International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

L.50

(07/2010)

SERIES L: CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

Requirements for passive optical nodes: Optical distribution frames for central office environments

Recommendation ITU-T L.50

Recommendation ITU-T L.50

Requirements for passive optical nodes: Optical distribution frames for central office environments

Summary

Recommendation ITU-T L.50 deals with general requirements for individual optical distribution frames (ODF), as well as combined frames (ODCF), in a central office environment, including cable ducting systems between multiple ODFs.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T L.50	2003-11-28	6
2.0	ITU-T L.50	2010-07-29	15

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). 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 Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation 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 Recommendation is required of any party.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

CONTENTS

		Page
1	Scope	1
2	References	1
3	Definitions	1
3.1	Terms defined elsewhere	1
3.2	Terms defined in this Recommendation	1
4	Abbreviations and acronyms	3
5	Conventions	3
6	Functional requirements of ODFs and ODCFs	3
6.1	General requirements	3
6.2	Access and maintenance	3
6.3	Termination of cables	3
6.4	Storage and protection of splices and optical devices	4
6.5	Connectors and cross-connection of circuits	4
6.6	Pigtail storage and routing	4
6.7	Optical fibre duct	4
7	Performance evaluation test programme	4
Appendix I – Performance evaluation criteria (example)		5
I.1	Mechanical evaluation	5
I.2	Optical evaluation	5
Appendix II – Performance test programme for ODF (example)		7
II.1	Mechanical and optical evaluation	7
Appendix III – Product characterization checklist		9
Appendix IV – Example of the performance evaluation method for optical duct components		11
IV.1	Performance test of optical fibre duct	11
Bibliography		12

Recommendation ITU-T L.50

Requirements for passive optical nodes: Optical distribution frames for central office environments

1 Scope

This Recommendation describes the functional requirements of optical distribution frames (ODF) in central office environments.

It does not apply to:

– active network elements such as optical line terminals (OLTs);

– outdoor cabinets;

– termination boxes at the customer premises.

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 K.25] Recommendation ITU-T K.25 (2000), *Protection of optical fibre cables.*

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

3 Definitions

3.1 Terms defined elsewhere

None.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 central office environment: The term "central office environment" refers to any room or space inside a building that is only accessible to qualified staff. Examples: Traditional central offices and local exchanges, co-location rooms, other leased rooms inside building.

3.2.2 frame: Frame refers to the mechanical structure to which cables are attached and that holds all other elements of the optical distribution frame (ODF). It may be a rack and shelve-type structure, similar to what is used to contain the electronics, as well as any other type of structure. Its main functions are mechanical support and a basic level of protection of its content.

3.2.3 fibre organizer: In a node, the optical fibres are to be properly managed and guided from where a cable or pigtail enters the node, until it leaves again. The fibre organizer comprises the whole of the means and features that are intended to guide and store fibres, pigtails, splices, connectors and passive devices inside a node, at any location where they are not protected by the cable sheath.

3.2.4 optical distribution combined frame (ODCF): ODCF refers to a combination of several individual ODFs into a superstructure in order to provide more capacity than can be held by a single ODF. Another reason for creating an ODCF may be the need for multiple service providers to connect to the optical access network. An ODCF includes the necessary means and features to route cables between the individual ODFs.

An example of an ODCF, in which different functionalities are spread over the different individual frames, is shown in Figure 1. If there is no optical fibre duct between individual ODFs, it is necessary to do the connection between the ODFs by using optical cables for the protection of the fibre.

