

# TECHNICAL SPECIFICATION

Fibre optic interconnecting devices and passive components –  
Conditions for testing the protection against dust and water ingress of passive  
optical protective housings and hardened fibre optic connectors (IP5X, IPX4,  
IPX5, IPX6)

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IEC Central Office  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**FIBRE OPTIC INTERCONNECTING DEVICES  
AND PASSIVE COMPONENTS –**

**Conditions for testing the protection against dust  
and water ingress of passive optical protective housings and  
hardened fibre optic connectors (IP5X, IPX4, IPX5, IPX6)**

FOREWORD

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The text of this Technical Specification is based on the following documents:

Draft	Report on voting
86B/4475/DTS	86B/4516A/RVDTS

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Specification is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/standardsdev/publications](http://www.iec.ch/standardsdev/publications).

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## INTRODUCTION

This document includes conditions for testing the protection against dust and water ingress of passive optical protective housings and hardened fibre optic connectors according to IEC 60529.

The conditions included in this document are applicable for testing the IP ratings as summarized in Table 1.

**Table 1 – Overview of conditions for IP ratings covered in this document**

Passive optical protective housings and hardened fibre optic connectors	
Degree of protection against dust	Degree of protection against water
-	IPX4 (protected against splashing water)
IP 5X (dust-protected)	IPX5 (protected against water jets)
-	IPX6 (protected against powerful water jets)

Suitable acceptance conditions for the degree of protection as listed in Table 1 were searched for in IEC SC 86B and CENELEC TC 86BXA and different options were evaluated and discussed. The acceptance conditions in this document were presented and agreed in the Autumn 2019 meeting of IEC SC 86B/WG 6. This information was handed over to WG4, where this document was developed.

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The acceptance conditions for first characteristic numeral 5 (dust ingress) according to IEC 60529 define that the protection is satisfactory if, on inspection, talcum powder has not accumulated together with and any other kind of dust in quantity and location that could interfere with the correct operation of equipment or impair safety. Additionally, it is satisfactory if no dust deposits where it could lead to tracking along the creepage distances. Dust accumulation does usually not impair the correct operation or impair the safety of passive optical protective housings containing optical fibre cables, fibres, connectors and passive optical components, and of hardened fibre optic connectors. Therefore, these conditions do not support the evaluation if the product has passed or failed. It is not necessary to ban dust ingress for passive optical protective housings and hardened fibre optic connectors with IP5X rating (dust-protected). Applicable acceptance conditions for IP5X are included in this document specifically for passive optical products.

Conditions for IP1X, IP2X, IP3X and IP4X rating (against solid foreign objects) are not included in this document because probes with a defined form and diameter are used.

The acceptance conditions for second characteristic numerals (water ingress) according to IEC 60529 define that if any water has entered, it generally does not interfere with the correct operation of the equipment or impair safety, not deposit on insulation parts where it could lead to tracking along the creepage distances, not reach live parts or windings not designed to operate when wet, not accumulate near the cable end or enter the cable if any, and not accumulate without doing any harm to the equipment. Water ingress does usually not impair the correct operation or impair the safety of passive optical protective housings containing optical fibre cables, fibres, connectors and/or passive optical components, and of hardened fibre optic connectors. Therefore, these conditions do not support the evaluation if the product has passed or failed. It is not necessary to ban water ingress for passive optical protective housings and hardened fibre optic connectors with IPX4, IPX5 and IPX6 rating (splashing water or water jet). A single fixed limit (e.g. 1 %, 0,1 %) was considered as not suitable for all sizes of protective housings and hardened connectors, because it may be too low for the determination of the volume of water ingress for small housings (e.g. 0,1 % of 0,1 l = 0,1 ml) but suitable for larger housings. On the other hand, a larger limit that is suitable for small housings may allow an excessive volume of water ingress in large housings that was also not considered as suitable (e.g. 1 % of 750 l = 7,5 l). To take small and large housings into account, a higher percentage for housings having a small inner volume ( $\leq 1$  l) and a lower percentage for large volumes (above 1 l) was considered as the best solution. Applicable acceptance



conditions for IPX4, IPX5 and IPX6 are included in this document specifically for passive optical products.

Requirements against water ingress with IPX1, IPX2 and IPX3 (dripping and spraying) rating are not specified in the performance standards for optical products. Therefore, no conditions are included in this document for these ratings.

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## FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS –

### Conditions for testing the protection against dust and water ingress of passive optical protective housings and hardened fibre optic connectors (IP5X, IPX4, IPX5, IPX6)

#### 1 Scope

This document defines the conditions for testing the protection against dust and water ingress of passive optical protective housings and hardened fibre optic connectors (IP5X, IPX4, IPX5, IPX6) performed according to IEC 60529.

The conditions in this document supplement the test requirements specified in IEC 60529.

