteristics of a 50/125 µm multimode graded index optical fibre cable,* L.36, *Single mode fibre optic connectors*, and L.12, *Optical fibre joints*.

9.4 Input power limitation and safety aspects

The following documents describe input power limitation and safety aspects.

IEC 61292-4 TR: *Optical amplifiers – Part 4: Maximum permissible optical power for the damage-free and safe use of optical amplifiers, including Raman amplifiers*.

IEC 60825-2: *Safety of laser products – Part 2: Safety of optical fibre communication systems (OFCS)*.

9.5 Reliability of optical fibre cable

Reliability issues of optical fibre cable are given in ITU-T Recs L.14, *Measurement method to determine the tensile performance of optical fibre cables under load*, L.45, *Minimizing the effect on the environment from the outside plant in telecommunication networks*, L.46, *Protection of telecommunication cables and plant from biological attack*, and IEC/TR 62048, *Optical fibres – Reliability – Power law theory*.

9.6 Optical loss properties due to hydrogen

Information on optical loss properties due to hydrogen is given in ITU-T Rec. L.27, *Method for estimating the concentration of hydrogen in optical fibre cables*, and IEC 60793-2-50, (Addresses loss increase with time).

9.7 Environmental test conditions for fibres

The following documents describe the environmental test conditions for fibres.

IEC 60793-1-50, *Optical fibres – Part 1-50: Measurement methods and test procedures – Damp heat (steady state)*.

IEC 60793-1-51, *Optical fibres – Part 1-51: Measurement methods and test procedures – Dry heat*.

IEC 60793-1-52, *Optical fibres – Part 1-52: Measurement methods and test procedures – Change of temperature*.

IEC 60793-1-53, *Optical fibres – Part 1-53: Measurement methods and test procedures – Water immersion*.

IEC 60793-1-54, *Optical fibres – Part 1-54: Measurement methods and test procedures – Gamma irradiation*.

9.8 Optical fibre cable network maintenance

The following ITU-T Recommendations describe the optical fibre cable network maintenance.

ITU-T Rec. L.25, *Optical fibre cable network maintenance*.

ITU-T Rec. L.29, *As-laid report and maintenance/repair log for marinized terrestrial cable installation*.

ITU-T Rec. L.40, *Optical fibre outside plant maintenance support, monitoring and testing system*.

ITU-T Rec. L.41, *Maintenance wavelength on fibres carrying signals*.

ITU-T Rec. L.53, *Optical fibre maintenance criteria for access networks*.

Appendix I

Standardized criteria

I.1 Criteria for revising the optical fibre Recommendations

A Recommendation covers a group of fibres which are *approximately* the same in both of the following respects:

1) Primary wavelength region of intended operation.

2) Chromatic dispersion value in the primary wavelength region of intended operation.

Within each Recommendation, the base category should be described in Table 1, while other categories may be described in subsequent tables, including at least two attribute types (fibre and cable) for each table. A third attribute type (links) remains under study.

The fibre Recommendation may include the main parameters of mode field diameter, cut-off wavelength, and chromatic dispersion. The values of these parameters must be broad enough to encompass all of the fibre categories in the Recommendation.

The *base category* (for which the Recommendation was originally created, and which serves as the default category), is described in Table 1. Minor changes in the parameter values of Table 1 may be made from time to time to keep Table 1 aligned with current industry practice.

Further categories, typically based on new fibre parameters, may be created, providing they distinguish implementation variations that support different transmission strategies. The categories shall be designated in the order of their adoption. Several examples, which differ in one or more parameter values, may be given to illustrate each category of fibre. It is expected that there will be a few fibre Recommendations, each containing at most a few categories, with a few examples within each category, all arrived at by consensus on the part of the experts. A brief descriptor must be provided for each category and example, as well as the history of the modification of specification values and revised dates.