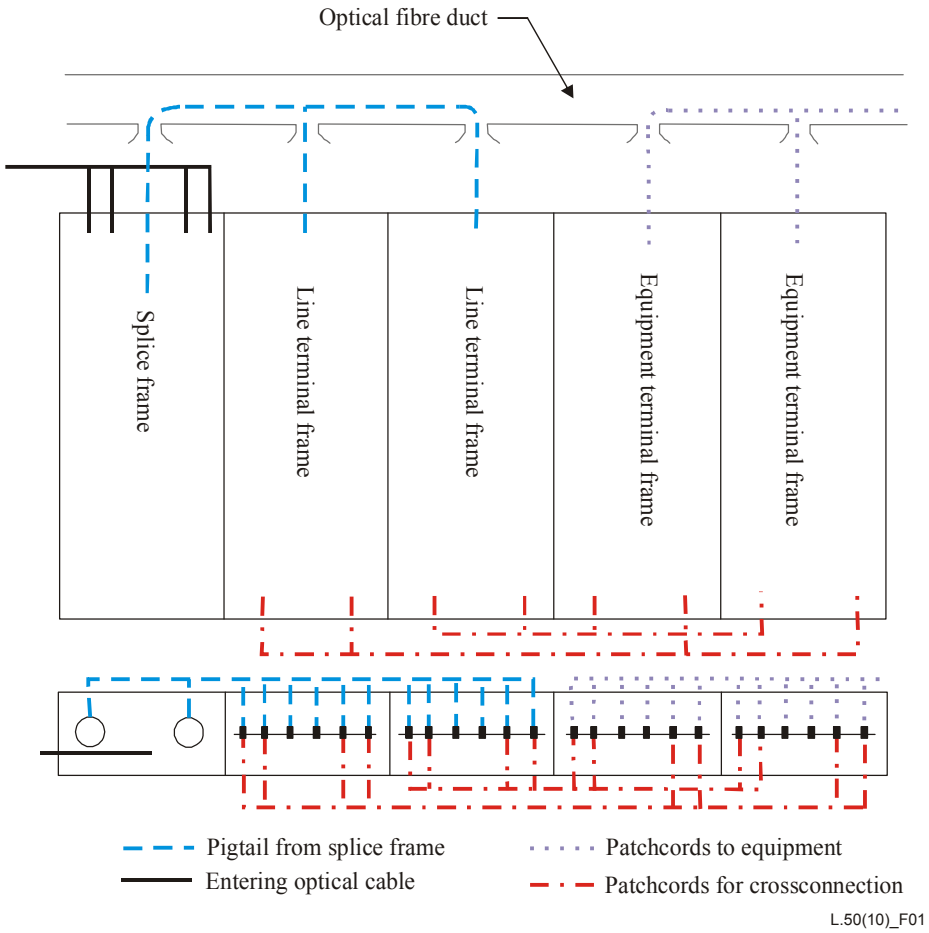


Figure 1 – Construction of ODCF (example)

3.2.5 optical distribution frame (ODF): The term "ODF" refers to a frame, including the fibre organizer and the means to store and guide pigtails and cables inside the frame.

In the industry the term "ODF" is often used as the general term including both individual frames, as well as combinations of multiple frames, or optical distribution combined frame (ODCF).

3.2.6 optical fibre duct: Optical fibre ducts are dedicated ducts or suspendable gutter systems that hold and guide indoor (pigtail) cables as they are routed from and to optical distribution frames (ODFs) or within an optical distribution combined frame (ODCF).

Optical fibre ducts are sometimes also referred to as "raceway" systems.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations:

ODCF Optical Distribution Combined Frame

ODF Optical Distribution Frame

OLT Optical Line Terminal

5 Conventions

No special conventions are used within this Recommendation.

6 Functional requirements of ODFs and ODCFs

Since OD(C)Fs are optical nodes, the general principles of [ITU-T L.51] are applicable. The specific requirements for OD(C)Fs are listed below, sorted by their typical functions. Not all of these functions are necessarily present simultaneously in each individual OD(C)F.

6.1 General requirements

– Each OD(C)F must comply to the general requirements listed in clause 8 of [ITU-T L.51].

– Dimensional compatibility to existing local or international frame standards should be considered.

– In general, a minimum fibre bend radius of 30 mm must be ensured throughout the entire OD(C)F. For special applications or fibre types, a smaller bend radius may be agreed between customer and supplier.

– A modular design, which can accommodate combinations of different functions, is preferable.

– The OD(C)F must allow easy identification of all connections.

– For the cases that it is likely that an ODF would be in the future expanded to an ODCF, the individual ODF should have the necessary provisions to combine them into an ODCF, in any required orientation (e.g., side by side, back-to-back, etc.). Provisions for guiding (pigtail) cables between individual ODFs should be provided (e.g., through the sides, back, top, bottom or front plane, or via a separate ducting system as appropriate).

6.2 Access and maintenance

An OD(C)F should be re-accessible without interruptions to the live circuits, other than the ones that are subject to reconfiguration.

This implies that it shall be possible to separate fibre circuits up to the desired separation level as defined in [ITU-T L.51]. These separation levels are not applicable for pigtail bundles.

