INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

L.50

(11/2003)

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

ITU-T Recommendation L.50

ITU-T Recommendation L.50

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

Summary

This Recommendation deals with general requirements for optical distribution frames (ODF) in a central office environment.

Source

ITU-T Recommendation L.50 was approved on 28 November 2003 by ITU-T Study Group 6 (2001-2004) under the ITU-T Recommendation A.8 procedure.

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 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, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

CONTENTS

Introduction

When an optical node resides in a central office environment, it is generally contained in a rack or frame. This is commonly referred to as an optical distribution frame (ODF) or optical termination frame (OTF). In this Recommendation, the term "ODF" will be used.

With the increasing demand for broadband services, the number of fibres to be terminated and managed at the central office is growing rapidly. Therefore, it is important to establish appropriate guidelines for designing an ODF.

ITU-T Recommendation 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 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 Recommendation K.11 (1993), *Principles of protection against overvoltages and overcurrents*.

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

3 Terms and definitions

This Recommendation defines the following terms:

3.1 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. ODF does not include the means for routing cables or pigtails outside the frame (also known as pigtail ducts or "raceway" systems).

3.2 frame: "Frame" refers to the mechanical structure to which cables are attached and that holds all other elements of the ODF. It may be a rack and shelve type of 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.

3.3 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.

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

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations:

ODF Optical Distribution Frame

OLT Optical Line Terminal

5 Functional requirements of ODFs

Since ODFs are optical nodes, the general principles of ITU-T Rec. L.51 are applicable. The specific requirements for ODF are listed below, sorted by their typical functions. Not all of these functions are necessarily present simultaneously in each individual ODF.

5.1 General requirements

– Each ODF must comply to the general requirements as listed in clause 8/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 ODF. For special applications or fibre types, a smaller bend radius may be agreed between customer and supplier.

– A modular design, which allows the combinations of all types of functions, is preferable.

– The ODF must allow easy identification of all connections.

5.2 Access and maintenance

An ODF 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 Rec. L.51. These separation levels are not applicable for pigtails bundles.

5.3 Termination of cables

An ODF must allow:

– the termination of one or more cable ends of various cable construction and diameter, including:
  - attachment of the cable sheath;
  - termination of strength members;
  - electrical connection of metallic cable elements in accordance with ITU-T Rec. K.11;

– 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).

5.4 Storage and protection of splices and optical devices

The ODF 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.

5.5 Connectors and cross-connection of circuits

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

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

5.6 Pigtail storage and routing

– An ODF must contain the necessary means to guide and store pigtail overlengths in an orderly manner.

6 Performance evaluation test programme

The performance evaluation programme for an ODF 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.

An example of evaluation criteria and a performance test programme can be found in Appendices I and II.

Appendix I

Performance evaluation criteria (Example)

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: 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: ITU-T Rec. G.652 matched cladding.

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

International standard: 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: 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 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/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.

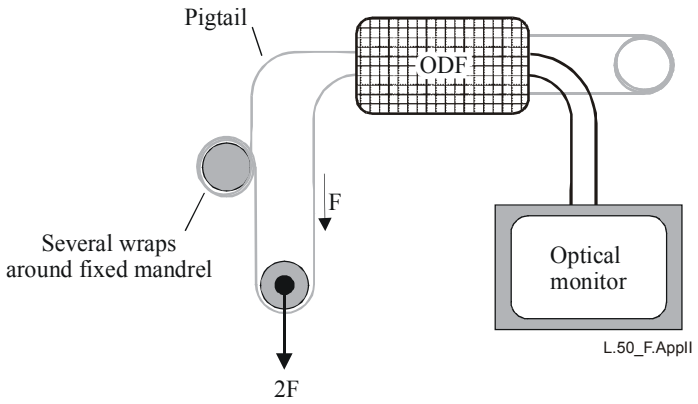
NOTE 4 – The need for static or dynamic optical stability is to be agreed between customer and supplier. The appropriate performance criteria are to be selected accordingly in the test programme of 6.2.1/L.51.

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: Visual appearance:
(See Note 4) 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: 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/L.51.

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

II.1.3 Vibration *(Note 5)*

International standard: 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...)
– 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:	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:	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:	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 checklist facilitates the systematic characterization of the features and capabilities of an ODF. It reflects the parameters that are described in ITU-T Rec. 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 7.1/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/L.51)*

– ***Optical stability level***

- ☐ Static
- ☐ Dynamic (transient free)

– ***Wavelength*** *(see 6.3/L.51)*

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

– ***Cable construction*** *(see 6.1.1/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 6.1.2/L.51)*

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

– ***Passive devices*** *(see 6.1.3/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 6.2.2/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 7.2/L.51)*

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

– ***Additional (conditional) requirements*** *(see Appendix III/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: .....

SERIES OF ITU-T RECOMMENDATIONS

Series A	Organization of the work of ITU-T
Series B	Means of expression: definitions, symbols, classification
Series C	General telecommunication statistics
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	TMN and network maintenance: international transmission systems, telephone circuits, telegraphy, facsimile and leased circuits
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Telephone transmission quality, telephone installations, local line networks
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 and open system communications
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, 2004