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Optical External Network Test Interface

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ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B
Association à but non lucratif enregistrée à la
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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Access, Terminals, Transmission and Multiplexing (ATTM).

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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Introduction

An Optical External Network Test Interface (ENTI) is a passive element that sits at the boundary between the Access Network (AN) and the end user (subscriber's) in-house FITH Network.

From a certain point of view ENTI can be regarded as a testing demarcation point between the access network and the wiring at the customer premises. External Network Test Interface ENTI defines the point for testing the operator's network while isolated from the customer's home wiring.

The present document is harmonised with CENELEC TC 215 document EN 50700 [34].

1 Scope

The present document defines the functional and technical characteristics applicable to the Optical External Network Test Interface (ENTI) terminated with Singlemode fibre which provides testing capability at the demarcation point between the line of the FTTH operator's network and the customer's cabling inside the house.

The present document describes optical ENTI for new homes in coherence with the definition used in EN 50700 [34]. An optical ENTI is positioned in a distribution space. It is connected to an ONT by an optical terminated cord.

The home cabling is not considered in the present document.

The present document specifies the functional characteristics and performance requirements for the optical ENTI within the subscriber premises and for the needs of the FTTH optical access network.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference/.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] EN 50174-2: "Information technology - Cabling installation - Part 2: Installation planning and practices inside buildings", (produced by CENELEC).

[2] EN 50377 series: "Connector sets and interconnect components to be used in optical fibre communication systems - Product specifications", (produced by CENELEC).

[3] EN 60793-2-50: "Optical fibres - Part 2-50: Product specifications - Sectional specification for class B single-mode fibres", (produced by CENELEC).

[4] EN 60794-2: "Optical fibre cables - Part 2: Indoor optical fibre cables - Sectional specification", (produced by CENELEC).

[5] EN 60794-2-20: "Optical fibre cables - Part 2-20: Indoor cables - Family specification for multi-fibre optical cables", (produced by CENELEC).

[6] EN 60794-2-50: "Optical fibre cables - Part 2-50: Indoor cables - Family specification for simplex and duplex cables for use in terminated cable assemblies", (produced by CENELEC).

[7] EN 60794-3-10: "Optical fibre cables - Part 3-10: Outdoor cables - Family specification for duct, directly buried and lashed aerial optical telecommunication cables", (produced by CENELEC).

[8] EN 60794-3-11: "Optical fibre cables - Part 3-11: Outdoor cables - Product specification for duct, directly buried and lashed aerial single-mode optical fibre telecommunication cables", (produced by CENELEC).

[9] EN 60794-3-20: "Optical fibre cables - Part 3-20: Outdoor cables - Family specification for self-supporting aerial telecommunication cables", (produced by CENELEC).

[10] EN 61753-131-3: "Fibre optic interconnecting devices and passive components - Performance standard - Part 131-3: Single-mode mechanical fibre splice for category U - Uncontrolled environment", (produced by CENELEC).

[11] ETSI TS 100 783: "Transmission and Multiplexing (TM); Passive optical components; Fibre optic fusion splices for single-mode optical fibre transmission systems for indoor and outdoor applications; Common requirements and conformance testing".

[12] ETSI ETS 300 019-1-3: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-3: Classification of environmental conditions; Stationary use at weatherprotected locations".

[13] EN 61756-1: "Fibre optic interconnecting devices and passive components - Interface standard for fibre management systems - Part 1: General and guidance", (produced by CENELEC).

[14] EN 61754: "Fibre optic interconnecting devices and passive components - Fibre optic connector interfaces", (produced by CENELEC).

[15] EN 61755: "Fibre optic interconnecting devices and passive components - Fibre optic connector optical interfaces", (produced by CENELEC).

[16] IEC 60825-1: "Safety of laser products - Part 1: Equipment classification and requirements".

[17] IEC 60825-2: "Safety of laser products - Part 2: Safety of optical fibre communication systems (OFCS)".

[18] EN 61280-4-2: "Fibre-optic communication subsystem test procedures - Part 4-2: Installed cable plant - Single-mode attenuation and optical return loss measurement", (produced by CENELEC).

[19] IEC 60950-1: "Information technology equipment - Safety - Part 1: General requirements".

