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 / Testing Equipment

Description

Examples of microduct optical fibre cables and microducts Figures A.1, A.2 and A.3 provide examples of different microduct optical fibre cables and microducts.

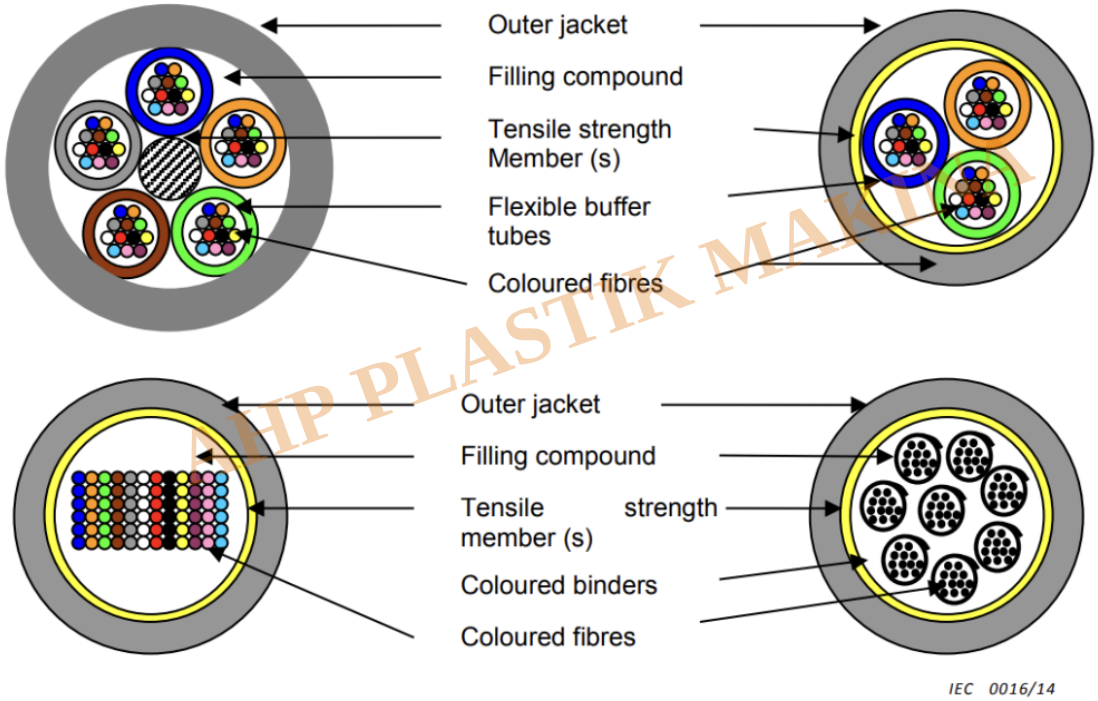


Figure A.1 – Microduct optical fibre cables (not to scale)

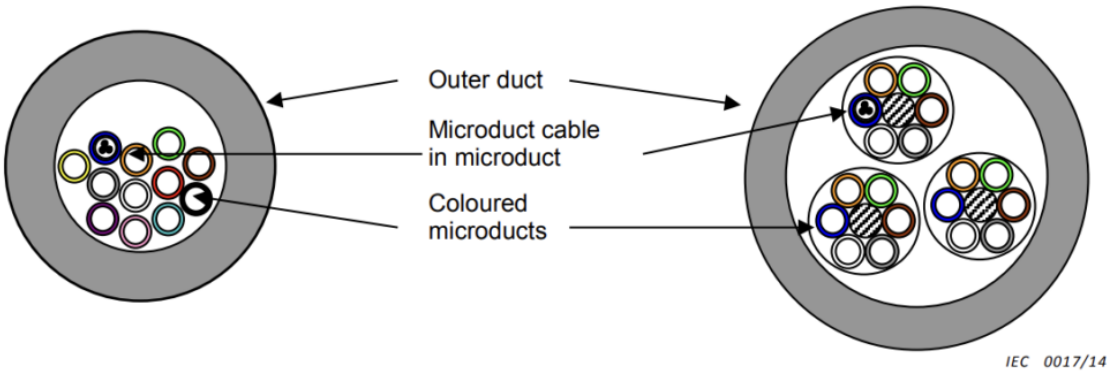


Figure A.2 – Protected microduct in pre-installed ducts (not to scale)

