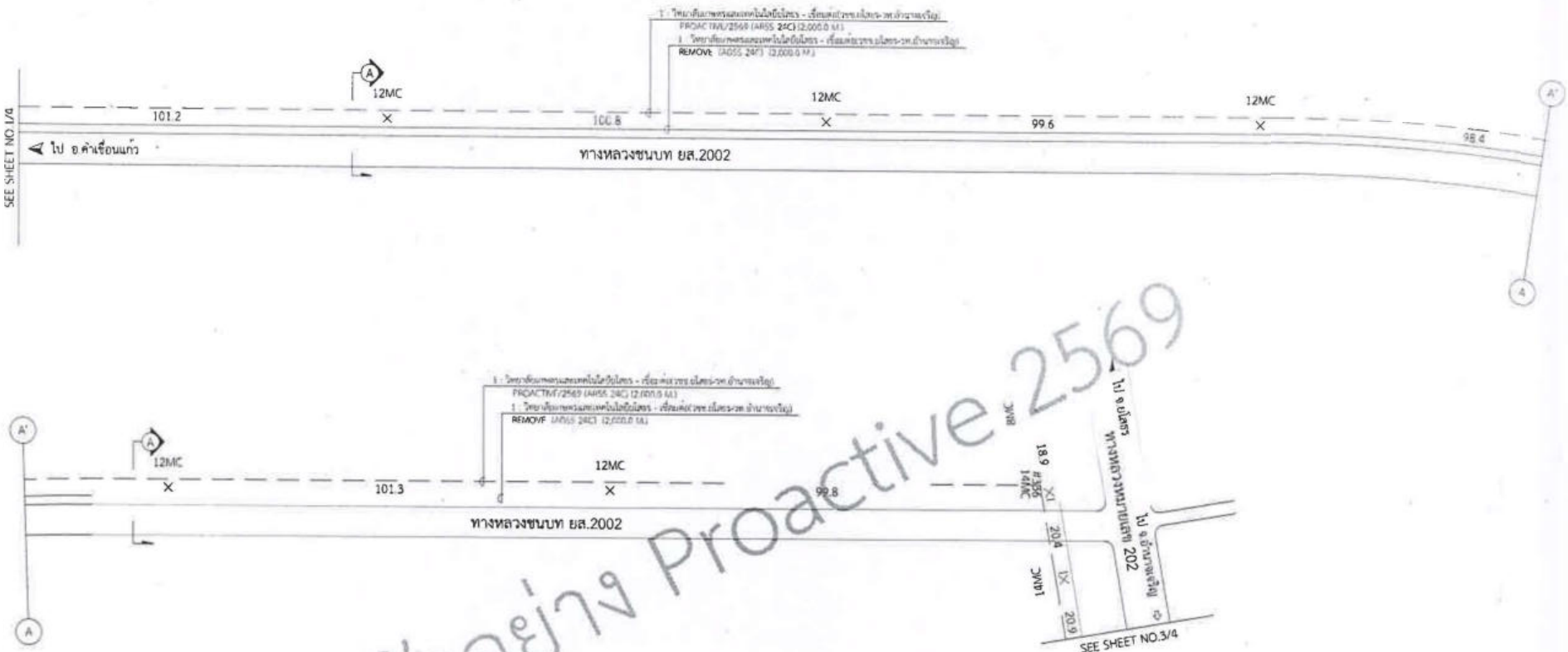
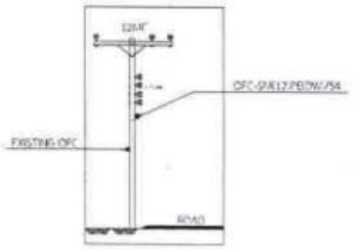
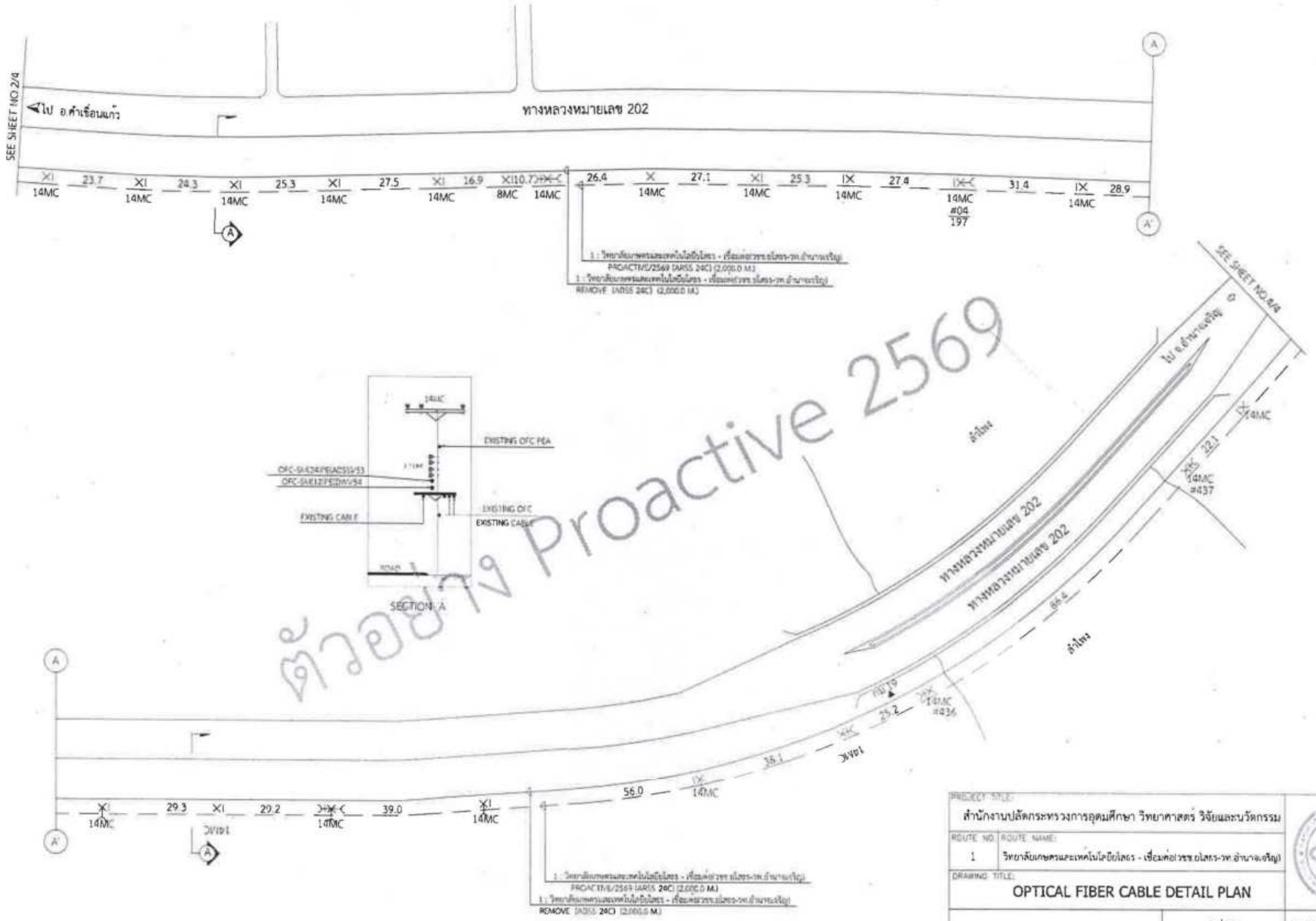




SECTION (A)

PROJECT TITLE: สำนักงานปลัดกระทรวงการอุดมศึกษา วิทยาศาสตร์ วิจัยและนวัตกรรม				
ROUTE NO. 1	ROUTE NAME: วิทยาลัยเกษตรและเทคโนโลยียโสธร - เชื่อมต่อ(วชช.ยโสธร-วท.อำนาจเจริญ)			
DRAWING TITLE: OPTICAL FIBER CABLE DETAIL PLAN				
		สป.อว.		DETAIL DESIGN DRAWING
DESIGN BY	UPDATE BY	CHECKED	REVIEWED	APPROVED
DRAWN:	DRAWN:	NAME:		
CHECKED:	CHECKED:	SIGN:		
DATE:	DATE:	DATE:		
		SHEET NO. 2 /4	SCALE 1:1000	DRAWING NO.



PROJECT TITLE:
สำนักงานปลัดกระทรวงการอุดมศึกษา วิทยาศาสตร์ วิจัยและนวัตกรรม

ROUTE NO.	ROUTE NAME:
1	วิทยาลัยเกษตรและเทคโนโลยีบึงโขงฯ - เชื่อมต่อ(วชช.บึงโขงฯ-วท.อำนาจเจริญ)

DRAWING TITLE:
OPTICAL FIBER CABLE DETAIL PLAN

สป.อว.

DETAIL DESIGN DRAWING

DESIGN BY	UPDATE BY	CHECKED	REVIEWED	APPROVED
DRAWN:	DRAWN:	NAME:		
CHECKED:	CHECKED:	SIGN:		
DATE:	DATE:	DATE:		

SHEET NO.	SCALE	DRAWING NO.
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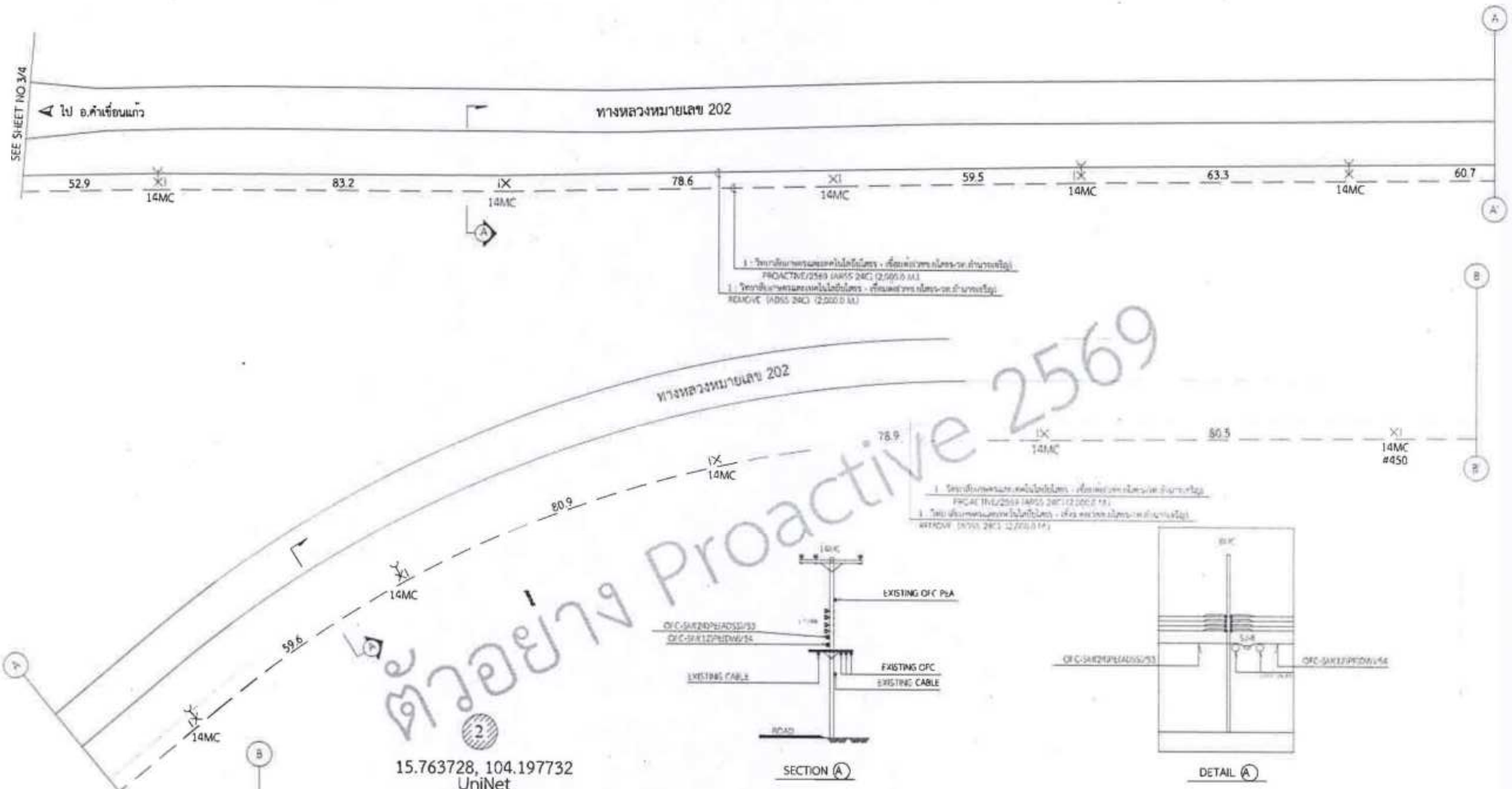

PROJECT TITLE:
สำนักงานปลัดกระทรวงการอุดมศึกษา วิทยาศาสตร์ วิจัยและนวัตกรรม

ROUTE NO.	ROUTE NAME
1	วิทยาลัยเกษตรและเทคโนโลยียโสธร - เชื่อมต่อ(ทช.)ยโสธร-ทช.อำนาจเจริญ

DRAWING TITLE:
OPTICAL FIBER CABLE DETAIL PLAN

สป.อว.

