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**Transmission and Multiplexing (TM);
Functional and system parameters for single-mode
optical fibre pigtailed fixed attenuators**

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Foreword

This Interim European Telecommunication Standard (I-ETS) has been produced by the Transmission and Multiplexing (TM) Technical Committee of the European Telecommunications Standards Institute (ETSI), and is now submitted for the Public Enquiry phase of the ETSI standards approval procedure.

An ETSI standard may be given I-ETS status either because it is regarded as a provisional solution ahead of a more advanced standard, or because it is immature and requires a "trial period". The life of an I-ETS is limited to three years after which it can be converted into an ETS, have its life extended for a further two years, be replaced by a new version, or be withdrawn.

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1 Scope

This I-ETS applies to fibre-pigtailed optical fixed attenuators to be used in single-mode optical fibre transmission networks and which are designed to be spliced into the optical path. This includes splices which are fabricated to produce an attenuation and which are fitted with an appropriate protector. It does not cover variable attenuators or attenuators that are based on connectors. This I-ETS is intended to establish uniform requirements for the following aspects:

- optical, environmental and mechanical properties;
- test conditions;
- acceptance criteria.

Acceptance criteria will be interpreted with respect to the consideration that some of the parameters specified in this I-ETS may be affected by measurement uncertainty arising either from measurement or calibration errors.

2 Normative references

- [1] EN 180000 (1995): "Generic specification: Fibre optic attenuators".
- [2] IEC 1300-3-2 (1995): "Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Examinations and measurements - Part 3-2: Polarization dependence of a single-mode fibre optic device".
- [3] draft IEC 1300-2-14: "Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Tests - Part 2-14: Optical power handling".
- [4] draft IEC 1300-2-42: "Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Tests - Part 2-42: Static side load".
- [5] IEC 1300-2-5 (1995): "Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Tests - Part 2-5: Torsion/twist".
- [6] EN 186000-1 (1993): "Generic specification: Connector sets for optical fibres and cables; Part 1: Requirements, test methods and qualification approval procedures".
- [7] ETS 300 019: "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment".

3 Definition

For the purposes of this I-ETS, the following definition applies:

optical attenuator: A passive optical component which produces a controlled signal attenuation when inserted in an optical path.

4 Details, measurements and performance requirements

In this I-ETS a range, or the limit of allowed variation, expressed as a percentage, shall be interpreted as a percentage change in the attenuation measured in decibels (dB). For example, a range of $\pm 5\%$ for a 10 dB attenuator would be $\pm 0,5$ dB.

4.1 Visual inspection

In accordance with EN 180000 [1], subclause 4.4.1.

Details:

preconditioning procedure: standard atmospheric conditions for 1 hour (see subclause 4.1 of EN 180000 [1]);
 recovery procedure: standard atmospheric conditions for 1 hour (see subclause 4.1 of EN 180000 [1]);
 deviation: none.

Requirements:

workmanship shall be in accordance with subclause 2.4.2 of EN 180000 [1].

4.2 Attenuation value

In accordance with EN 180000 [1], subclause 4.4.5. Attenuation is to be specified at either 1 310 nm or 1 550 nm.

4.2.1 Attenuation value at 1 310 nm

Details:

test method: depending on device configuration;
 wavelength: 1 310 nm (peak emission);
 spectral width of source: < 10 nm;
 launch mode conditions: fibre cladding mode fully stripped;
 lengths: L1 > 1 000 mm, L2 > 1 000 mm, L3 > 1 000 mm, L4 > 1 000 mm, L5 > 1 000 mm;
 maximum mean attenuation of temporary joint: 0,20 dB;
 maximum standard deviation of temporary joint attenuation: 0,10 dB;
 preconditioning procedure: standard atmospheric conditions for 1 hour (see subclause 4.1 of EN 180000 [1]);
 recovery procedure: standard atmospheric conditions for 1 hour (see subclause 4.1 of EN 180000 [1]);
 deviations: one measurement per direction.

Requirements:

allowable attenuation values: nominal value 5 dB = 4,5 to 5,5 dB;
 nominal value 10 dB = 9 to 11 dB;
 nominal value 15 dB = 13,5 to 16,5 dB;
 nominal value 20 dB = 18 to 22 dB.