[20] IEC 61300-3-1: "Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 3-1: Examinations and measurements - Visual examination".

[21] IEC 60529: "Degrees of protection provided by enclosures (IP Code)".

[22] IEC 61300-2-27: "Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-27: Tests - Dust - Laminar flow".

[23] IEC 61300-2-26: Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-26: Tests - Salt mist".

[24] IEC 61753-101-2: "Fibre optic interconnecting devices and passive components performance standard - Part 101-2: Fibre management systems for Category C - Controlled environment".

[25] IEC 61300-2-12: "Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-12: Tests - Impact".

[26] IEC 61300-2-4: "Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-4: Tests - Fibre or cable retention".

[27] IEC 61300-2-42: "Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-42: Tests - Static side load for strain relief".

[28] IEC 61300-2-6: "Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-6: Tests - Tensile strength of coupling mechanism".

[29] IEC 61300-2-2: "Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-2: Tests - Mating durability".

[30] IEC 61300-2-9: "Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-9: Tests - Shock".

[31] EN 60794-3: "Optical fibre cables - Part 3: Sectional specification - Outdoor cables", (produced by CENELEC).

[32] IEC 61300-2-33: "Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-33: Tests - Assembly and disassembly of fibre optic mechanical splices, fibre management systems and closures".

[33] IEC 61300-2-5: "Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-5: Tests - Torsion".

[34] EN 50700: "Information technology - Premises distribution access network (PDAN) cabling to support deployment of optical broadband networks", (produced by CENELEC).

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] EN 50491-6-1: "General requirements for Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS) - Part 6-1: HBES installations - Installation and planning".

[i.2] EN 50173-4: "Information technology - Generic cabling systems - Part 4: Homes".

[i.3] EN 50173-6: "Information technology - Generic cabling systems - Part 6: Distributed building services".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

cable element: smallest construction unit in a cable

EXAMPLE: Cable subassembly comprising one or more optical fibres inside a common covering.

distribution space: space within a home that corresponds to the installation space IS4 or IS5 of EN 50491-6-1 [i.1] and that can house a home distributor (secondary home distributor) of EN 50173-4 [i.2] or a service distributor of EN 50173-6 [i.3] together with associated equipment

hybrid patchcord: optical patchcord or work area cord with different fibre optic connector on each end

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

APC	Angled Physical Contact
EN	European Norm
ENTI	External Network Test Interface
FITH	Fibre In The Home
FTTH	Fibre To The Home
IP	Ingress Protection
LSPM	Laser Source Power Meter

OAP Operator Access Point

NOTE: See EN 50700 [34].

ONT Optical Network Terminal
OTDR Optical Time Domain Reflectometer
PC Physical Contact
PDAN Premises Distribution Access Network
SI Subscriber Interface

NOTE: See EN 50700 [34].

4 Functional characteristics

4.1 Generalities

Optical ENTI is the physical point at which a subscriber is provided with access to an operator's optical communications network.

An ENTI device will be installed for each subscriber.

Optical ENTI unit is enclosed in a durable housing appropriate for use in a distribution space and constitutes integral part of the subscriber line of the operator's network.

Optical ENTI is substantially related to EN 50700 [34] network functional elements such as OAP (Operator Access Point) and SI (Subscriber Interface). However it describes this part of the optical network in a detail that covers operator's needs to maintain

The connection of a branching cable (or a single element extracted from the connection cable or from the connection cable itself) with the Optical Network Termination at the customer premises could be accomplished through the Subscriber Interface (SI) called optical External Network Test Interface (ENTI) here.

Figure 1 illustrates typical configurations.

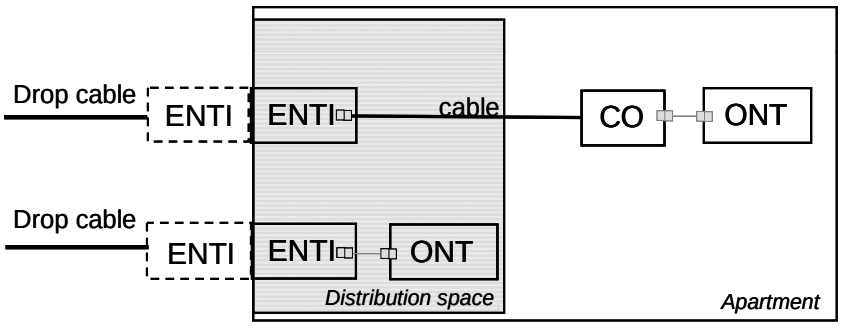

Figure 1: Illustration of typical cabling configurations at the customer premises

The ENTI:

- is a part of the demarcation point;
- is a measuring and testing point;
- will allow isolation of customer's in-house cabling from the operator's network;
- will encompass laser safety;
- will allow optical connectivity.