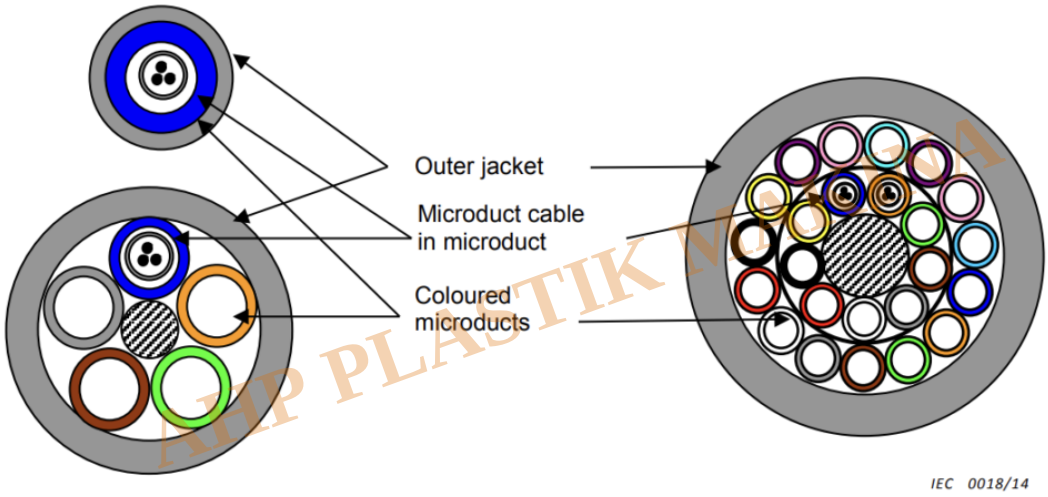


Figure A.3 – Protected microduct with tight integral outer duct (not to scale)

5 Microduct optical fibre cable

5.1 Tests applicable

The 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 cable

Characteristics	Family requirements	Test methods	Remarks
Tensile performance	5.2	IEC 60794-1-21, Method E1	
Crush	5.3	IEC 60794-1-21, Method E3	
Impact	5.4	IEC 60794-1-21, Method E4	
Repeated bending	5.5	IEC 60794-1-21, Method E6	
Torsion	5.6	IEC 60794-1-21, Method E7	
Kink	5.7	IEC 60794-1-21, Method E10	
Bend	5.8	IEC 60794-1-21, Method E11B	
Temperature cycling	5.9	IEC 60794-1-22, Method F1	
Water penetration	5.10	IEC 60794-1-22, Method F5B	
Ageing	5.11	IEC 60794-1-22, Method F9	
Fibre ribbons (if used)			
Ribbon stripping	5.12	IEC 60794-1-21, Method E5B	
Separability of individual fibres from ribbon	5.13	IEC 60794-1-23, Method G5	

5.2 Tensile performance

a) Family requirements

Under short-term tensile load the fibre strain shall not exceed 60 % of the fibre proof strain. After removal of load, there shall be no change in attenuation. Other criteria may be agreed between customer and supplier.

Under visual examination without magnification there shall be no damage to the sheath or to the cable elements.

b) Test conditions

Method: IEC 60794-1-21, Method E1

Length under tension: Not less than 50 m. Shorter lengths may be used by agreement between customer and supplier, taking into account the measurement accuracy and end effects

Fibre length: Finished cable length

Tensile load on cable: 1 × W

Diameter of test pulleys: Not less than the minimum loaded bending diameter specified for the microduct optical fibre cable

5.3 Crush
a) Family requirements
After removal of the short-term load, there shall be no change in attenuation. Under visual examination, there shall be no damage to the microduct cable. The imprint of the plate or mandrel on the microduct cable is not considered mechanical damage.
b) Test conditions
Method: IEC 60794-1-21, Method E3A
Load (plate/plate): 500 N
Duration of load: 1 min

