

## ประกาศกระทรวงอุตสาหกรรม

ฉบับที่ ๕๐๐๒ (พ.ศ. ๒๕๖๐)

ออกตามความในพระราชบัญญัติมาตรฐานผลิตภัณฑ์อุตสาหกรรม

พ.ศ. ๒๕๑๑

เรื่อง กำหนดมาตรฐานผลิตภัณฑ์อุตสาหกรรม

เส้นใยนำแสง

เล่ม ๑ (๓๒) วิธีการวัดและขั้นตอนการทดสอบ - ความสามารถในการลอกของสารเคลือบ

อาศัยอำนาจตามความในมาตรา ๑๕ แห่งพระราชบัญญัติมาตรฐานผลิตภัณฑ์อุตสาหกรรม พ.ศ. ๒๕๑๑ ซึ่งแก้ไขเพิ่มเติมโดยพระราชบัญญัติมาตรฐานผลิตภัณฑ์อุตสาหกรรม (ฉบับที่ ๗) พ.ศ. ๒๕๕๘ รัฐมนตรีว่าการกระทรวงอุตสาหกรรมออกประกาศกำหนดมาตรฐานผลิตภัณฑ์อุตสาหกรรม เส้นใยนำแสง เล่ม ๑ (๓๒) วิธีการวัดและขั้นตอนการทดสอบ - ความสามารถในการลอกของสารเคลือบ มาตรฐานเลขที่ มอก. 2768 เล่ม 1 (32) - 2559 ไว้ ดังมีรายละเอียดต่อท้ายประกาศนี้  
ทั้งนี้ ให้มีผลตั้งแต่วันที่ประกาศในราชกิจจานุเบกษาเป็นต้นไป

ประกาศ ณ วันที่ ๑๐ เมษายน พ.ศ. ๒๕๖๐

อุตตม สาวนายน

รัฐมนตรีว่าการกระทรวงอุตสาหกรรม

# มาตรฐานผลิตภัณฑ์อุตสาหกรรม

## เส้นใยนำแสง

### เล่ม 1(32) วิธีการวัดและขั้นตอนการทดสอบ – ความสามารถ ในการลอกของสารเคลือบ

#### ทั่วไป

มาตรฐานผลิตภัณฑ์อุตสาหกรรมนี้กำหนดขึ้นโดยรับ IEC 60793-1-32 Edition 2.0 (2010-05) Optical fibres - part 1-32: Measurement methods and test procedures – Coating strippability มาใช้โดยวิธีพิมพ์ซ้ำ (reprinting) ในระดับเหมือนกันทุกประการ (identical) โดยใช้ IEC ฉบับภาษาอังกฤษเป็นหลัก

#### ขอบข่าย

มาตรฐานผลิตภัณฑ์อุตสาหกรรมนี้ มีจุดมุ่งหมายเพื่อทดสอบเส้นใยนำแสงที่ผลิตจากโรงงานหรือเส้นใยนำแสงที่ต่อมา ถูกเคลือบเพิ่มเติม (tight buffered) ด้วยพอลิเมอร์ชนิดต่าง ๆ การทดสอบนี้สามารถใช้กับเส้นใยนำแสงหลังการผลิตหรือหลังจากเส้นใยนำแสงอยู่ในภาวะแวดล้อมต่าง ๆ แล้ว

สามารถใช้วิธีนี้กับเส้นใยนำแสงประเภท A1 ประเภท A2 ประเภท A3 กลุ่ม B และกลุ่ม C

จุดประสงค์ของมาตรฐานฉบับนี้เพื่อระบุข้อกำหนดคุณลักษณะที่ต้องการสำหรับลักษณะเฉพาะทางกล – ความสามารถในการลอกของสารเคลือบ การทดสอบนี้ใช้ในการหาค่าแรงที่จำเป็นในการลอกสารเคลือบออกจากเส้นใยนำแสงตามแนวความยาว

การทดสอบนี้ไม่มีจุดมุ่งหมายเพื่อเพิ่มความแข็งแรงของเส้นใยนำแสงหลังลอกสารเคลือบรวมทั้งไม่ระบุเงื่อนไขที่ดีที่สุดในการลอกสารเคลือบ

