
Blown Optical Fibre Cable Specification

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Changes:

ABBREVIATIONS AND	
Mm	Milimetre
oC	Degree Celsius
kN	Kilo Newton
kPa	Kilo Pascal
HDPE	High Density Poly Ethylene
OD	Outside diameter
ID	Inside diameter
PNGN	Penang Next Generation Network project



A. PURPOSE

- 1.1. This Request for Quotation (RFQ) document specifies the minimum technical requirements and standards for the construction, properties, testing & packing of Single Mode Blown Optical Fibre Cable to be supplied to PDC Telco/MY.NeuTrans for PNGN.
- 1.2. The prospective suppliers are required to submit Statement of Compliance to this specification as part of RFQ evaluation purpose.

B. SCOPE

- 1.1. This specification provides general design and transmission criteria for Loose Buffer Tube Standard Single Mode Fibre Cables containing 24, 48, 72, 96, 144, 192 or 216 fibre cores.
- 1.2. PDC Telco/MY.NeuTrans reserves the right to amend this specification in order to correct errors, omission or discrepancies or to reflect any change in policy.
- 1.3. An addendum shall be issued to affect any changes to this specification and all intending participants shall be notified.
- 1.4. The participant shall submit design details and description complete with diagram of the offered fibre cable and other characteristics that may not have been specifically mentioned in this specification. The participant shall submit other technical document as supporting document.

C. SINGLE MODE OPTICAL FIBRE CABLE

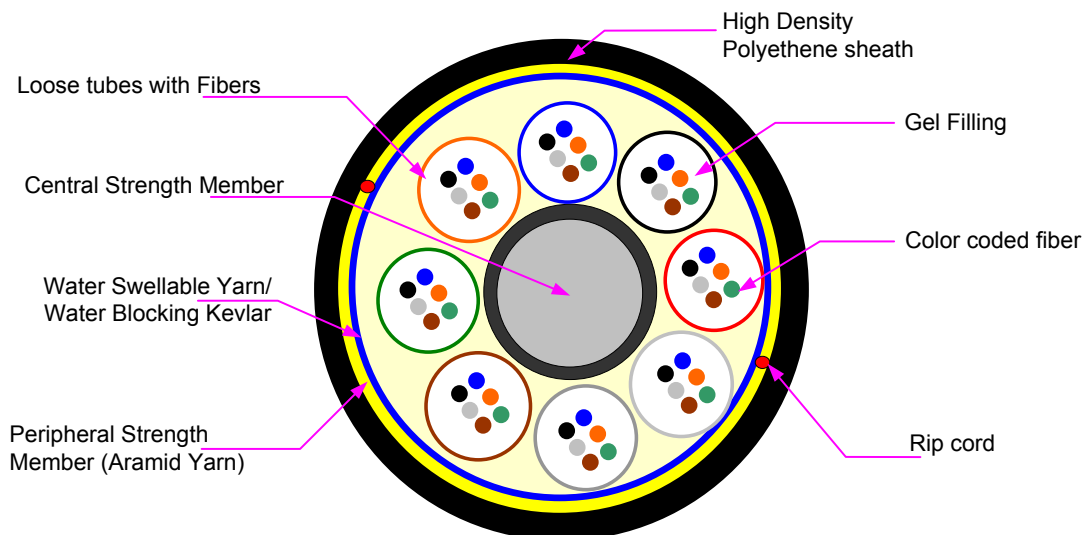
C.1 GENERAL

1.1. Fibre Optic Cable shall be metal-free construction and shall be designed for maximum capacity and minimizing the cable outer diameter. The cable design shall be totally filled and incorporate loose buffer tubes stranded around a central dielectric strength member and a polyethylene outer sheath for overall protection of the cable core.

1.2. General structure of the cable is as per illustration shown in the diagram of Typical Cross Section Loose Buffer Tube Blown Optical Fibre Cable below.

1.3. The participant shall produce similar diagram for the cable offered and supplied.

i.) cable tube design



TYPICAL CROSS SECTION LOOSE BUFFER TUBE OPTICAL FIBRE CABLE

(Example is for illustration purposes)

ii.) Colour codes shall comply to EIA 598 standards or equivalent.

