IEC 60794-5-20

Edition 1.0 2014-02

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Optical fibre cables –
Part 5-20: Family specification – Outdoor microduct fibre units, microducts and protected microducts for installation by blowing

Câbles à fibres optiques –
Partie 5-20: Spécification de famille – Eléments fibres en microconduit extérieur, microconduits et microconduits protégés pour installation par soufflage

IEC 60794-5-20:2014-02(en-fr)

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

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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OPTICAL FIBRE CABLES –

Part 5-20: Family specification – Outdoor microduct fibre units, microducts and protected microducts for installation by blowing

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International Standard IEC 60794-5-20 has been prepared by subcommittee 86A: Fibres and cables,of IEC technical committee 86: Fibre optics.

This bilingual version (2017-10) corresponds to the monolingual English version, published in 2014-02.

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

CDV	Report on voting
86A/1497/CDV	86A/1543/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.

The French version of this standard has not been voted upon.

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

A list of all parts of 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 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

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OPTICAL FIBRE CABLES –

Part 5-20: Family specification – Outdoor microduct fibre units, microducts and protected microducts for installation by blowing

1 Scope

This part of IEC 60794 is a family specification that covers outdoor microduct fibre units and corresponding microducts and protected microducts for installation by blowing. The protected microducts are intended for duct, directly buried or lashed applications.

Microduct fibre units differ from microduct optical fibre cables (see IEC 60794-5-10) in that they provide less protection to the fibres that they contain. Specifically, microduct fibre units rely on the structure of the microduct, protected microduct or appropriate housing to support installation and to provide additional mechanical protection for the optical fibre over the lifetime of the product.

Systems built with components covered by this standard are subject to the requirements of sectional specification IEC 60794-5 where applicable.

Annex A gives examples of microduct optical fibre units and microducts.

Annex B describes a blank detail specification for outdoor microduct fibre units and the associated microducts and incorporates some minimum requirements. Detail product specifications may be prepared on the basis of this family specification using Annex B as a guide. Annex C provides normative product constructions for microduct optical fibre units, microducts and protected microducts.

The parameters specified in this standard may be affected by measurement uncertainty arising either from measurement errors or calibration errors due to lack of suitable standards. Acceptance criteria should be interpreted with respect to this consideration.

The number of fibres tested is intended to be representative of the microduct fibre unit design and should be agreed between the customer and supplier.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60304, *Standard colours for insulation for low-frequency cables and wires*

IEC 60793-1-40, *Optical fibres – Part 1-40: Measurement methods and test procedures – Attenuation*

IEC 60793-1-53, Optical fibres – Part 1-53: Measurement methods and test procedures – Water immersion

IEC 60793-2-10, *Optical fibres – Part 2-10: Product specifications – Sectional specification for category A1 multimode fibres*

IEC 60793-2-50, *Optical fibres – Part 2-50: Products specification – Sectional specification for class B single-mode fibres*

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

IEC 60794-1-2, *Optical fibre cables – Part 1-2: Generic specification – Basic optical cable test procedures*

IEC 60794-1-21, *Optical fibre cables – Part 1-21: Generic specification – Basic optical cable test procedures – Mechanical test methods*

IEC 60794-1-22, *Optical fibre cables – Part 1-22: Generic specificaiton – Basic optical cable test procedures – Environmental test methods*

IEC 60794-3:2001, *Optical fibre cables – Part 3: Sectional specification – Outdoor cables*

IEC 60794-5, *Optical fibre cables – Part 5: Sectional specification – Microduct cabling for installation by blowing*

IEC 60794-5-10, *Optical fibre cables – Part 5-10: Family specification – Outdoor microduct optical fibre cables, microducts and protected microducts for installation by blowing*

IEC 60811-202, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 202: General tests – Measurement of thickness of non-metallic sheath*

IEC 60811-203, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 203: General tests – Measurement of overall dimensions*

IEC 60811-501, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 501: Mechanical tests – Tests for determining the mechanical properties of insulating and sheathing compounds*

IEC 60811-601, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 601: Physical tests – Measurement of the drop-point of filling compounds*

IEC 60811-602, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 602: Physical tests – Separation of oil in filling compounds*

IEC 60811-604, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 604: Physical tests – Measurement of absence of corrosive components in filling compounds*

ISO/IEC 11801, *Information technology − Generic cabling for customers premises*

3 Symbols

For the purposes of this part of IEC 60794 the following symbols apply.