4.2.2 Attenuation value at 1 550 nm

Details:

test method: depending on device configuration;
 wavelength: 1 550 nm (peak emission);
 spectral width of source: < 10 nm;
 launch mode conditions: fibre cladding mode fully stripped;

lengths (mm):	L1 > 1 000, L2 > 1 000, L3 > 1 000, L4 > 1 000, L5 > 1 000;
maximum mean attenuation of temporary joint:	0,20 dB;
maximum standard deviation of temporary joint attenuation:	0,10 dB;
preconditioning procedure:	standard atmospheric conditions for 1 hour (see subclause 4.1 of EN 180000 [1]);
recovery procedure:	standard atmospheric conditions for 1 hour (see subclause 4.1 of EN 180000 [1]);
deviations:	one measurement per direction.

Requirements:

allowable attenuation values:	nominal value 5 dB = 4,5 to 5,5 dB; nominal value 10 dB = 9 to 11 dB; nominal value 15 dB = 13,5 to 16,5 dB; nominal value 20 dB = 18 to 22 dB.
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4.3 Return loss

In accordance with EN 180000 [1], subclause 4.4.6.

4.3.1 Return loss at 1 310 nm

Details:

minimum launch power of source:	-10 dBm;
spectral width of source:	< 10 nm;
launch fibre length:	> 1 000 mm;
launch mode conditions:	fibre cladding mode fully stripped;
wavelength:	1 310 nm (peak emission);
source stability:	variation < ± 0,1 dB;
branching device type:	2 x 2 "Transmissive Star";
branching device directivity:	> 60 dB;
branching device excess loss:	< 0,20 dB;
detector area:	> 1 mm ² ;
detector linearity:	better than 1 %;
preconditioning procedure:	standard atmospheric conditions for 1 hour (see subclause 4.1 of EN 180000 [1]);
recovery procedure:	standard atmospheric conditions for 1 hour (see subclause 4.1 of EN 180000 [1]);
temporary joint to be formed from fusion splices:	< 0,20 dB excess loss.

All fibre ends to be anti-reflection terminated.

Requirements:

return loss:	> 25 dB, > 35 dB, > 50 dB or > 55 dB depending on system requirements.
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4.3.2 Return loss at 1 550 nm

Details:

minimum launch power of source:	-10 dBm;
spectral width of source:	< 10 nm;
launch fibre length:	> 1 000 mm;
launch mode conditions:	fibre cladding mode fully stripped;
wavelength:	1 550 nm (peak emission);
source stability:	variation < ± 0,1 dB;
branching device type:	2 x 2 "Transmissive Star";
branching device directivity:	> 60 dB;

branching device excess loss:	< 0,20 dB;
detector area:	> 1 mm ² ;
detector linearity:	better than 1 %;
preconditioning procedure:	standard atmospheric conditions for 1 hour (see subclause 4.1 of EN 180000 [1]);
recovery procedure:	standard atmospheric conditions for 1 hour (see subclause 4.1 of EN 180000 [1]);
temporary joint to be formed from fusion splices:	< 0,20 dB excess loss.

All fibre ends to be anti-reflection terminated.

Requirements:

return loss:	> 25 dB, > 35 dB, > 50 dB or > 55 dB depending on system requirements.
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4.4 Modal noise

Test method and performance requirements are under study.

4.5 Spectral dependence of attenuation values

In accordance with EN 180000 [1], subclause 4.4.7.

Requirements:

spectral dependence of attenuation:	variation $\leq 5\%$ in the wavelength regions of 1 260 nm to 1 360 nm or 1 480 nm to 1 580 nm.
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4.6 Polarization dependence of attenuation values

In accordance with IEC 1300-3-2 [2], method A (all polarization states).

Requirements:

attenuation variation:	$\leq 0,2$ dB.
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4.7 Optical power handling

In accordance with IEC 1300-2-14 [3].

Details:

CW test:	
optical power:	10 mW;
test duration:	10 minutes.
pulsed light test:	
peak power:	10 mW;
pulse duration:	0,2 to 0,8 μ s;
light pulses:	10 ⁴ ;
repetition rate:	10 to 1 000 pulses/s.

