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Proposed automotive connector testing

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References

- IEC 61753-1, Fibre optic interconnecting devices and passive components – Performance standard – Part 1: General and guidance

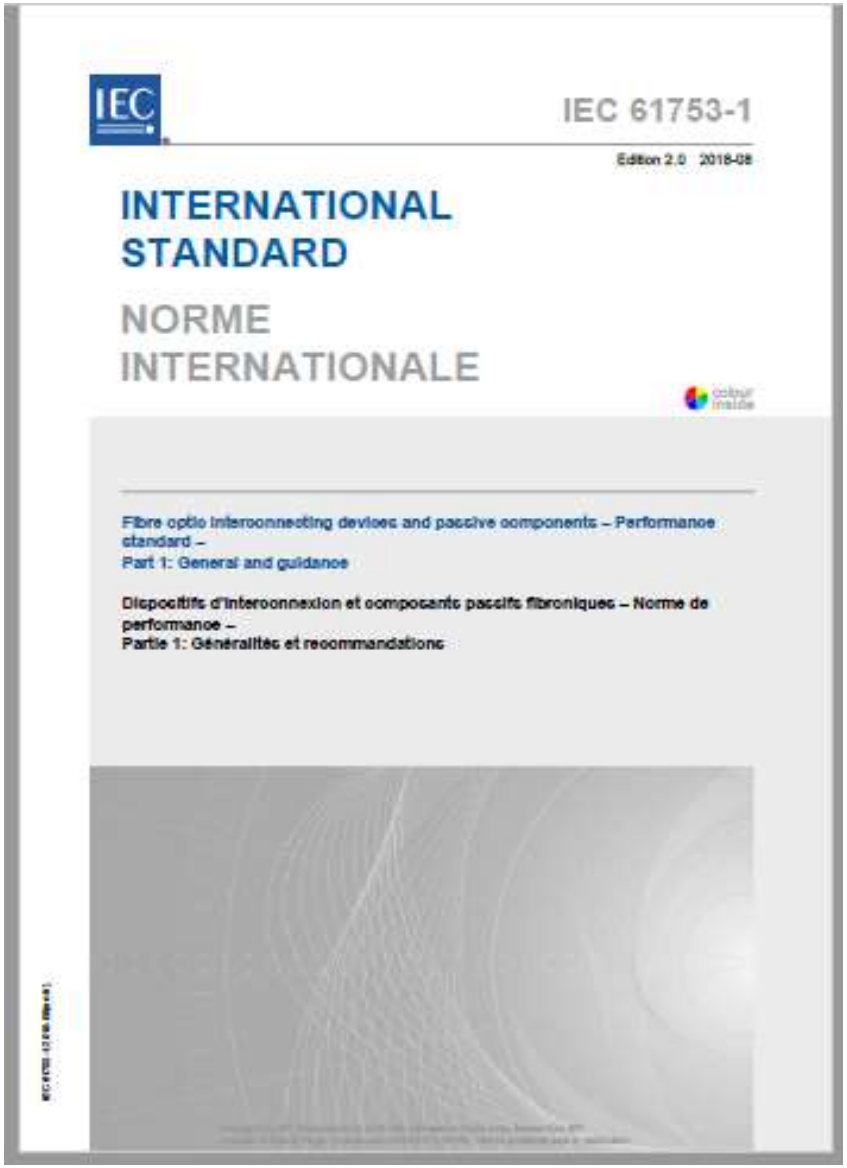
- IEC 61753-021-6, Fibre optic interconnecting devices and passive components performance standard – Part 021-6: Grade B/2 single-mode fibre optic connectors for category OP+ – Uncontrolled environment

- Optical Multi-Gigabit Link Connectivity requirements, v0.50, Markus Dittmann 2020-April-07

Motivation

- While connector testing is not required as part of the IEEE 802.3cz Standard, no standardized optical connector testing for automotive applications is currently available to reference.
- It is proposed that IEC 61753-1, “Fibre optic interconnecting devices and passive components – Performance standard” be considered by IEEE 802.3cz as a basis for developing the automotive test requirements
  - Performance Standards define the requirements for standard optical performance under a set of specified conditions.
  - Each standard contains a series or a set of tests and measurements with clearly stated conditions, severities and pass/fail criteria.
  - The series of tests, commonly referred to as an operating service environment or performance category, are intended to be run on a “one-off” basis to prove the product’s ability to satisfy the requirements of a specific application, market sector or user group.
- A new service environment for automotive applications is proposed
  - While a comprehensive set of tests has been proposed, other tests can be added; in addition, the tests severities are subject to change.