การทดสอบนี้ออกแบบไว้สำหรับเส้นใยนำแสงที่มีการเคลือบพอลิเมอร์ ที่มีเส้นผ่านศูนย์กลางภายนอกอยู่ในช่วงพิสัย 240  $\mu\text{m}$  ถึง 900  $\mu\text{m}$  ไม่แนะนำให้ใช้วิธีนี้กับเส้นใยที่เคลือบพอลิเมอร์ขนาดเส้นผ่านศูนย์กลางภายนอกต่ำกว่า 230  $\mu\text{m}$  หรือมากกว่า 930  $\mu\text{m}$

คำเตือน – เส้นใยนำแสงอาจแตกหักได้ในระหว่างการลอกสารเคลือบ ซึ่งอาจเป็นอันตรายต่อผิวหนังและตาได้ แนะนำให้สวมแว่นตานิรภัยป้องกัน

#### เอกสารอ้างอิง

รายละเอียดให้เป็นไปตาม IEC 60793-1-32: 2010 ข้อ 2.

#### เครื่องมือ

รายละเอียดให้เป็นไปตาม IEC 60793-1-32: 2010 ข้อ 3.

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IEC 60793-1-32:2010

### **การเตรียมตัวอย่างทดสอบ**

รายละเอียดให้เป็นไปตาม IEC 60793-1-32: 2010 ข้อ 4.

#### **ขั้นตอน**

รายละเอียดให้เป็นไปตาม IEC 60793-1-32: 2010 ข้อ 5.

#### **การคำนวณ**

รายละเอียดให้เป็นไปตาม IEC 60793-1-32: 2010 ข้อ 6.

#### **รายงานผลทดสอบ**

รายละเอียดให้เป็นไปตาม IEC 60793-1-32: 2010 ข้อ 7.

#### **สารสนเทศจำเพาะ**

รายละเอียดให้เป็นไปตาม IEC 60793-1-32: 2010 ข้อ 8.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

OPTICAL FIBRES –

**Part 1-32: Measurement methods and test procedures –  
Coating strippability**

FOREWORD

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International Standard IEC 60793-1-32 has been prepared by subcommittee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics.

This second edition cancels and replaces the first edition published in 2001 and constitutes a technical revision.

This edition has been modified to include current practices in the market place.

The text of this standard is based on the following documents:

CDV	Report on voting
86A/1273/CDV	86A/1310/RVC

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of IEC 60793-1 series, published under the general title *Optical fibres – Measurement methods and test procedures*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

**IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.**

## OPTICAL FIBRES –

### Part 1-32: Measurement methods and test procedures – Coating strippability

#### 1 Scope

This part of IEC 60793 is intended primarily for testing either fibres as produced by a fibre manufacturer or subsequently overcoated (tight buffered) using various polymers. The test can be performed either on fibres as produced or after exposure to various environments.

This test applies to A1, A2, A3, B and C fibres.

The object of this standard is to establish uniform requirements for the mechanical characteristic – coating strippability. This test quantifies the force required to mechanically remove the protective coating from optical fibres along their longitudinal axis.

This test is not intended as a means to maximize fibre strength after the coating is removed nor is it intended to specify the best conditions for field stripping of optical fibres.

This test is designed for optical fibres having polymeric coatings with nominal outer diameters in the range of 240  $\mu\text{m}$  to 900  $\mu\text{m}$ . Application of this method to fibres with outer coating diameters outside the range of 230  $\mu\text{m}$  to 930  $\mu\text{m}$  is not recommended.

Warning – Fibres can fracture while being stripped and pierce skin and eyes. Use of protective eyewear is recommended.

#### 2 Normative references

The following referenced documents are indispensable for the application 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 60793-1 (all parts), *Optical fibres – Measurement methods and test procedures*

#### 3 Apparatus

##### 3.1 Tensile equipment

Use a suitable device, for example a vertical tensile tester, which provides relative motion between the test fibre and a stripping tool and is capable of imparting constant motion at the velocity found in 5.2, without jerking the fibre under test or the stripping tool.

Use a device capable of providing relative motion in two directions to allow resetting. Provide suitable means for clamping and maintaining the stripping tool blades perpendicular to the fibre axis or in a position that prevents fibre bending, and for securing one end of the test fibre. To prevent fibre breakage, secure the fibre at the clamping point without stressing the fibre excessively.

Examples of test arrangements are shown in Figure 2.



### 3.2 Load cell

Use any appropriate device that is capable of sensing the force imparted to the fibre during the removal of the fibre coating.