6.3 Termination of cables

An OD(C)F must allow:

– the termination of one or more cable-ends of various cable constructions and diameters, including:
  - attachment of the cable sheath;
  - termination of strength members;
  - storage of uncut fibre loops;
  - electrical connection of metallic cable elements in accordance with [ITU-T K.25];

– the addition or removal of a cable without disturbing the cables that are already present;

– the possibility of entering cables and pigtails through any plane of the ODF (top, bottom, sides or back) is preferable.

6.4 Storage and protection of splices and optical devices

The OD(C)F should be able to properly store:

– fibre splices;

– different types of passive devices (including coupler and filter devices, used for network testing purposes) and the related bare fibre or ribbon overlengths.

6.5 Connectors and cross-connection of circuits

– Within a single ODF, it should be possible to connect and reroute any incoming circuit to any outgoing circuit, with a fixed length of patchcords or a pigtail end.

– Within an ODCF, it may be an advantage to be able to connect any circuit to any other circuit; however, in reality, only a certain percentage requires this level of flexibility throughout the entire ODCF. Cross-connect schemes and capacity, as well as the required patchcord lengths, are to be agreed between supplier and customer.

– Each individual connector must be accessible, without the need to disconnect other (adjacent) connectors.

6.6 Pigtail storage and routing

– An OD(C)F must contain the necessary means to guide and store pigtail overlengths in an orderly manner.

– Provision to properly store unused connectors or cable ends should be present if necessary for the application.

– Provisions to group and identify pigtails and jumpers for easy retrieval are recommended.

6.7 Optical fibre duct

– Optical fibre ducts shall be able to protect and lead optical (pigtail) cables. It should not be harmful to optical fibres and cables and should not cause a change in attenuation.

– The duct should fit in horizontal and vertical fibre pathways.

7 Performance evaluation test programme

The performance evaluation programme for an OD(C)F should take into account:

– both mechanical integrity and optical stability;

– the effects of:

  • the environmental conditions in which it will be installed;

  • all typical manipulations, related to an intervention at the ODF;

– all available functionalities of the product;

– the general principles for optical nodes as per [ITU-T L.51].

An example of evaluation criteria and a performance test programme can be found in Appendices I and II. An example of a product characterization checklist can be found in Appendix III. An example of evaluation criteria for optical fibre duct systems can be found in Appendix IV.

Appendix I

Performance evaluation criteria (example)

(This appendix does not form an integral part of this Recommendation)

This appendix contains an example of performance criteria values. Exact performance criteria are to be determined between customer and supplier. The performance evaluation criteria shall be assessed during or after the tests in Appendix II.

I.1 Mechanical evaluation

I.1.1 Visual appearance

International standard: [b-IEC 61300-3-1].

Conditions: Examination of product with the unaided naked eye.

Requirement: No defects which would affect product performance.

I.2 Optical evaluation

NOTE 1 – All optical losses indicated are referenced to the initial optical signal at the start of the test.

NOTE 2 – An "incoming fibre" is defined as a part of an optical circuit containing the fibre entering the product, connected to a fibre leaving the product. One optical circuit can contain many "incoming fibres". Light will sequentially flow through all the "incoming fibres".

NOTE 3 – Fibre type used for single mode: [b-ITU-T G.652] matched cladding.

I.2.1 Change in insertion loss (static optical stability)

International standard: [b-IEC 61300-3-3], Method 1.

Conditions: Source wavelength: 1310, 1550 or 1625 nm (select the highest applicable wavelength).

Requirements: $\Delta IL \leq 0.2$ dB (1310/1550 nm) per incoming fibre during the test (excursion loss).
$\Delta IL \leq 0.5$ dB (1625 nm) per incoming fibre during the test (excursion loss).
$\Delta IL \leq 0.1$ dB (1310/1550/1625 nm) per incoming fibre after the test (residual loss).
If optical connectors are part of the optical path:
$\Delta IL \leq 0.3$ dB (1310/1550 nm) per incoming fibre during the test (excursion loss).
$\Delta IL \leq 0.5$ dB (1625 nm) per incoming fibre during the test (excursion loss).
$\Delta IL \leq 0.2$ dB (1310/1550/1625 nm) per incoming fibre after the test (residual loss).

I.2.2 Transient loss (dynamic optical stability)

International standard: [b-IEC 61300-3-28].

