

**Transmission and Multiplexing (TM);  
Dense wavelength division multiplexing devices;  
Common requirements and conformance testing**

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**Reference**

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## Foreword

This ETSI Standard (ES) has been produced by ETSI Technical Committee Transmission and Multiplexing (TM), and is now submitted for the ETSI standards Membership Approval Procedure.

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# 1 Scope

The present document applies to pigtailed fibber optic Dense-Wavelength Division Multiplexer (D-WDM) devices to be used in single mode optical transmission networks for signals at a maximum bit rate of 10 Gbit/s, in weather protected, temperature controlled environments corresponding to ETS 300 019-1-3 [5], class 3.1.

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 D-WDM 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 the present document 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 optic D-WDM device is defined in clause 3 of the present document.

NOTE: For connectorized devices the requirements of I-ETS 300 671 [11] should be considered in addition to the present document.

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# 2 References

The following documents contain provisions, which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

- [1] EN 181000 (1994): "Generic specification: Fibre optic branching devices".
- [2] IEC 62074-1: "Fibre Optic WDM devices-Part 1: Generic Specification".
- [3] IEC 61300-X-X (X-X = different sub-parts): "Fibre optic interconnecting devices and passive components - Basic test and measurement procedures".
- [4] EN 188101 (1995): "Family Specification: Single-mode dispersion unshifted (B1.1) optical fibre".
- [5] ETSI ETS 300 019: "Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment".
- [6] EN 188000 (1992): "Generic specification: Optical fibres".
- [7] ITU-T Recommendation G.692: "Optical interfaces for multichannel systems with optical amplifier".
- [8] ITU-T Recommendation G.671: "Transmission characteristics of passive optical components".

- [9] IEC 61300-3-29: "Measurement techniques for Dense Wavelength Division Multiplexing (DWDM) components".
- [10] IEC 86B/1232/NP: "Directivity".
- [11] ETSI I-ETS 300 671: "Transmission and Multiplexing (TM); Passive optical components; Fibre optical connectors for single-mode optical fibre communication systems; Common requirements and conformance testing".

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## 3 Definition

For the purposes of the present document, the following definition applies:

**Dense-Wavelength Division Multiplexer (D-WDM):** passive optical component which separates (and/or combines) two or more signal at different wavelength from one (two) or more inputs into two (one) or more outputs. "Dense" refers to a class of components operating with channel spacing equal or less than 800 GHz.

All the parameter definitions shall be in accordance with IEC 62074-1 [2].

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## 4 Tests

All measurements shall be carried out at normal room conditions, unless otherwise stated. If the device is provided with an active temperature control, this shall be set at the setpoint specified by the manufacturer.

The requirements apply to every combination of input and output port.

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 and the operating wavelength of the device during an environmental test shall be measured for a single input/output port combination. The attenuation and the 1dB-bandwidth after a test shall be remeasured in accordance with subclauses 4.2.2 and 4.2.3.

### 4.1 Visual Inspection

In accordance with IEC 61300-3-1 [3].

- 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 Optical tests

#### 4.2.1 Operating wavelength

- Requirements: All the operating wavelengths shall be in accordance with ITU Recommendation G.692 [7].

#### 4.2.2 Attenuation

- Method: IEC 61300-3-29 [9].
- Condition: Attenuation shall be determined as the worst case over all the states of polarization.

Details:	Left for further study.
Requirements:	Maximum allowable attenuation: $(n \times 0,5 + 4)$ dB, where n is the greater number between the input port number and the output port number.

### 4.2.3 1 dB-bandwidth

Method:	IEC 61300-3-29 [9].
Condition:	The 1 dB-bandwidth shall be determined as the worst case over all the states of polarization.
Details:	Left for further study.
Requirements:	Minimum 1 dB-bandwidth (centred at the operating wavelength):
	<ul style="list-style-type: none"> <li>- Class I: <math>0,15 \Delta f</math> nm, where <math>\Delta f</math> is the channel spacing;</li> <li>- Class II: <math>0,3 \Delta f</math> nm, where <math>\Delta f</math> is the channel spacing. The 1 dB- bandwidth shall be in any case greater than electrical bandwidth of the signal.</li> </ul>