DETAIL DESIGN DRAWING

DESIGN BY	UPDATE BY	CHECKED	REVIEWED	APPROVED
DRAWN:	DRAWN:	NAME:		
CHECKED:	CHECKED:	SIGN:		
DATE:	DATE:	DATE:		

SHEET NO.	SCALE	DRAWING NO.
4 /4	1:1000	

SPECIFICATION

FOR

ALL DIELECTRIC SELF SUPPORTING (ADSS)

SINGLE MODE OPTICAL FIBER 24 CORES CABLE

สำนักงานปลัดกระทรวงการอุดมศึกษา วิทยาศาสตร์ วิจัยและนวัตกรรม

Specification for All Dielectric Self Supporting single mode optical fiber cable (ADSS OFC for Core Network)

1. **General**

1.1. This specification covers the requirements of All Dielectric Self Supporting (ADSS) single mode optical fiber cable to be supplied to "UniNet" Ministry of Higher Education, Science, Research and Innovation intended primarily for use in outside plant network.

1.2. The ADSS single mode optical fiber cable herein after referred to as the "CABLE" shall comply with the requirements of this specification and generally meet any latest relevant IEEE std. 1222 ,ITU-T Recommendations G.652 D or equivalent; unless otherwise specified in these specifications.

1.3. This specification shall be mainly designed to apply for core network/backbone network which is the optical network link from the exchange or access node to other exchanges or access node

1.4. The fiber type of the cable is Zero Dispersion Un-Shifted Single Mode (ZDUSSM) optical fiber. The number of fibers in cable shall be 24 fiber counts.

1.5. The primary design consideration of the cable shall protect the optical fibers from environmental and mechanical stresses.

1.6. The cable shall be applied for aerial and duct installation.

1.7. The cable proposed shall be new and its lifetime shall be at least 20 years without any significant deterioration. The Calculation of Optical Fiber life time shall be stated by the bidder

1.8 The cable proposed shall be comply with TIS.2166-2548.

1.9. CABLE shall be designed for hang on distribution transmission line structures of the Provincial Electricity Authority. CABLE shall be constructed and installed for operation under the following conditions:

Climate	tropical
Relative Humidity, non-condensing	up to 95%
Maximum pole span length	80 m
Ambient air temperature	up to 50° C

2. Optical fiber characteristics

2.1 Physical Characteristics

ZDUSSM requirements are defined:

Fiber Description		Zero Dispersion Un-Shifted Single-Mode (ZDUSSM) (Dual Window) ITU-T G.652 D
Fiber	Type	Single mode type
	Material	High Grade Silica
Mode field diameter		9.2 ± 0.6 μm
Mode field concentricity error		Max. 0.6 μm
Cladding diameter		125 ± 1 μm
Cladding non-circularity		Max. 2 %
Coating	material	UV acrylate
	diameter	250 ± 15 μm
Fiber tensile strength		In accordance with IEC 60793-1-30 0.7 Gpa (1%)

2.2 Optical characteristics

Attenuation	at 1310 nm	Max. 0.40 dB/km
	at 1383 nm	Max. 0.35 dB/km
	at 1550 nm	Max. 0.25 dB/km
	at 1625 nm	Max. 0.30 dB/km
Zero dispersion wavelength		1300 ~ 1324 nm
Zero dispersion slope		Max. 0.092 ps/(nm^2.km)
Chromatic dispersion	at 1310 nm	Less than 3.5 ps/(nm.km)
	at 1550 nm	Less than 20 ps/(nm.km)
Cable cut-off wavelength (λcc) or Fiber cut-off wavelength (λc)		Less than 1260 nm or 1100 ~ 1280 nm
Macrobend loss (100 turns, radius : 25 mm) at 1550 nm		Max. 0.1 dB
Polarization mode dispersion (PMD Link Design Value)		Less than 0.2 ps/km$^{1/2}$

Attenuation variation

The attenuation coefficient between 1,285 nm and 1,330 nm shall not exceed the attenuation coefficient at 1,310 nm by more than 0.1 dB/km. The attenuation of the fiber shall be distributed uniformly throughout its length such that there are no point discontinuities in excess of 0.1 dB.

3. Optical fiber cable

3.1 Construction of optical fiber cable

The design of the Optical fiber cable shall account for the varying operating and environmental conditions that CABLE shall experience while in service.

3.1.1 Buffer tube

Loose tube buffer construction shall be implemented. The individually coated optical fiber(s) shall be surrounded by a buffer for protection from physical damage during fabrication, installation, and operation of the cable. The fiber coating and buffer shall be strippable for splicing and termination.

(a) Buffer tubes:

A buffer tube shall be sleeved over multiple fibers forming a fiber unit. A fiber unit shall consist of no more than 6 fibers. Each fiber unit shall be individually identifiable utilizing the color code presented in Table 3. If loose tube buffer construction is provided, buffer tubes shall be filled with a water-blocking gel.

(b) Fiber units:

All fibers contained in a fiber unit shall be identical in construction and optical performance. There shall be no mixture of ZDUSSM and NZDSSM type fibers within a fiber unit nor shall there be a significant range in their performance.

3.1.2 Cable materials

The materials used for CABLE construction, shall meet the following requirements:

(a) Water blocking material

CABLE shall be used water blocking material such as yarns or tape to prohibit any moisture ingress or any water longitudinal migration within the fiber optic unit or along the fiber optic cable. The water tightness of the cable shall meet or exceed the test performance criteria as per IEC-60794-1-2-F5. The water blocking material contain a super absorbent polymer (SAP) with rapidly swell upon contact with water.

(b) Outside jacket materials

The outer CABLE jacket shall consist of carbon black polyethylene resin to prevent damage from exposure to ultra-violet light, weathering, and high levels of pollution. The jacket shall conform to high density polyethylene (HDPE) standards as defined in ASTM D1248 CABLE configuration shall have a round profile.

(c) Non-metallic materials

CABLE design shall incorporate non-metallic elements in its construction

(d) Sheathing removal

CABLE sheath design shall permit easy removal without damage to the optical fibers or fiber units. The design shall incorporate two continuous ripcords under the jackets of each sheath for the entire length of CABLE.

3.1.3 Jacket construction

The jacket shall be black, smooth, concentric, and shall be free from holes, splits, blisters and other surface flaws. The jacket shall be extruded directly over the cable core and shall also be non-hygroscopic.

3.1.4 Inner strength members

A central strength member shall provide the mechanical strength to support the cable and provide cushioning against crushing. The central strength member shall be decoupled from the jacket materials.

The central strength member shall be made of non-metallic material, glass fiber reinforced plastic (FRP) or equivalent type material, as required.

The construction of the optical fiber cable shall be in accordance with Table 1 and Fig. 1

Table 1 Construction of cable

Number of fiber		24
Optical Fiber	Construction	According 2.1
Filling Compound	Material	Thixotropic Jelly Compound
Loose Tube	Material	(PBT) Polybutylene Terephthalate with color coding
	Fiber per Tube	6
	Inner Diameter	1.5 ± 0.1 mm
	Outer Diameter	2.2 ± 0.1 mm
	Assembly	Fibers are brought together with the filling compound and placed in the extruded tube
Filler Rod	Material	Polyethylene
	Quantity	1
Central Strength Member	Material	FRP (Fiberglass Reinforce with Plastic) If necessary jacketed with polyethylene
	Diameter	1.8 ± 0.1 mm
Stranding	Method	Reverse oscillation lay (ROL) technique (SZ Direction)
Water Blocking Element	Material	Swellable Yarn
Core Covering	Material	Water Blocking Tape
Additional Strength Member	Material	Aramid Yarn
Ripcord	Material	Polyester cord
Sheath	Material	UV - proof Black high-density polyethylene
	Thickness	Minimum 1.5 mm
Approx. Cable Diameter		11.5 mm
Approx. Cable Weight		85.0 kg/km

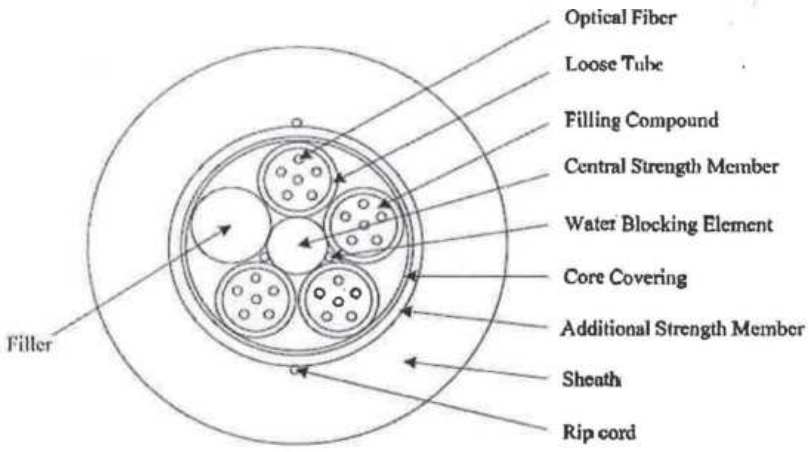

Fig. 1 Cross section of optical fiber cable

4. Fiber coding

Fiber units shall be identifiable in accordance with TIA / EIA - 598 - A (Optical Fiber Cable Color Coding). color-coding scheme. The color coding of the optical fiber and loose tube specified in Table 2 and 3. The color-coding system shall be discernible throughout the design life of the cable.

Table 2 Identification of optical fiber

Fiber No.	Fiber color
1	Blue
2	Orange
3	Green
4	Brown
5	Slate
6	White

Table 3 Identification of loose tube

Loose tube No.	Loose tube color
1	Blue
2	Orange
3	Green
4	Brown

Coloring utilized for color coding optical fibers shall be integrated into the fiber coating and shall be homogenous. The color shall not bleed from one fiber to another and shall not fade during fiber preparation for termination or splicing.

Each cable shall have trace-ability of each fiber back to the original fiber manufacturer's fiber number and parameters of the fiber. If more than the specified number of fibers are included in any cable, the spare fibers shall be tested by the cable manufacturer and any defective fibers shall be suitably bundled, tagged and identified at the factory by the vendor.

5. Requirements and Cable Characteristics

Table 4 provides ADSS Electrical and Mechanical Requirements for the minimum performance characteristics. CABLE installations are required.

Table 4 ADSS Electrical and Mechanical Requirements

Parameters		Value
Maximum span length		80 m
Initial Sag (% of span length)		1.0%
Maximum allowable pulling tension (During installation)		2,000 N
Worst case loading condition Maximum wind velocity (Short-term)	Maximum wind velocity	90 km/hr.
	Temperature	25 °C
Minimum bending Radius	During installation or handling	20 x External Diameter of Cable
	During service or fixed	15 x External Diameter of Cable

The bidder must submit the CABLE test report from manufacturer with company seal. The bidder who failure to comply shall be disqualify.