Additional functional characteristics of the ENTI are:

- fibre management system within housing (tray, splice holder, etc.);
- fibre overlength for consecutive splicing as well as management of fibre overlengths.

4.2 Optical ENTI location

ENTI, as it is described in the present document for new homes, will be located inside a distribution space (collocated near the home distributor as depicted in figure 2).

Optical ENTI characteristics for use outside a distribution space in existing homes are not considered in the present document.

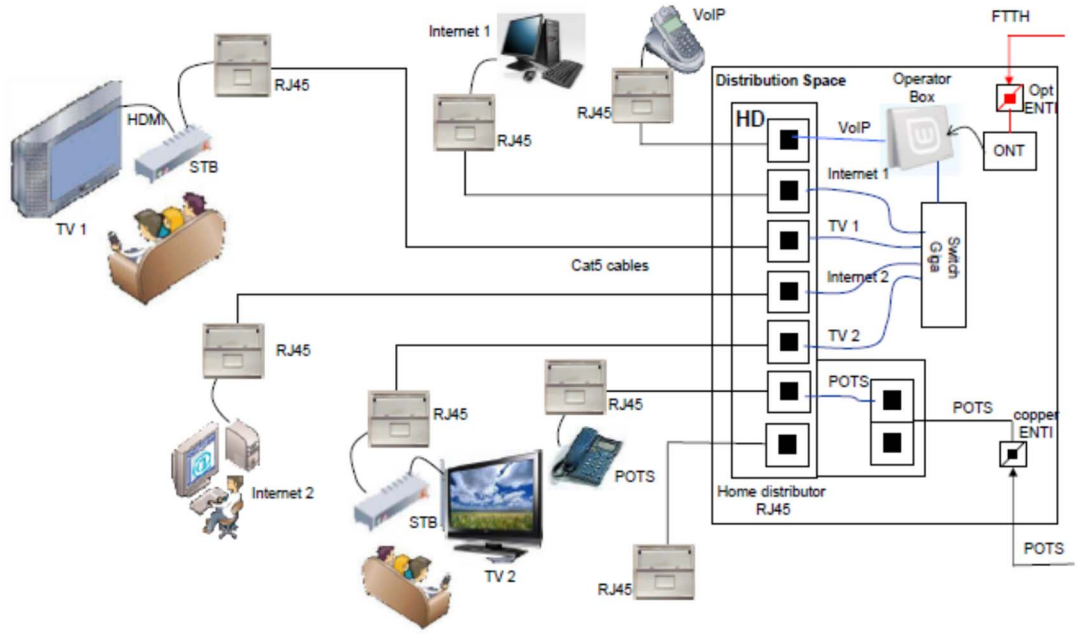

Figure 2: Optical ENTI within a distribution space

4.3 Optical termination

4.3.1 Optical termination components and requirements

Optical termination is accomplished by means of fibre optic connector plug and adaptor. The termination of the fibre is a connector plug. The connector plug can be pre-terminated (pre-terminated cable) at the manufacturer's plant or by means of field mountable connector system. Connector plug is positioned in the adaptor. Adaptor is a part of the optical ENTI outlet and it is an integral part of the optical termination.

Optical termination has two connection functions:

- connection to the ONT;
- connection to the measuring equipment.

By plugging another connector into the adaptor optical connection interface is accomplished.

The requirements on optical connection interface are:

- mechanical;
- optical.

The mechanical connector interface requirements shall be according to EN 61754 [14] series and optical connector interface according to EN 61755 [15] series.

Optical connectors may be PC or APC type specified in EN 50377 [2] series.

