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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).

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it can be converted into an ETS, have its life extended for a further two years, be replaced by a new version, or be withdrawn.

The I-ETS refers to fibre pigtailed components. The optical fibre pigtailed components or other external fibre interfaces are those described in EN 188000 [6] and EN 188101 [4].

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1 Scope

This Interim European Telecommunication Standard (I-ETS) applies to balanced fibre branching devices to be used in single mode optical transmission networks. Unbalanced fibre branching devices should satisfy similar mechanical and environmental requirements. The scope is to establish minimum uniform requirements for the following aspects:

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

Some users may have additional specific requirements such as a need to verify performance at lower temperatures. These users should specify branching devices conforming to the basic ETSI performance standard plus additional tests or more severe test conditions.

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. Test methods are in accordance with EN 181000 [1] unless otherwise specified.

A fibre branching device is defined in subclause 3.1 of this I-ETS.

2 Normative references

This I-ETS incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this I-ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

- [1] EN 181000 (1994): "Generic specification: Fibre optic branching devices".
- [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] IEC 1300-2-5 (1995): "Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Tests - Part 2-5: Torsion/twist".
- [4] EN 188101 (1995): "Family Specification: Single-mode dispersion unshifted (B1.1) optical fibre".
- [5] ETS 300 019: "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment".
- [6] EN 188000 (1992): "Generic specification: Optical fibres".
- [7] IEC 68-2-30: "Environmental testing - Part 2: Tests. Test Db and guidance: Damp heat, cyclic (12 + 12-hour cycle)".

3 Definition

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

fibre branching device: A passive optical component which splits the incoming signal (M) to a number of outputs (N).

4 Tests

All tests are to be carried out to validate performance over the optical pass bands 1 260 nm to 1 360 nm and 1 480 nm to 1 580 nm. This is the minimum requirement for devices corresponding to class I as described in subclause 4.2. Extensions to these windows are covered by classes II and III. Class II specifies additional attenuation limits for 1 450 nm to 1 480 nm and 1 580 nm to 1 600 nm. Class III devices shall meet the class II requirements and additionally have defined attenuation limits for 1 600 nm to 1 650 nm.

A minimum length of fibre or cable of 1,5 m per port shall be included in all climatic and environmental tests. Unless otherwise specified, the attenuation of the device during a test shall be measured for a single input/output port combination. The attenuation after a test shall be remeasured in accordance with subclause 4.2. The values of attenuation given in subclause 4.2 shall be maintained throughout the tests in subclauses 4.7 to 4.21. In addition the return loss requirements of subclause 4.3, the polarization sensitivity requirements of subclause 4.5 and the directivity requirements of subclause 4.6 shall be maintained throughout the tests in subclauses 4.7 to 4.21.

4.1 Visual Inspection

In accordance with EN 181000 [1] subclause 4.5.1.

Details:

- The device shall be examined for defects using a magnifying glass giving a magnification of between 3 and 8 times. Any markings shall be visible without the use of optical aids.

Requirements:

- The workmanship of the device shall be satisfactory. In particular the protective case shall have no signs of damage or incorrect assembly. The cable or fibre entry points shall be correctly bonded and there should be no damage or bending evident in the cable or fibre.
- As a minimum, the package shall be marked with the manufacturers identification mark and a serial number which allows the date of manufacture to be determined.

4.2 Attenuation

Attenuation requirements for $1 \times N$ and $2 \times N$ devices are detailed in subclause 4.2.2. Three classes of requirements have been identified. Note that, for example, a device complying with the Class III requirement shall comply with tables 1, 2 and 3 simultaneously:

Class	Description	Attenuation requirement	Abbreviation
I	Standard and obligatory requirement for telecommunications operation in 1 260 nm to 1 360 nm and 1 480 nm to 1 580 nm bands.	table 1	Standard (S)
II	Extended wavelength operation over a 150 nm pass band in the 1 550 nm optical window.	tables 1 and 2	Extended (E)
III	Extended further in a third window.	tables 1, 2 and 3	Maintenance (M)

4.2.1 Details

Method: EN 181000 [1], subclause 4.5.5.
Condition: The minimum and maximum attenuation values apply to any combination of input and output port.

4.2.2 Requirements

Other numbers of output ports can be specified.