IEC 61753-1 defines the tests and severities



Automotive tests

Test No.	Test
1	Attenuation
2	Return loss (random mate)
3	High temperature endurance
4	Cold
5	Change of temperature
6	Humidity-condensation cycle test
7	Vibration
8	Flex
9	Mating durability
10	0° proof (cable retention)
11	Torsion
12	Salt mist
13	Solvent resistance
14	Dust

Automotive optical tests

No	Test	Requirements	Details
1	Attenuation (Method 2)	Grade AUm performance level: Mean $\leq$ 0.8 dB Maximum = 1.6 dB for $\geq$ 97% of samples Test wavelengths: 980 nm $\pm$ 30 nm	IEC 61300-3-34 DUT type 5, insertion method (2) Source characteristics: reference to IEC 61300-3-4 (attenuation) Specimen shall be optically functioning.

Automotive optical tests (cont.)

2	Return loss	Grade 1m performance level: Minimum > 20 dB Test wavelengths: 980 nm ± 20 nm	IEC 61300-3-6, method branching devices Source stability: ± 0,20 dB over the measuring period or at least 1 h Detector linearity: within 5% of the power levels to be measured Preconditioning procedure: clean plug and adapter according to manufacturer's instructions.

Automotive environmental tests

3	Dry heat - High temperature endurance	Attenuation: All attenuation measurements shall meet the criteria specified Return loss: All return loss measurements shall meet the criteria specified Test wavelengths: 980 nm ± 20 nm	IEC 61300-2-18 Temperature: +105 °C ± 2 °C for 168 h Length of the cable on each side of the connector inside the chamber: 1,5 m minimum Sampling rate: initially at room ambient, at least every 6 h during the test and at the end of the test at room ambient. Preconditioning procedure: before test, specimens shall be maintained in room temperature condition for 2 h. Clean plug and adapter according to manufacturer's instructions. Recovery procedure: after test, specimens shall be maintained in room temperature condition for 2 h. The connector samples shall not be uncoupled or cleaned at any time before, during, or after the test.

Automotive environmental tests (cont.)

4	Cold	Attenuation: All attenuation measurements shall meet the criteria specified Return loss: All return loss measurements shall meet the criteria specified Test wavelengths: 980 nm ± 20 nm	IEC 61300-2-17 Temperature: -40°C ± 2 °C for 168 h Length of the cable on each side of the connector inside the chamber: 1,5 m minimum Sampling rate: initially at room ambient, at least every 6 h during the test and at the end of the test at room ambient. Preconditioning procedure: before test, specimens shall be maintained in room temperature condition for 2 h. Clean plug and adapter according to manufacturer's instructions. Recovery procedure: after test, specimens shall be maintained in room temperature condition for 2 h. The connector samples shall not be uncoupled or cleaned at any time before, during, or after the test.

Automotive environmental tests (cont.)

5	Change of temperature	Attenuation: All attenuation measurements shall meet the criteria specified Return loss: All return loss measurements shall meet the criteria specified Test wavelengths: 980 nm ± 20 nm	IEC 61300-2-22, Test Nb High temperature dwell: +105 °C ± 2 °C Room ambient dwell: +23°C ± 2 °C Low temperature dwell: -40 °C ± 2 °C Duration at each dwell temperature: 1 h Ramp time = 1 h Number of cycles: 21 Length of the cable on each side of the connector inside the chamber: 1,5 m minimum for pigtails and 3 m minimum for patchcords Specimen shall be optically functioning.

Automotive environmental tests (cont.)

6	Composite temperature humidity cyclic test	Attenuation: All attenuation measurements shall meet the criteria specified Return loss: All return loss measurements shall meet the criteria specified Test wavelength: 980 nm ± 20 nm	IEC 61300-2-21 Z/AD profile with exposure to cold and humidity cycles Temperature range: –10 °C to +65 °C Humidity: 93 % RH at the maximum temperature 3 h dwells at the temperature extremes 10 cycles High temperature dwell: +65 °C ± 2 °C Room ambient dwell: +23 °C ± 2 °C Low temperature dwell::-10 °C ± 2 °C Relative humidity: 90 % to 100 % ± 2 % during dwells at +23 °C and 65 °C. Uncontrolled but not dehumidified during ramps and at -10 °C. Cycle profile: 23 °C to -10 °C to +65 °C to -10 °C to +23 °C. Ramp time = 1 h, except change from -10 °C to +65 °C and +65 °C to –10°C must occur faster (20 min max.) to maximize condensation. Duration at each dwell temperature: 2 h Number of cycles: 14