Tube Number	Tube Color	Fibre Number	Fibre Color
1	Blue	1	Blue
2	Orange	2	Orange
3	Green	3	Green
4	Brown	4	Red
5	Gray	5	Gray
6	White	6	Yellow
7	Red	7	Brown
8	Black	8	Violet
9	Yellow	9	White
10	Pink	10	Pink
11	Violet	11	Black
12	Turquoise	12	Aqua
13 or higher	The colour code is repeated, Black stripe or dash is added	13 or higher	The colour code is repeated, Black stripe or dash is added

C.2 CENTRAL MEMBER

- 1.1. The central member shall be manufactured of fibre reinforced plastic (FRP) to provide tensile strength and anti-buckling properties.
- 1.2. The central member shall be over coated with low-density polyethylene, or similar material, if required to increase the diameter for optimum spacing between buffer tubes during stranding

C.3 CHARACTERISTICS OF STANDARD SINGLE MODE FIBRE

- 1.1. The standard optical fibres shall have the following characteristics.
 - 1.1.1. The optical fibre shall be single mode.
 - 1.1.2. Designed for use in the 1310nm and 1550nm region.
 - 1.1.3. Mode field diameter
 - a. $9.2 \mu\text{m} \pm 0.4 \mu\text{m}$ at 1310 nm
 - b. $10.4 \mu\text{m} \pm 0.8 \mu\text{m}$ at 1550nm.
 - 1.1.4. The optical fibre shall be silica glass core.
 - 1.1.5. The cladding diameter shall be $125\mu\text{m} \pm 7\mu\text{m}$.
 - 1.1.6. Core-cladding concentricity shall be $\leq 0.5 \mu\text{m}$.

1.1.7. The cladding non-circularity $\leq 1\%$.

1.1.8. Fibre curl is ≥ 4.0 m radius curvature.

1.1.9. The coating shall be Ultra Violet (UV) curable acrylate

1.1.10. Coating diameter shall be $245\mu\text{m} \pm 5\mu\text{m}$

1.1.11. Coating-Cladding concentricity shall be $< 12 \mu\text{m}$.

1.1.12. Attenuation bare fibre shall be as the following:

<u>Wavelength</u>	<u>Value</u>
1300 - 1320 nm	≤ 0.34 dB/km
1540 - 1570 nm	≤ 0.20 dB/km

1.1.13. Attenuation of cabled fibre shall be as the following:

<u>Wavelength</u>	<u>Value</u>
a. 1300 -1320nm	≤ 0.35 dB/km
b. 1540 - 1570nm	≤ 0.22 dB/km

1.1.14. Chromatic Dispersion

<u>Wavelength</u>	<u>Value</u>
1285 - 1330 nm	≤ 3.5 ps/(nm.km)
1550 nm	≤ 18 ps/(nm.km)
1625 nm	≤ 22 ps/(nm.km)

1.1.15. Cable cutoff wavelength (λ_{cc}) shall be ≤ 1450 nm

1.1.16. Zero Dispersion Wavelength (λ_0)

$$1301 \leq \lambda_0 \leq 1325 \text{ nm}$$

1.1.17. Zero Dispersion Slope (S_0) at λ_0 shall be ≤ 0.092 ps/(nm².km)

1.1.18. Polarization mode dispersion (PMD) shall be ≤ 0.1 ps/ $\sqrt{\text{km}}$

1.1.19. PMD link design value shall be ≤ 0.04 ps/ $\sqrt{\text{km}}$

1.1.20. At Operating Temperature of 00C to +600C the induced attenuation at 1310nm and 1550nm shall be ≤ 0.05 dB/km.

1.1.21. The entire length of fibre is subjected to a tensile proof test of ≥ 100 kpsi (0.7 GN/m²)

C.4 IDENTIFICATION OF OPTICAL FIBRES

1.1. Each fibre, in a buffer tube, shall be distinguishable from all other fibres in the same tube by means of color-coding.

