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SERIES L: ENVIRONMENT AND ICTS, CLIMATE
CHANGE, E-WASTE, ENERGY EFFICIENCY;
CONSTRUCTION, INSTALLATION AND PROTECTION
OF CABLES AND OTHER ELEMENTS OF OUTSIDE
PLANT

Passive optical devices

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PLANT

Passive optical devices

Optical fibre splices

Recommendation ITU-T L.400/L.12

ITU-T L-SERIES RECOMMENDATIONS

ENVIRONMENT AND ICTS, CLIMATE CHANGE, E-WASTE, ENERGY EFFICIENCY; CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

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Recommendation ITU-T L.400/L.12

Optical fibre splices

Summary

Recommendation ITU-T L.400/L.12 specifies splices of single-mode and multimode optical fibres. It describes suitable procedures for splicing that should be carefully followed in order to obtain reliable splices between single optical fibres or ribbons. The procedures apply to both single optical fibres and ribbons (mass splicing).

Splices are critical points in the optical fibre network, because they strongly affect the quality and lifetime of links. In fact, the splice should ensure high quality and stability of performance with time. High quality in splicing is usually characterized by low splice loss and tensile strength near that of the fibre proof test level. Splices should be stable over the design life of the optical fibre link under its expected environmental conditions.

At present two technologies, fusion and mechanical, can be used for splicing glass optical fibres and the choice between them depends upon the expected functional performance and considerations of installation and maintenance. These splices are designed to provide permanent connections.

The following elements have been modified in this edition of Recommendation ITU-T L.400/L.12:

- maximum attenuation of fibre splices depending on the alignment method (active core, active cladding and passive V-groove alignment);
- maximum attenuation for mechanical splices;
- validation of splicing procedure is added with average and maximum attenuation (97% of the splices) of fibre splices;
- the appendix with Japanese experience is removed;
- inclusion of Appendix II, which shows the increase in attenuation when splicing different types of optical fibres by taking into account the mode field diameter mismatch, the core-cladding concentricity and the cladding diameter;
- inclusion of Appendix III, which explains the fibre imaging process in fusion splicing machines.

History

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Keywords

Fusion splice, mechanical splice, optical fibre splice.

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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.

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Recommendation ITU-T L.400/L.12

Optical fibre splices

1 Scope

This Recommendation specifies splices of single-mode and multimode optical fibres. It describes suitable procedures for splicing that should be carefully followed in order to obtain reliable splices between single optical fibres or ribbons. The procedures apply to both single optical fibres and ribbons (mass splicing).

In addition, this Recommendation describes the optical, mechanical and environmental properties, recommended test methods and recommended test severities that should be considered for an optical fibre splice. Moreover, validation tests of the splice procedure are given to obtain the expected optical splice properties.

Further information is provided in chapter 6 of [b-ITU-T TR-OFCS]. The fibres should be in accordance with [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] and [ITU-T G.657].

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- [ITU-T G.651.1] Recommendation ITU-T G.651.1 (2018), *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 (2016), *Characteristics of a single-mode optical fibre and cable*.
- [ITU-T G.653] Recommendation ITU-T G.653 (2010), *Characteristics of a dispersion-shifted, single-mode optical fibre and cable*.
- [ITU-T G.654] Recommendation ITU-T G.654 (2020), *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 (2010), *Characteristics of a fibre and cable with non-zero dispersion for wideband optical transport*.
- [ITU-T G.657] Recommendation ITU-T G.657 (2016), *Characteristics of a bending loss insensitive single-mode optical fibre and cable*.
- [IEC 61300-1] IEC 61300-1:2016, ¹ *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 1: General and guidance*.

¹ Withdrawn.

- [IEC 61300-2-1] IEC 61300-2-1:2009, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-1: Tests – Vibration (sinusoidal)*.
- [IEC 61300-2-4] IEC 61300-2-4:2019 + AMD1:2020, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-4: Tests – Fibre or cable retention*.
- [IEC 61300-2-5] IEC 61300-2-5:2009, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-5: Tests – Torsion*.
- [IEC 61300-2-7] IEC 61300-2-7:2013, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-7: Tests – Bending moment*.
- [IEC 61300-2-9] IEC 61300-2-9:2017, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-9: Tests – Shock*.
- [IEC 61300-2-17] IEC 61300-2-17:2010, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-17: Tests – Cold*.
- [IEC 61300-2-18] IEC 61300-2-18:2005, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-18: Tests – Dry heat – High temperature endurance*.
- [IEC 61300-2-21] IEC 61300-2-21:2009, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-21: Tests – Composite temperature/humidity cyclic test*.
- [IEC 61300-2-22] IEC 61300-2-22:2007, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-22: Tests – Change of temperature*.
- [IEC 61300-2-26] IEC 61300-2-26:2006, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-26: Tests – Salt mist*.
- [IEC 61300-2-27] IEC 61300-2-27:1995, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-27: Tests – Dust – Laminar flow*.
- [IEC 61300-2-45] IEC 61300-2-45:1999, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-45: Tests – Durability test by water immersion*.
- [IEC 61300-3-3] IEC 61300-3-3:2009, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-3: Examinations and measurements – Active monitoring of changes in attenuation and return loss*.
- [IEC 61300-3-4] IEC 61300-3-4:2012, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-4: Examinations and measurements – Attenuation*.
- [IEC 61300-3-6] IEC 61300-3-6:2008, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-6: Examinations and measurements – Return loss*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

None

3.2 Terms defined in this Recommendation

This Recommendation defines the following term:

3.2.1 optical fibre splice: Permanent or separable joint whose purpose is to couple optical power between two optical fibres, achieved by either a fusion or a mechanical technique.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

IL	Insertion Loss
MFD	Mode Field Diameter
OTDR	Optical Time Domain Reflectometer
RH	Relative Humidity
RL	Return Loss
UV	Ultraviolet

5 Conventions

None.

6 Types of splices – general description

All optical fibre splices mentioned in this Recommendation should be suitable for indoor applications as well as for outdoor environments when stored in an appropriate enclosure.

6.1 Fusion splices

Different methods exist to obtain a fusion splice of single fibres or ribbons. Electric arc-fusion is the most widely used method to make reliable single or mass optical splices in the field. The fusion process is realized by using specially developed splicing machines.

To make a fusion splice, all protective coatings are removed from the fibres, and the fibres are cleaved and then positioned and aligned between two electrodes in the splicing machine. An electric arc heats the glass until the melting or softening point is reached and at the same time the fibres are brought together longitudinally in such a way that a geometrically continuous glass filament is obtained. The fibre alignment in these machines can be passive (V-groove alignment) or active (light injection and detection system or core and cladding profile monitoring and alignment system). A suitable protection device is then applied to the splice area to protect the bare fibre and to allow handling and storage without adversely affecting the physical integrity of the splice. The cleave quality and the intensity and the duration of the arc, as well as the differences between the fibres (refractive index profile, mode field diameter (MFD), core-cladding concentricity, cladding diameter) to be spliced determine the splice loss. In addition, the quality of coating removal, fibre cleaving, and splice protection contribute to long-term mechanical reliability in the field.