I.2 Guideline for conducting measurement round robins for optical fibres and cables

a) ***Objectives***: ITU-T Study Group 15, Question 15 round robins should be carried out for completing the content of the test method or fibre parameters described in the G.65x series of Recommendations. For example, when determining the RTM and ATM for test methods of a parameter, or when a parameter value is specified in the Recommendation, the round robin is needed. This round robin activity is different from an academic one.

b) ***Coordinators***: In principle, the editor of each Recommendation should coordinate the round robin activity. The responsible editor may appoint a substitute coordinator from ITU-T Study Group 15, Question 15 members.

c) ***Participants***: The round robin participants are fundamentally limited to only ITU-T Members. Non-ITU-T members may participate only when ITU-T Study Group 15, Question 15 members accept the necessity of their participation.

d) ***Round robin results handling***: Round robin results should be utilized for revising the Recommendation The coordinator can present the round robin results only when all ITU-T Study Group 15, Question 15 members, or all participants in the round robin, accept the necessity of disclosure of the round robin results.

Appendix II

Optical fibre cable structures

The following ITU-T Recommendations describe the optical fibre cable structures.

ITU-T Rec. L.10, *Optical fibre cables for duct and tunnel application*.

ITU-T Rec. L.26, *Optical fibre cables for aerial application.*

ITU-T Rec. L.28, *External additional protection for marinized terrestrial cables*.

ITU-T Rec. L.43, *Optical fibre cables for buried application.*

ITU-T Rec. L.58, *Optical fibre cables: Special needs for access network.*

Appendix III

Fibre optics hardware and passive components

The following ITU-T Recommendations are related to fibre optics hardware and passive components.

ITU-T Rec. L.13, *Performance requirements for passive optical nodes: Sealed closures for outdoor environments*.

ITU-T Rec. L.30, *Markers on marinized terrestrial cables*.

ITU-T Rec. L.31, *Optical fibre attenuators*.

ITU-T Rec. L.36, *Single mode fibre optic connectors*.

ITU-T Rec. L.37, *Fibre optic (non-wavelength selective) branching devices*.

ITU-T Rec. L.50, *Requirements for passive optical nodes: Optical distribution frames in central office environments*.

ITU-T Rec. L.51, *Passive node elements for fibre optic networks – General principles and definitions for characterization and performance evaluation.*

ITU-T Rec. L.54, *Splice closures for marinized terrestrial cables (MTC)*.

Appendix IV

Construction and installation practices

The construction issues are given in the ITU-T Handbook entitled "*Construction, Installation, Jointing and Protection of Optical Fibre Cables*" and "*Marinized Terrestrial Cables*" developed under SG 6. The following ITU-T Recommendations are related to construction and installation practices.

ITU-T Rec. L.38, *Use of trenchless techniques for the construction of underground infrastructures for telecommunication cable installation*.

ITU-T Rec. L.48, *Mini-trench installation technique*.

ITU-T Rec. L.49, *Micro-trench installation technique*.

ITU-T Rec. L.52, *Deployment of Passive Optical Networks (PON)*.

ITU-T Rec. L.56, *Installation of optical fibre cables along railways*.

ITU-T Rec. L.57, *Air-assisted installation of optical fibre cables*.

Appendix V

Status of optical fibre and cable specifications in ITU-T and IEC

V.1 Fibre specifications

The status of optical fibre specifications in ITU-T and IEC is listed in Table V.1

Table V.1 – Status of optical fibre specifications in ITU-T and IEC

Optical fibre specification			
ITU-T		**IEC**	
Fibre category	**Recommendation**	**Fibre category**	**Document**
50/125 µm multimode graded index optical fibre	G.651	A1 a multimode fibre	IEC 60793-2-10
Single-mode optical fibre	G.652	B1.1 single-mode fibre B1.3 single-mode fibre	IEC 60793-2-50
Dispersion-shifted single-mode optical fibre	G.653	B2 single-mode fibre	
Cut-off shifted single-mode optical fibre	G.654	B1.2 single-mode fibre	
Non-zero dispersion shifted single-mode optical fibre	G.655	B4 single-mode fibre	

V.2 Fibre cable specifications

The status of IEC 60794 regarding optical cables is shown in Figure V.1.

