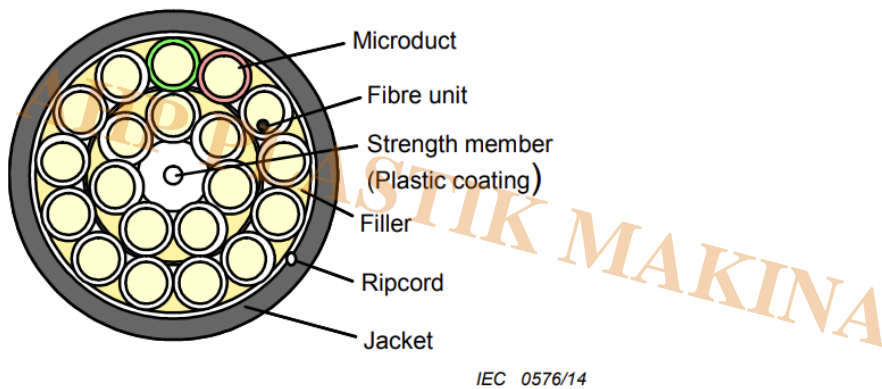


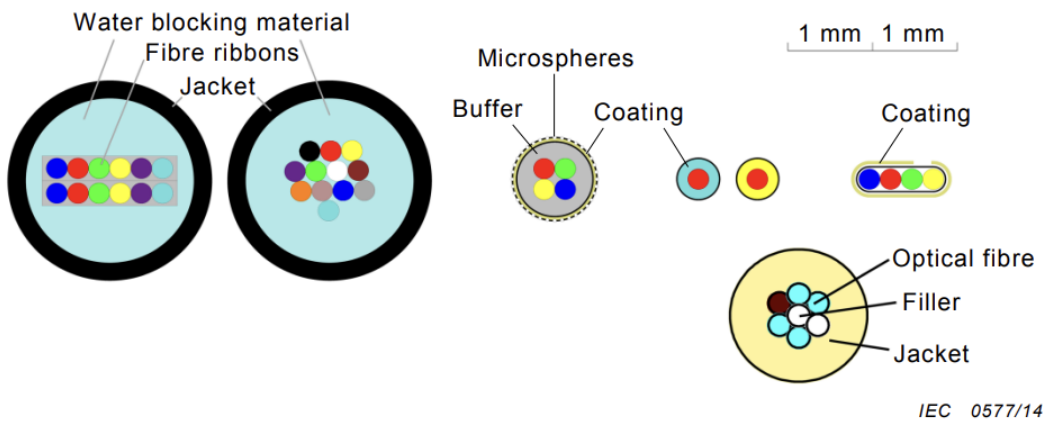
# IEC 60794-5-20 Optical fibre cables –“Family Specification –“ Outdoor Microduct Fibre Units, Microducts and Protected Microducts for Installation by Blowing / Testing Equipment

## Description

Figure A.1 and Figure A.2 give useful examples of microduct fibre units, microducts, and protected microducts.



**Figure A.1 – Protected microducts, tight package**



**Figure A.2 – Microduct fibre units**

## 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 <sup>a</sup>	5.3	IEC 60794-1-21 Method E1	
Crush	5.4	IEC 60794-1-21 Method E3	
Repeated bending <sup>a</sup>	5.5	IEC 60794-1-21 Method E6	
Torsion <sup>a</sup>	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
<sup>a</sup> 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  $\hat{\approx}$  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:  $40 \sqrt{d}$  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:  $40 \sqrt{d}$  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:  $40 \sqrt{d}$  or 60 mm whichever is greater

Number of turns/helix: 4

Number of cycles: 3

### 5.9 Temperature cycling

a) Family requirements

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:

â€“  $\pm 0,15$  dB/km for single-mode fibre and shall be reversible to measurement uncertainty when measured in the 1 550 nm region;

â€“  $\pm 0,3$  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 fibre unit length of at least 1 000 m.