5.4 Impact

a) Family requirements Under visual examination without magnification there shall be no damage to the sheath or to the cable elements. The imprint of the striking surface on the sheath is not considered mechanical damage. The residual increase in attenuation shall be <0,1 dB at 1 550 nm.

b) Test conditions

Method: IEC 60794-1-21, Method E4

Number of impacts: One in 3 different places spaced not less than 500 mm apart

Striking surface radius: 300 mm

Impact energy: 1 J

5.5 Repeated bending
a) Family requirements
Under visual examination without magnification there shall be no damage to the sheath and to the cable elements.
b) Test conditions
Method: IEC 60794-1-21, Method E6
Bending diameter: 40 × d
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 sheath or to the cable elements.

There shall be no change in attenuation after the test.
b) Test conditions
Method: IEC 60794-1-21, Method E7
Length under test: 2 m

5.7 Kink

a) Family requirements
Under visual examination, without magnification, there shall be no damage to the cable.
b) Test conditions
Method: IEC 60794-1-21, Method E10
Minimum diameter: 40 × d

5.8 Bend

a) Family requirements

There shall be no change in attenuation after the test when measured at room temperature. If required, the change in attenuation when tested at –30 °C shall be ?0,1 dB for singlemode fibre and <=0,4 dB for multimode fibre.

b) Test conditions

Method: IEC 60794-1-21, Method E11A

Diameter of mandrel: 40 × d

Number of turns/helix: 4

Number of cycles: 3

5.9 Temperature cycling
a) Family requirements
Attenuation measurements shall be taken during the last cycle.
For TA1 to TB1 there shall be no change in attenuation as defined in IEC 60794-1-1.
For TA1 to TA2 and TB1 to TB2, 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.
b) Test conditions
Method: IEC 60794-1-22, Method F1
Sample length under test: Finished microduct cable, length of at least 1 000 m.
High temperature, TB2: +60 °C to +70 °C, depending on customer requirements.
High temperature, TB1: +30 °C to +60 °C depending on customer requirements.
Low temperature, TA1: –15 °C.
Low temperature, TA2: TA1 to –30 °C or –40 °C depending on customer requirements.

NOTE: Other temperature values corresponding to specific climate conditions can be agreed between supplier and customer.
Number of cycles: 2

5.10 Water penetration
a) Family requirements

The cable shall not propagate water longitudinally according to requirements of IEC 60794-1-2, Method F5B.
b) Test conditions
Method: IEC 60794-1-22, Method F5B

5.11 Ageing
a) Family requirements: according to 11.5 of IEC 60794-1-22:2012, Method F9
b) Test conditions
Method: IEC 60794-1-22, Method F9

5.12 Ribbon strippability
a) Family requirements
At least 25 mm of the ribbon matrix and the fibres' protective coatings shall be removable with commercially available stripping tools with no fibre breakage. Any remaining coating residue shall be readily removable using isopropyl alcohol wipes.
b) Test conditions
Method: IEC 60794-1-21, Method E5B

5.13 Fibre ribbon separability
a) Family requirements
Maximum tear force 4,4 N
b) Test conditions
Method: IEC 60794-1-22, Method G5

6 Microduct
6.1 Tests applicable
Tests shall be selected from Table 3, in accordance with the relevant product specification. If the microduct is only to be used in a protected microduct, some tests may not be relevant.

Table 3 – Tests applicable for mechanical and environmental performance of a microduct

Characteristics	Family requirements	Test methods	Remarks
Tensile performance	6.2	Under consideration, IEC 60794-1-21 Method E1	
Crush	6.3	IEC 60794-1-21 Method E3A	
Impact	6.4	Under consideration, IEC 60794-1-21 Method E4	
Repeated bending	6.5	IEC 60794-1-21 Method E6	
Torsion	6.6	IEC 60794-1-21 Method E7	
Kink	6.7	IEC 60794-1-21 Method E10	

Bend	6.8	IEC 60794-1-21 Method E11B	
Microduct route verification test	6.9	IEC 60794-1-21, Method E23	
Microduct pressure withstand	6.10	IEC 60794-1-22, Method F13	
Ageing	6.11	Under consideration	

6.2 Tensile performance

a) Family requirements

Under visual examination without magnification there shall be no damage after the test and the microduct shall pass the inner clearance test (Annex E).

b) Test conditions

Method: Generally IEC 60794-1-21, Method E1

NOTE Use of IEC 60811-501 is under consideration.