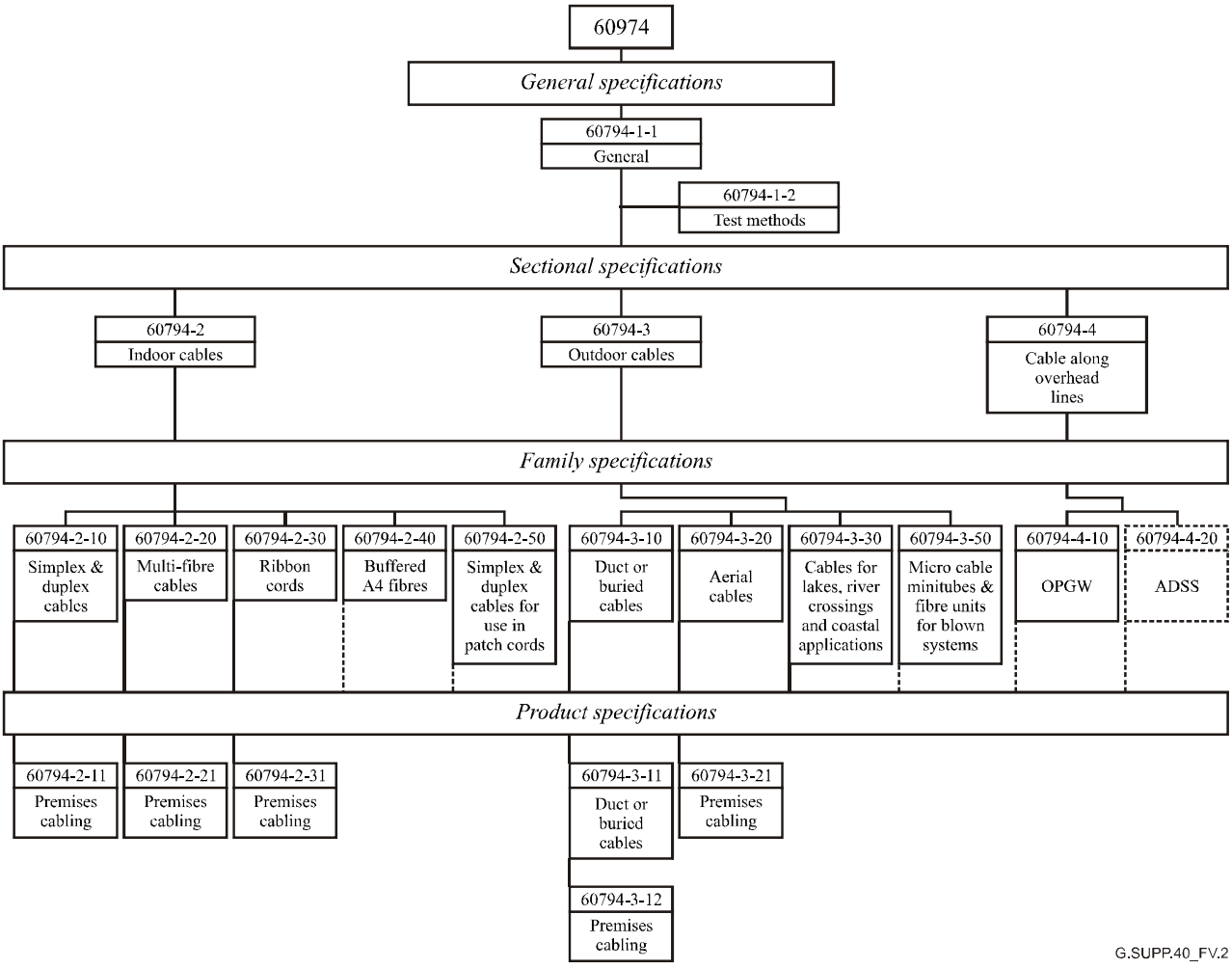

Figure V.1 – Status of IEC 60794 regarding optical cables

Appendix VI

Comparison of ITU-T Recommendations and IEC documents concerning test methods

VI.1 Test methods for single-mode fibres

VI.1.1 Documents are available in both ITU-T and IEC

ITU-T Recs.	Test methods		IEC documents	Test methods
G.650.1			IEC 60793	
5.1	Test methods for the mode field diameter	⇔	IEC 60793-1-45	Optical fibres – Part 1-45: Measurement methods and test procedures – Mode field diameter
5.1.1	Reference test method: The far-field scan		Annex A	Far field scan
5.1.2	First alternative test method: The variable aperture technique		Annex B	Variable aperture
5.1.3	Second alternative test method: The near-field scan		Annex C	Near-field scan
5.1.4	Third alternative test method: Bidirectional backscatter difference		Annex D	Bidirectional backscatter difference
G.650.1			IEC 60793	
5.2	Test methods for the cladding diameter, core concentricity error and cladding non-circularity	⇔	IEC 60793-1-20	Optical fibres – Part 1-20: Measurement methods and test procedures – Fibre geometry
5.2.1	Reference test method: The near-field image technique		Annex C	Near-field light (Gray-scale technique)
5.2.2	First alternative test method: The refracted near-field technique		Annex A	Refracted near-filed
5.2.3	Second alternative test method: The side-view technique		none	

ITU-T Recs.	Test methods		IEC documents	Test methods
G.650.1			IEC 60793	
5.2.4	Third alternative test method: The transmitted near-field technique		Annex C	Near-field light (Single near-field scan technique)
G.650.1			IEC 60793	
5.3	Test methods for the cut-off wavelength	⇔	IEC 60793-1-44	Optical fibres – Part 1-44: Measurement methods and test procedures – Cut-off wavelength
5.3.1	Reference test method for the cut-off wavelength (λc) of the primary coated fibre and reference test method for the cut-off wavelength (λcj) of jumper cables: The transmitted power technique		Annex C	Fibre cut-off wavelength λc
5.3.2	Alternative test method for λc: The split-mandrel technique		Annex C	Fibre cut-off wavelength λc
5.3.3	Reference test method for the cut-off wavelength (λcc) of the cabled fibre: The transmitted power technique		Annex B	Cabled cut-off wavelength, λcc, using cabled fibre