The cable characteristics tests shall be conducted in accordance as following;

Tensile Loading Test

Test Method : มอก. 2051 - 2543 - E1 or IEC 60794 - 1 - 2 - E1 A

Test Length : 100 - 200 m

Tensile Loading : 2,000 N

Period : At least 1 hour

Criteria : Attenuation change before, during and after testing shall not
: exceed 0.05 dB @ 1550 nm and no physical damage
: A fiber strain shall not be greater than 0.33 % during and after
: testing.

Bending Test

Test Method	: มอก. 2051 - 2543 - E11 B or IEC 60794 - 1 - 2 - E11 B
Mandrel Diameter	: 20 x D (D is outer diameter excluding messenger wire)
Number of Cycle	: At least 10 cycles
Criteria	: Attenuation change during and after testing shall not
	: exceed 0.1 dB @ 1550 nm and no physical damage

Crush or Compressive Loading Test

Test Method	: มอก. 2051 - 2543 - E3 or IEC 60794 - 1 - 2 - E3
Test Plate	: 100 mm
Load	: 2,200 N
Position	: At least 3 times at 3 places where not less than 500 mm apart
Period	: At least 10 minute each
Criteria	: Attenuation change during and after testing shall not
	: exceed 0.1 dB @ 1550 nm and no physical damage

Torsion or Twist Test

Test Method	: มอก. 2051 - 2543 - E7 or IEC 60794 - 1 - 2 - E7
Test Length	: 1 m
Mess of Weight	: 4.5 kg
Number of Cycle	: At least 10 cycles
Angle	: ± 180°
Criteria	: Attenuation change during and after testing shall not
	: exceed 0.1 dB @ 1550 nm and no physical damage

Impact Test

Test Method	: มอก. 2051 - 2543 - E4 or IEC 60794 - 1 - 2 - E4
Impact Energy	: 4.4 N.m According to Table 1 for Outside Plant application of
	: TIA/EIA-455-25C Drop hammer mass and resulting test
	: Impact energy

Radius of Hammer Head: 12.5 mm

Number of Cycle	: Two in 3 different places spaced not less than 500 mm apart
Criteria	: Attenuation change during and after testing shall not
	: exceed 0.1 dB @ 1550 nm and no physical damage

Water Penetration Test

Test Method	: มอก. 2051 - 2543 - F5 B or IEC 60794 - 1 - 2 - F5 B
Height of Water	: 1 m
Cable Length	: 3 m
Period	: At least 24 hours
Criteria	: At the end of holding time, no water shall have leaked from
:	the opposite end of the cable.

Temperature Cycling Test

Test Method	: มอก. 2051 - 2543 - F1 or IEC 60794 - 1 - 2 - F1
Number of Cycle	: At least 2 cycle
Cycle and Temperature	: 1 cycle consists of - 10°C for 16 hours and + 70°C for 16
	: hours excluding soaking time
Criteria	: Attenuation change during and after testing shall not
	: exceed 0.1 dB/km @ 1550 nm and no physical damage

Flexing Test

Test Method	: มอก. 2051 - 2543 - E6 or IEC 60794 - 1 - 2 - E6
Mandrel Diameter	: 20 x D (D is outer diameter excluding messenger wire)
Mess of Weight	: 4.5 kg
Number of Cycle	: At least 10 cycles
Criteria	: Attenuation change during and after testing shall not
	: exceed 0.1 dB @ 1550 nm and no physical damage

6. Information Marking

6.1 Cable identification markings:

Alphabet interval 1 meter as detail given below, the characters are approximately 3 mm in height and the color shall preferably be white.

- THAI INDUSTRIAL STANDARD logo and words: มอก. 2166-2548
- Property of "UniNet" สำนักงานคณะกรรมการการอุดมศึกษา (สป.อว.)
- Name of manufacturer
- Year of manufacture
- Type and number of cores
- Purchase Contract Number
- Cable length every 1 meter from 0000 to 4000 meters

6.2 Reel markings:

Each side of every reel of CABLE shall be permanently marked in a minimum of 3 cm high white lettering with the following information.

- The vendors' address
- UniNet's destination address
- Cable part number
- Specification as to the type of cable, length, number of fibers, cable segment number, inspection stamp and date.

6.3 Cable drums:

All optical fiber cabling shall be supplied on strong drums provided with lagging of adequate strength, constructed to protect the cabling against all damage and displacement during transit, storage, and subsequent handling during installation. Both ends of the cable shall be sealed as to prevent the escape of filling compounds during shipment and handling.

Contractor shall be supplied on all drums in lengths of not less than 4,000 meters/drum for installation and not less than 2,000 meters/drum for spare.

There shall be no factory splices allowed within a continuous length of CABLE. Only one continuous cable length shall be provided on each drum. The lengths of cable to be supplied on each drum shall be determined by a "schedule" prepared by and the responsibility of Contractor.

---------- End Specifications ADSS-24----------

SPECIFICATION

FOR

OPTICAL FIBER CABLE DROP WIRE TWISTED 12 CORES

(DROP WIRE OFC FOR ACCESS NETWORK)

สำนักงานปลัดกระทรวงการอุดมศึกษา วิทยาศาสตร์ วิจัยและนวัตกรรม

Specification for Optical Fiber Cable Drop Wire Twisted 12 Cores

(Drop Wire OFC for Access network)

1. General

1.1. This specification covers the requirements of the standard single mode optical fiber cable for access service (Drop wire Twisted) to be supplied to "UniNet" Ministry of Higher Education, Science, Research and Innovation intended primarily for use in outside plant network.

1.2. The standard single mode optical fiber cable for access service (Drop wire Twisted) herein after referred to as the "DW-CABLE" shall comply with the requirements of this specification and generally meet any latest relevant ITU-T Recommendations G.652.D or equivalent; unless otherwise specified in these specifications.

1.3. This specification shall be mainly designed to apply for distribution and access service networks which are the optical networks link from the exchange or access node to other exchanges or access node and also supply for last mile service links.

1.4. The fiber type of the cable is Zero Dispersion Un-Shifted Single Mode (ZDUSSM) optical fiber. The number of fibers in cable shall be 4, 6, 8 and 12 fiber counts.

1.5. The primary design consideration of the cable shall protect the optical fibers from environmental and mechanical stresses.

1.6. The cable proposed shall be new and its lifetime shall be at least 20 years without any significant deterioration. The Calculation of Optical Fiber life time shall be stated by the bidder

1.8. DW-CABLE shall be designed for hang on distribution transmission line structures of the Provincial Electricity Authority. DW-CABLE shall be constructed and installed for operation under the following conditions:

Climate	tropical
Relative Humidity, non-condensing	up to 95%
Maximum pole span length	40 m
Ambient air temperature	up to 50° C

2. Optical fiber characteristics

2.1 Physical Characteristics

ZDUSSM requirements are defined:

Fiber Description		Zero Dispersion Un-Shifted Single-Mode (ZDUSSM) (Dual Window) ITU-T G.652 D
Fiber	type	Single mode type
	material	High Grade Silica
Mode field diameter		9.2 ± 0.6 μm
Mode field concentricity error		Max. 0.6 μm
Cladding diameter		125 ± 1 μm
Cladding non-circularity		Max. 2 %
Coating	material	UV acrylate
	diameter	250 ± 15 μm
Fiber tensile strength		In accordance with IEC 60793-1-30, 0.7 Gpa (1%)

2.2 Optical characteristics

Attenuation	at 1310 nm	Max. 0.40 dB/km
	at 1383 nm	Max. 0.35 dB/km
	at 1550 nm	Max. 0.25 dB/km
	at 1625 nm	Max. 0.30 dB/km
Zero dispersion wavelength		1300 ~ 1324 nm
Zero dispersion slope		Max. 0.092 ps/(nm^2.km)
Chromatic dispersion	at 1310 nm	Less than 3.5 ps/(nm.km)
	at 1550 nm	Less than 20 ps/(nm.km)
Cable cut-off wavelength (λcc) or Fiber cut-off wavelength (λc)		Less than 1260 nm or 1100 ~ 1280 nm
Macrobend loss (100 turns, radius : 25 mm) at 1550 nm		Max. 0.1 dB
Polarization mode dispersion (PMD Link Design Value)		Less than 0.2 ps/km$^{1/2}$

Attenuation variation

The attenuation coefficient between 1,285 nm and 1,330 nm shall not exceed the attenuation coefficient at 1,310 nm by more than 0.1 dB/km. The attenuation of the fiber shall be distributed uniformly throughout its length such that there are no point discontinuities in excess of 0.1 dB.

3. Optical fiber cable

The design of the Optical fiber cable shall account for the varying operating and environmental conditions that DW-CABLE shall experience while in service. The construction of the optical fiber cable for access service shall be in accordance with Table 1, Fig. 1 and 2.

Table 1 Construction of optical fiber cable for access service

Number of fiber		4 and 8	6 and 12
Fiber buffer tube	Material	Single layer of polybutylene terephthalate (PBT)	
	Fiber/tube	4	6
Filling Compound in buffer tube	Material	Thixotropic Jelly	
The filler	Material	Polyethylene	
	Quantity	1 ~ 2	1 ~ 2
The water blocking materials	Material	Swellable yarn	
Core Covering	Material	Water Blocking Tape	
Core binding	Material	Polyester yarn	
Ripcord	Material	Polyester cord	
	Direction	Two ripcords shall be placed under the sheath to be diametrically opposite of each other	
Outer sheath (on cable core)	Material	UV - proof high density black polyethylene	
	Thickness	Minimum 1.5 mm	
	Web	Minimum 1.0 x 0.5 mm	
Messenger wire	Material	Fiber Reinforcement Plastic (FRP)	
	Diameter	Minimum 2.5 mm	
Outer sheath (on messenger wire)	Material	UV - proof high density black polyethylene	
	Thickness	Minimum 1.0 mm	
Approx. Cable Diameter		8.6 mm	
Max. cable height		12.8 mm	
Approx. Cable Weight		80.0 kg/km	