4.3.2 Pre-terminated connectors as pigtails

A pigtail is a product configuration consisting of a piece of cable terminated with connector on one end.

It is a classical solution comprising fibre splicing:

- fusion splice;
- mechanical splice.

Considering 3 additional re-splicing and reconfigurations 0,8 m of fibre overlength shall also be stored.

Splice protector types are summarized in EN 61756-1 [13].

The splice loss may increase if fibres of different types are spliced.

4.3.3 Field mountable, pre-terminated connectors with fibre stub

Pre-terminated connector with fibre stub is a product configuration consisting of terminated connector and a small length of fibre (stub) stored within connector body.

Termination of the cable with connector can be accomplished by fusion or mechanical splice. Fusion splicing requires special splicing machines. Mechanical splice is done by cleaving the fibre and connecting fibre stub by means of refractive index matching gel.

There is no need for splice protector, holder and additional fibre tray.

The fusion splice loss may increase if fibres of different types are spliced.

Measuring aspects such as connection budget, connector type and testing procedure shall be defined.

4.3.4 Pre-ferruled cables

Pre-terminated cables with pre-ferruled connector plugs are semi terminated drop fibres. The cable is pre-ferruled at least at one end. The connector body can be mounted after pre-terminated cable is installed in the customer technical room/space. The other end can be terminated with connector. This would remove the need for splicing in the final drop or in the customer's premises and significantly reduce the cost and skill-set required for installation and maintenance of the final drop.

The cable storage for cable overlength caused by uncertain cable length definition shall be foreseen. To avoid measured lengths of fibre drop cables, solutions that can store up to 20 m slack in the "customer's technical room" are needed.

4.3.5 Pre-terminated cables

Pre-terminated cables with pre-terminated connector plugs are terminated drop fibres. The cable is pre-terminated at least at one end. This would remove the need for splicing in the final drop or in the customer's premises and significantly reduce the cost and skill-set required for installation and maintenance of the final drop.

The cable storage for cable overlength caused by uncertain cable length definition shall be foreseen. To avoid measured lengths of fibre drop cables, solutions that can store up to 20 m slack in the "customer's technical room" are needed.

4.4 Optical measuring and testing features

The measuring features shall allow all optical measurements mainly measurements of attenuation and return loss. Measuring features shall allow attenuation and return loss measurements for both OTDR (Optical Time Domain Reflectometer) and LSPM (Laser Source Power Meter).

4.5 Connection to ONT

Optical Network Termination (ONT) is connected to ENTI by means of optical terminated cord. Optical terminated cord is a product defined as a fibre optic cable terminated with connector on both ends.

Connectors terminated on cord shall be of the same type as in optical ENTI and ONT. Hybrid patchcords are possible. Connectors from EN 50377 series [2] shall be applied.

The cable connecting ENTI and ONT shall be based on requirements defined in EN 60794-2-50 [6].

4.6 Optical ENTI outlet

The parts of the optical ENTI outlet besides connector and adaptor are:

- outlet having facilities to be fastened inside technical room;
- means for incoming cables;
- fibre tray with guiding and storage elements;
- allow fibre bend radius of 15 mm for fibres according to EN 60793-2-50 [3] category B6.

4.7 Opening and prevention of damaging of outlet and fibre

- Using a screwdriver by unskilled people shall not cause irreversible damage of the outlet.
- If the outlet is accidentally opened the forces to the fibre shall be below fibre damaging levels.

5 Particular characteristics

5.1 Environmental conditions

The environmental conditions of the materials which are installed inside customer's premises are those applicable to the equipment of telecommunications in service, at fixed station, in sites protected from the bad weather, at partially controlled temperature: clause 3.2 of ETSI ETS 300 019-1-3 [12].

The environmental conditions of the materials which are installed outside customer's premises are those applicable to the equipment of telecommunications in service, at fixed station, in sites protected from the bad weather, at not temperature-controlled locations: clause 3.3 of ETSI ETS 300 019-1-3 [12].

5.2 Laser safety

Due to the potentially increased hazards arising from higher optical powers, additional user information may be needed. The safety measures to protect against effects caused exclusively by thermal, optomechanical and related effects in passive optical components and optical cables shall be accomplished.