Microduct length under tension: >1 m

Tensile load on microduct: 1 × W

Duration of load: 10 min

6.3 Crush

a) Family requirements

Under visual examination, without magnification, there shall be no damage to the microduct. After the recovery time, the microduct shall pass the inner clearance test (Annex E) and there shall be no splitting or permanent damage. The imprint of the plate is not considered as mechanical damage.

b) Test conditions

Method: IEC 60794-1-21, Method E3A

Sample length: 250 mm

Load (plate/plate): 500 N

Duration time: 1 min

Recovery time: 1 h

6.4 Impact

a) Family requirements

Under visual examination without magnification there shall be no damage to the microducts. The microduct shall pass the inner clearance test (Annex E) and there shall be no splitting or permanent damage. The imprint of the striking surface on the microduct is not considered mechanical damage.

b) Test conditions

Method: IEC 60794-1-21, Method E4

Striking surface radius: 300 mm

Impact energy: 1 J

Recovery time: 1 h

Number of impacts: One in 3 different places spread not less than 500 mm apart

6.5 Repeated bending

a) Family requirements

Under visual examination without magnification there shall be no damage to the microducts. The microduct shall pass the inner clearance test (Annex E) and there shall be no splitting or permanent

damage.
b) Test conditions
Method: IEC 60794-1-21, Method E6
Bending diameter: 40 × OD
Load: Adequate to assure uniform contact with the mandrel
Number of cycles: 25

6.6 Torsion
a) Family requirements
Under visual examination without magnification there shall be no damage to the microducts. The microduct shall pass the inner clearance test (Annex E) and there shall be no splitting or permanent damage.
b) Test conditions
Method: IEC 60794-1-2, Method E7
Maximum gauge length: 2 m
6.7 Kink
a) Family requirements
Under visual examination, without magnification, there shall be no damage to the microducts after the test and shall pass the inner clearance test (Annex E). The microduct shall attain the required minimum diameter without kinking.
b) Test conditions
Method: IEC 60794-1-21, Method E10
Minimum diameter: 20 × OD

6.8 Bend
a) Family requirements
The outer and inner diameter of the microducts shall show, under visual examination without magnification, no damage and after the test and shall pass the inner clearance test (Annex E).
b) Test conditions
Method: IEC 60794-1-21, Method E11B
Diameter of mandrel: 40 × OD
Number of cycles: 3
6.9 Microduct route verification test
a) Family requirements
Objects of the required size can be passed through the microduct.
b) Test conditions
Method: IEC 60794-1-21, Method E23
6.10 Microduct pressure withstand
a) Family requirements
Under visual examination, without magnification, there shall be no damage to the microducts.
b) Test conditions
Method: IEC 60794-1-22, Method F13

All microducts shall resist an air pressure of at least 2,5 × the installation pressure at a temperature of 20 °C for a period of 0,5 h.
All microducts shall resist a proof test pressure of at least 1,3 × the installation pressure at

a temperature of 40 °C for a period of 24 h.

6.11 Ageing

a) Family requirements

Tests to be performed after the aging period should be agreed between the customer and supplier and may include dimensions, inner clearance test, shrinkage, changes to surface finish, pressurization or installation test of the microduct cable.

b) Test conditions

Method: Under consideration

Ageing condition: Under consideration (+60 °C for 3 months; 7 days at 70 °C; 7 days at 85 °C)

7 Protected microduct(s)

7.1 Tests applicable

Tests shall be selected from Table 4, in accordance with the relevant product specification.

