IEC 60794-1-401

Edition 1.0 2021-07

INTERNATIONAL STANDARD

Optical fibre cables –
Part 1-401: Generic specification – Basic optical cable test procedures – Electrical test methods – Short-circuit test (for OPGW, OPPC and OPAC), Method H1

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OPTICAL FIBRE CABLES –

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FOREWORD

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IEC 60794-1-401 has been prepared by subcommittee 86A: Fibres and cables, of IEC technical committee 86: Fibre optics. It is an International Standard.

This first edition cancels and replaces the first edition of IEC 60794-1-24 published in 2014. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) OPPC is included;

b) the test methods have been updated.

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

Draft	Report on voting
86A/2044/CDV	86A/2127/RVC

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 International Standard 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. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all the parts in the IEC 60794 series, published under the general title *Optical fibre cables*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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- withdrawn,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

INTRODUCTION

The electrical tests contained in IEC 60794-1-24:2014 will now be individually numbered in the IEC 60794-1-4xx series. Each test method is now considered to be an individual document rather than part of a multi-test method compendium. Full cross-reference details are given in IEC 60794-1-2.

OPTICAL FIBRE CABLES –

Part 1-401: Generic specification – Basic optical cable test procedures – Electrical test methods – Short-circuit test (for OPGW, OPPC and OPAC), Method H1

1 Scope

This part of IEC 60794 applies to the short-circuit test intended to assess the performance of an optical ground wire (OPGW) or optical phase conductor (OPPC) under typical short-circuit, or the impact on the performance of optical attached cable (OPAC) under short-circuit current on the messenger wire.

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 60793-1-46, *Optical fibres – Part 1-46: Measurement methods and test procedures – Monitoring of changes in optical transmittance*

IEC 60794-1-1, *Optical fibre cables – Part 1-1: Generic specification – General*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the definitions given in IEC 60794-1-1 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

3.2 Abbreviated terms

OPAC optical attached cable
OPGW optical ground wire
OPPC optical phase conductor
RTS rated tensile strength

4 Sample

4.1 OPGW and OPPC testing

4.1.1 Two samples test method

A typical arrangement using two test samples is shown in Figure 1a).

Two samples, each being at least 10 m long, shall be terminated at each end with suitable fittings. In sample A, one or more thermocouples shall be inserted into holes drilled into the optical unit to monitor the optical unit temperature. In sample B, one or more thermocouples shall be attached to the OPGW/OPPC to monitor the locations where OPGW/OPPC maximum temperature is expected (i.e. between ACS wires, or between ACS and aluminium alloy wires). The optical attenuation of the monitored fibres shall be measured according to IEC 60793-1-46. The test length of the optical fibre shall be longer than 100 m. The test loop shall preferably include at least 24 fibres (fibre concatenation shall be used), or all the fibres in the cable when the fibre count is lower. If the OPGW/OPPC under test comprises multiple units (tubes) with optical fibres, the measured fibres shall be taken from all units in equal numbers.

4.1.2 One sample test method

A typical arrangement using one test sample is shown in Figure 1b).

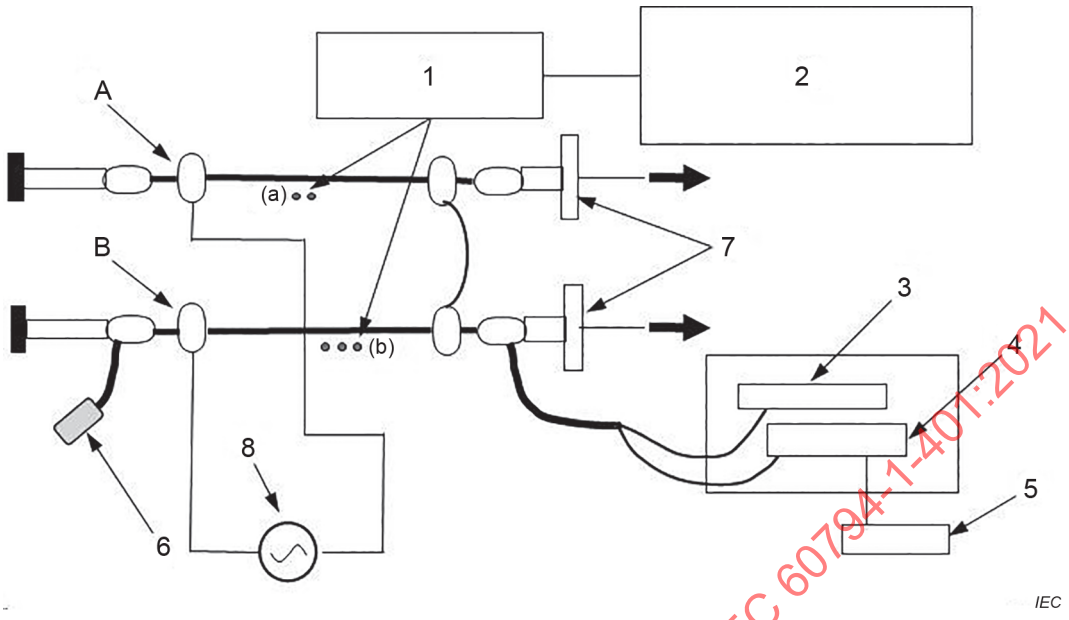
The sample, at least 10 m long, shall be terminated at each end with suitable fittings. One or more thermocouples shall be inserted through the strands of the OPGW/OPPC onto the surface of the optical unit to monitor the optical unit temperature. One or more thermocouples shall be attached to the wires of the OPGW/OPPC to monitor the OPGW/OPPC temperature. The optical attenuation of the monitored fibres shall be measured according to IEC 60793-1-46. The test length of the optical fibre shall be longer than 100 m. The test loop shall preferably include at least 24 fibres (fibre concatenation shall be used), or all fibres in the cable when the fibre count is lower. If the OPGW/OPPC under test comprises multiple units (tubes) with optical fibres, the measured fibres shall be taken from all units in equal numbers.