### 3.3 Transducer amplifier

This device receives signals from the load cell and indicates the tensile force on the test fibre up to the point when the coating is stripped off. The transducer shall acquire the force data at a rate > 100 Hz. The transducer and/or measurement system shall have the ability to plot the test data on a continuous chart, such as a strip chart or line chart. It shall also have the capability of capturing sufficient information to calculate the maximum and average forces, along with the amplitude and frequencies of any oscillations in the force during the stripping process

The accuracy of the force measurement shall be stated in the detail specification.

### 3.4 Stripping tool

**3.4.1** Because the results from this test are strongly dependent upon the design of tool used, it is important that the following tool design guidelines be observed:

- a) Unless otherwise specified in the detail specification, use tool blades with the diameter of the hole greater than the nominal cladding diameter of the fibre to be stripped in order not to damage the cladding surface. The stripping tool shall be constructed such that the blades form a circular aperture. A practical example is a hole which is 15  $\mu\text{m}$  larger than the nominal cladding diameter; for 125  $\mu\text{m}$  cladding diameter fibres this results in a 140  $\mu\text{m}$  circular hole.
- b) The stripping tool blades shall be constructed such that the blades do not cause fibre bending. Stripping tools in which the blades butt together in the same plane are preferred in this test.

**3.4.2** Mount the stripping tool on the test fixture and provide a means to hold it closed around the fibre using suitable clamps. Ensure the fibre is pulled in a direction normal to the plane of the blades.

**3.4.3** Replace the stripping tools at intervals as dictated by a documented quality schedule, when the blades become dull or damaged, or whenever wear appears sufficient to affect the test results.

NOTE Tool wear can affect any or all of the following:

- fibre breakage,
- the amount of residue left on the glass surface,
- the way in which the coating is removed from the fibre, and
- the force required to remove the coatings.

### 3.5 Fibre guide

A fibre guide shall be provided to support the fibre which extends past the stripping tool blade (if not already designed into the tool) and which meets the following requirements:

- a) the guide shall support the fibre to prevent sagging due to the weight of the fibre;
- b) the guide shall prevent bending of the fibre caused by buckling of the fibre coating as it is removed;
- c) the guide shall be located as close to the stripping tool as possible without interfering with the stripping operation;

- d) the guide shall allow for easy insertion into the test set-up and for easy cleaning, and shall provide freedom from interference if the coating buckles.

## 4 Specimen preparation

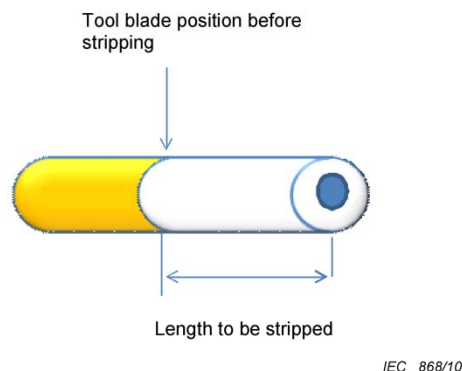
### 4.1 Representative sample

The sampling should consist of a minimum of 10 specimens assumed to be representative of the population of fibres under evaluation. The specimens should be tested and their results will be averaged.

### 4.2 Strip length

The length of fibre stripped on a particular piece can affect the strip force. However for 245  $\mu\text{m}$  nominal coating diameter fibres, the length of fibre stripped has minimal effect on the strip force. The length of fibre stripped shall be specified in the detail specification. For 245  $\mu\text{m}$  nominal coating diameter fibres, a preferred value is 30 mm. For larger coating diameter, shorter stripping lengths are preferred, e.g. 15 mm.

To perform the measurement a specimen of fibre must be provided that is longer than just the specified length to be stripped. The total specimen length consists of the fibre required to secure itself to the capstan, the fibre between the capstan and the stripping tool (see Figure 2) and the fibre length to be stripped that extends past the stripping tool (see Figure 1). The total specimen length shall be sufficiently long to meet this deployment. The test results are not dependent on the total sample length. The test results are, in part, dependent on the length of fibre to be stripped.



**Figure 1 – Length of fibre to be stripped**

## 5 Procedure

### 5.1 Introduction

This procedure involves

- a) severing the coating at the prescribed distance from the end of the fibre;
- b) then removing the coating from the fibre while measuring the force required to accomplish this removal.