High temperature, TB2: +60 Â°C to +70 Â°C, depending on customer requirements.

High temperature, TB1: +30 Â°C to +60 Â°C depending on customer requirements.

Low temperature, TA1: â€“15 Â°C.

Low temperature, TA2: TA1 to â€“30 Â°C or â€“40 Â°C depending on customer requirements

Note (temperatures): Other temperature values corresponding to specific climate conditions can be agreed between supplier and customer.

Number of cycles: 2

### 5.10 Ageing

a) Family requirements: as per IEC 60794-1-22, Method F9

b) Test conditions:

Method: IEC 60794-1-22, Method F9

### 5.11 Water immersion

a) Family requirements

Attenuation coefficient change at room temperature:

“ ± 0,05 dB/km at 1 550 nm for single-mode fibre;

“ ± 0,2 dB/km at 850 nm and 1 300 nm for multimode fibre.

The attenuation shall be monitored throughout the test at least once every 24 h.

b) Test conditions

Method: IEC 60793-1-53

Water: Distilled, demineralized or de-ionized water which has a PH of between 5,0 and 8,0

Dwell time: 30 days

### 5.12 Buffer removal

a) Family requirements

The buffer materials shall be removable such that primary coated fibres or fibre ribbons shall be free from fibre unit sheathing and/or buffer materials and free from damage following the test.

b) Test conditions

The method for buffer removal shall be defined by the supplier.

## 6 Microduct

### 6.1 Tests applicable

Tests shall be selected from the following 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 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	

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

### 6.2 Tensile performance

#### a) Family requirements

Under visual examination, without magnification, there shall be no damage after the test and 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

### 6.3 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  
Load (plate/plate): 500 N  
Duration time: 1 min

Recovery time 1h

#### 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  $\tilde{A}$ — OD

Load: Adequate to assure uniform contact with the mandrel

Number of cycles: 25

#### 6.6 Torsion

a) Family requirements

Under consideration

b) Test conditions

Method: IEC 60794-1-21 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  $\tilde{A}$ — 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

## 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

## 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 Å— OD

Number of cycles: 3

## 6.9 Microduct route verification test

### a) Family requirements

Objects of the required size, including any blowing tip if used in practice, 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 Å— the installation pressure at a temperature of 20 Å°C for a period of 0,5 h.

All microducts shall resist a proof test pressure of at least 1,3 Å— the installation pressure at a temperature of 40 Å°C for a period of 24 h.

## 6.11 Ageing

### a) Family requirements



Under consideration

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

b) Test conditions

Method: Under consideration

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

## 7 Protected microducts

### 7.1 Tests applicable

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

**Table 4 – Tests applicable for mechanical and environmental performance of 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	
Torsion	7.6	IEC 60794-1-21 Method E7	
Kink	7.7	IEC 60794-1-21 Method E10	
Bend	7.8	IEC 60794-1-21 Method E11B	
Microduct route verification test	7.9	IEC 60794-1-21 Method E23	
Microduct pressure withstand	7.10	IEC 60794-1-22 Method F13	
Ageing	7.11	Under consideration	

### 7.2 Tensile performance

a) Family requirements

Under visual examination, without magnification, there shall be no damage after the test and 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 or 2 700 N, whichever is the smaller

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 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 Å— 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 Å— 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 Å— OD

Number of cycles: 3

### 7.8 Microduct route verification test

a) Family requirements

Objects of the required size, including any blowing tip if used in practice, 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 Å— the installation pressure at a temperature of 20 Å°C for a period of 0,5 h.

All microducts shall resist a proof test pressure of at least 1,3 Å— the installation pressure at a temperature of 40 Å°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 could include dimensions, inner clearance test, shrinkage, changes to surface finish, pressurization or installation test of the microduct fibre unit.

b) Test conditions

Method: Under consideration

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

### Category

1. Equipment for Standards
2. Standards