Automotive mechanical tests

7	Vibration (sinusoidal)	Attenuation: All attenuation measurements shall meet the criteria specified Return loss: All return loss measurements shall meet the criteria specified Test wavelengths: 980 nm ± 20 nm	IEC 61300-2-1 Frequency range: 45 Hz per min, 10 Hz to 55 Hz Maximum frequency sweep: 2,5 min Endurance duration per axis: 2 h Number of axes: three orthogonal Number of sweeps per axis: 120 Vibration amplitude: 1,5 mm peak to peak

Automotive mechanical tests (cont.)

8	Flexing of the strain relief of fibre optic devices	Attenuation: All attenuation measurements shall meet the criteria specified Return loss: All return loss measurements shall meet the criteria specified Test wavelengths: 980 nm ± 20 nm	IEC 61300-2-44 Magnitude of the tensile load: 8,9 N for connectors with reinforced cable 5,9 N for SFF connectors with reinforced cable Cycle: 0 ° to +90 ° to 0 ° to -90 ° to 0 ° (continuous with reversing at ± 90 °) Number of cycles: 100 Rate of application of the tensile load: 1 N/s for reinforced cable

Automotive mechanical tests (cont.)

8	Mating durability	Attenuation: All attenuation measurements shall meet the criteria specified Return loss: All return loss measurements shall meet the criteria specified Test wavelengths: 980 nm ± 20 nm	IEC 61300-2-2 Cycling rate: not less than 3 s between each engagement and separation Cycling method: the test is to be conducted manually with the operator standing on the floor for all cleanings and reconnections to simulate operating conditions. Number of cycles: 20 minimum Specimen shall be optically functioning.

Automotive mechanical tests (cont.)

10	Cable retention	Attenuation: All attenuation measurements shall meet the criteria specified Return loss: All return loss measurements shall meet the criteria specified Test wavelength: 980 nm ± 20 nm	IEC 61300-2-50 Magnitude of the tensile load: 100 N for reinforced cables Duration of the test (maintaining the load): 5 s minimum Specimen does not need to be optically functioning during the test.

Automotive mechanical tests (cont.)

11	Torsion/twist	Attenuation: All attenuation measurements shall meet the criteria specified in 7.4. Return loss: All return loss measurements shall meet the criteria specified in 7.4. Test wavelengths: 980 nm ± 20 nm	IEC 61300-2-5 Magnitude of the tensile load: Reinforced jacketed cables: Load: 13,3 N Cycle: ± 900 ° (± 2,5 revolutions) Number of cycles: 10 (cycle rate not specified) 900-micron buffered fibres: Load: 7,4 N Cycle: ± 540 ° (± 1,5 revolutions) Number of cycles: 10 (cycle rate not specified)

Automotive exposure tests

12	Salt mist	Attenuation: All attenuation measurements shall meet the criteria specified Return loss: All return loss measurements shall meet the criteria specified Test wavelengths: 980 nm ± 20 nm	IEC 61300-2-26 Salt solution 5% NaCl (pH 6,5 – 7,2) 7 days duration

Automotive exposure tests (cont.)

13	Resistance to solvents and contaminating fluids	Attenuation: All attenuation measurements shall meet the criteria specified Return loss: All return loss measurements shall meet the criteria specified Test wavelengths: 980 nm ± 20 nm	IEC 61300-2-34 Solvents: • HCl at pH 2 • NaOH at pH 12 • Cable compound (petroleum jelly), ISO1998-1:1998,1.60.132 • Automotive diesel oil ISO 1998-1:1998, 1.20.131, and EN 590 • 0 % nonylphenol ethoxylate solution (Igepal) (at 50 °C ± 2 ° C) Duration: Automotive diesel – 1 hour immersion, 24 hour drying at RT Others: 5 days, no drying

Automotive exposure tests (cont.)

14	Dust (IP 6x)	Attenuation: All attenuation measurements shall meet the criteria specified Return loss: All return loss measurements shall meet the criteria specified Test wavelengths: 980 nm ± 20 nm	IEC 60529 Dust type: talcum powder Particle size: < 75 μ m Dust density: 2 kg/m3 Pressure: 2 kPa underpressure inside enclosure 8 h duration

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