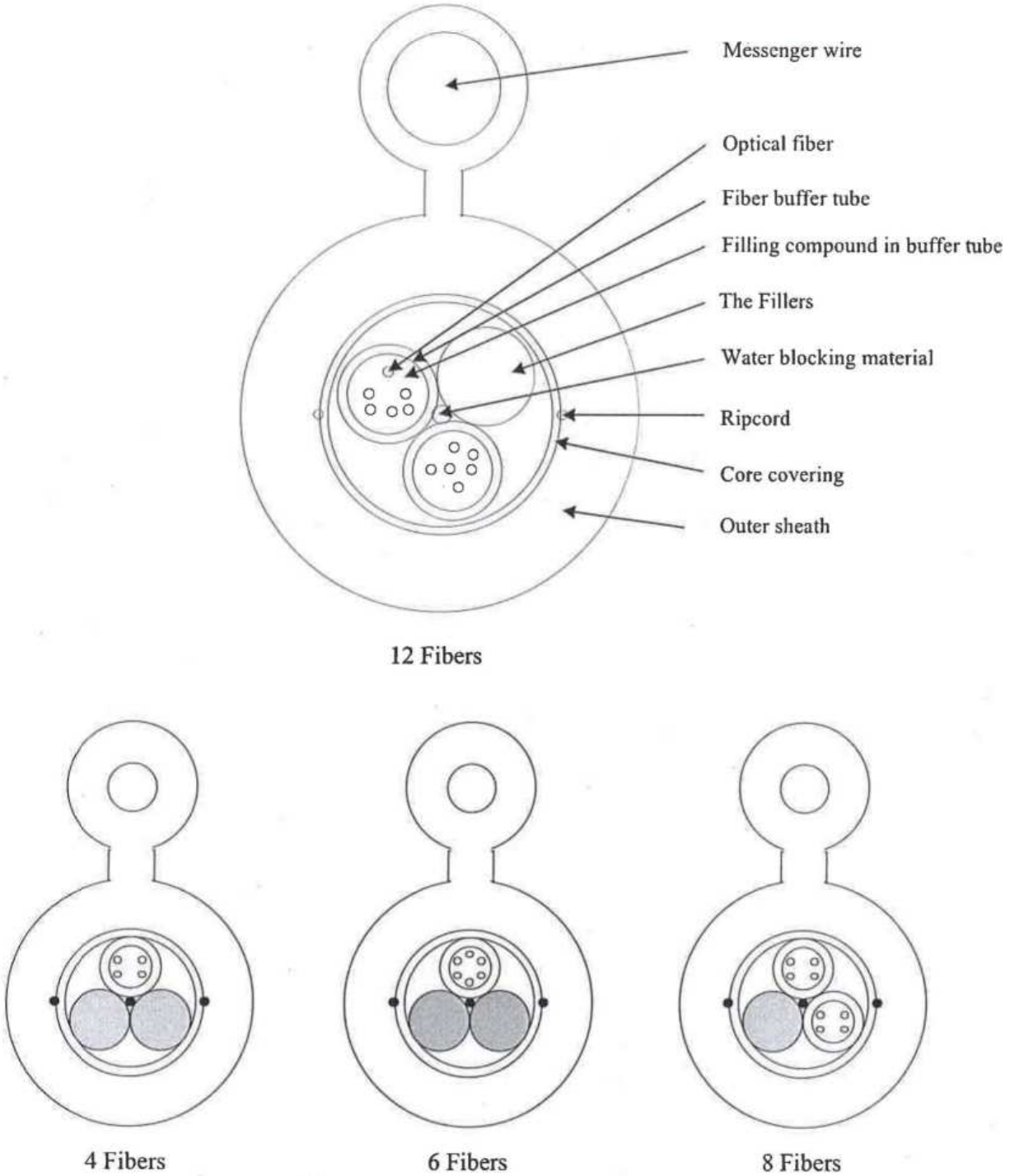

Fig. 1 Cross-section of optical fiber cable for access service

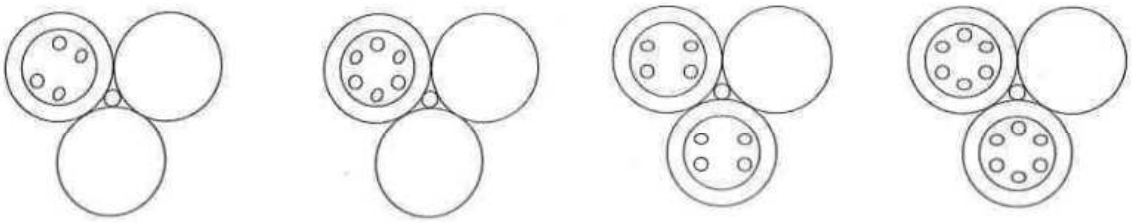

Fig. 2 Cross-section of optical fiber cable core

4. Color coding

The color coding of the optical fiber and loose tube that specified in Table 2 and Table 3 respectively, shall be in accordance with EIA/TIA-598-A (Optical Fiber Color Coding)

Table 2 Identification of optical fiber

Fiber no.	Fiber color
1	Blue
2	Orange
3	Green
4	Brown
5	Slate
6	White

Table 3 Identification of fiber buffer tube

Fiber buffer tube no.	Fiber buffer tube color
1	Blue
2	Orange

Table 4 Cable structure

Fiber Capacities	No. of elements by layers		Loose tubes x Fiber in loose tube
	Tube	Filler	
4	1	2	1 x 4
6	1	2	1 x 6
8	2	1	2 x 4
12	2	1	2 x 6

5. Mechanical and Environmental Test

The bidder must submit the CABLE test report from manufacturer with company seal.

The bidder who failure to comply shall be disqualify.

The optical fiber cable DW-CABLE has to pass the following list of Mechanical and Environmental Test

Tensile Loading Test

Test Method	: มอก. 2051 - 2543 - E1 or IEC 60794 - 1 - 2 - E1 A
Test Length	: 100 - 200 m
Tensile Loading	: 1,000 N
Period	: At least 1 hour
Criteria	: Attenuation change before, during and after testing shall not
	: exceed 0.05 dB @ 1550 nm and no physical damage
	: A fiber strain shall not be greater than 0.33 % during and after
	: testing.

Bending Test

Test Method	: มอก. 2051 - 2543 - E11 B or IEC 60794 - 1 - 2 - E11 B
Mandrel Diameter	: 20 x D (D is outer diameter excluding messenger wire)
Number of Cycle	: At least 10 cycles
Criteria	: Attenuation change during and after testing shall not
	: exceed 0.1 dB @ 1550 nm and no physical damage

Crush or Compressive Loading Test

Test Method	: มอก. 2051 - 2543 - E3 or IEC 60794 - 1 - 2 - E3
Test Plate	: 100 mm
Load	: 2,200 N
Position	: At least 3 times at 3 places where not less than 500 mm apart
Period	: At least 10 minute each
Criteria	: Attenuation change during and after testing shall not
	: exceed 0.1 dB @ 1550 nm and no physical damage

Torsion or Twist Test

Test Method	: มอก. 2051 - 2543 - E7 or IEC 60794 - 1 - 2 - E7
Test Length	: 1 m
Mess of Weight	: 4.5 kg
Number of Cycle	: At least 10 cycles
Angle	: ± 180°
Criteria	: Attenuation change during and after testing shall not
	: exceed 0.1 dB @ 1550 nm and no physical damage

Impact Test

Test Method	: มอก. 2051 - 2543 - E4 or IEC 60794 - 1 - 2 - E4
Impact Energy	: 2.9 N.m According to Table 1 for Drop cable application of
	: TIA/EIA-455-25C Drop hammer mass and resulting test
	: Impact energy
Radius of Hammer Head: 12.5 mm	
Number of Cycle	: Two in 3 different places spaced not less than 500 mm apart
Criteria	: Attenuation change during and after testing shall not
	: exceed 0.1 dB @ 1550 nm and no physical damage

Water Penetration Test

Test Method	: มอก. 2051 - 2543 - F5 B or IEC 60794 - 1 - 2 - F5 B
Height of Water	: 1 m
Cable Length	: 3 m
Period	: At least 24 hours
Criteria	: At the end of holding time, no water shall have leaked from the opposite end of the cable.

Temperature Cycling Test

Test Method : มอก. 2051 - 2543 - F1 or IEC 60794 - 1 - 2 - F1

Number of Cycle : At least 2 cycles

Cycle and Temperature : 1 cycle consists of - 10°C for 16 hours and + 70°C for 16
: hours excluding soaking time

Criteria : Attenuation change during and after testing shall not
: exceed 0.1 dB/km @ 1550 nm and no physical damage

Flexing Test

Test Method : มอก. 2051 - 2543 - E6 or IEC 60794 - 1 - 2 - E6

Mandrel Diameter : 20 x D (D is outer diameter excluding messenger wire)

Mess of Weight : 4.5 kg

Number of Cycle : At least 10 cycles

Criteria : Attenuation change during and after testing shall not
: exceed 0.1 dB @ 1550 nm and no physical damage

Table 5 Technical information of the cable

Item		Specification
Minimum Bending Radius	During Installation or handling	20 x External Diameter of cable
	During Service or fixed	15 x External Diameter of cable

6. Information Marking

6.1 Cable identification markings:

Alphabet interval 1 meter as detail given below, the characters color shall preferably be white.

- THAI INDUSTRIAL STANDARD logo and words: มอก. 2166-2548
- Property of "UniNet" สำนักงานคณะกรรมการการอุดมศึกษา (สป.อว.)
- Name of manufacturer
- Year of manufacture
- Type and number of cores
- Purchase Contract Number
- Cable length every 1 meter from 0000 to 4000 meters

6.2 Reel markings:

Each side of every reel of DW-CABLE shall be permanently marked in a minimum of 3 cm high white lettering with the following information.

- The vendors' address
- UniNet's destination address
- Cable part number
- Specification as to the type of cable, length, number of fibers, cable segment number, inspection stamp and date.

6.3 Cable drums:

All optical fiber cabling shall be supplied on strong drums provided with lagging of adequate strength, constructed to protect the cabling against all damage and displacement during transit, storage, and subsequent handling during installation. Both ends of the cable shall be sealed as to prevent the escape of filling compounds during shipment and handling.

Contractor shall be supplied on all drums in lengths of not less than 4,000 meters/drum for installation and not less than 2,000 meters/drum for spare.

There shall be no factory splices allowed within a continuous length of DW-CABLE. Only one continuous cable length shall be provided on each drum. The lengths of cable to be supplied on each drum shall be determined by a "schedule" prepared by and the responsibility of Contractor.

---------- End Specifications DW-CABLE----------

SPECIFICATION

FOR

ANTI-RODENT SELF-SUPPORTING OPTICAL FIBER CABLE 12 AND 24 CORES

(OFC FOR CORE NETWORK)

สำนักงานปลัดกระทรวงการอุดมศึกษา วิทยาศาสตร์ วิจัยและนวัตกรรม

Specification for Anti-Rodent Self-Supporting Optical Fiber Cable 12 And 24 Cores (OFC For Core Network)

1. General

1.1. This specification covers the requirements of the standard single mode Anti-Rodent Self-Supporting optical fiber cable to be supplied to "UniNet" Ministry of Higher Education, Science, Research, and Innovation intended primarily for use in outside plant network.

1.2. The standard single mode Anti-Rodent Self-Supporting aerial optical fiber cable herein after referred to as the "CABLE" shall comply with the requirements of this specification and generally meet any latest relevant ITU-T Recommendations G.652 D or equivalent; unless otherwise specified in these specifications.

1.3. This specification shall be mainly designed to apply for core network/backbone network which are the optical networks link from the exchange or access node to other exchanges or access node.

1.4. The fiber type of the cable is Zero Dispersion Un-Shifted Single Mode (ZDUSSM) optical fiber. The number of fibers in cable shall be 12 and 24 fiber counts.

1.5. The primary design consideration of the cable shall protect the optical fibers from environmental and mechanical stresses.

1.6. The cable shall be applied for aerial installation.

1.7. The cable proposed shall be new and its lifetime shall be at least 20 years without any significant deterioration. The Calculation of Optical Fiber life time shall be stated by the bidder

1.8. The cable proposed shall be complying with TIS.2166-2548.

1.9. CABLE shall be designed for hang on distribution transmission line structures of the Provincial Electricity Authority. CABLE shall be constructed and installed for operation under the following conditions:

Climate	tropical
Relative Humidity, non-condensing	up to 95%
Maximum pole span length	80 m
Ambient air temperature	up to 50° C

2. Optical fiber characteristics

2.1 Physical Characteristics

ZDUSSM requirements are defined:

Fiber Description		Zero Dispersion Un-Shifted Single-Mode (ZDUSSM) (Dual Window) ITU-T G.652 D
Fiber	Type	Single mode type
	Material	High Grade Silica
Mode field diameter		9.2 ± 0.6 μm
Mode field concentricity error		Max. 0.6 μm
Cladding diameter		125 ± 1 μm
Cladding non-circularity		Max. 2 %
Coating	Material	UV acrylate
	Diameter	250 ± 15 μm
Fiber tensile strength		In accordance with IEC 60793-1-30, 0.7 Gpa (1%)

2.2 Optical characteristics

Attenuation	at 1310 nm	Max. 0.40 dB/km
	at 1383 nm	Max. 0.35 dB/km
	at 1550 nm	Max. 0.25 dB/km
	at 1625 nm	Max. 0.30 dB/km
Zero dispersion wavelength		1300 ~ 1324 nm
Zero dispersion slope		Max. 0.092 ps/(nm^2.km)
Chromatic dispersion	at 1310 nm	Less than 3.5 ps/(nm.km)
	at 1550 nm	Less than 20 ps/(nm.km)
Cable cut-off wavelength (λcc) or Fiber cut-off wavelength (λc)		Less than 1260 nm or 1100 ~ 1280 nm
Macrobend loss (100 turns, radius : 25 mm) at 1550 nm		Max. 0.1 dB
Polarization mode dispersion (PMD Link Design Value)		Less than 0.2 ps/km$^{1/2}$

Attenuation variation

The attenuation coefficient between 1,285 nm and 1,330 nm shall not exceed the attenuation coefficient at 1,310 nm by more than 0.1 dB/km. The attenuation of the fiber shall be distributed uniformly throughout its length such that there are no point discontinuities in excess of 0.1 dB.

3. Optical fiber cable

The design of the Optical fiber cable shall account for the varying operating and environmental conditions that CABLE shall experience while in service. The construction of the optical fiber cable for access service shall be in accordance with Table 1, Fig. 1 and 2.