Requirements:

attenuation after test:	within $\pm 10\%$ of initial value.
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4.8 Vibration

In accordance with EN 180000 [1], subclause 4.5.1.

Details:

frequency range:	10 to 55 Hz;
displacement:	0,75 mm;
number of axes:	three orthogonal;
endurance duration per axis:	0,5 hours;
number of cycles (10-55-10):	15.

Requirements:

attenuation change after test: < ± 5 % of the initial value.

4.9 Pulling

In accordance with EN 180000 [1], subclause 4.5.4.

Details:

magnitude and rate of application of the tensile load:	100 \pm 5 N at a speed of 5 N/s for reinforced cable; 5 \pm 0,5 N at a speed of 0,5 N/s for primary coated fibres;
point of application of the tensile load:	0,3 m from the end of the device;
duration of the test(maintaining the load):	120 s at 100 N; 60 s at 5 N.

Requirements:

attenuation change after test: < ± 5 % of the initial value.

4.10 Fibre flexing or cable nutation

Under consideration.

4.11 Torsion

In accordance with IEC 1300-2-5 [5].

Details:

magnitude of the tensile load:	15 N (for reinforced cable terminated attenuators); 2 N (for primary coated fibre terminated attenuators);
point of application of the tensile load:	0,2 m from the end of the attenuator;
duration of the test:	25 cycles, (not to exceed the cable specification).

Requirements:

attenuation change after test: < ± 5 % of the initial value.

4.12 Drop test

In accordance to EN 180000 [1], subclause 4.5.14.

Details:

number of drops:	5;
drop height:	1,5 m.

Requirements:

attenuation change after test: $< \pm 5\%$ of the initial value.

4.13 Cold

In accordance with EN 180000 [1], subclause 4.5.17.

Details:

temperature: -25°C ;
duration of exposure: 16 hours;
optically functioning or not: optically functioning;
preconditioning procedure: standard atmospheric conditions for 2 hours (see subclause 4.1 of EN 180000 [1]);
recovery procedure: allow specimen to return to 20°C in period not exceeding 2 hours.

Requirements:

initial measurements and performance requirements:
attenuation value at 1 310 nm and/or 1 550 nm as specified previously;
measurements and performance requirements during test:
change in attenuation value: $< \pm 5\%$ of the initial value;
attenuation change after test: $< \pm 5\%$ of the initial value.

During the test, the attenuation value shall be measured at a maximum interval of 1 hour.

4.14 Dry heat

In accordance with EN 180000 [1], subclause 4.5.18.

Details:

temperature: $+70^{\circ}\text{C}$;
duration of exposure: 96 hours;
optically functioning or not: optically functioning (if required);
preconditioning procedure: standard atmospheric conditions for 2 hours (see subclause 4.1 of EN 180000 [1]);
recovery procedure: allow specimen to return to 20°C in period not exceeding 2 hours.

Requirements:

initial measurements and performance requirements:
attenuation value at 1 310 nm and/or 1 550 nm as specified previously;
measurements and performance requirements during test:
change in attenuation value: $< \pm 5\%$ of the initial value;
attenuation change after test: $< \pm 5\%$ of the initial value.

During the test, the attenuation value shall be measured at a maximum interval of 1 hour.

4.15 Damp heat (steady state)

In accordance with EN 180000 [1], subclause 4.5.19.

Details:

temperature:	40°C;
relative humidity:	93 % ± 2 %;
exposure duration:	96 hours;
optically functioning or not:	optically functioning;
preconditioning procedure	standard atmospheric conditions for 2 hours (see subclause 4.1 of EN 180000 [1]);
recovery procedure:	allow specimen to return to 20°C in period not exceeding 2 hours.

Requirements:

initial measurements and performance requirements:	attenuation value at 1 310 nm and/or 1 550 nm as specified previously;
measurements and performance requirements during test:	
change in attenuation value:	< ± 5 % of the initial value;
attenuation change after test:	< ± 5 % of the initial value.