Table 1: Wavelengths 1 260 nm to 1 360 nm and 1 480 nm to 1 580 nm

N	M = 1		M = 2	
	Attenuation: minimum [dB]	Attenuation: maximum [dB]	Attenuation: minimum [dB]	Attenuation: maximum [dB]
2	2,60	4,20	2,50	4,50
3	4,10	5,90	4,00	6,10
4	5,40	7,80	5,30	8,10
6	6,80	9,50	6,70	9,80
8	8,10	11,40	8,00	11,70
12	9,50	13,00	9,40	13,30
16	10,80	14,90	10,70	15,20
24	12,00	16,60	11,95	17,40
32	13,10	18,60	13,10	18,90

Table 2: Wavelengths 1 450 nm to 1 480 nm and 1 580 nm to 1 600 nm

N	M = 1		M = 2	
	Attenuation: minimum [dB]	Attenuation: maximum [dB]	Attenuation: minimum [dB]	Attenuation: maximum [dB]
2	2,60	4,20	2,50	4,50
3	4,00	6,00	3,90	6,20
4	5,10	8,00	5,00	8,30
6	6,40	10,10	6,30	10,40
8	7,60	11,60	7,50	11,90
12	8,90	13,90	8,80	14,20
16	10,10	15,40	10,10	15,70
24	11,30	16,70	11,20	18,00
32	12,40	19,20	12,30	19,50

Table 3: Wavelength 1 600 nm to 1 650 nm

N	M = 1		M = 2	
	Attenuation: minimum [dB]	Attenuation: maximum [dB]	Attenuation: minimum [dB]	Attenuation: maximum [dB]
2	2,30	4,50	2,20	4,80
3	3,70	6,30	3,60	6,60
4	4,70	8,40	4,60	8,70
6	6,10	10,40	6,00	10,70
8	7,10	12,30	7,00	12,60
12	8,50	14,20	8,40	14,50
16	9,50	16,20	9,40	16,50
24	10,90	17,25	10,80	18,45
32	11,90	20,10	11,80	20,50

4.3 Return loss

Method: EN 181000 [1], subclause 4.5.6.

Condition: All ports not under test shall be optically terminated to avoid unwanted reflections contributing to the measurement.

Requirements: Return loss \geq 55 dB

4.4 Spectral dependence of attenuation

The test wavelength requirement for attenuation measurements is that at least three test wavelengths shall be used within each operating window. Modelling to produce a spectral fit and confidence limit from discrete wavelength measurements is under study.

4.5 Polarization sensitivity

Method: IEC 1300-3-2 [2], method A (all polarization states).
Condition: The allowable sensitivity applies to every combination of input and output port.
Requirements: Maximum allowable loss variation of 0,20 dB for $N \leq 4$ and 0,50 dB for $N > 4$.

4.6 Directivity

Directivity is also known as isolation or crosstalk. It is a measure of the attenuation between two ports which are intended to be isolated.

Method: EN 181000 [1], subclause 4.5.5 (attenuation).
Condition: The directivity between input ports shall be measured for devices with two input ports. For all devices the directivity between each of the output ports shall be measured. All ports not under test shall be optically terminated to avoid unwanted reflections contributing to the measurement.
Requirements: Directivity ≥ 55 dB

4.7 Vibration

Method: EN 181000 [1], subclause 4.6.1.

Details:

frequency range:	10 Hz to 55 Hz;
displacement:	0,75 mm;
number of axes:	three orthogonal;
endurance duration per axis:	0,50 hours;
number of cycles (10-55-10):	15.

Requirements: The attenuation shall be within the following limits of the initial value:

$\pm 0,30$ dB where $N \leq 4$;
 $\pm 0,50$ dB where $N > 4$.

During the test, the attenuation value shall be measured at a maximum interval of 2 ms.

4.8 Cable pulling

Method: EN 181000 [1], subclause 4.6.4.

Details:

magnitude of tensile load:	100 \pm 5 N for reinforced cable; 5 \pm 0,5 N for coated fibre.
rate of application:	5 N/s for reinforced cable; 0,5 N/s for coated fibre.
duration at peak load:	120 s for reinforced cable; 60 s for coated fibre.

Requirements: The attenuation shall be within the following limits of the initial value:

$\pm 0,30$ dB where $N \leq 4$;
 $\pm 0,50$ dB where $N > 4$.

During the test, the attenuation value shall be measured at least once while the peak load is applied.

4.9 Torsion

This test is not applicable to devices terminated with primary coated fibre.

Method: IEC 1300-2-5 [3].