λ_{CC}	Cabled fibre cut-off wavelength
ΔD	minimum wall thickness
$\Delta D'$	Minimum thickness of the outer sheath of the protected microduct
d	Nominal outer diameter of the fibre unit
DS	Detail specification
ID	Nominal inner diameter of the microduct

OD Nominal outer diameter of the microduct

OD' Nominal outer diameter of the protected microduct

T_M The acceptable amount of short-term tensile load that can be applied to the fibre unit without permanent degradation of the characteristics of the fibres in the tensile performance test

T_{A1} Temperature cycling test low-temperature limit (usage and storage) according to IEC 60794-1-2, Method F1

T_{A2} Temperature cycling test secondary low-temperature limit for extended storage temperature range according to IEC 60794-1-2, Method F1

T_{B1} Temperature cycling test high-temperature limit (usage and storage) according to IEC 60794-1-2, Method F1

T_{B2} Temperature cycling test secondary high-temperature limit for extended storage temperature range according to IEC 60794-1-2, Method F1

t_1 Temperature cycling dwell time

$n \times d$ The product of a variable and the fibre unit outer diameter used for determining appropriate sizes for bends, mandrels, etc.

$n \times OD$ The product of a variable and the outer diameter of the microduct used for determining appropriate sizes for bends, mandrels, etc.

n $\times$ *OD*' The product of a variable and the outer diameter of the protected microduct used for determining appropriate sizes for bends, mandrels, etc.

W Weight of 1 km of microduct, protected microduct or fibre unit

4 General requirements

4.1 Construction

4.1.1 General

In addition to the constructional requirements in IEC 60794-5, where applicable, the following considerations apply to outdoor microduct fibre units and their corresponding microducts and protected microducts.

The products covered in this specification should be designed and manufactured for expected operating lifetimes of at least 20 years.

The microduct fibre units are designed to be installed in microducts or protected microducts and in appropriate housings. The microducts and protected microducts that are compatible for use with microduct fibre units are defined in this document. Microduct fibre units are optimised for installation and operating lifetime in these microducts.

It shall be possible to install or remove the microduct fibre unit from microduct or protected microduct by blowing during the operational lifetime except under the following conditions:

a) microduct fibre units or microducts are compromised by multiple installation or removal operations;

b) microducts are fouled with sediment, debris, or other foreign matter due to inadequate maintenance;

c) microducts are damaged by extrinsic factors such as dig-ups, earth heaves, etc.

In such cases, the affected section of microduct shall be cleared, repaired or replaced prior to any microduct fibre unit installations.

The microduct fitness should be verified with dimensional clearance and static pressure testing of the microduct route.

The materials in the microduct fibre unit, microduct or protected microduct shall take into consideration local regulations.

4.1.2 Microduct fibre units

In general, microduct fibre units are the smallest and most flexible of all optical cable products for outdoor use and are intended for installation within microducts. The fibre unit structure is designed to improve blowing performance compared to a bare fibre and to provide mechanical and environmental protection for the fibres during installation and over the life of the product. Fibre unit designs are not described in detail but some examples are given in Annex A. The microduct fibre units are not as mechanically robust as traditional outdoor optical fibre cables and, therefore, require the use of suitable installation and handling practices to prevent damage. Ad hoc installation practices could degrade optical performance or reduce the product's operating lifetime.

4.1.3 Microducts

A microduct suitable for installation of microduct fibre units is a small, flexible, lightweight tube with an outer diameter typically 8 mm or less. Compared to microduct optical fibre cables (see IEC 60794-5-10), microduct fibre units place greater reliance on microducts and protected microducts or appropriate closures to provide mechanical protection for the optical fibres. Therefore, a microduct must meet the realistic impact, compression and bending requirements for an application. A protected microduct may be required (see 4.1.4).

Microducts shall be able to resist pressure differences needed for installation by blowing. The microducts shall be circular and uniform in cross-section throughout their length, and their inner surface may have a low coefficient of friction. Inner- and outer-diameters shall be specified. As an option, a supplier may provide a special lining or lubricating coating on the interior of the microduct to aid installation. These layers should not reduce the specified inside diameter of the microduct.

Microducts generally are intended for benign installation within ducts or as components within a protected microduct as described in 4.1.4. In all cases, it shall be possible to identify each individual microduct throughout the length. When using colours they shall be a reasonable match to IEC 60304.

Microducts installed outdoors and not occupied shall be sealed at each end to prevent the introduction of moisture, debris, insects, or other such foreign contaminants that could subsequently hinder the successful installation of fibre unit. Microducts installed outdoors and not immediately occupied shall be tested for obstructions prior to use.