The international standards IEC 60825-1 [16] and IEC 60825-2 [17] shall be taken into consideration.

5.3 Installation and dimensioning

The ENTI outlet is designed:

- To have an attachment unit allowing horizontal/vertical adjustment (EN 50174-2 [1]).
- No specific tools for installation.
- To ensure a protection against wet wall effects.

- To allow minimum fibre bending radius of 15 mm for fibres according to EN 60793-2-50 [3], category B6.

5.4 Fibre types

The fibre types for the cables and connectors shall be according to EN 60793-2-50 [3], categories B1.3 or B6_a fibre.

5.5 Fibre splices

Fibre splices shall be either mechanical splices according to EN 61753-131-3 [10] or fusion splices according to ETSI TS 100 783 [11].

5.6 Fibre optic connectors

Fibre optic connectors at ENTI shall conform to EN 50377 series [2].

Following functionalities of the connector should be considered:

- Protection class: IP 54.
- Crimped strain relief connector.
- Cost optimized.
- Dust protection.
- Eye protection.
- Ferrule protection (within the shape of connector).
- Optimized length (stiff length).
- Self-unlocking within 30° cone, snap connection.
- Overall connector diameter < 6 mm, pulling capabilities in ducts.
- Spring loaded ferrule.
- Ferrule rotation secured.

5.7 Optical cables to be installed in ENTI outlet

Cable requirements in ENTI shall cover all three optical cable possibilities defined in standardization documents:

- Loose tube outdoor cable types (EN 60794-3-10 [7] and EN 60794-3-11 [8]).
- Breakout indoor cable types (EN 60794-2 [4] and EN 60794-2-20 [5]).
- Optical self-supporting aerial cable (EN 60794-3-20 [9]).
- Mini-breakout (riser or distribution cables) indoor cable types (EN 60794-2 [4] and EN 60794-2-20 [5]).
- The fibre type in the cable of the operator's network shall comply with fibre classes defined in EN 60793-2-50 [3], categories B1.3 or B6_a.
- To be able to connect the fibres from the operator network (outdoor cable) with the fibre of the customer cable (indoor cable).
- To be able to check the state of optical connection.

The attenuation requirements for the cabled fibre are defined in relevant cable specification.

The marking of the cable according to EN 60794-3 [31] will be on its sheath.

There is a need to define cable ending in ENTI from the operator network as well as cable cord that is connecting ENTI with ONT.

5.8 Measuring or monitoring of the optical line

The ENTI is designed to allow the following tests:

- To be able to measure the optical attenuation of the line at the connection of the access cable and at the connection of the customer's cable(s).
- To be able to measure the optical reflection of the line at the connection of the access cable and at the connection of the customer's cable(s).

5.9 Measurements with OTDR

The measuring procedure is defined in EN 61280-4-2 [18].

If OTDR is used for the measurements of the optical line following aspects shall be considered:

- use of the launch and tail test cord;
- bidirectional measurements as reference method;
- unidirectional measurements with increased measurement uncertainty.

The bidirectional measurement requires simultaneous access to central office and ENTI for each fibre link and gives a correct evaluation of following events:

- splices, optical connectors, fibres and bends;
- return loss of splices and optical connectors, as well as local fibre defects.

In most situations it is not possible to have access to central office to perform bidirectional OTDR measurements. In these situations alternative, simplified unidirectional OTDR measuring method that gives acceptable indication for network operator regarding the optical external network quality can be applied.

It is important to note that the unidirectional OTDR measurements do not present the real values because of certain intrinsic fibre parameter differences in the link.

5.10 Measurements with LSPM

The measuring procedure is defined in EN 61280-4-2 [18], one-cord reference method.

This method uses optical power measurement equipment consisting of:

1) Light source
2) Test cords
3) Power meter

The results of this measuring method deliver an absolute attenuation value of the link without any evaluation of the occurred events such as splices, connectors, low bends.

5.11 Operations

Following aspects shall be covered prior to any removing of the ENTI housing cover or measuring as well as reconfiguring actions:

- Instructions should be provided to personnel handling connectors in optical systems.
- Cleanliness of the connectors is very important.
- Appropriate measuring cords shall be used.

5.12 Miscellaneous

The appropriate marking for laser devices according to IEC 60825-2 [17] shall be visible on the ENTI housing.