### 5.2 Stripping rate

The force required to remove coatings from fibre is dependent, in part on the stripping rate. If results of different tests are to be comparable, the same stripping rate should be used. Set up

the test equipment so as to impart a relative motion between the fibre and the stripping tool at the rate specified in the detail specification. A preferred value for 245  $\mu\text{m}$  nominal coating is 500 mm/min. For fibre with larger nominal coating, a lower value is preferred, .e.g. 10 mm/min to 25 mm/min.

### 5.3 Preconditioning

Unless otherwise specified, pre-condition the test samples for a minimum of 2 h at the standard test conditions given in IEC 60793-1 series.

### 5.4 Calibrating the transducer amplifier

Calibrate the transducer and load cell before each series of tests or as dictated by a documented calibration schedule.

### 5.5 Loading the test specimen

Ensure the area around both blades of the stripping tool is free of debris and/or build-up from any previous use before loading the fibre.

Secure one end of the test fibre to the test fixture so that it will not slip under load (e.g. wrap one end of the fibre three times around an 80 mm diameter capstan). Thread the other end through the stripping tool and insert it through the fibre guide/support.

### 5.6 Stripping the coating

Start the test apparatus to provide a constant relative motion between the fibre and the stripping tool.

Observe and record the force required to remove the coating from the glass fibre. Exclude data from fibres that break during the test.

The test is complete when the coating has been completely removed from the fibre.

NOTE Any remaining coating residue visible to the naked eye should be easy to remove by gently wiping the fibre with a laboratory tissue.

## 6 Calculations

### 6.1 Calculation of the reported value for a specimen

Calculate the average and standard deviation of the sampling.

### 6.2 Calculation for the value of a piece

There are two approaches to measuring strip force. Both incorporate the same experimental technique but each emphasizes a different focal point for the strip force.

### 6.3 Approach 1 – Average strip force

Start the test apparatus to provide a constant relative motion between fibre and stripping tool. Observe and record the force required to remove the coating from the glass fibre. Exclude data from fibres which break during the test. The average strip force is then calculated, excluding the initial 20 % of the strip length data. The average of the sampling strip force values is then reported as "average strip force".

#### 6.4 Approach 2 – Peak strip force

Start the test apparatus to provide a constant relative motion between the fibre and stripping tool. Observe and record the force required to remove the coating from the glass fibre. The peak strip force is then recorded. Exclude data from fibres which break during the test. The average of the sampling peak strip force values is then reported as “peak strip force”.

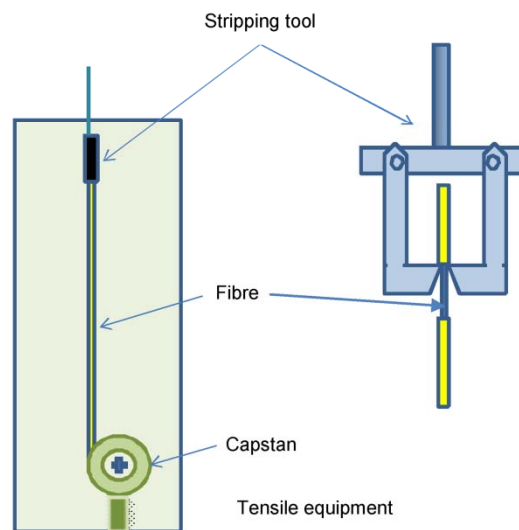
### 7 Documentation

7.1 The following information should be presented:

- test date;
- identification of the fibre tested including coating outer diameter and coating material type;
- average of strip force results (10 or more test pieces);
- method of calculation for a given piece: average or peak.

7.2 The following information should be available for each test:

- identification and type of stripping tool used including manufacturer and nominal blade hole size;
- strip rate;
- length of coating stripped;
- standard deviation or range of the pieces tested for a specimen;
- number of fibres which broke or were damaged before completely removing the coating;
- environmental conditions for preconditioning and during the test including temperature and relative humidity;
- mention, if the coating residue is not readily removable as required in 5.6.



Either the stripping tool or the capstan is fixed

IEC 869/10

**Figure 2 – Example of test arrangement**

## **8 Specification information**

The detail specification shall specify the following information:

- failure or acceptance criteria;
  - any deviations to the procedure that apply.
-