4.1.4 Protected microducts

A protected microduct is one or more microducts surrounded by a protective sheath, a larger protective duct and/or an integral thick sheath (such that it complies with the requirements of Clause 7). A protected microduct can provide additional crush and impact protection compared to a stand-alone microduct. This additional protection may be needed for a specific operating environment or installation method. The protective sheath may include an integrated layer of armouring or thicker outer sheath. In all cases it shall be possible to identify each individual microduct throughout the length. When using colours, they shall be a match to IEC 60304 using visual inspection.

4.1.5 Microduct fittings

Microduct fittings are components needed to physically align, connect and seal the junction between two of more sections of microduct, or to connect microduct to hardware, or to seal the space between a microduct fibre unit and microduct. Multiple microducts may be connected in series in order to support extended microduct fibre unit installation distances, or connected in a branch-type configuration with multiple output terminae for a given input, within the same system. The latter may be employed in campus type local area networks

(LANs) or fibre-to-the-premises (FTTP) applications to allow for additional flexibility that can support frequent changes to the physical optical distribution system.

Fittings should be appropriate to the microduct construction. Also, mechanical and environmental performance requirements of fittings may require that such be tested while attached to sections of ducting (or hardware) to ensure intermateability and operational compatibility. The specific physical and material attributes of any fittings used should be agreed between the customer and supplier.

Microduct fittings shall be able to resist pressure differences needed for installing microduct fibre units by blowing. When attached to microducts the fittings must pass the pressurization test of 6.10. Fittings shall allow for the smooth transition of microduct fibre units between successive sections of microduct, or between microducts and hardware, and shall be constructed and installed to prevent jamming of the microduct fibre unit at splice, branch, or other connection points under maximum installation pressures.

Successive sections of microduct may also be welded or otherwise secured together along the same longitudinal axis without the use of mechanical fittings. Such junctions shall meet the same mechanical and dimensional requirements as for joints made using mechanical fittings.

Translucent or transparent materials may be used to support the identification of populated microducts and for troubleshooting installation related issues.

4.1.6 Microduct hardware

Microduct hardware includes the housings and closures that support the termination of microduct fibre units, including splicing or connectorization. Because microduct fibre units are generally compatible with traditional outdoor fibre optic cable hardware, accounting for the relatively small size, no specific requirements for microduct hardware are included herein. In some applications, it may be appropriate to use hardware that is compatible with the microducts in order to create a sealed microduct cabling system. One example is when empty microducts are pre-installed in hardware to support future microduct fibre unit placement.

4.2 Optical fibres

There shall be no fibre splice in a delivered length, unless otherwise agreed by the customer and supplier.

It shall be possible to identify each individual fibre throughout the length of the microduct fibre unit.

The transmission performance shall be in accordance with Annex D.

4.3 Installation performance tests

4.3.1 Installation conditions

A test route may be used to verify the field performance of a microduct fibre unit , microduct, and/or protected microduct as agreed between the customer and supplier. Ambient conditions can affect installation performance and, therefore should be monitored. Alternatively, the supplier can provide performance data from a specified test route under specific ambient conditions using a specified installation method.

Verifying that a microduct fibre unit or microduct can be installed using a blown installation technique is critical. Any installation performance requirement shall be agreed upon between the customer and supplier.

4.3.2 Tests applicable

Tests that are applicable for installation performance are given in Table 1.

Table 1 – Tests applicable for installation performance

Characteristics	Family requirements	Test methods	Remarks
General requirements	Agreement between customer and supplier		
Route verification inner clearance test	Agreement between customer and supplier	IEC 60794-1-21 Method E23	
Installation test	Agreement between customer and supplier; typically a minimum distance and time of installation over a specified route is required	Agreement between customer and supplier; typically, duct type and size, route terrain, installation device, maximum air pressure and ambient air conditions should be specified or noted with the results	

4.3.3 Mechanical and environmental tests

Based on the expected operating conditions over the life of the product, including the mechanical loads exerted on the product during installation, the following clauses specify product performance for microduct fibre units, microducts and protected microducts.

5 Microduct fibre unit

5.1 Tests applicable

Tests that are applicable for mechanical and environmental performance are given in Table 2.