1.2. The color-coding for fibres and tubes shall be as specified in this document.

1.3. The color formulation shall be compatible with the fibre coating and the loose buffer tube.

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- 1.4. The color formulation shall be heat stable.
 - 1.5. It shall not be susceptible to migration and shall not affect the transmission characteristics of the optical fibres.
 - 1.6. The color for all fibres and tubes shall be bright.
 - 1.7. The different color for each fibre shall be clearly distinguishable.
 - 1.8. The group of colors in one buffer tube shall be the same as in the other buffer tubes.

C.5 FIBRE MANUFACTURERS

- 1.1. The participant shall indicate whether the fibre was self drawn or purchased from other supplier.
- 1.2. The participant shall specify the fibre supplier's name and year of manufacturing.
- 1.3. All the fibres in one cable shall be from one supplier only.
- 1.4. Optical fibres from different manufacturers shall not be placed in any of the cable under the same batch or order.
- 1.5. The optical fibres shall not contain any factory splices.
- 1.6. The recommended fibres are Corning, Sumitomo Electric, Fujikura, Furukawa/OFS, Prysmian/Draka.

C.6 LOOSE BUFFER TUBES

- 1.1. Loose tube shall be extruded from a material having a coefficient of friction sufficiently low to allow free movement of fibre and mechanically compatible with all cable components.
- 1.2. Loose tube shall be stranded around the dielectric strength member using reverse oscillation or “SZ” stranding process.
- 1.3. Loose tubes material shall be Polybutylene terephthalate or equivalent alternative. Diameter of loose tube shall be 1.6 mm nominal (12 fibres per tube). The number of loose buffer tubes varies with number of optical fibres.
- 1.4. Each loose buffer tube shall be distinguishable from other buffer tubes in the cable by means of color code, as per section 4.7.
- 1.5. The colors shall be readily recognizable, colorfast and be compatible with other cable components.

C.7 LOOSE BUFFER TUBE FILLING COMPOUND

- 1.1. Filling compound shall be compatible with the primary coating of fibre.
- 1.2. Loose buffer tube filling compound shall allow free movement of fibre and to prevent water intrusion and migration.

1.3. The compound shall be non-toxic, present no dermal hazards, non-nutritive to fungus, non-hygroscopic and electrically nonconductive and be free of silicone-based products.

1.4. The compound shall be free from foreign matter and shall be compatible with all other cable components.

C.8 FILLER ROD

1.1. Filler rod(s), may be included in place of loose buffer tubes in the cable core to lend symmetry to the cable cross-section where needed.

1.2. The filler rods shall be plastic or similar material, which shall be Black or Natural in color.

1.3. The filler color shall not be different in any of the cable under the same batch or order.

1.4. The outside diameter of filler rods shall be the same as the outer diameter of the loose buffer tubes and shall be placed so that they do not interrupt the consecutive positioning of loose buffer tubes

C.9 STRANDING

1.1. Completed loose buffer tubes shall be stranded around the central member in SZ formation.

1.2. Filler rods, where required, shall be arranged in core stranding positions.

1.3. Empty buffer tube shall not be used as filler rod.

C.10 BINDER

1.1. Sufficient numbers of binders (minimum two) shall be applied over the stranded loose buffer tubes. The binder also function as protection to the loose tube when perform ring cut/branch off.

C.11 WATER BLOCKING ELEMENTS

1.1. The water swell able yarns or equivalent shall be used to prevent water ingress in cable core.

1.2. The component shall be non-toxic, present no dermal hazards, non-nutritive to fungus, hygroscopic and electrically non conductive.

1.3. The component shall be free from foreign matter and compatible with all other cable components.

1.4. The component shall also be easily removed without the use of solvents.

C.12 CABLE SHEATH

1.1. The cable shall be sheathed with black high density polyethylene

1.2. The radial thickness of the polyethylene shall be 0.5 mm (Nominal).

Participant to advise the minimum allowable radial thickness for each type

of cables in order to get the right cable size that could improve the blowing performance.

1.3. The cable sheath shall provide adequate mechanical protection against impact, crushing and abrasion.

1.4. The sheath shall also be sufficiently flexible to allow a bending radius of 20 times the cable diameter during installation and 10 times the cable diameter after installation.