Table 4 – Tests applicable for mechanical and environmental performance of a protected microduct

Characteristics	Family requirements	Test methods	Remarks
Tensile performance	7.2	Under consideration, IEC 60794-1-21, Method E1	
Crush	7.3	IEC 60794-1-21, Method E3A	
Impact	7.4	IEC 60794-1-21, Method E4	
Repeated bending	7.5	IEC 60794-1-21, Method E6	
Kink	7.6	IEC 60794-1-21, Method E10	
Bend	7.7	IEC 60794-1-21, Method E11B	
Microduct route verification test	7.8	IEC 60794-1-21, Method E23	
Microduct pressure withstand	7.9	IEC 60794-1-22, Method F13	
Ageing	7.10	Under consideration	

7.2 Tensile performance

a) Family requirements

Under visual examination, without magnification, there shall be no damage after the test and the test shall pass the inner clearance test (Annex E).

b) Test conditions

Method: Generally to IEC 60794-1-21, Method E1

NOTE Use of IEC 60811-501 is under consideration.

Microduct length under tension: >1 m

Tensile load on microduct: 1 × W
Duration of load: 10 min

7.3 Crush
a) Family requirements
Under visual examination, without magnification, the microduct shall show no damage. After the recovery time the microduct shall pass the inner clearance test (Annex E) and there shall be no splitting or permanent damage. The imprint of the plate is not considered as mechanical damage.
b) Test conditions
Method: IEC 60794-1-21, Method E3A
Sample length: 250 mm
Load: 1 kN (duct); 2 kN (buried)
Duration time: 1 min
Recovery time: 1 h

7.4 Impact
a) Family requirements
Under visual examination without magnification there shall be no damage to the microducts. The microduct shall pass the inner clearance test (Annex E) and there shall be no splitting or permanent damage. The imprint of the striking surface on the microduct is not considered as mechanical damage.
b) Test conditions
Method: IEC 60794-1-21, Method E4
Striking surface radius: 300 mm
Impact energy: 3 J (duct); 15 J (buried)
Recovery time: 1 h
Number of impacts: One in 3 different places spread not less than 500 mm
apart

7.5 Repeated bending
a) Family requirements
Under visual examination without magnification there shall be no damage to the microducts. The microduct shall pass the inner clearance test (Annex E) and there shall be no splitting or permanent damage.
b) Test conditions
Method: IEC 60794-1-21, Method E6
Bending diameter: 40 × OD’
Load: Adequate to assure uniform contact with the mandrel
Number of cycles: 25

7.6 Kink
a) Family requirements
Under visual examination, without magnification, there shall be no damage to the microducts after the test and shall pass the inner clearance test (Annex E). The microduct shall attain the required minimum diameter without kinking.
b) Test conditions
Method: IEC 60794-1-21, Method E10

Minimum diameter: 20 × OD’

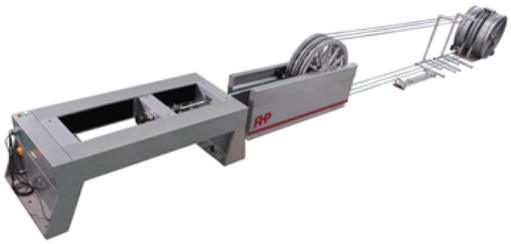
7.7 Bend
a) Family requirements
The outer and inner diameter of the microducts shall show, under visual examination without magnification, no damage and after the test and shall pass the inner clearance test (Annex E).
b) Test conditions
Method: IEC 60794-1-21, Method E11B
Diameter of mandrel: 40 × OD’
Number of cycles: 3

7.8 Microduct route verification test
a) Family requirements
Objects of the required size can be passed through the microduct.
b) Test conditions
Method: IEC 60794-1-21, Method E23

7.9 Microduct pressure withstand
a) Family requirements
Under visual examination, without magnification, there shall be no damage to the microducts.
b) Test conditions
Method: IEC 60794-1-22, Method F13
All microducts shall resist an air pressure of at least 2,5 × the installation pressure at a temperature of 20 °C for a period of 0,5 h.
All microducts shall resist a proof test pressure of at least 1,3 × the installation pressure at a temperature of 40 °C for a period of 24 h.