Table 1 Construction of optical fiber cable for Anti-Rodent Self-Supporting optical fiber cable

Number of fiber		12	24
Fiber buffer tube	Material	Single layer of polybutylene terephthalate (PBT)	
	Fiber/tube	6	
Filling Compound in buffer tube	Material	Thixotropic Jelly	
The filler	Material	Polyethylene	
	Quantity	3	1
The water blocking materials	Material	Swellable yarn	
Core Covering	Material	Water Blocking Tape	
Additional Strength Member	Material	Aramid yarns	
Core binding	Material	Polyester yarn	
Ripcord	Material	Aramid cords	
	Direction	Two ripcords shall be placed under the armor to be diametrically opposite of each other	
Armor	Material	A corrugated steel tape coated with Polymer on both sides	
	Thickness	Steel tape : Nominal 0.15 mm Polymer: Nominal 0.05 mm	
Outer sheath	Material	UV - proof high density black polyethylene	
	Thickness	Minimum 1.5 mm	
Approx. Cable Diameter		11.5 mm	
Approx. Cable Weight		120 kg/km	

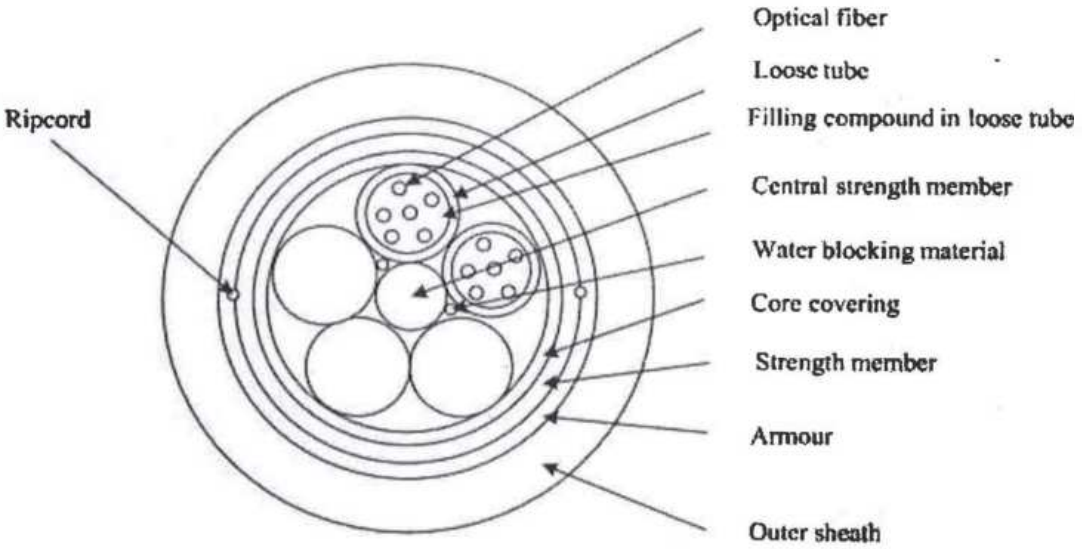

Fig. 1 Cross-section of Anti-Rodent Self-Supporting Optical Fiber Cable

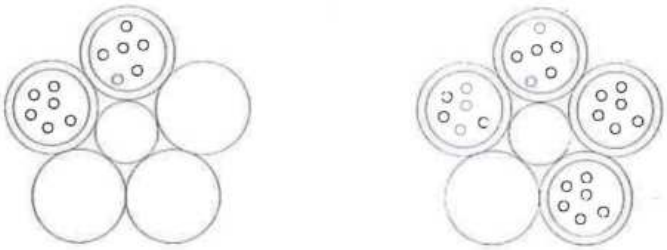

Fig. 2 Cross-section of optical fiber cable core

4. Color coding

The color coding of the optical fiber and loose tube that specified in Table 2 and Table 3 respectively, shall be in accordance with EIA/TIA-598-A (Optical Fiber Color Coding)

Table 2 Identification of optical fiber

Fiber no.	Fiber color
1	Blue
2	Orange
3	Green
4	Brown
5	Slate
6	White

Table 3 Identification of fiber buffer tube

Fiber buffer tube no.	Fiber buffer tube color
1	Blue
2	Orange
3	Green
4	Brown

Table 4 Cable structure

Fiber Capacities	No. of elements by layers		Loose tube x Fiber in loose tube
	Tube	Filler	
12	2	3	2 x 6
24	4	1	4 x 6

5. Mechanical and Environmental Test

The optical fiber cable CABLE has to pass the following list of Mechanical and Environmental Test

Tensile Loading Test

Test Method	: มอก. 2051 - 2543 - E1 or IEC 60794 - 1 - 2 - E1 A
Test Length	: 100 - 200 m
Tensile Loading	: 1,800 N
Period	: At least 1 hour
Criteria	: Attenuation change before, during and after testing shall not exceed 0.05 dB @ 1550 nm and no physical damage : A fiber strain shall not be grater than 0.33 % during and after testing.

Bending Test

Test Method	: มอก. 2051 - 2543 - E11 B or IEC 60794 - 1 - 2 - E11 B
Mandrel Diameter	: 20 x D (D is outer diameter excluding messenger wire)
Number of Cycle	: At least 10 cycles
Criteria	: Attenuation change during and after testing shall not exceed 0.1 dB @ 1550 nm and no physical damage

Crush or Compressive Loading Test

Test Method	: มอก. 2051 - 2543 - E3 or IEC 60794 - 1 - 2 - E3
Test Plate	: 100 mm
Load	: 2,200 N
Position	: At least 3 times at 3 places where not less than 500 mm apart
Period	: At least 10 minute each
Criteria	: Attenuation change during and after testing shall not exceed 0.1 dB @ 1550 nm and no physical damage

Torsion or Twist Test

Test Method	: มอก. 2051 - 2543 - E7 or IEC 60794 - 1 - 2 - E7
Test Length	: 1 m
Mess of Weight	: 4.5 kg
Number of Cycle	: At least 10 cycles
Angle	: ± 180°
Criteria	: Attenuation change during and after testing shall not exceed 0.1 dB @ 1550 nm and no physical damage

Impact Test

Test Method	: มอก. 2051 - 2543 - E4 or IEC 60794 - 1 - 2 - E4
Impact Energy	: 4.4 N.m According to Table 1 for Outside Plant application of : TIA/EIA-455-25C Drop hammer mass and resulting test impact energy
Radius of Hammer Head	: 12.5 mm
Number of Cycle	: Two in 3 different places spaced not less than 500 mm apart
Criteria	: Attenuation change during and after testing shall not exceed 0.1 dB @ 1550 nm and no physical damage

Water Penetration Test

Test Method	: มอก. 2051 - 2543 - F5 B or IEC 60794 - 1 - 2 - F5 B
Height of Water	: 1 m
Cable Length	: 3 m
Period	: At least 24 hour
Criteria	: At the end of holding time, no water shall have leaked from the opposite end of the cable.

Temperature Cycling Test

Test Method : มอก. 2051 - 2543 - F1 or IEC 60794 - 1 - 2 - F1

Number of Cycle : At least 2 cycles

Cycle and Temperature : 1 cycle consists of - 10°C for 16 hours and + 70°C for 16 : hours excluding soaking time

Criteria : Attenuation change during and after testing shall not exceed 0.1 dB/km @ 1550 nm and no physical damage

Flexing Test

Test Method : มอก. 2051 - 2543 - E6 or IEC 60794 - 1 - 2 - E6

Mandrel Diameter : 20 x D (D is outer diameter excluding messenger wire)

Mess of Weight : 4.5 kg

Number of Cycle : At least 10 cycles

Criteria : Attenuation change during and after testing shall not exceed 0.1 dB @ 1550 nm and no physical damage

Table 5 Technical information of the cable

Item		Specification
Minimum Bending radius	During Installation or handling	20 x External Diameter of cable
	During Service or fixed	15 x External Diameter of cable

The bidder must submit the CABLE test report from manufacturer with company seal.

The bidder who failure to comply shall be disqualify.

6. Information Marking

6.1 Cable identification markings:

Alphabet interval 1 meter as detail given below, the characters color shall preferably be white.

- THAI INDUSTRIAL STANDARD logo and words: มอก. 2166-2548
- Property of "UniNet" สำนักงานคณะกรรมการการอุดมศึกษา(สป.อว.)
- Name of manufacturer
- Year of manufacture
- Type and number of cores
- Purchase Contract Number
- Cable length every 1 meter from 0000 to 4000 meters

6.2 Reel markings:

Each side of every reel of CABLE shall be permanently marked in a minimum of 3 cm high white lettering with the following information.

- The vendors' address
- UniNet's destination address
- Cable part number
- Specification as to the type of cable, length, number of fibers, cable segment number, inspection stamp and date.

6.3 Cable drums:

All optical fiber cabling shall be supplied on strong drums provided with lagging of adequate strength, constructed to protect the cabling against all damage and displacement during transit, storage and subsequent handling during installation. Both ends of the cable shall be sealed as to prevent the escape of filling compounds during shipment and handling.

Contractor shall be supplied on all drums in lengths of not less than 4,000 meters/drum for installation and not less than 2,000 meters/drum for spare.

There shall be no factory splices allowed within a continuous length of CABLE. Only one continuous cable length shall be provided on each drum. The lengths of cable to be supplied on each drum shall be determined by a "schedule" prepared by and the responsibility of Contractor.

---------- End Specifications Anti-Rodent Self-Supporting Optical Fiber Cable ----------

Optical fiber cable Installation Hardware

The fittings and accessories described herein are indicative of installation hardware typically used for ADSS CABLE installations and shall not necessarily be limited to the following:

1. **Materials:**

   All suspension clamp, dead end clamp and pipe holding clamp assemblies shall be fabricated from aluminum or aluminum alloy.

2. **Suspension clamp assemblies:**

   Preformed armor grip suspension clamps and rods shall be designed to carry for the safety of the maximum vertical load and shall have a slip strength that is not exceeded the manufacturer maximum rated CABLE load (MRCL) and maximum rated CABLE strain (MRCS).

3. **Dead End clamp assemblies**:

   Dead end clamp assemblies shall allow the CABLE to be continuous pass through without cutting the CABLE. The slip strength shall not be less than the rated tensile strength of the CABLE.

4. **Pipe holding clamp assemblies**:

   Clamp assemblies shall be designed with proper force to hold the down pipe without becoming loose from the tower structure. The clamp assemblies shall locate on the proper places with considerable intervals.

5. **Vibration dampers**:

   CABLE installed on transmission lines which it has a span length over 80meters shall use Spiral Vibration Dampers (if needed) located over the reinforcing rodsof the fittings at suspension and tension points on each span. Determining the exact placement of vibration dampers is belonged to the contractors.

Contractor shall have the responsibility for determining and design, selecting the proper fitting and accessories used for the standard ADSS cable installations of the project.

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Contractor shall have the responsibility for determining and design, selecting the proper fitting and accessories used for the standard ADSS cable installations of the project.

Optical fiber termination and splicing

Splicing of the optical fiber cabling shall be minimized through careful Contractor planning. **There shall be no mid-span splices allowed**. All required splices shall be planned to occur at tower structures or within facilities.

All optical fiber splicing shall be accomplished with fusion splices and each splice shall be fitted with a splice protection sheath. All splices and bare fiber shall be neatly installed in covered splice trays supporting no more than 12 splices each.

(1) Splice enclosures

(A) Suitable splice enclosures shall be provided to encase the optical cable fusion splices in protective, moisture and dust free environment. The splice enclosures shall be compiled with the followings:

IN-LINE CLOSURE FOR OPTICAL FIBER CABLE

(In-line closure for core network)

1. GENERAL

1.1 This specification covers requirement of re-enterable fiber optic splice closure that shall be met to ensure the satisfactory operation of a fiber optic splice closure in outside plant environments.

1.2 This specification contains criteria for fiber optic splice closure which shall be installed in horizontal direction.

1.3 The scope of uses, the closure according to this specification shall be applied to use for covering the spliced fibers of optical fiber cable in core network (may called as "backbone") installing in manhole, direct buried and aerial optical fiber cable network

1.4 Full details of this following information shall be provided in bidding document by bidder. Failure in this item, the proposal shall be disqualified.

- Product specification issued by product manufacturer.
- The material and grade of material used as per Section 3.1 in this specification.