C.13 RIP CORD

1.1. The cable shall contain at least one ripcord under the sheath for easy stripping of outer sheath.

1.2. The ripcord shall be polyester binder yarn or nylon bundle binder.

1.3. The ripcord shall be easily identified, preferably by means of having different color.

1.4. The ripcord shall be Nylon or other material strong enough to make a longitudinal cut on the cable sheath. A ripcord, for easy sheath stripping shall be installed under the cable sheath.

C.14 CABLE SHEATH MARKING

1.1. Name Marking

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- i) The cable sheath shall be inkjet printed with marking every meter interval throughout the entire length of the cable.
 - ii) The following detail shall be marked with 3mm height white letters.
 - a) PDC Telco/MY.NeuTrans
 - b) Number of fibre
 - c) Manufacturer
 - d) Year of manufacturing
 - e) Sequentially numbered length in meter

1.2. The markings shall be clearly distinguishable and be resistant to abrasion encountered during cable placement.

1.3. Renumbering the sequential length by remarking with a different colour shall not be allowed. Existing length marks shall be removed and new length markings be placed for the entire length of the cable.

C.15 PACKING

1.1. The cable shall be delivered in drum size as in the following:

- i) 4,000m per drum for cables 24 fibre and below
- ii) 2,000m per drum for cables 48 fibre and above

1.2. The drum size shall have a diameter of ≤ 2 meter.

1.3. Each drum shall be marked with a unique serial number.

1.4. Extra cable slack, preferably at both ends of the cable, shall be made available, on each cable drum, for testing purpose.

C.16 DESIGN REQUIREMENTS


Cable shall meet all the material properties and test requirements specified in below table.

Physical Requirements	Requirement	Test methods
Tensile Test: 500 N for 6 element 1000 N for 8 element 1200 N for 12 element	Fibre Strain at maximum load: < 0.33%. After test, change in attenuation < 0.05 dB/km @ 1550 nm	IEC-60794 (Method- E1A)
Crush Test: 1000 N/100 mm for 5 minutes	After test, change in Attenuation < 0.05 dB/km @ 1550 nm (before & after completion of test) No fibre break	IEC-60794 (Method- E3)
Impact Test: 1 Nm , 3 Impacts	After test, change in Attenuation < 0.05 dB/km @ 1550 nm (before & after completion of test) No jacket cracking and fibre break	IEC-60794 (Method- E4)
Repeated Bending:	After test, change in Attenuation < 0.05 dB/km @ 1550 nm	IEC-60794


Maximum bending radius 15x OD, 10 Cycles	(before & after completion of test) No jacket cracking and fibre break	(Method- E6)
Torsion (Twist)Test: Samples less than 2 m, 1Kg, 10 cycles	After test, change in Attenuation < 0.05 dB/km @ 1550 nm (before & after completion of test) No jacket cracking and fibre break	IEC-60794 (Method- E7)
Bend Test: Minimum Bend Radius 10x Cable Diameter (No load)	After test, change in Attenuation < 0.05 dB/km @ 1550 nm (before & after completion of test) No jacket cracking and fibre break	IEC-60794 (Method- E11)
Water Penetration Test: Sample Length 3m, Height 1m for 24 hrs	No leakage water through open end of cables	IEC-60794-1-2
Temperature Cycling Test: -Temperature Range (-30°C to+60°C) -Minimum duration 4 hrs, 2 Cycles	Attenuation shall be measured by OTDR @1310nm, 1550nm& 1625 nm on minimum 10% of the randomly selected fibres. The difference in attenuation result before and after the test shall be not be more than 0.05 dB /km	IEC-60794 (Method- F1)

C.17 ENVIRONMENTAL CONDITIONS

1.1. Operation, installation and shipping/storage temperature ranges shall be as follows:

- | | | |
|------|------------------|----------------|
| i) | Operation | -30°C to +60°C |
| ii) | Installation | -30°C to +60°C |
| iii) | Shipping/Storage | -30°C to +60°C |
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D. TECHNICAL DOCUMENTATION