4.2 OPAC testing

A typical arrangement for testing OPAC is shown in Figure 2.

The OPAC test sample, at least 10 m long, is attached to the messenger wire with suitable fittings according to the arrangement used in service (the messenger wire used and the type of attachment, such as tight side by side or twine with a certain pitch, shall be specified in the particular conditions). One or more thermocouples shall be attached to the messenger wire to record the temperature achieved during the test. The optical attenuation of the monitored fibres shall be measured according to IEC 60793-1-46. The test length of optical fibre shall be longer than 100 m. The test loop shall preferably include at least 24 fibres (fibre concatenation shall be used), or all fibres in the cable when the fibre count is lower. If the OPAC under test comprises multiple units (tubes) with optical fibres, the measured fibres shall be taken from all units in equal numbers.

5 Apparatus

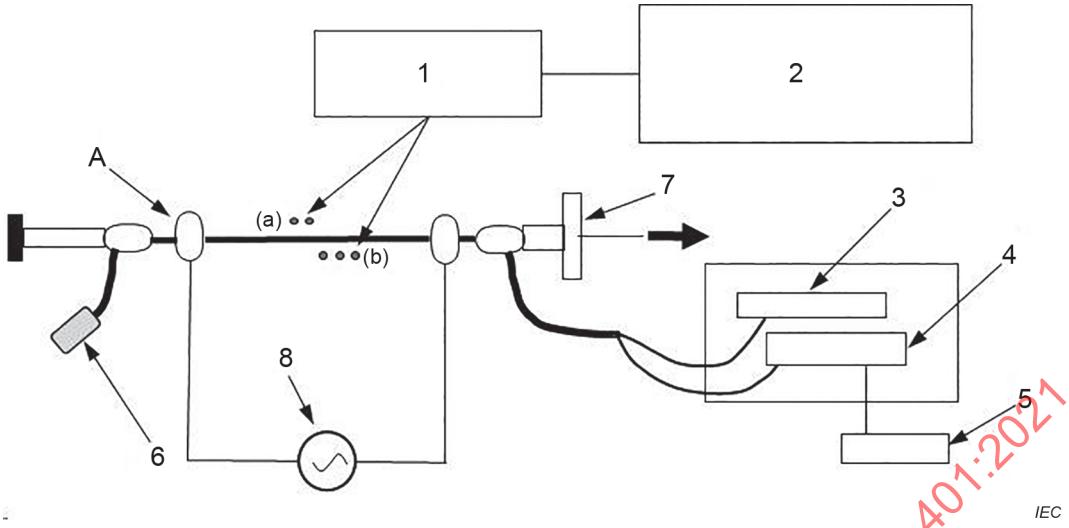


Key

1 thermocouples
- armour temperature is measured (b)
- optical core surface temperature is measured (a)

2 thermocouple recorder
3 light source
4 power meter
5 recorder
6 fibre looped
7 mechanical load system
8 AC current source
A, B test samples

a) two samples test arrangement



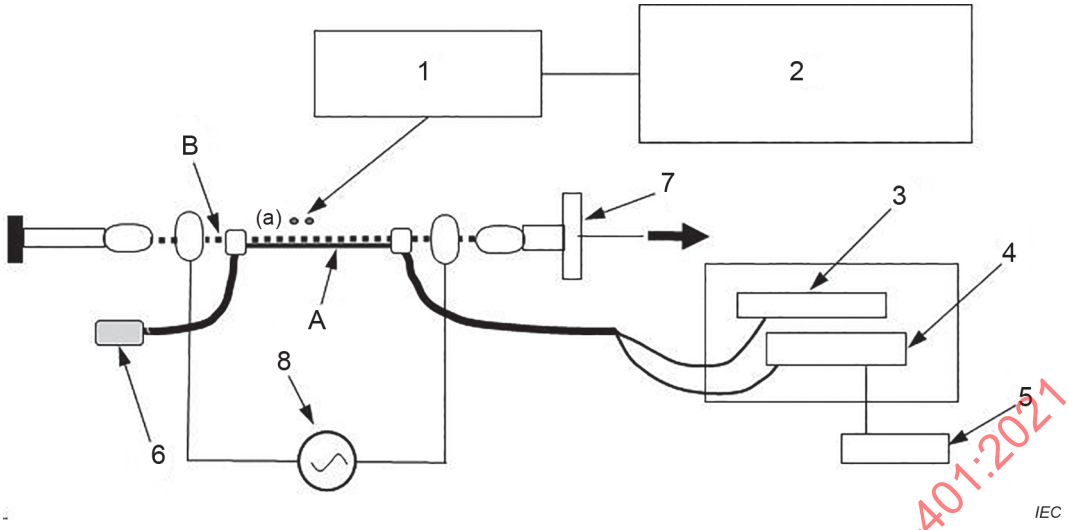
Key

1 thermocouples
- armour temperature is measured (b)
- optical core surface temperature is measured (a)