2. GENERAL REQUIREMENTS

2.1 The configuration of the fiber optic cable closure shall be in-line design and allowable for easy re-entry, splicing, assembly and installation as follow: straight joint and branch joint. Dome closure is not concerned in this specification.

2.2 The closure kit shall be easy for handling and installation. The closure shall allow easy fiber access during installation and maintenance.

2.3 The closure shall be able of accepting additional cables without removal of the sheath retention or strength member clamping hardware on previously terminated cables or disturbing existing splices.

2.4 The closure shall be sealed with high quality grade rubber gasket or silicon gasket or equivalent. The cable sealing of closure shall be based on gel-tape or sealing tape technology or equivalent. The heat shrinkable seal system is not allowable.

2.5 The cable port seal shall be non heat shrink seal while the gap between the cable port seal of the closure and the cable shall be tightened by sealing system.

2.6 All small parts of fastener hardware used to assemble the closure body for opening/closing the closure such as nuts, bolts and other assembling hardware etc shall be captivated for preventing accidental loss (connect with housing) and for easy workability during installation and maintenance activities.

2.7 The closure shall be possible to terminate different cable types. The strength members of the cables shall be mechanically attached to the inner hardware of the closure.

2.8 The closure shall at least contain 6 (SIX) entrance port. Each cable ports required shall be capable to accommodate for ADSS cable diameter around 10 – 12 mm. ,DW cable diameter around 8-10 mm. and Figure 8 Armored Aerial Optical Fiber Cable 24 Cores diameter around 13-20 mm.Unused cable ports shall be closed with plugs. At least 1(one) set of the branch off kit accessories (minimum 2 sub cable ports) installing at cable port for distribution cable shall be separately provided.

2.9 The closure shall be capable of accommodating splice organizer which accept fusion splice method. The closure shall have provisions, for storing fiber splices in an orderly and identifiable manner, mountings for splice organizer assembly, and space for fiber access.

2.10 The closure organizer tray shall be 12 fibers per organizer tray and hinge-able parts (or hinging tray).

2.11 All fiber cable elements shall be routed in such a way that no transmission degradation is seen after accessing these cable elements. The minimum bend radius of the fibers after installation shall be 30 mm throughout the whole closure system.

2.12 Installation of the closure shall not require special tool or equipment, other than those normally carried by splicer or craftsman. The closure shall be designed for installation by using

the amount of tool types as less as possible. Tool-less installation and wrench tool of hex flat head bolt/nut are preferably, the insert lock head bolt/nut shall not be allowable.

2.12 The closure shall be provided two self-supporting aerial strand clamps which made from stainless steel. Its clamps shall be capable to accommodate for ADSS cable (no sharp edges, corners, burrs or other hazardous features that could result in damage to the cable)

2.13 The closure shall have no sharp edges, corners, burrs or other hazardous features that could result in damage to the fiber or injury to splicer or craftsman.

2.14 The closure kit shall at least consist of the following components:

a) Closure cover 1 set

b) Fiber splice organizer

c) Clamping for mounting on cable strand 1 set

d) Heat shrink splice protector (Sleeve size 60 mm) with stainless steel reinforced metal rod.

e) Sealing gasket

f) Sealing tape or gel tape or equivalent

g) Buffer tube or transportation tube, if necessary, depending on each manufacturer product design.

h) Cable clamps

i) Alcohol tissue

j) Shield continuity, bonding and external grounding components (Suitable for closure type)

k) Dummy plugs for unused cable port

l) Instruction at least one per closure kit preparing in Thai or English language including:

- Installation and maintenance instruction
- Description how to manage or arrange the fiber inside closure
- Drawings or pictures of fully fiber installed inside closure and finish installed closure related to applications concerned.

3. TECHNICAL REQUIREMENTS

3.1. Material Requirements

3.1.1. Housing or Covers shall be fabricated from black durable high density thermoplastic, which resists to solvents and stress cracking and be compatible with chemicals and other materials used in the various closure applications. This plastic also resists deterioration when exposed to the ultraviolet ray of the sun for long life. Dimension of housing shall be less than 400 x 200 x 130 mm. weight $\leq$2.50 kg.

3.1.2. All gaskets shall be fabricated from high quality grade rubber or equivalent and be compatible with chemicals and other materials to which they might be exposed in normal applications.

3.1.3. Splice tray and tray cover shall be made of polycarbonate or ABS in white or similar color. The black color is not acceptable.

3.1.4. Reinforced metal rod for protective sleeve shall be made of stainless steel.

3.1.5. All outside parts of metallic materials shall be made of stainless steel (304 series grade) such as bolts, nuts, and self stranding clamps.

IN-LINE CLOSURE FOR OPTICAL FIBER CABLE

(In-line closure for Distribute and Last mile network)

1. GENERAL

1.1 This specification covers requirement of re-enterable fiber optic splice closure that shall be met to ensure the satisfactory operation of a fiber optic splice closure in outside plant environments.

1.2 This specification contains criteria for fiber optic splice closure which shall be installed in horizontal direction.

1.3 The scope of uses, the closure according to this specification shall be applied to use for covering the spliced fibers of optical fiber cable in core network (may called as "Distribute or Last mile") installing in manhole, direct buried and aerial optical fiber cable network

1.4 Full details of this following information shall be provided in bidding document by bidder. Failure in this item, the proposal shall be disqualified.

- Product specification issued by product manufacturer.
- The material and grade of material used as per Section 3.1 in this specification.

2. GENERAL REQUIREMENTS

2.1 The configuration of the fiber optic cable closure shall be in-line design and allowable for easy re-entry, splicing, assembly and installation as follow: straight joint and branch joint. Dome closure is not concerned in this specification.

2.2 The closure kit shall be easy for handling and installation. The closure shall allow easy fiber access during installation and maintenance.

2.3 The closure shall be able of accepting additional cables without removal of the sheath retention or strength member clamping hardware on previously terminated cables or disturbing existing splices.

2.4 The closure shall be sealed with high quality grade rubber gasket or silicon gasket or equivalent. The cable sealing of closure shall be based on gel-tape or sealing tape technology or equivalent. The heat shrinkable seal system is not allowable.

2.5 The cable port seal shall be non heat shrink seal while the gap between the cable port seal of the closure and the cable shall be tightened by sealing system.

2.6 All small parts of fastener hardware used to assemble the closure body for opening/closing the closure such as nuts, bolts and other assembling hardware etc shall be captivated for preventing accidental loss (connect with housing) and for easy workability during installation and maintenance activities.

2.7 The closure shall be possible to terminate different cable types. The strength members of the cables shall be mechanically attached to the inner hardware of the closure.

2.8 The closure shall at least contain 4 (Four) entrance port. Each cable ports required shall be capable to accommodate for DW cable diameter around 8-10 mm. Unused cable ports shall be closed with plugs. At least 1(one) set of the branch off kit accessories (minimum 2 sub cable ports) installing at cable port for distribution cable shall be separately provided.

2.9 The closure shall be capable of accommodating splice organizer which accept fusion splice method. The closure shall have provisions, for storing fiber splices in an orderly and identifiable manner, mountings for splice organizer assembly, and space for fiber access.

2.10 The closure organizer tray shall be 12 fibers per organizer tray and hinge-able parts (or hinging tray).

2.11 All fiber cable elements shall be routed in such a way that no transmission degradation is seen after accessing these cable elements. The minimum bend radius of the fibers after installation shall be 30 mm throughout the whole closure system.

2.12 Installation of the closure shall not require special tool or equipment, other than those normally carried by splicer or craftsman. The closure shall be designed for installation by using the amount of tool types as less as possible. Tool-less installation and wrench tool of hex flat head bolt/nut are preferably, the insert lock head bolt/nut shall not be allowable.

2.12 The closure shall be provided two self supporting aerial strand clamps which made from stainless steel. Its clamps shall be capable to accommodate for DW cable (no sharp edges, corners, burrs or other hazardous features that could result in damage to the cable)

2.13 The closure shall have no sharp edges, corners, burrs or other hazardous features that could result in damage to the fiber or injury to splicer or craftsman.

2.14 The closure kit shall at least consist of the following components:

a) Closure cover 1 set

b) Fiber splice organizer

c) Clamping for mounting on cable strand 1 set

d) Heat shrink splice protector (Sleeve size 60 mm) with stainless steel reinforced metal rod.

e) Sealing gasket

f) Sealing tape or gel tape or equivalent

g) Buffer tube or transportation tube, if necessary depending on each manufacturer product design.

h) Cable clamps

i) Alcohol tissue

j) Shield continuity, bonding and external grounding components (Suitable for closure type)

k) Dummy plugs for unused cable port

l) Instruction at least one per closure kit preparing in Thai or English language including :

- Installation and maintenance instruction
- Description how to manage or arrange the fiber inside closure
- Drawings or pictures of fully fiber installed inside closure and finish installed closure related to applications concerned.

3. TECHNICAL REQUIREMENTS

3.1. Material Requirements

3.1.1. Housing or Covers shall be fabricated from black durable high density thermoplastic, which resists to solvents and stress cracking and be compatible with chemicals and other materials used in the various closure applications. This plastic also resists deterioration when exposed to the ultraviolet ray of the sun for long life. Dimension of housing shall be less than 50x220x170 mm. weight 1.2 kg.

3.1.2. All gaskets shall be fabricated from high quality grade rubber or equivalent and be compatible with chemicals and other materials to which they might be exposed in normal applications.

3.1.3. Splice tray and tray cover shall be made of polycarbonate or ABS in white or similar color. The black color is not acceptable.

3.1.4. Reinforced metal rod for protective sleeve shall be made of stainless steel.

3.1.5. All outside parts of metallic materials shall be made of stainless steel (304 series grade) such as bolts, nuts, and self stranding clamps.

WALL MOUNTED FIBER DISTRIBUTION FRAME

1. GENERAL

1.1. This specification covers the requirements of the fiber distribution frame intended to use for cross connection of fiber network

1.2. This FDF shall be designed under indoor environmental condition which used in building. The primary design consideration of the FDF shall protect the optical fiber from environmental and mechanical stresses.

1.3. The fiber patch cord and pigtail used for this FDF specification

1.4. Full details of this following information shall be provided in technical bidding proposal by bidder. Failure in this section the proposal shall be disqualified.

- Product specification and drawings or pictures of all product components
- The material used and grade (or composite material) in detail for all components of product proposed
- Pictures of fully loaded termination of FDF covering housing, patching and splicing area (showing the wiring of splicing tray and connectorized pigtails) and description how to manage or arrange the cables, pigtails and patch cords wiring of FDF .

2. DESIGN AND FEATURE

The wall mounted FDF shall accommodate 12, 24 and 48 fibers and shall at least composed of followings :

- Wall mounted FDF housing
- Splicing area

Splice tray(s)

Bending control devices

- Patching area

Patch panel

2.1. Wall mounted FDF housing

2.1.1. FDF housing shall conform to or exceed IP20 protection level

2.1.2. FDF shall be separated into 2 compartments; a splicing area and a patching area.

2.1.3. FDF housing shall have 2 swing doors and shall be lockable by key which one door shall be used for covering splicing area and another door shall be L-shaped swing design using for covering patching area according to figure 1. Each swing door shall be attached to the housing with an internally positioned hinge.

2.1.4. Splicing area and patching area in the FDF housing shall be provided at least 2 entrance ports at each specified position which the entrance positions shall follow as figure 1. The entrance ports shall be sealed with a solid removable grommet.

2.1.5. The enclosed wall mountFDF shall be as follows:

Fiber capacities	Typical dimension	
	Minimum area (WxH) (mm^2)	Minimum depth (D) (mm)
12	82,350.0	85
24	136,968.0	85
48	136,986.0	140

Thickness (minimum): 1.5 mm

The bidder can propose any dimensions of width and height but its total area (WxH) shall not below than the minimum area (WxH) as specified in table 1.

2.1.6. FDF housing design shall focus on maximum modularity and flexibility to allow easy on-site assembly and to suite with any types of FDF applications.

2.1.7. FDF housing shall be capable of being installed wall mounted. No access from the rear. For safety reason, FDF housing shall be provided the mounting hardware to secure and assure the FDF housing to be firmly installed with building wall or other available structures.