Conditions: Source wavelength: 1310, 1550 or 1625 nm (select the highest applicable wavelength) Unpolarized; Detector bandwidth: (0-1500) Hz.

Requirements:

$\Delta IL \leq 0.5$ dB (1310/1550 nm) during the test measured in the life circuit (transient loss).

$\Delta IL \leq 1.0$ dB (1625 nm) during the test measured in the life circuit (transient loss).

$\Delta IL \leq 0.1$ dB (1310/1550/1625 nm) after the test in the life circuit (residual loss).

If optical connectors are part of the optical path:

$\Delta IL \leq 0.5$ dB (1310/1550 nm) during the test measured in the life circuit (transient loss).

$\Delta IL \leq 1.0$ dB (1625 nm) during the test measured in the life circuit (transient loss).

$\Delta IL \leq 0.2$ dB (1310/1550/1625 nm) after the test in the life circuit (residual loss).

Appendix II

Performance test programme for ODF (example)

(This appendix does not form an integral part of this Recommendation)

This appendix contains an example of a performance test programme. The detailed test programme and corresponding values are to be determined between customer and supplier.

NOTE 1 – All testing is at room temperature, unless otherwise stated.

NOTE 2 – Construct of optical samples according to Appendix I of [ITU-T L.51].

NOTE 3 – Temperature ranges for air-cycling are typical values for indoor non-temperature-controlled environments (IN). Adaptations to specific local conditions can be agreed between customer and supplier.

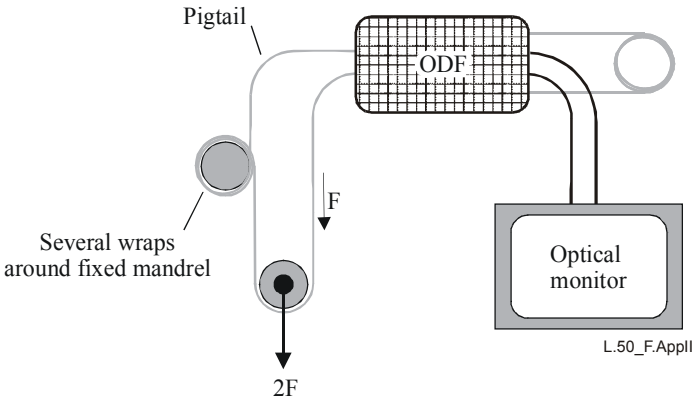
NOTE 4 – The need for static or dynamic optical stability is to be agreed between customer and supplier. The appropriate performance criteria are to be selected accordingly in the test programme of clause 6.2.1 of [ITU-T L.51].

NOTE 5 – The values mentioned for shock and vibration are not sufficient to guarantee earthquake resistance. Products intended to be used in risk areas may require more severe test conditions.

II.1 Mechanical and optical evaluation

II.1.1 Axial load on pigtail

International standard: Not available.



Conditions: Load on pigtail: To be agreed between customer and supplier.
Typical values are in the range of 10 N to 70 N.
Test time: 10 minutes.

Performance criteria: (See Note 4) Visual appearance:
Static: Change of insertion loss (residual loss) on the manipulated pigtail.
Dynamic: Transient loss in the circuits adjacent to the manipulated pigtail.

II.1.2 Intervention at a node

International standard: [b-IEC 61300-2-33].

Conditions: Execute all manipulations that will normally occur for this product during an intervention after initial installation. A list of typical manipulations can be found in Appendix II of [ITU-T L.51].

Performance criteria: (Note 4) Static: Change of insertion loss (residual loss).
Dynamic: Transient loss.

II.1.3 Vibration *(Note 5)*

International standard:	[b-IEC 61300-2-1].
Conditions:	Sweep range: Minimum (10-55) Hz sinusoidal at 1 octave/minute; Crossover frequency: 9 Hz. *For subunits:* (e.g., shelves, modules, etc.) – amplitude below 9 Hz: 1.5 mm; – acceleration above 9 Hz: 5 m/s^2 (~0.5 g). *For a complete ODF:* (e.g., rack + subunits installed) – amplitude below 9 Hz: 0.3 mm; – acceleration above 9 Hz: 1 m/s^2 (~0.1 g). Direction: 3 mutually perpendicular axes. Duration: 10 cycles/axis.
Performance criteria: (Note 4)	Visual appearance: Static: Change in insertion loss (residual loss). Dynamic: Transient loss.