7.10 Ageing
a) Family requirements
Under consideration.
Tests to be performed after the aging period should be agreed between the customer and supplier and can include dimensions, inner clearance test, shrinkage, changes to surface finish, pressurization or installation test of the microduct cable.
b) Test conditions
Method: Under consideration
Ageing condition: Under consideration (+60 °C for 3 months; 7 days at 70 °C; 7 days at 85 °C)

Examples of testing Equipment



Tensile Tester According to IEC 60794-1-21 Method E1

This measuring method applies to optical fiber cables which are tested at a particular tensile strength to examine the behavior of the attenuation and/or the fiber elongation strain as a function of the load on a cable which may occur during installation. This method is intended to be nondestructive (the tension applied shall be within the operational values).

- According to IEC 60794-1-21 Method E1
- Load capacity: 100 kN
- Accuracy class: ±0.5%
- Measuring range: 0.4%-100%
- Loading speed: 0.2~250 mm/min
- Deformation measuring accuracy: ±0.5%
- Displacement measuring accuracy: ±0.3%
- Elongation measurement
- gauge length: 1000mm
- Measuring resolution is better than 10?m
- Accuracy is better than ±0.5%.
- Crosshead travel: 800
- Report in MS EXCEL
- Data communication port is USB

Crush Tester as per IEC-60794-1-21 Method E3

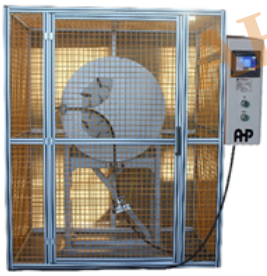
AHP's Optical Fiber Cable Crush Testing Machine complies with employs an IEC-60794-1-2 Method E3to perform Crush test on optical cables.
Cable is laid under compression and then the attenuation of fiber optics is measured.
It employs servo-controlled system to apply compressive force on the cable in constant speed and maintains the compression force in specified period.

- Force capacity: 10KN
- Travel: 200mm
- Loading speed : up to 250mm/min
- Accuracy class: ±0.5%
- Computer is up to the customer
- Reporting in MS EXCEL

Optical Fiber Impact Tester According to IEC-60794-1-21 Method E4

Optical Fiber Cable Impact Testing Machine is used to determine the ability of optical fiber cable withstand impact in compliance with IEC-60794-1-2-E4.

- Maximum drop height: 1000mm
- Impact cycles: 1-9999 cycles
- Test Frequency: 10 cycles/min
- Hammer diameter: 20mm
- Striking surface curvature: 300mm
- Mass of striker: 0.45kg
- Mass of weights: 5 pcs of 0.5kg



Repeated Bending Tester According to IEC-60794-1-21 Method E6

Optical Fiber Cable Repeated Bending Testing Machine is used to determine the ability of a fiber optic cable to withstand repeated bending.

- Touch screen 7”
- Bending Angle: 90 degrees
- Bending cycles: up to 9999
- Bending radius: 75,200,300mm
- Frequency of loading: 10-30 cycles/min
- Mass of weights: 1-10kg
- Safety cover included

Torsion Tester According to IEC-60794-1-21 Method E7

Optical Fiber Cable Torsion Testing Machine is used to determine the ability of optical fiber cable to withstand mechanical twisting.

- Touch screen 7”
- Max distance between grips: 1000mm
- Torsion angle: 90, 180, 360 degrees
- Twisting cycles: up to 9999
- Frequency of loading: 50-30 cycles per minute
- Mass of weights: 1-10kg

Kink Tester According to IEC 60794-1-21 Method E10

Optical Fiber Cable Kink Testing Machine is used to determine the loop diameter at the onset of the kinking of an optical fiber cable in accordance with IEC-60794-1-2-E10.

- Pulling head stroke: 50-500 mm
- Pulling speed: 0 – 100 mm/s
- Transparent cover: 1000 x 700 mm
- Display: 7inch touch screen
- Save test results to internal memory

Category

1. Equipment for Standards
2. Standards