- 1.1. The participant shall provide a copy of the detail test result for each drum supplied.
 - 1.2. The participant shall also provide the summary for the technical detail for the manufactured cables as in the sample format provided. Refer to Technical Detail List 1 & 2.
 - 1.3. The participant shall submit the installation manual (IM) as part of the submission. The installation manual shall indicate on the blown optical fibre in any kind of standard installation methods in telecommunication environment. The participant shall provide technical support, expertise and knowledge transfer on how to operate and maintain on the offered products during the contract term.
 - 1.4. The Technical Detail List is non-exhaustive, participant shall provide other characteristics not mentioned in this specifications but readily available with the manufacturer.
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E. FACTORY ACCEPTANCE TEST

- 1.1. The participant shall submit the propose Factory Acceptance Test procedure as part of the submission.
- 1.2. The user reserves the right to amend some or all parts of the proposed acceptance test and shall conduct the full evaluation (ie: Factory Acceptance Test (FAT) upon confirmation and approved by PDC Telco/MY.NeuTrans.
- 1.3. Testing shall be performed at the convenient time to both the successful participant and PDC Telco/MY.NeuTrans's representatives. All tests shall be witnessed by PDC Telco/MY.NeuTrans personnel. The supplier shall notify PDC Telco/MY.NeuTrans two weeks prior to the acceptance test date. PDC Telco/MY.NeuTrans shall have the right to reject any batch of the cables that is not according to the standard requirement. All cost for the testing shall be borne by the supplier inclusive of PDC Telco/MY.NeuTrans's staff accommodation and transportation
- 1.4. The participant shall conduct its own test for all the completed cables prior to the factory acceptance test by the user.
- 1.5. The participant at its own cost to perform blowing test and compatibility with the approved PDC Telco/MY.NeuTrans's microduct supplier (if any) or others in term of compatibility and blowing performance. The participant may conduct on its own and may share the certificate of the conformance with PDC Telco/MY.NeuTrans as reference



F. REFERENCES

ITU-T G.652D - International Telecommunications Union Recommendation G.652
version D

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

Technical Detail list:

Standard Single Mode Fibre (G.652D)

Item	Description	PDC Telco/ MY.NeuTrans Specifications	Supplier
1	Single Mode Fibre	ITU-T G.652D	
2	Mode field diameter	9.2 μm \pm 0.4nm at 1310nm. 10.4 μm \pm 0.8 μm at 1550nm.	
3	Cladding diameter	125.0 μm \pm 0.70 μm	
4	Core/Cladding concentricity error	\leq 0.5 μm	
5	Cladding non-circularity error	\leq 0.80%.	
6	The coating diameter is	245 μm \pm 5 μm	
7	Fibre curl	\geq 4.0m radius of curvature	
8	The coating	UV curable acrylate.	
9	Coating diameter	245 μm \pm 5 μm	
10	Coating-cladding concentricity	$<$ 12 μm	
11	Attenuation bare fibre	1300 - 1320nm \leq 0.34dB/km 1383 nm \leq 0.34dB/km 1550 nm \leq 0.20 dB/km	
	Attenuation at cable stage	1300 - 1320nm \leq 0.35dB/km 1550 nm \leq 0.22 dB/km	
12	Chromatic Dispersion	1285 - 1330nm \leq 3.50 ps/(nm.km) 1550nm \leq 18.0 ps/(nm.km) 1625nm \leq 22.0 ps/(nm.km)	
13	PMD	\leq 0.10 ps/ $\sqrt{\text{km}}$	
14	PMD Link Design Value	\leq 0.06 ps/ $\sqrt{\text{km}}$	
15	Cable cut-off wavelength (λ_{cc})	\leq 1260nm	
16	Zero Dispersion Wavelength (λ_0)	1301 \leq $\lambda_0 \leq$ 1325nm	
17	Zero Dispersion Slope (S_0)	\leq 0.090ps/(nm ² .km)	

18	Operating Temperature	0°C to +60°C	
19	Induced Attenuation at Operating Temperature	At 1310 and 1550nm shall be ≤ 0.05 dB/km	
20	Tensile Proof Test	≥ 100kpsi (0.70 GN/m ²)	
21	Fibre Supplier Name	Supplier to specify	

-----End of Specification-----