II.1.4 Shock *(Note 5)*

International standard:	[b-IEC 61300-2-9].
Conditions:	Wave form: Half sine; Duration: 11 ms; Acceleration: 150 m/s^2 (~15 g) Direction: 3 mutually perpendicular axes. Number of shocks: 3 up and 3 down per axis.
Performance criteria: (Note 4)	Visual appearance: Static: Change in insertion loss (residual loss). Dynamic: Transient loss.

II.1.5 Temperature cycling (IN)

International standard:	[b-IEC 61300-2-22].
Conditions:	Lowest/highest temperature: (–10/+60 ± 2)°C; Humidity: uncontrolled Dwell time: 4 hrs; Transition time: 2 hrs. Number of cycles: At least 2 cycles.
Performance criteria: (Note 4)	Visual appearance: Static/Dynamic: Change in insertion loss (excursion loss).

II.1.6 Damp heat

International standard:	[b-IEC 61300-2-19].
Conditions:	Temperature: (+40 ± 2)°C; Humidity: (93 ± 3)% RH; Duration: 96 hrs.
Performance criteria: (Note 4)	Visual appearance: Static/Dynamic: Change in insertion loss (excursion loss).

Appendix III

Product characterization checklist

(This appendix does not form an integral part of this Recommendation)

This checklist facilitates the systematic characterization of the features and capabilities of an ODF. It reflects the parameters that are described in [ITU-T L.51]. It may be useful for preparation of the products' test programme as well as product description for tenders and purchasing specifications, comparison of different or competitive products and creation of commercial information and ordering guides.

Product name: .....

Application environment(s) *(see clause 7.1 of [ITU-T L.51])*

- ☐ IC Indoor temperature controlled
- ☐ IN Indoor non-temperature controlled
- ☐ E Extreme (describe differences versus a basic environmental class)

Optical functionality and compatibility *(see clause 6 of [ITU-T L.51])*

– ***Optical stability level***

- ☐ Static
- ☐ Dynamic (transient free)

– ***Wavelength*** *(see clause 6.3 of [ITU-T L.51])*

- ☐ 1310 nm
- ☐ 1550 nm
- ☐ 1625 nm
- ☐ Other: .....

– ***Cable construction*** *(see clause 6.1.1 of [ITU-T L.51])*

- ☐ Loose buffer tube
- ☐ Micro-sheath
- ☐ Central core
- ☐ Slotted core
- ☐ Blown fibre
- ☐ Break-out cable
- ☐ Interfacility cable
- ☐ Optical Power Ground Wire (OPGW) cable
- ☐ Other: .....

– ***Fibre type, fibre grouping, fibre coating*** *(see clause 6.1.2 of [ITU-T L.51])*

- ☐ Multimode
- ☐ Single mode
- ☐ Single fibre
- ☐ Ribbon 4
- ☐ R8
- ☐ R12
- ☐ R24
- ☐ Other: .....
- ☐ Primary coated (~250 µm)
- ☐ Secondary coated (~900 µm)

– ***Passive devices*** *(see clause 6.1.3 of [ITU-T L.51])*

☐ Splice type: ☐ Fusion
☐ Mechanical (brand/type): .....

☐ Splice protector type:
☐ Heatshrink (min/max dimensions): .....
☐ Mechanical (brand/type): ....

☐ Connectors: (Specify brand/type): ....

☐ Branching devices: (Describe type, split ratio, etc.): ....
Delivered as pre-assembled/pre-fibred modules ☐ Yes ☐ No

☐ Other passive devices: Describe):..... .....
Delivered as pre-assembled/pre-fibred modules ☐ Yes ☐ No

– ***Fibre storage and separation level*** *(see clause 6.2.2 of [ITU-T L.51])*

	Circuit separation level				
	ME	SE	SR	SC	SF
☐ Uncut fibre (looped fibre)	☐	☐	☐	☐	☐
☐ Splices	☐	☐	☐	☐	☐
☐ Passive optical components	☐	☐	☐	☐	☐
☐ Other:	☐	☐	☐	☐	☐

ME Multiple element
SC Single circuit
SE Single element
SF Single fibre
SR Single ribbon

Additional or special requirements and features

– ***Storage/transport conditions*** *(see clause 7.2 of [ITU-T L.51])*

☐ Normal: Public transport – indoor storage
☐ Special handling/transport: .....
☐ Special storage: .....