5.3.4	Alternative test method for the cut-off wavelength (λcc) of the cabled fibre		Annex A	Cabled cut-off wavelength, λcc, using uncabled fibre
G.650.1			IEC 60793	
5.4	Test methods for the attenuation	⇔	IEC 60793-1-40	Optical fibres – Part 1-40: Measurement methods and test procedures – Attenuation
5.4.1	Reference test method: The cut-back technique		Annex A	Cut-back
5.4.2	First alternative test method: The backscattering technique		Annex C	Backscattering
5.4.3	Second alternative test method: The insertion loss technique		Annex B	Insertion loss

ITU-T Recs.	Test methods		IEC documents	Test methods
G.650.1			IEC 60793	
5.5	Test methods for the chromatic dispersion	⇔	IEC 60793-1-42	Optical fibres – Part 1-42: Measurement methods and test procedures – Chromatic dispersion
5.5.1	Reference test method: The phase-shift technique		Annex A	Phase shift (Annex C: Differential phase shift)
5.5.2	First alternative test method: The interferometric technique		Annex D	Interferometry
5.5.3	Second alternative test method: The pulse delay technique		Annex B	Spectral group delay in time domain
G.650.1			IEC 60793	
5.6	Test methods for prooftesting	⇔	IEC 60793-1-30	Optical fibres – Part 1-30: Measurement methods and test procedures – Fibre proof test
5.6.1	Reference test method: Longitudinal tension			Fibre proof test
G.650.1				
Appendix II	Test method for measuring chromatic dispersion uniformity based on the backscattering technique	⇔	None	
G.650.2			IEC 60793	
5.1	Test methods for polarization mode dispersion	⇔	IEC 60793-1-48	Optical fibres – Part 1-48: Measurement methods and test procedures – Polarization mode dispersion
5.1.1	Reference test method: The Stokes parameter evaluation technique		Annex B	Stokes evaluation method Jones matrix eigenanalysis (JME) Poincare's sphere analysis (PSA)
5.1.2	First alternative test method: State of polarization (SOP) method		Annex B	State of polarization (SOP)
5.1.3	Second alternative test method: Interferometric method		Annex C	Interferometric method Weak mode coupling Strong mode coupling

ITU-T Recs.	Test methods
G.650.2	
5.1.4	The fixed analyser technique
G.650.2	
Appendix III	Test methods for effective area (A*eff*)
III.1	The far-field scan (FFS) technique
III.2	The variable aperture (VA) technique
III.3	The near-field scan (NFS) technique