5.13 Documentation

In each package of ENTI, documentation should be provided including a technical note of installation and a technical note of operation and maintenance.

5.14 Recycling

The ENTI is designed:

- To limit the number of components and materials.
- To support the concept facilitating the recycling of materials.
- To provide the indications necessary for the recycling of the material at the end of the lifetime.
- To provide a mechanical protection of the connector industry (case).
- To respect the safety requirements EN 60950-1 [19].

6 Testing

The purpose of the tests described hereafter, applicable to optical ENTI or outlet are to approve all transmission, environmental and mechanical requirements specified in the present document.

Table 1: Tests applicable to optical ENTI and housing

Tests required	Standards or Specifications	Requirements
Visual inspection	According to the method 1a of the IEC 61300-3-1 [20]	Conform to the method 1a of the IEC 61300-3-1 [20]
Test of implementation	The test with for goal to test and check all the functions of the product. It makes it possible to validate the note of assembly and wiring proposed	One should not observe deformation, of fracture of the various components or subset of the product
Test of re-intervention or reconfiguration	According to EN 61300-2-33 [32]. The goal is to test the aptitude of optical connections to support the mechanical constraints due to handling of the customers	No damage at the end of 10 complete cycles of connection
Degree of protection	IEC 60529 [21]	The wall outlet will be in conformity with the degree of protection IP40
Eye protection	IEC 60825-2 [17]	Consideration of the requirements for laser classes and hazards
Dust protection	IEC 61300-2-27 [22]	Connector robustness against dust
Corrosion of metal parts	IEC 61300-2-26 [23]: salt spray during 96 hours	No trace of corrosion impacting the functionality of the product should be observed on the metal parts
Fibre management system performance tests	IEC 61753-101-2 [24]	The optical performance of the full equipped ENTI shall not deteriorate below given requirements
Vibration test	Class 3.2 of ETSI ETS 300 019-1-3 [12]	Robustness to vibration impact
Impact	IEC 61300-2-12 [25]	One should not observe displacement, of visual degradation (crossing cracking, fracture)
Connector robustness 1	IEC 61300-2-4 [26] IEC 61300-2-42 [27]	Robustness of the jack
Connector robustness 2	IEC 61300-2-6 [28]	Interlocking mechanism
Mating durability	IEC 61300-2-2 [29]	500 matings
Torsion plug in outlet, plug in adaptor	IEC 61300-2-5 [33]	Robustness of the connection between cable and connector
Side load on plug in adaptor/outlet	IEC 61300-2-42 [27]	Robustness of the adaptor/outlet
Shock	IEC 61300-2-9 [30]	Acceleration: 180 m/s^2 peak Pulse duration: 6 ms Waveform: half-sine Test duration: 100 bumps in 6 directions (Total 600) Testing information DUTs were tested in transport package Requirements No mechanical damage, no loose parts Test conditions Test temperature: 23 ±5 °C Relative Humidity: < 75 %

Annex A (informative): Relation to EN 50700

EN 50700 [34] specifies the optical fibre optical fibre access network cabling within multi-subscriber premises termed the Premises Distribution Access Network (PDAN). The premises may comprise single or multiple buildings.

However EN 50700 [34] does not specify either the access network cabling external to the premises or the cabling within the subscriber space for onward distribution of services beyond the customer premises 140 equipment.

Furthermore EN 50700 [34] defines:

a) the structure and configuration of the optical fibre cabling;

b) cabling performance requirements;

c) implementation options.

Therefore EN 50700 [34] is normatively referenced in the present document.

The present document is defining a part of the single subscriber cabling where. Subscriber can be located in a single premise or within the multi-subscriber premises.

Annex B (informative): Bibliography

CENELEC EN 50173-1: "Information technology - Generic cabling systems - Part 1: General requirements".

CENELEC EN 60794-2-10: "Optical fibre cables - Part 2-10: Indoor optical fibre cables - Family specification for simplex and duplex cables".

ETSI TS 102 973: "Access Terminals, Transmission and Multiplexing (ATTM); Network Termination (NT) in Next Generation Network architectures".

History

Document history		
V1.1.1	October 2010	Publication
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