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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

Supplement 40 to the ITU-T G-series Recommendations provides information on the background and specifications used in the development of optical fibre and cable ITU-T Recommendations such as Recommendations ITU-T G.651.1, ITU-T G.652, ITU-T G.653, ITU-T G.654, ITU-T G.655, ITU-T G.656, ITU-T G.657 and L series Recommendations. It also contains information used in the development of test method Recommendations such as Recommendations ITU-T G.650.1, ITU-T G.650.2 and ITU-T G.650.3. Moreover, this Supplement maps ITU-T documents to optical fibre and cable standards developed under IEC.

History

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2.0	ITU-T G Suppl. 40	2006-11-10	15
3.0	ITU-T G Suppl. 40	2010-06-11	15

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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.

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Supplement 40 to ITU-T G-series Recommendations

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, terrestrial system interface, components, submarine systems and physical infrastructure Recommendations currently being developed in ITU-T. 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 which are 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 criteria for optical fibres in ITU-T Study Group 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 G.650.1] Recommendation ITU-T G.650.1 (2004), *Definitions and test methods for linear, deterministic attributes of single-mode fibre and cable*.

[ITU-T G.650.2] Recommendation ITU-T G.650.2 (2005), *Definitions and test methods for statistical and non-linear related attributes of single-mode fibre and cable*.

[ITU-T G.650.3] Recommendation ITU-T G.650.3 (2008), *Test methods for installed single-mode optical fibre cable links*.

[ITU-T G.651.1] Recommendation ITU-T G.651.1 (2007), *Characteristics of a 50/125 µm multimode graded index optical fibre cable for the optical access network*.

[ITU-T G.652] Recommendation ITU-T G.652 (2009), *Characteristics of a single-mode optical fibre and cable*.

[ITU-T G.653] Recommendation ITU-T G.653 (2006), *Characteristics of a dispersion-shifted single-mode optical fibre and cable*.

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[ITU-T G.654] Recommendation ITU-T G.654 (2006), *Characteristics of a cut-off shifted single-mode optical fibre and cable*.

[ITU-T G.655] Recommendation ITU-T G.655 (2009), *Characteristics of a non-zero dispersion-shifted single-mode optical fibre and cable*.

[ITU-T G.656] Recommendation ITU-T G.656 (2006), *Characteristics of a fibre and cable with non-zero dispersion for wideband optical transport*.

[ITU-T G.657] Recommendation ITU-T G.657 (2009), *Characteristics of a bending-loss insensitive single-mode optical fibre and cable for the access network*.

[ITU-T G.663] Recommendation ITU-T G.663 (2000), *Application related aspects of optical amplifier devices and subsystems*.

[ITU-T G.664] Recommendation ITU-T G.664 (2006), *Optical safety procedures and requirements for optical transport systems*.

[ITU-T G.695] Recommendation ITU-T G.695 (2009), *Optical interfaces for coarse wavelength division multiplexing applications*.

[ITU-T G-Sup.39] ITU-T G-series Recommendations – Supplement 39 (2006), *Optical system design and engineering considerations*.

[ITU-T G-Sup.47] ITU-T G-series Recommendations – Supplement 47 (2009), *General aspects of optical fibre and cable*.

[ITU-T L.12] Recommendation ITU-T L.12 (2008), *Optical fibre splices*.

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

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

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

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

[ITU-T L.36] Recommendation ITU-T L.36 (2008), *Single-mode fibre optic connectors*.

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

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

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

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

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

[ITU-T L.64] Recommendation ITU-T L.64 (2007), *ID tag requirements for infrastructure and network elements management*.

[ITU-T L.66] Recommendation ITU-T L.66 (2007), *Optical fibre cable maintenance criteria for in-service fibre testing in access networks*.

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[ITU-T L.68] Recommendation ITU-T L.68 (2007), *Optical fibre cable maintenance support, monitoring and testing system for optical fibre cable networks carrying high total optical power*.

[ITU-T L.74] Recommendation ITU-T L.74 (2008), *Maintenance of cable tunnels*.

[ITU-T L.87] Recommendation ITU-T L.87 (2010), *Optical fibre cables for drop applications*.

[IEC 60793-1-20] IEC 60793-1-20 (2001), *Optical fibres – Part 1-20: Measurement methods and test procedures – Fibre geometry*.

[IEC 60793-1-21] IEC 60793-1-21 (2001), *Optical fibres – Part 1-21: Measurement methods and test procedures – Coating geometry*.

[IEC 60793-1-22] IEC 60793-1-22 (2001), *Optical fibres – Part 1-22: Measurement methods and test procedures – Length measurement*.

[IEC 60793-1-30] IEC 60793-1-30 (2010), *Optical fibres – Part 1-30: Measurement methods and test procedures – Fibre proof test*.

[IEC 60793-1-31] IEC 60793-1-31 (2010), *Optical fibres – Part 1-31: Measurement methods and test procedures – Tensile strength*.

[IEC 60793-1-32] IEC 60793-1-32 (2010), *Optical fibres – Part 1-32: Measurement methods and test procedures – Coating strippability*.

[IEC 60793-1-33] IEC 60793-1-33 (2001), *Optical fibres – Part 1-33: Measurement methods and test procedures – Stress corrosion susceptibility*.

[IEC 60793-1-34] IEC 60793-1-34 (2006), *Optical fibres – Part 1-34: Measurement methods and test procedures – Fibre curl*.

[IEC 60793-1-40] IEC 60793-1-40 (2001), *Optical fibres – Part 1-40: Measurement methods and test procedures – Attenuation*.

[IEC 60793-1-41] IEC 60793-1-41 (2010), *Optical fibres – Part 1-41: Measurement methods and test procedures – Bandwidth*.

[IEC 60793-1-42] IEC 60793-1-42 (2007), *Optical fibres – Part 1-42: Measurement methods and test procedures – Chromatic dispersion*.

[IEC 60793-1-43] IEC 60793-1-43 (2001), *Optical fibres – Part 1-43: Measurement methods and test procedures – Numerical aperture*.

[IEC 60793-1-44] IEC 60793-1-44 (2001), *Optical fibres – Part 1-44: Measurement methods and test procedures – Cut-off wavelength*.

[IEC 60793-1-45] IEC 60793-1-45 (2001), *Optical fibres – Part 1-45: Measurement methods and test procedures – Mode field diameter*.

[IEC 60793-1-47] IEC 60793-1-47 (2009), *Optical fibres – Part 1-47: Measurement methods and test procedures – Macrobending loss*.

[IEC 60793-1-48] IEC 60793-1-48 (2007), *Optical fibres – Part 1-48: Measurement methods and test procedures – Polarization mode dispersion*.

[IEC 60793-1-49] IEC 60793-1-49 (2006), *Optical fibres – Part 1-49: Measurement methods and test procedures – Differential mode delay*.

[IEC 60793-1-50] IEC 60793-1-50 (2001), *Optical fibres – Part 1-50: Measurement methods and test procedures – Damp heat (steady state)*.

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