– ***Additional (conditional) requirements*** *(see Appendix III of [ITU-T L.51])*

☐ Earthquake resistance according to: .....
☐ Sealed rack (IP rating) according to: .....
☐ Fire-related performance according to: .....
☐ Fire retardancy according to: .....
☐ Halogen-free according to: .....
☐ Low smoke emission according to: .....
☐ Electrical grounding and shield continuity according to: .....
☐ Current surge according to: .....
☐ Insulation resistance according to: .....
☐ Contact resistance according to: .....
☐ Rodent resistance according to: .....
☐ Other: ..... according to: .....

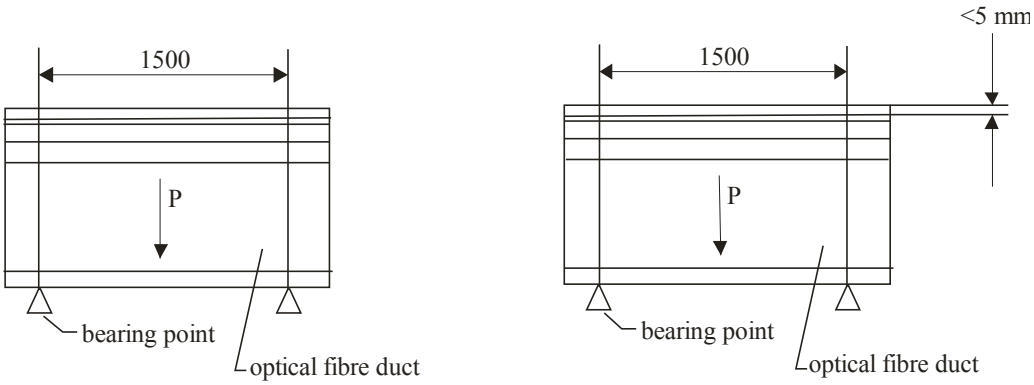
Appendix IV

Example of the performance evaluation method for optical duct components

(This appendix does not form an integral part of this Recommendation)

IV.1 Performance test of optical fibre duct

International standard: Not available.



Conditions: Load(P) on duct:

To be agreed between customer and supplier.
(Typical values are in the range of 280 N to 320 N)
Test time: 10 minutes.

Requirement: No defects which would affect product performance.
$\Delta H \leq 5$ mm.

Bibliography

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

[b-IEC 61300-2-1] IEC 61300-2-1 ed3.0 (2009), *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-1: Tests – Vibration (sinusoidal)*.

[b-IEC 61300-2-9] IEC 61300-2-9 ed1.0 (1995), *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-9: Tests – Shock*.

[b-IEC 61300-2-19] IEC 61300-2-19 ed2.0 (2005), *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-19: Tests – Damp heat (steady state)*.

[b-IEC 61300-2-22] IEC 61300-2-22 ed2.0 (2007), *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-22: Tests – Change of temperature*.

[b-IEC 61300-2-33] IEC 61300-2-33 ed2.0 (2006), *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-33: Tests – Assembly and disassembly of fibre optic closures*.

[b-IEC 61300-3-1] IEC 61300-3-1 ed2.0 (2005), *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-1: Examinations and measurements – Visual examination*.

[b-IEC 61300-3-3] IEC 61300-3-3 ed3.0 (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*.

[b-IEC 61300-3-28] IEC 61300-3-28 ed1.0 (2002), *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-28: Examinations and measurements – Transient loss*.

SERIES OF ITU-T RECOMMENDATIONS

Series A	Organization of the work of ITU-T
Series D	General tariff principles
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	Transmission systems and media, digital systems and networks
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	Cable networks and transmission of television, sound programme and other multimedia signals
Series K	Protection against interference
Series L	**Construction, installation and protection of cables and other elements of outside plant**
Series M	Telecommunication management, including TMN and network maintenance
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Terminals and subjective and objective assessment methods
Series Q	Switching and signalling
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks, open system communications and security
Series Y	Global information infrastructure, Internet protocol aspects and next-generation networks
Series Z	Languages and general software aspects for telecommunication systems

Printed in Switzerland
Geneva, 2010