Details:

magnitude and rate of application of the tensile load:

15 N at a speed of 1 N/s (for reinforced cable terminated devices);
2 N at a speed of 0,1 N/s (for secondary coated fibre terminated devices);

point of application of the tensile load: 0,2 m from the end of the device;

duration of the test: 25 cycles (not to exceed the cable specification);
rotation: $\pm 180^\circ$.

Requirements: The attenuation shall be within the following limits of the initial value:

$\pm 0,30$ dB where $N \leq 4$;
 $\pm 0,50$ dB where $N > 4$.

4.10 Drop

Method: EN 181000 [1], subclause 4.6.14.

Details:

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

Requirements: The attenuation shall be within the following limits of the initial value:

$\pm 0,30$ dB where $N \leq 4$;
 $\pm 0,50$ dB where $N > 4$.

4.11 Fibre nutation

This test is intended for use with devices terminated with reinforced cable.

Method: EN 181000 [1], subclause 4.6.35.

Details:

number of cycles: 10;
tensile force: 10 N.

Requirements: The attenuation shall be within the following limits of the initial value:

$\pm 0,30$ dB where $N \leq 4$;
 $\pm 0,50$ dB where $N > 4$.

4.12 Cold

Method: EN 181000 [1], subclause 4.6.17.

Details:

temperature:	-25°C;
duration of exposure:	16 hours;
preconditioning procedure:	standard atmospheric conditions for 2 hours;
recovery procedure:	allow specimen to return to 20°C in period not exceeding 2 hours.

Requirements: During the test, the attenuation limits of subclause 4.2 shall be met. During and on completion of the test, the attenuation shall be within the following limits of the initial value:

$\pm 0,30$ dB where $N \leq 4$;
 $\pm 0,50$ dB where $N > 4$.

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

4.13 Dry heat

Method: EN 181000 [1], subclause 4.6.18.

Details:

temperature:	+70°C;
duration of exposure:	96 hours;
preconditioning procedure:	standard atmospheric conditions for 2 hours (see subclause 4.1 of EN 181000 [1]);
recovery procedure:	allow specimen to return to 20°C in period not exceeding 2 hours.

Requirements: During the test, the attenuation limits of subclause 4.2 shall be met. During and on completion of the test, the attenuation shall be within the following limits of the initial value:

$\pm 0,30$ dB where $N \leq 4$;
 $\pm 0,50$ dB where $N > 4$.

During the test, the attenuation value shall be measured at a maximum interval of 1 hour during the first 16 hours and thereafter at a maximum interval of 24 hours until completion of the test.

4.14 Damp heat (steady state)

Method: EN 181000 [1], subclause 4.6.19.

Details:

temperature:	40°C;
relative humidity:	93 % \pm 2 %;
exposure duration:	96 hours;
preconditioning procedure:	standard atmospheric conditions for 2 hours (see subclause 4.1 of EN 181000 [1]);
recovery procedure:	allow specimen to return to 20°C in period not exceeding 2 hours.

Requirements: During the test, the attenuation limits of subclause 4.2 shall be met. During and on completion of the test, the attenuation shall be within the following limits of the initial value:

$\pm 0,30$ dB where $N \leq 4$;
 $\pm 0,50$ dB where $N > 4$.

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

4.15 Damp heat (cyclic)

This test shall be carried out on branching devices which are to be used in weather protected environments corresponding to ETS 300 019 [5], classes 3.3, 3.4 or 3.5.

The test should therefore be carried out in accordance with IEC 68-2-30 [7]. Test cycle variant 1 is preferred but this cycle requires special test chambers and variant 2 is acceptable for qualification.

Details:

test cycle	variant 1 or 2;
high temperature:	+55°C;
low temperature:	+25°C;
duration of each cycle:	24 hours;
number of cycles:	6;
pre-conditioning procedure:	2 hours at normal ambient conditions;
recovery procedure:	16 hours at normal ambient conditions.

Requirements: During the test, the attenuation limits of subclause 4.2 shall be met. During and on completion of the test, the attenuation shall be within the following limits of the initial value:

$\pm 0,30$ dB where $N \leq 4$;
 $\pm 0,50$ dB where $N > 4$.

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

4.16 Change of temperature

Method: EN 181000 [1], subclause 4.6.22.

Details:

high temperature:	+70°C;
low temperature:	-25°C;
duration at extreme temperatures:	1 hour;
number of cycles:	12;
rate of temperature change:	1°C/minute;
preconditioning procedure:	standard atmospheric conditions for 2 hours;
recovery procedure:	allow specimen to return to 20°C in period not exceeding 2 hours.