During the test, the attenuation value shall be measured at a maximum interval of 1 hour.

4.16 Change of temperature

In accordance with EN 180000 [1], subclause 4.5.22.

Details:

high temperature:	+70°C;
low temperature:	-25°C or -40°C;
duration:	1 hour;
number of cycles:	12;
rate of temperature change:	1°C per minute;
optically functioning or not:	optically functioning;
preconditioning procedure:	standard atmospheric conditions for 2 hours (see subclause 4.1 of EN 180000 [1]);
recovery procedure:	allow specimen to return to 20°C in period not exceeding 2 hours.

Requirements:

initial measurements and performance requirements:	attenuation value at 1 310 nm or 1 550 nm as specified previously.
measurements and performance requirements during test:	
change in attenuation value:	< ± 5 % of the initial value;
attenuation change after test:	< ± 5 % of the initial value.

During the test, the attenuation value shall be measured at a maximum interval of 10 minutes.

4.17 Corrosive atmosphere (salt mist)

In accordance with EN 180000 [1], subclause 4.5.26.

This test shall be carried out on attenuators which are to be used in weather protected environments corresponding to ETS 300 019 [7], classes 3.3, 3.4 or 3.5 or in non-weather protected environments corresponding to ETS 300 019 [7], class 4.1.

Details:

atmosphere:	5 % sodium chloride (NaCl) salt solution, pH 6,5 - 7,2;
temperature:	+35°C;
duration of test:	96 hours;
preconditioning procedure:	standard atmospheric conditions for 1 hour (see subclause 4.1 of EN 180000 [1]);
recovery procedure:	standard atmospheric conditions for 1 hour (see subclause 4.1 of EN 180000 [1]).

Requirements:

attenuation change after test: < ± 5 % of the initial value.

4.18 Industrial atmosphere

In accordance with EN 180000 [1], subclause 4.5.28.

This test shall be carried out on attenuators which are to be used in weather protected environments corresponding to ETS 300 019 [7], classes 3.3, 3.4 or 3.5 or in non-weather protected environments corresponding to ETS 300 019 [7], class 4.1.

Details:

atmosphere:	sulphur dioxide (SO ₂) 25 ppm;
temperature and relative humidity:	+25°C, 75 %;
duration of test:	96 hours;
preconditioning procedure:	standard atmospheric conditions for 1 hour (see subclause 4.1 of EN 180000 [1]);
Recovery procedure:	standard atmospheric conditions for 1 hour (see subclause 4.1 of EN 180000 [1]).

Requirements:

attenuation change after test: < ± 5 % of the initial value.

4.19 Dust

In accordance with EN 180000 [1], subclause 4.5.27.

This test shall be carried out on attenuators which are to be used in weather protected environments corresponding to ETS 300 019 [7], classes 3.3, 3.4 or 3.5 or in non-weather protected environments corresponding to ETS 300 019 [7], class 4.1.

Details:

dust particle size:	diameter < 150 µm;
temperature and relative humidity:	+35°C, 60 %;
duration of test:	10 minutes.

Requirements:

attenuation change after test: < ± 5 % of the initial value.

4.20 Condensation

In accordance with EN 186000-1 [6], subclause 4.5.21.

This test shall be carried out on attenuators which are to be used in weather protected environments corresponding to ETS 300 019 [7], classes 3.3, 3.4 or 3.5 or in non-weather protected environments corresponding to ETS 300 019 [7], class 4.1.

Details:

high temperature:	+65°C;
low temperature:	-10°C;
humidity:	93 % ± 2 %;
profile:	Z/AD;
number of cycles:	10;
preconditioning procedure:	2 hours at normal ambient conditions;
recovery procedure:	2 hours at normal ambient conditions.

Requirements:

initial measurements and performance requirements:

attenuation value at 1 310 nm and/or 1 550 nm as specified previously;

measurements and performance requirements during test:

change in attenuation value:	< ± 5 % of the initial value;
attenuation change after test:	< ± 5 % of the initial value.

During the test the attenuation value shall be measured at a maximum interval of 1 hour.

History

Document history	
August 1996	Public Enquiry PE 112: 1996-08-19 to 1996-12-13