2 thermocouple recorder
3 light source
4 power meter
5 recorder
6 fibre looped
7 mechanical load system
8 AC current source
A test sample

b) one sample test arrangement

Figure 1 – OPGW/OPPC short-circuit test arrangement



Key

1 thermocouple
– messenger temperature is measured
2 thermocouple recorder
3 light source
4 power meter
5 recorder
6 fibre looped
7 mechanical load system
8 AC current source
A OPAC cable under test (solid line)
B messenger (dotted line)

Figure 2 – OPAC short-circuit test arrangement

6 Procedure

6.1 OPGW testing

The general test conditions are as follows:

– tensile load: 15 % to 20 % of rated tensile strength (RTS)
– sample length: ≥ 10 m
– fibre test length: > 100 m
– fault current intensity: as agreed between customer and supplier
– fault current duration: as agreed between customer and supplier
– number of pulses: 3 minimum
– waveform: to be symmetrical after the 3rd cycle

The initial sample temperature shall be 40 °C ± 5 °C, if not otherwise agreed between customer and manufacturer.

6.2 OPPC testing

The general test conditions are as follows:

– tensile load: 15 % to 20 % of RTS (rated tensile strength)
– sample length: ≥ 10 m
– fibre test length: > 100 m
– fault current intensity: as agreed between customer and supplier
– fault current duration: as agreed between customer and supplier
– number of pulses: 3 minimum
– waveform: to be symmetrical after the 3rd cycle

The initial sample temperature shall be the one in a steady state at which the cable is transporting its nominal current rating (tolerance ± 5 °C). In case the OPPC may operate in emergency conditions during its lifetime, the emergency condition temperature (worst case) shall be considered as the initial sample temperature for the short-circuit. Other initial sample temperature values may be agreed between customer and manufacturer.

6.3 OPAC testing

The general test conditions are as follows:

– tensile load applied on messenger: as agreed between customer and supplier
– sample length: ≥ 10 m
– fibre test length: > 100 m
– messenger maximum temperature: refer to the detail specification
– fault current duration: refer to customer specification
– number of pulses: 3 minimum
– waveform: to be symmetrical after the 3rd cycle

The initial messenger wire temperature shall be mutually agreed between the customer and the supplier and be consistent with the in-service conditions.

6.4 Common procedure for all tested cables

For each pulse, the fault current (I) and duration (t) can vary slightly from the target values. The objective is to achieve the short-circuit rating (I^2t in kA^2s) for each pulse. To recognize the practical issues of performing this test, the following allowances are made. The average of the specified number of pulses shall exceed the minimum I^2t level specified by the supplier. However, no single pulse shall be less than 95 % of the minimum I^2t level.

The current pulses shall be applied with the cable being allowed to cool down to within 5 °C of the initial temperature between each pulse.

The optical attenuation of the test fibres shall be monitored continuously at 1 550 nm from at least 2 min before, until at least 5 min after each current pulse. Different monitoring wavelengths can be used if agreed between customer and supplier.

The temperature of the messenger wire shall also be monitored.

The tested cable shall be dismantled after the short-circuit current test. Each component of the cable shall be separated and inspected for excessive wear, discoloration, deformation or signs of breakdown. The sections of the cable nearest to the terminating hardware and at mid-point of the span should be checked.

7 Requirements

The acceptance criteria for the test shall be as stated in the detail specification.

A permanent or temporary increase in optical attenuation greater than 0,15 dB/km of the test fibre, at 1 550 nm nominal wavelength, shall constitute failure.

On completion, the maximum temperature reached by any component in the OPGW or OPPC shall be within the allowed temperature range specified by the supplier for this component. Report any visible degradation on the metallic elements, such as bird-caging effect on wires, during the test or after releasing the load.

During the test, the messenger wire that the OPAC is attached to should attain the temperature lower that the maximum specified by the customer.

Excessive wear, discoloration, deformation or breakdown shall not be observed after the exposure to the current pulse.

8 Details to be specified

8.1 OPGW and OPPC testing

– Procedure used (one sample or two samples test method)
– Initial sample temperature
– Fault current intensity
– Fault current duration
– Number of pulses
– Maximum allowable temperature at each electrical pulse.

8.2 OPAC testing

– Messenger tensile load
– Initial sample temperature
– Maximum temperature to be reached by the messenger wire
– Fault current duration
– Number of pulses