Requirements: During the test, the attenuation limits of subclause 4.2 shall be met. During and on completion of the test, the attenuation shall be within the following limits of the initial value:

$\pm 0,30$ dB where $N \leq 4$;
 $\pm 0,50$ dB where $N > 4$.

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

4.17 Corrosive atmosphere (salt mist)

This test shall be carried out on devices which are to be used in non-weather protected environments corresponding to ETS 300 019 [5], class 4.1.

Method: EN 181000 [1], subclause 4.6.26.

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;
recovery procedure:	standard atmospheric conditions for 1 hour.

Requirements: The attenuation shall be within the following limits of the initial value:

$\pm 0,30$ dB where $N \leq 4$;
 $\pm 0,50$ dB where $N > 4$.

4.18 Industrial atmosphere

This test shall be carried out on devices which are to be used in weather protected environments corresponding to ETS 300 019 [5], classes 3.3, 3.4 or 3.5 or in non-weather protected environments corresponding to ETS 300 019 [5], class 4.1.

Method: EN 181000 [1], subclause 4.6.28.

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;
recovery procedure:	standard atmospheric conditions for 1 hour.

Requirements: The attenuation shall be within the following limits of the initial value:

$\pm 0,30$ dB where $N \leq 4$;
 $\pm 0,50$ dB where $N > 4$.

4.19 Dust

This test shall be carried out on devices which are to be used in weather protected environments corresponding to ETS 300 019 [5], classes 3.3, 3.4 or 3.5 or in non-weather protected environments corresponding to ETS 300 019 [5], class 4.1.

Method: EN 181000 [1], subclause 4.6.27.

Details:

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

Requirements: The attenuation shall be within the following limits of the initial value:

$\pm 0,30$ dB where $N \leq 4$;
 $\pm 0,50$ dB where $N > 4$.

4.20 Condensation

This test shall be carried out on devices which are to be used in weather protected environments corresponding to ETS 300 019 [5], classes 3.3, 3.4 or 3.5, or in non-weather protected environments corresponding to ETS 300 019 [5], class 4.1.

Method: EN 181000 [1], subclause 4.6.21.

Details:

preconditioning procedure: standard atmospheric conditions for 2 hours;
recovery procedure: allow specimen to return to 20°C in a period not exceeding 2 hours.

Requirements: During the test, the attenuation limits of subclause 4.2 shall be met. During and on completion of the test, the attenuation shall be within the following limits of the initial value:

$\pm 0,30$ dB where $N \leq 4$;
 $\pm 0,50$ dB where $N > 4$.

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

4.21 Water immersion

This test shall be carried out on devices which are to be used in weather protected environments corresponding to ETS 300 019 [5], classes 3.3, 3.4 or 3.5 or in non-weather protected environments corresponding to ETS 300 019 [5], class 4.1.

Method: EN 181000 [1], subclause 4.6.24.

Details:

head of water: 150 mm;
temperature: +43°C;
duration: 168 hours.

Requirements: During the test, the attenuation limits of subclause 4.2 shall be met. During and on completion of the test, the attenuation shall be within the following limits of the initial value:

$\pm 0,30$ dB where $N \leq 4$;
 $\pm 0,50$ dB where $N > 4$.

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

5 Acceptance criteria

5.1 Attenuation and return loss

A minimum sample size of 20 shall be measured at the required operation wavelength in accordance with subclause 4.2 and subclause 4.3.

5.2 Other optical, environmental and mechanical requirements

A minimum sample size of 4 shall be subjected to each test. Any parallel or serial grouping of tests can be used, provided that each test or serial group of tests is preceded by visual inspection and followed by the change of temperature test. Mechanical or environmental acceptance obtained from these tests may apply to other devices of the same design which have different attenuation values. Products which can be approved on the basis of commonality of design shall be agreed between the user and the supplier. The user may require a number of additional tests.

5.3 Pass/fail criteria

To satisfy the qualification approval requirements of this I-ETS performance specification there shall be no failures of any in the sample groups for any test parameter. If a failure does occur this shall be investigated and the cause of failure identified and corrected. The test which is affected shall then be repeated using the minimum sample size stated in this I-ETS.

A fully documented test report and supporting data shall be prepared and shall be available for inspection. Failures and the corrective action taken to eliminate failures shall be documented and evidence shall be presented to show that the corrective action will have no detrimental effect on the performance in any of the other tests. Design changes, as opposed to improvements in quality control, will usually be deemed to necessitate a repeat of the full qualification programme.

History

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