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Optical fibre splices

Recommendation ITU-T L.12

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Optical fibre splices

Summary

Splices are critical points in the optical fibre network, as they strongly affect not only the quality of the links, but also their lifetime. In fact, the splice shall ensure high quality and stability of performance with time. High quality in splicing is usually defined as low splice loss and tensile strength near that of the fibre proof-test level. Splices shall be stable over the design life of the system 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.

Source

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FOREWORD

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Optical fibre splices

1 Scope

This Recommendation deals with the application of splices of single-mode and multimode optical fibres. It describes a suitable procedure for splicing that shall be carefully followed in order to obtain reliable splices between optical fibres or ribbons. This procedure applies both to single fibres or ribbons (mass splicing). In addition, this Recommendation advises on the optical, mechanical and environmental testing methods required for the splice system design and equipment qualification. Further information is provided in [b-ITU-T Handbook].

The fibres shall 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 Normative 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 (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 (2005), *Characteristics of a single-mode optical fibre and cable*.
- [ITU-T G.653] Recommendation ITU-T G.653 (2003), *Characteristics of a dispersion-shifted single-mode optical fibre and cable*.
- [ITU-T G.654] Recommendation ITU-T G.654 (2004), *Characteristics of a cut-off shifted single-mode optical fibre and cable*.
- [ITU-T G.655] Recommendation ITU-T G.655 (2006), *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 (2006), *Characteristics of a bending loss insensitive single mode optical fibre and cable for the access network*.
- [IEC 61300] IEC 61300-x-series (in force), *Fibre optic interconnecting devices and passive components - Basic test and measurement procedures*.
<<http://www.iec.ch/cgi-bin/procgi.pl/www/iecwww.p?wwwprog=sea22.p&search=iecnumber&header=IEC&pubno=61300>>
- [IEC 61755-2-x] IEC 61755-2-series (2006), *Fibre optic connector optical interfaces*.
<<http://www.iec.ch/cgi-bin/procgi.pl/www/iecwww.p?wwwprog=sea22.p&search=iecnumber&header=IEC&pubno=61755&part=2>>

[IEC/TR 62316] IEC/TR 62316 (2007), *Guidance for the interpretation of OTDR backscattering traces*.
<<http://webstore.iec.ch/webstore/webstore.nsf/artnum/037447>>

3 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

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

4 Types of splices: General description

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

4.1 Fusion splices

Different methods exist to obtain a fusion splice of 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 the protective coatings are removed from the fibre, the fibres are cleaved and then positioned and aligned between two electrodes in the splicing machine. An electric arc heats the silica 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 splice is obtained. This process produces a continuous glass filament. The fibre alignment in these machines can be passive (v-groove alignment) or active (light injection and detection system or core/cladding profile monitoring and alignment system). A suitable protection device is then applied to the splice 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 two fibres to be spliced determine the splice loss. In addition, the quality of coating removal, fibre cleaving and splice protection contribute to the long-term mechanical reliability in the field.

4.2 Mechanical splices

Mechanical splices have different structures and physical designs, and usually include the following basic components:

- surface for aligning mating fibre ends;
- a retainer to keep the fibres in alignment;
- an index matching material (gel, grease, adhesive, etc.) placed between the fibre ends.

They can be used for single fibres or ribbons. Some designs allow installation on the fibres at the end of a cable in the factory for faster jointing in the field.

An optical matching material between the ends of the fibres can be used to reduce Fresnel reflections. This material shall be chosen to match the optical properties of the fibre. Common index matching materials include silicon gels, UV-curable adhesive, epoxy resins and optical