2.1.8. FDF housing shall permit easy access to cables, patch cords and pigtails during installation, maintenance and upgrade without removal the other existing components

and without disturbing the systems already in service.

2.1.9. Optical fiber cables and patch cords shall be organized, stored and mechanically protected in the housing. Provision shall be made for the adequate protection and bend control of cables, patch cords and pigtails throughout the housing (called positive fiber management). A minimum bend radius of 30 mm shall be respected to all bend controls.

2.1.10. All critical bend positions of whole length of patch cord wiring, there shall be bend control devices which have curve surface structure. Hoop or ring or equivalent is not allowable to use for patch cord as such critical bend position.

2.1.11. Protective color coating of the FDF housing shall use powder color coating method with minimum thickness of 50 μm. The other color coatings than powder color coating are not allowable.

2.1.12. Standard kit content of the FDF housing shall be as follows:

1) Pre-mounted fiber wiring management component for all length of cable, OFC loose tube, patch cord, pigtail such as bending control device, etc. The fiber wiring management components shall also be sufficiently installed in cable/OFC tube routing and patch cord routing area.

2) Installation Instructions (at least 1 set)

☐ Fully in details of installation Instruction.

☐ Drawings or pictures of fully loaded termination of wall mounted FDF proposed and description how to manage or arrange the cables, pigtails and patch cords wiring of FDF.

3) Identification strips or marking of manufacturer

4) Identification label/marking/card/card holder and record system to identify the cables, patch cords, pigtails, fibers, station route and caution sign etc.

5) Cable termination system for instance: cable attachment plate with cable clamp and strength member fixations

6) Flexible tubing, transportation (protection) tube etc.

7) Wall mounting kit.

2.1.13. The bidder can propose the different design from as specified in figure 1 which can be proved that having better performance and easier operation.

2.2 Splicing Area

2.2.1. The splicing area as defined in this specification shall consist of splice tray holder and splice trays. The splicing components shall be designed to be mounted in FDF housing.

2.2.2. The appearance of product shall be precise, elaborate and none of deformation, sharp edge, crack, scratch, flaw, stain and burr. Its functionality shall be easy for operation.

2.2.3. The splice tray shall provide mechanical protection and storage of pigtails, fibers, splices, connectors and other passive optical devices in FDF housing.

2.2.4. The splice tray shall be designed to allow the accommodation of the fibers with a minimum bend radius of 30 mm throughout the whole system after installation.

2.2.5. The splicing organizer tray shall be hinge-able parts (or hinging tray) and accommodate the single splices up to 12 fibers per organizer tray. The tray holder belt or equivalent shall be also provided.

2.2.6. The splicing components mounting design shall focus on maximum modularity and flexibility to allow easy on-site assembly and to suite with any types of FDF applications.

2.2.7. The splice protection sleeve holder/slot of the splice tray shall be able to hold the spliced fibers securely and shall not be loose at either vertical or horizontal alignment of the splice tray.

2.2.8. The bidder can propose the different design from as specified above which having better performance and easier-operation and it shall then be acceptable with requiring to maintain the maximum capacity 12 fibers/tray and shall able to be mounted in FDF housing.

2.3 Patching Area

The patching area as defined in this specification shall be required as follows:

General Requirements

2.3.1. The appearance of product shall be precise, elaborate and none of deformation,

sharp edge, crack, scratch, flaw, stain and burr. Its functionality shall be easy for operation.

2.3.2. The patch panel shall be designed to be securely mounted in FDF housing. Patch panel mounting kit shall be provided.

2.3.3. The patch panel shall be designed for easy operation to access the connector for patching or other maintenance activities.

2.3.4. Protective color coating of the patch panel shall use powder color coating method with minimum thickness of 80 μm. The other color coatings than powder color coating are not allowable.

2.3.5. The whole patch panel area should be in same background color.

Specific Requirements

2.3.6. **In case of FC/UPC connector used,**

1) Through adaptor shall be the standard D-shaped, ceramic alignment sleeve. It shall be allow terminating with the same standard connector type of the manufacturer.

2) The patch panel hole for through adaptor shall be the standard D shape. To be easily accessed for patching and maintenance.

3) The minimum hole spacing of through adaptor (measured from center to center) in horizontal and vertical interval shall be 25 mm and 19 mm respectively. The minimum spacing below bottom row shall be 24 mm when measured up to center of the lowest row hole of the through adaptor. The minimum spacing between the last column hole and the inner edge of the patch panel shall be 24 mm as shown in figure 2. The spacing shall be designed based on easy-access to all connectors.

4) The patch panel capacity shall be equipped with through adaptor required according to table 2 (Ordering Information) which accommodate 12 fibers (6 rows x 2 columns), 24 fibers (6 rows x 4 columns or 12 rows x 2 columns) or maximum 48 fibers (12 rows x 4 columns). Running fiber count pattern shall be as per figure 2.

2.3.7. **In case of SC/UPC connector used,**

1) Through adaptor shall be the standard square shaped, ceramic alignment sleeve. It shall be allow terminating with the same standard connector type of the manufacturer.

2) The patch panel hole for through adaptor shall be the standard square shaped. To be easily accessed for patching and maintenance.

3) The minimum hole spacing of through adaptor (measured from center to center) in the vertical interval shall be 25 mm which the horizontal interval shall be depends on the manufacturer design. The minimum spacing below bottom row shall be 24 mm when measured up to center of the lowest row hole of the through adaptor. The minimum spacing between the last column hole and the inner edge of the patch panel shall be 24 mm as shown in figure 3. The spacing shall be designed based on easy-access to all connectors.

4) The patch panel capacity shall be equipped with through adaptor required according to table 2 (Ordering Information) which accommodate 12 fibers (6 rows x 2 columns), 24 fibers (6 rows x 4 columns or 12 rows x 2 columns) or maximum 48 fibers (12 rows x 4 columns). Running fiber count pattern shall be as per figure 3. The number of columns can be different from as specified but each row shall be in even number of through adaptor.

3. MATERIAL REQUIREMENTS

3.1. Housing

3.1.1. Material: made of metal material shall be steel or aluminum or equivalent.

3.1.2. Housing thickness shall not be less than 1.5 mm

3.2. Splicing and patch panel area

3.2.1. Tray: Polycarbonate, PBT or ABS

3.2.2. Through adapter : Ni (nickel) plated brass or stainless steel (300 series grade) or better corrosion resistance material for metal part, and ceramic alignment sleeve.

3.2.3. Patch panel: made of same FDF housing material.

3.3. All metal hardware and metal part shall be resistant to the corrosive influences

they may encounter in normal use.

4. PERFORMANCE REQUIREMENTS

4.1. Through Adaptor Endurance

Each side of through adaptor shall be terminated and re-terminated with standard connector. Each side of through adaptor shall withstand a minimum mating/demating of 500 times after test check the appearance (as specified below). The attenuation and return loss change per connector before and after test shall be less than 0.2 dB and 2 dB respectively when used the 1310, 1550 nm source wavelength.

The appearance: the sample shall be examined with naked eyes for damage and the sample shall not appear the deformation, flaws, defects or cracks that could impair functionality.

4.2. FDF housing door Endurance

Each side of the FDF housing door shall be opened to its extreme position. This door shall then be closed again into its extreme position. This sequence shall be repeated 500 cycle times.

5. PRODUCT MARKING AND IDENTIFICATION

5.1. All major component of wall mounted FDF shall be marked with manufacturer trademark or name.

5.2. Identification label/marking/card/card holder and record system for fiber routing, fiber count number or other necessary sign or detail in whole wall mounted FDF area shall be provided.

6. ORDERING INFORMATION

Table 2

Product Type	Capacity(fibers)	Packing
Wall mounted FC/UPC 12F	12	1 set/box
Wall mounted FC/UPC 24F	24	1 set/box
Wall mounted FC/UPC 48F	48	1 set/box
Wall mounted SC/UPC 12F	12	1 set/box
Wall mounted SC/UPC 24F	24	1 set/box

Wall mounted SC/UPC 48F	48	1 set/box

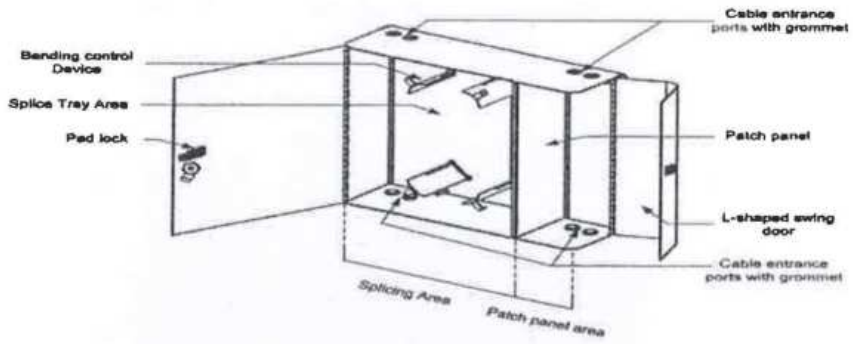

Figure 1 An example of a wall mounted FDF housing design

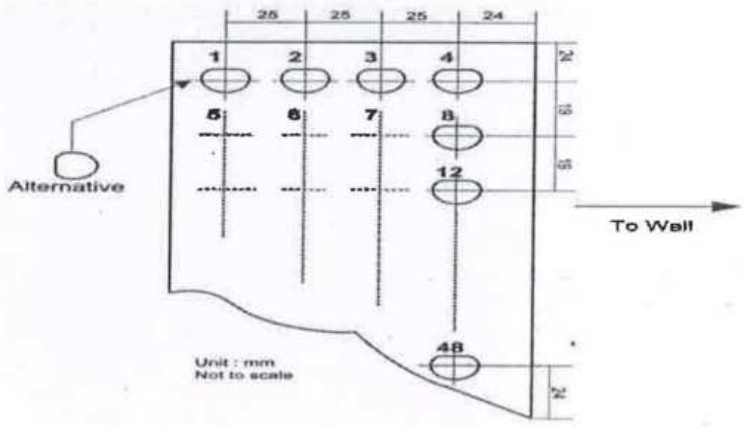

Figure 2 Typical FC patch panel of wall mounted FDF 48F (12 rows x 4 columns) (minimum spacing required)

FIBER DISTRIBUTION FRAME (FDF) FOR EXCHANGE

(FDF for Exchange)

1. GENERAL

1.1. This specification covers the requirements of the fiber distribution frame (FDF) to be supplied intended to use for cross connection of fiber network in building.

1.2. This FDF shall be designed under indoor environmental condition which used in building. The primary design consideration of the FDF shall protect the optical fiber from environmental and mechanical stresses. The FDF required as this specification shall be in accordance with figure 1 to 3 or better design.

1.3. The fiber patch cord and pigtail used for this FDF specification shall be according to patch cord and pigtail specification.

1.4. Full details of this following information shall be provided in technical bidding proposal by bidder. Failure in this section the proposal shall be is qualified.

- Product specification and drawings (or pictures) of all product components issued by manufacturer.

- The material used and grade (or composite material) in detail for all components of product proposed.

- Pictures of fully loaded termination of FDF covering the rack, patching/splicing shelf (showing the wiring of splicing tray, connectorized pigtails, through adaptors and patch cords) and description how to manage or arrange the cables, pigtails and patch cords wiring of FDF.

2. Design and Feature

FDF required in this specification shall at least compose of followings:

- FDF Rack (herein after referred to as the "Rack") :
  - Enclosed Rack (Rack with cabinet), 19" rack size (482.6 mm)
  - Part of optical fiber cable (OFC) routing and OFC loose tube routing
  - Part of excess patch cord storage and patch cord routing

- Shelf Units (or may called sub-rack).
    - Patching/splicing shelf

The FDF proposed shall be designed in accordance with figure 1 (Dimension and allocation of FDF).

2.1. **FDF Rack**

2.1.1. The rack shall be the metal rack and shall be compliant with ETSI specification ETS 300 119-2 (Engineering requirement for rack and cabinet). The rack shall be enclosed in cabinet with swing double doors and meet the IP20 protection level according to IEC 60529. Its double doors shall be lockable, transparent and removable/re-assembling.