IEC documents	Test methods
IEC 60793	
Annex A	Fixed analyzer measurement method Extrema counting (EC) Fourier transform (FT)
IEC/TR 62284	
IEC/TR 62284	Effective area measurements of single-mode optical fibres – Guidance
Annex A	Direct far-field method measurement specifics
Annex B	Variable aperture in the far-field method measurement specifics
Annex C	Near-field method measurement specifics

VI.2 Test methods for multimode fibres

VI.2.1 Documents available in both ITU-T and IEC

ITU-T Recs.	Test methods
G.651	
6.1	Reference test method and alternative test method for geometrical and optical parameters measurements
6.2	Reference test method for geometrical and alternative test method for numerical aperture: the refracted near-field technique
6.3	Alternative test method for geometrical parameters: the near-field technique

IEC documents	Test methods
IEC 60793	
IEC 60793-1-20	Optical fibres – Part 1-20: Measurement methods and test procedures – Fibre geometry
Annex A	Refracted near-field
Annex C	Near-field light distribution (Single near-field scan technique)

ITU-T Recs.	Test methods		IEC documents	Test methods
G.651			IEC 60793	
6.4	Reference test method for the numerical aperture: far-field light distribution	⇔	IEC 60793-1-43	Optical fibres – Part 1-43: Measurement methods and test procedures – Numerical aperture
G.651				
6.5	Reference test method and alternative test methods for attenuation measurements	⇔	IEC 60793-1-40	Optical fibres – Part 1-40: Measurement methods and test procedures – Attenuation
6.6	The reference test method: the cutback technique		Annex A	Cut-back
6.7	First alternative test method: the insertion loss technique		Annex B	Insertion loss
6.8	Second alternative test method: the backscattering technique		Annex C	Backscattering
G.651				
6.9	Reference test method for baseband response measurements	⇔	IEC 60793-1-41	Optical fibres – Part 1-41: Measurement methods and test procedures – Bandwidth
6.10	Reference test method		Annex A	Impulse response
			Annex B	Frequency response

VI.3 Documents available only in IEC and not in ITU-T

IEC 60793-1-21	Optical fibres – Part 1-21: Measurement methods and test procedures – Coating geometry
IEC 60793-1-22	Optical fibres – Part 1-22: Measurement methods and test procedures – Length measurement
IEC 60793-1-31	Optical fibres – Part 1-31: Measurement methods and test procedures – Tensile strength
IEC 60793-1-32	Optical fibres – Part 1-32: Measurement methods and test procedures – Coating strippability
IEC 60793-1-33	Optical fibres – Part 1-33: Measurement methods and test procedures – Stress corrosion susceptibility
IEC 60793-1-34	Optical fibres – Part 1-34: Measurement methods and test procedures – Fibre curl
IEC 60793-1-47	Optical fibres – Part 1-47: Measurement methods and test procedures – Macrobending loss
IEC 60793-1-50	Optical fibres – Part 1-50: Measurement methods and test procedures – Damp heat (steady state)
IEC 60793-1-51	Optical fibres – Part 1-51: Measurement methods and test procedures – Dry heat
IEC 60793-1-52	Optical fibres – Part 1-52: Measurement methods and test procedures – Change of temperature
IEC 60793-1-53	Optical fibres – Part 1-53: Measurement methods and test procedures – Water immersion
IEC 60793-1-54	Optical fibres – Part 1-54: Measurement methods and test procedures – Gamma irradiation
IEC 60794-1-2	Optical fibre cables – Part 1-2: Generic specification – Basic optical cable test procedures
IEC/TS 62033	Attenuation uniformity in optical fibres
IEC 62221	Optical fibres – Measurement methods – Microbending sensitivity
IEC/TR 62245	Optical fibres – Measurement methods – Bend loss for A3 and A4 type fibres
IEC/TR 62283	Nuclear radiation – Fibre optic guidance
IEC/TR 62285	Non-linear coefficient measuring methods – Application guide
IEC/TR 62324	Single-mode optical fibres – Raman gain efficiency measurement using continuous wave method – Guidance

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