Table 2 – Tests applicable for mechanical and environmental performance of microduct fibre unit

Characteristics	Family requirements	Test methods	Remarks
Tensile performance[a]	5.3	IEC 60794-1-21 Method E1	
Crush	5.4	IEC 60794-1-21 Method E3	
Repeated bending[a]	5.5	IEC 60794-1-21 Method E6	
Torsion[a]	5.6	IEC 60794-1-2 Method E7	
Kink	5.7	IEC 60794-1-21 Method E10	
Bend	5.8	IEC 60794-1-21 Method E11	
Temperature cycling	5.9	IEC 60794-1-22 Method F1	
Ageing	5.10	IEC 60794-1-22 Method F9	
Water immersion test	5.11	IEC 60793-1-53	
Buffer removal	5.12	As agreed with customer	
Water penetration test	No requirement		Suitable means are used in the microduct cabling system for water blocking

[a] For small units (eg < 2 mm outer diameter; <100 N tensile rating), it may be more appropriate to omit some of these tests in favour of an installation test.

The above tests may need to be modified for use with these cables. In particular, special care needs to be taken when clamping cables in order to avoid end effects. Unacceptable damage may include rips, tears, splits, delamination or cracks in the microduct fibre unit. However, damage at the clamping interface does not constitute a failure.

5.2 Family requirements and test conditions for microduct fibre unit tests

Tests shall be selected from the following by the product specification.

5.3 Tensile performance

a) Family requirements

Under short-term tensile load the fibre strain shall not exceed 60 % of the fibre proof strain. Other criteria may be agreed between the customer and supplier.

b) Test conditions (loads ≥ 100 N)

Method:	Generally to IEC 60794-1-21 Method E1, with duration as stated below
Length under tension:	Not less than 10 m. Taking into account the measurement accuracy and end effects, shorter lengths may be used by agreement between the customer and supplier.
Fibre length:	Finished microduct fibre unit length.
Tensile load:	Equivalent to weight of 1 km of fibre unit
Duration of load	1 min
Diameter of test pulleys:	As agreed between customer and supplier but not less than the minimum loaded bending diameter specified for the microduct fibre unit. A minimum value of 60 mm is recommended.

Under visual examination without magnification there shall be no damage to the microduct fibre unit and there shall be no change in attenuation after the test.

c) Test conditions (loads < 100 N)

Apparatus:	Vertical tensometer
Length under tension:	Approx 250 mm.
Fibre length:	Finished microduct fibre unit length.
Tensile load:	Equivalent to weight of 1 km of fibre unit
Duration of load	1 min

Under visual examination without magnification there shall be no damage to the microduct fibre unit.

5.4 Crush

a) Family requirements

After removal of the load, there shall be no change in attenuation compared to before the application of the load. Under visual examination, there shall be no damage to the microduct fibre unit . The imprint of the plate on the microduct fibre unit is not considered mechanical damage.

b) Test conditions

Method:	IEC 60794-1-21 Method E3
Load (plate/plate):	100 N
Duration of load:	1 min

5.5 Repeated bending

a) Family requirements

Under visual examination without magnification there shall be no damage to the microduct fibre unit elements.

b) Test conditions

Method:	IEC 60794-1-21 Method E6
Bending diameter:	40 × d or 60 mm whichever is greater.
Load:	Adequate to assure uniform contact with the mandrel.
Number of cycles:	25

5.6 Torsion

a) Family requirements

Under visual examination without magnification there shall be no damage to the microduct fibre unit elements.

There shall be no change in attenuation after the test.

b) Test conditions

Method	Generally in accordance with IEC 60794-1-21 Method E7
Test length:	300 mm
Load:	Adequate to assure test sample is straight at start of test.

5.7 Kink

a) Family requirements

Under visual examination, there shall be no damage to the microduct fibre unit

b) Test conditions

Method:	IEC 60794-1-21 Method E10
Minimum diameter:	40 × d or 60 mm whichever is greater

5.8 Bend

a) Family requirements

There shall be no change in attenuation after the test when measured at room temperature.

b) Test conditions

Method:	IEC 60794-1-21 Method E11A
Diameter of mandrel:	40 × d or 60 mm whichever is greater
Number of turns/helix:	4
Number of cycles:	3

5.9 Temperature cycling

a) Family requirements

For T_{A1} to T_{B1} there shall be no change in attenuation as defined in IEC 60794-1-1.

For T_{A1} to T_{A2} and T_{B1} to T_{B2}, the change in attenuation coefficient shall be:

– ≤ 0,15 dB/km for single-mode fibre and shall be reversible to measurement uncertainty when measured in the 1 550 nm region;

– ≤ 0,3 dB/km for multimode fibre and shall be reversible to measurement uncertainty when measured in the 1 300 nm region.