Protective housings and hardened connectors containing electrical conductors, electrical connections, passive electrical components, active electrical equipment or electronics that transmit signals or provide power are not within the scope of this document.

#### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 61300-3-1, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-1: Examinations and measurements – Visual examination*

IEC 61300-3-4, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-4: Examinations and measurements – Attenuation*

IEC 61300-3-6, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-6: Examinations and measurements – Return loss*

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

#### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61753-1 and IEC 60529 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

## 4 Abbreviated terms

DUT device under test

## 5 Conditions for dust ingress testing (IP5X) of protective housings

### 5.1 General

The conditions in Clause 5 are applicable for testing the protection against dust ingress with IP5X rating (dust-protected) of passive optical protective housings according to IEC 60529. The conditions in Clause 5 supplement the test requirements specified in IEC 60529.

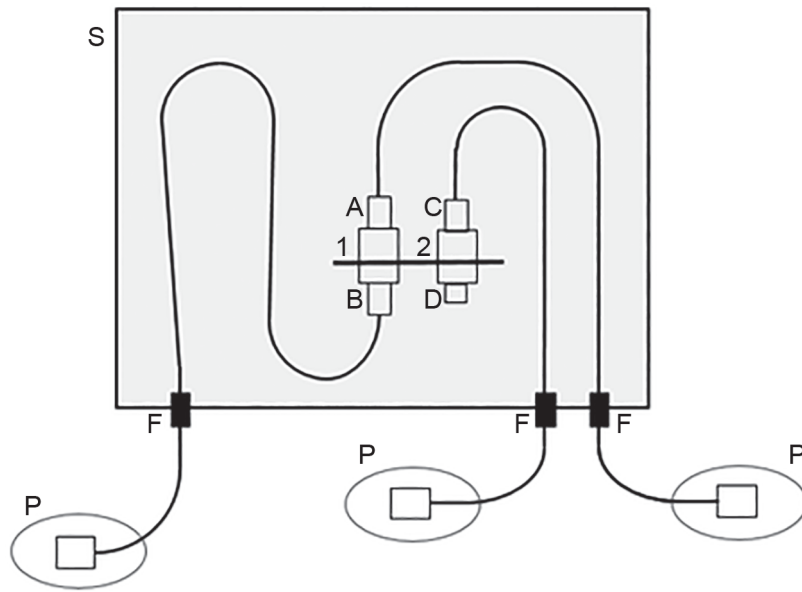
### 5.2 Preparation of test sample

The device under test (DUT) preparation shall be done in accordance with IEC 60529, according to the requirements in the relevant specification and with the supplement conditions in 5.2.

Within the DUT, one fibre circuit with one connection (connector plug A, adaptor 1, connector plug B) and with a connector plug C plugged in an adaptor 2 shall be mounted in an adaptor field of the DUT, as shown in Figure 1.

If not otherwise specified in the relevant specification, one circuit with one connection shall be prepared as shown in Figure 1. If more than one circuit with each a connection is specified, then Annex A shows the configuration with three circuits (and three tested connections) for illustration purposes and describes the procedure for more than one circuit.

A connector type with an optical interface that can be efficiently cleaned should be used, for example a LC or SC connector type. The dust cap D provided by the manufacturer of the adaptor 2 shall be mounted on the opposite side of connector plug C in adaptor 2.



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**Key**

- 1, 2 adaptor
- A, B, C connector plug
- D dust cap
- F cable feed through
- P protection of cable end with connector plug
- S protective housing

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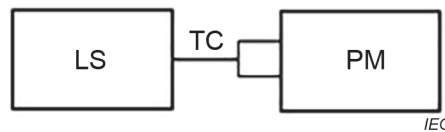
**Figure 1 – Example of DUT preparation**

All the fibre ends that are usually protected in cables shall exit the DUT and sealed according to the manufacturer’s instruction of the DUT. The second end of the cables shall be prepared for connection to optical performance measurement equipment (for example to a light source and a power meter) and protected during conditioning with dust or guided out of the dust chamber.

NOTE The fibre circuits and connector plugs in the DUT are arranged in the example given in Figure 1, Figure 3 and Figure 4 so that the preparation of the DUT can be easily recognised. In real products, the fibre circuits can be arranged in a different way. The pre-installed connector plugs (A, C) are typically oriented downward whereas the partly later installed cables and connector plugs (connected to the free port of adaptor 2) are oriented upward.

**5.3 Initial measurement**

A light source with a launch cord shall be connected with the power meter, as shown in Figure 2. Then the reference optical performance measurement shall be performed in accordance with IEC 61300-3-4 and/or IEC 61300-3-6.



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**Key**

- LS light source
- PM power meter
- TC launch cord

**Figure 2 – Example of reference optical performance measurement**