### 4.2.4 Minimum total interchannel crosstalk

Method:	IEC 61300-3-29 [9].
Condition:	Minimum total interchannel crosstalk attenuation shall be determined as the worst case over all the states of polarization.
Details:	Left for further study.
Requirements:	Minimum allowable value for the minimum total interchannel total crosstalk attenuation:
	<ul style="list-style-type: none"> <li>- Class I: 15 dB;</li> <li>- Class II: 20 dB.</li> </ul>

### 4.2.5 Minimum interchannel crosstalk

Method:	IEC 61300-3-29 [9].
Condition:	Minimum interchannel crosstalk attenuation shall be determined as the worst case over all the states of polarization.
Details:	Left for further study
Requirements:	Minimum allowable value for the minimum total interchannel total crosstalk attenuation:
	$-10 \text{Log} \left( \frac{1}{n-1} 10^{-0,1 \text{MTICA}} \right) - 3 \text{ dB}$ , where MTICA defines the minimum total interchannel crosstalk attenuation, specified in 4.2.4, while n is the number described in 4.2.2.

### 4.2.6 Uniformity

Method:	IEC 61300-3-29 [9].
Condition:	Uniformity shall be determined as the worst case over all the states of polarization and all the ports.
Details:	Left for further study.
Requirements:	Maximum allowable uniformity: 1,5 dB (for channel number $\leq 8$ ); 2 dB (for channel number $> 8 \leq 16$ ); 2,5 dB (for channel number $> 16$ ).

### 4.2.7 Return loss

Method:	IEC 61300-3-29 [9].
Details:	Left for further study.
Requirements:	Minimum allowable return loss: 40 dB.

### 4.2.8 Near-end crosstalk (or Directivity)

Method:	IEC 86B/1232/NP [10].
Condition:	All ports not under test shall be optically terminated to avoid unwanted reflections contributing to the measurement.
Details:	Left for further study.
Requirements:	Minimum allowable near-end crosstalk: 40 dB.

## 4.3 Environmental tests with continuous monitoring

The following requirements and details apply for all the tests, unless otherwise specified:

Requirements:	Attenuation: During and on completion of the test the limit of subclause 4.2.2 shall be met. During and on completion of the test, the attenuation shall be within +/- 0,3 dB with respect to the initial value.
	1 dB-bandwidth: During and on completion of the test the limit of subclause 4.2.3 shall be met.
Details:	During the test, measurements shall be taken at a maximum interval of 1 hour, unless otherwise stated.

### 4.3.1 Cold

Method:	IEC 61300-2-17 [3].
Details:	temperature: -5°C.
	duration of exposure: 96 hours.
	preconditioning procedure: standard atmospheric conditions for 2 hours.
	recovery procedure: allow specimen to return to 20°C in period not exceeding 2 hours.

### 4.3.2 Dry heat

Method:	IEC 61300-2-18 [3].
Details:	temperature: +40°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.



### 4.3.3 Damp heat (steady state)

Method: IEC 61300-2-19 [3].

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.

### 4.3.4 Change of temperature

Method: IEC 61300-2-22 [3].

Details: high temperature: +40°C.  
low temperature: -5°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.  
maximum time interval between measurements during the test: 15 minutes.

## 4.4 Mechanical tests without continuous monitoring

The following requirements apply for all the tests, unless otherwise specified.

Requirements: Attenuation: On completion of the test the limit of subclause 4.2.2 shall be met. However, the attenuation shall be within +/- 0.5 dB with respect to the initial value.

### 4.4.1 Vibration

Method:	IEC 61300-2-1 [3].	
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.

### 4.4.2 Fibre/Cable retention

Method:	IEC 61300-2-4 [3].	
Details:	magnitude of tensile load:	50 ± 2 N for reinforced cable 5 ± 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

### 4.4.3 Impact

This test will be applied only to devices in sub-assembly.

Method:	IEC 61300-2-12 [3].	
Details:	number of drops:	5
	drop height:	1,5 metres

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## 5 Acceptance criteria

### 5.1 Basic Optical Requirements

A minimum sample size of 10 shall be measured in accordance with subclauses from 4.2.2 to 4.2.8.

### 5.2 Other Optical and Environmental 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 (with continuous monitoring). 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 the present document 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 the present document.

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.

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## History

<b>Document history</b>		
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