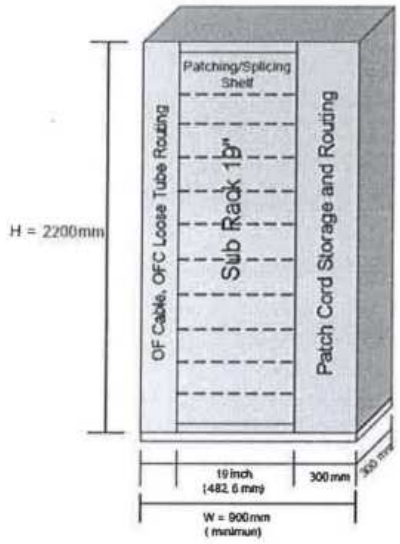

Figure 1 Dimension and allocation of FDF

2.1.2. The size of the enclosed rack shall be as follows:

- Height: 2,200 mm
- Width: 900 mm (minimum)
- Depth: 300 mm

2.1.3. The rack design shall focus on maximum modularity and flexibility to allow easy on-site assembly and to suite any kind of FDF application.

2.1.4. The rack shall be capable of being installed back to back, side to side or against the wall. No access from the rear or from either side. Since this is the floor type rack and 2.2 meters height for safety reason, the rack shall be provided the mounting hardware to secure and assure the FDF firmly installed with building floor or other available structures.

2.1.5. The rack shall have complete flexibility in patching from one side of the rack to the other, without the need to pre-calculate the individual cable lengths. Storage of excess length of patch cords shall be provided.

2.1.6. The rack shall permit easy access to cables, patch cords and pigtails during installation, maintenance and upgrade without removal the other existing shelf and without disturbing the systems already in service. The rack shall be only accessible from the FDF front side.

2.1.7. Optical fiber cables and patch cords shall be organized, stored and mechanically protected in the rack. Cables and patch cords shall be able to enter from the top or the bottom of the rack. Provision shall be made for the adequate protection and bend control of cables, patch cords and pigtails throughout the rack (called positive fiber management). A minimum bend radius of 30 mm shall be respected to all bend controls.

2.1.8. All critical bend positions of whole length of patch cord wiring, there shall be bend control devices which have curve surface structure. Hoop or ring or equivalent is not allowable to use for patch cord as such critical bend position.

2.1.9. Each individual units, its front panel controls and indicators shall be properly identified by simple symbols or labels in English or Thai.

2.1.10. The free location in rack or shelf units (for future extensions) shall be fitted with dust covers or dummy panels in order to prevent the shelf units from dust and improve the equipment appearance.

2.1.11. Protective color coating of the rack shall use powder color coating method with minimum thickness of 50 μm. The other color coatings than powder color coating are not allowable.

2.1.12. The rack (part of OF cable and OFC loose tube routing) shall be designed to allow the accommodation of the incoming/outgoing OFC up to 12 cables. The incoming/outgoing cable shall be handled by the break out unit to ensure the cable protection/management in between the rack unit to sub-rack unit. The incoming/outgoing cable shall be fitted into a cable attachment plate with cable clamp and then the cable loose tubes shall be distributed by cable break out unit device into the flexible tube before get into the shelf unit (splicing/patching shelf). All hardware concerned in this section shall be sufficiently provided to accommodate the in-out OFC as specified.

2.1.13. Standard kit content of the FDF rack shall be as follows:

1) Enclosed rack

2) Pre-mounted fiber wiring management component for all length of cable, OFC loose tube, patch cord, pigtail such as patch guide, patch drum, patch drum plate, cable hoop, bending control device etc. The fiber wiring management components shall also be sufficiently installed in cable/OFC tube routing and patch cord routing area.

3) Installation Instructions (at least 2 sets/FDF)

• Fully in details of installation Instruction.

• Drawings or pictures of fully loaded termination of FDF proposed and description how to manage or arrange the cables, pigtails and patch cords wiring of FDF.

4) Identification strips or marking of manufacturer

5) Identification label/marking/card/card holder and record system to identify the cables, patch cords, pigtails, fibers, station route and caution sign etc.

6) Cable termination system for instance: cable attachment plate with cable clamp, cable break out unit including cable gland and strength member fixations. The termination system component quantity shall also be sufficiently provided as specified.

7) Flexible tubing, transportation (protection) tube etc.

8) Earthing facility: connection of the metal parts to each other and a connection point to the building earthing, at least one (1) earthing point shall be provided in the rack, all metallic parts of the rack shall be electrically interconnected with this earthing point.

9) Cable shield ground facility

2.2. **Shelf Units**

The shelf units (may called sub-rack or patching/splicing shelf) as defined in this specification shall be required as follows:

General Requirements

2.2.1. The shelf units shall be of plug-in type and designed to be mounted in FDF rack (19") as specified in section 2.1.

2.2.2. The shelf unit requirement shall be the drawer (slide out) type or swing type. The splice magazine type or the connector module type is not allowable for this specification.

2.2.3. Manufacturing process and assembly of all shelf unit components shall use international industry standard. The appearance of product shall be precise, elaborate and none of deformation, sharp edge, crack, scratch, flaw, stain and burr. Its functionality shall be easy for operation.

2.2.4. Protective color coating of the shelf unit housing shall use powder color coating method with minimum thickness of 50 μm. The other color coatings than powder color coating are not allowable.

2.2.5. The whole patch panel area and front cover at the front side of shelf should be in same background color.

2.2.6. The patching/splicing shelf shall be designed to put in the same shelf unit together, herein after called "patching/splicing shelf".

2.2.7. The patching/splicing shelf shall provide mechanical protection and storage of pigtails, fibers, splices, connectors and other passive optical devices in FDF rack.

2.2.8. Through adaptor shall be ceramic alignment sleeve. It shall allow to terminate with the same standard connector type of the other manufacturer.

2.2.9. The shelf shall be designed to allow the accommodation of the fibers with a minimum bend radius of 30 mm throughout the whole system after installation.

2.2.10. Each patching/splicing shelf unit shall be fully covered with front cover (identification plate) when the shelf is in the extreme close position. Its front cover shall be hinge-able cover and inside of cover there shall be the label to note the fiber, routing details related to each fiber adaptor position on patching panel.

2.2.11. The splicing organizer tray shall be hinge-able parts (or hinging tray) and accommodate the single fusion splices up to 12 fibers per organizer tray and support the heat shrink splice protector (Sleeve size 60 mm). The tray holder belt shall be also provided.

2.2.12. The spacing on the pigtail side between the through adaptor and the splicing tray or fiber management devices, the spacing between those shall be kept the enough space to conveniently access all through adaptors, connectors and pigtails.

2.2.13.**In case of FC/UPC connector used,**

1) Each patching/splicing shelf capacity shall be equipped with through adaptor up to maximum 48 fibers (4 rows x 12 columns) and running fiber count as per figure 3

2) The patching panel shall be designed to be easy-removable to change the through adaptor from FC/UPC to be SC/UPC or LC without changing the major part of the shelf unit.

3) The patching panel hole for through adaptor shall be the standard D-shape. To be easily accessed for patching and maintenance, the minimum hole spacing of through adaptor (measured from center to center) in horizontal and vertical interval shall be 25 mm and 19 mm respectively. The minimum spacing below bottom row shall be 24 mm when measured up to center of lowest row hole of through adaptor hole as shown in figure 3.

2.2.14.**In case of SC/UPC connector used**

1) Each patching/splicing shelf capacity shall be equipped with through adaptor up to maximum 72 fibers (6 rows x 12 columns or other better allocations) and running fiber count as per figure 4.

2) The patching panel shall be designed for easy operation to access the connector for patching or other maintenance activities. The minimum spacing between through adaptors shall be in accordance with figure 4, except for the vertical spacing shall depend on manufacturer design based on easy-access to all connectors.

Specific Requirements

2.2.16. Design concept of patching access shall be only the front patching which is classified to be the shelf units as follows:

1) Drawer (slide out) type (as shown in figure 2)

2) Pivot or swing type (as shown in figure 3)

The bidder shall not propose combination of those two design concepts in one FDF. If not otherwise specified in TOR (Term of Reference), each bidder shall be able to propose both design concepts and bidding evaluation committee will considerate the design concept proposed to make decision what design concept should be selected.

2.2.17. **In case of shelf unit with drawer (slide out) type proposal**

1) The shelf unit design in general shall be referred to figure 2 for guideline.

2) The patching/splicing shelf unit shall consist of chassis with drawer and accommodate the mounting bracket for splicing trays, pigtail bend control devices, patching panel and identification front plate etc.

3) The patching/splicing shelf functionality shall be easy for operation. The drawer tray shall be securely locked by itself with the chassis while the drawer is opened by sliding out to its extreme position in order to prevent the shelf dropping down and also when the drawer tray is closed by sliding into its extreme position the drawer tray shall be securely locked by itself with the chassis.

2.2.18. **In case of shelf unit with pivot or swing type proposal**

1) The shelf unit design in general shall be referred to figure 2 for guideline.

2) The patching/splicing shelf unit shall at least consist of chassis with swing mechanism system, splicing trays, pigtail bend control devices, patching panel and identification front plate etc.

3) The patching/splicing shelf functionality shall be easy for operation. The drawer tray shall be securely locked by itself while the drawer is opened by swing out (swing to right side of operator) to its extreme position (90 degree) in order to prevent the shelf moving and also when the drawer tray is closed by sliding into its extreme position the drawer tray shall be securely locked by itself.

4) The patching/splicing shelf shall be designed to support the full load of its application without obstruction to swing-out and swing the patching/splicing shelf. The swing mechanism system shall be installed to strengthen the supporting of shelf-weight and its loads through the product service life.

2.2.19. The bidder can propose the different patching/splicing shelf design from as specified above which having better performance and easy operation than requirements in this specification and it shall then be acceptable requiring to maintain the maximum capacity of 48 fibers/shelf and 72 fibers/shelf within 3U (maximum)height shelf for FC and SC connector respectively.

3. Material Requirements

3.1. Rack

3.1.1. Material: made of metal material shall be steel or aluminum or equivalent. Non-metal material shall be allowable.

3.2. Shelf Units

3.2.1. Patching/Splicing shelf

1) Drawer: metal material chassis shall be steel, aluminum or equivalent and non-metal material shall be allowable.

2) Tray: Polycarbonate, PBT or ABS

3) Through adaptor: Ni (nickel) plated brass or stainless steel (300series grade) or better corrosion resistance material for metal part, and ceramic alignment sleeve.

3.2.2. Dummy panel (if any)

1) Drawer: metal material shall be steel, aluminum or equivalent and non-metal material shall be allowable.

3.3. All metal hardware and metal part shall be resistant to the corrosive influences they may encounter in normal use.

4. Product Marking and Identification

4.1. All major component of FDF shall be marked with manufacturer trademark or name.

4.2. Identification label/marking/card/card holder and record system for fiber routing, fiber count number or other necessary sign or detail in whole FDF area shall be provided.

5. Ordering Information

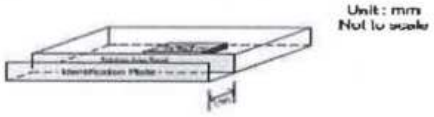

Figure 2 typical patching/splicing shelf unit

* Note : This figure 2 intend to explain the spacing between a patching panel and an identification plate and guide the general design of patching/splicing shelf.

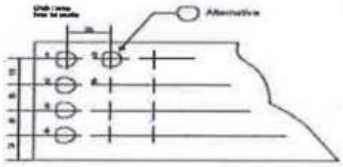

Figure 3 Typical FC patch panel of shelf unit (minimum spacing required)

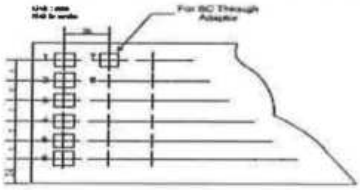

Figure 4 Typical SC patch panel of shelf unit (minimum spacing required)

SINGLE MODE FIBER PATCH CORD AND PIGTAIL

(FC/UPC, SC/UPC, LC/UPC)

1. GENERAL

1.1. This specification covers the requirements of the standard patch cord and pigtail to be supplied

1.2. The patch cord shall be used for optical fiber jump ring between FDF (Fiber Distribution Frame) on patching panel and equipment. The pigtail application shall be used to splice at non-connector end with incoming cable and another end of pigtail coupling with connector shall be terminated to patching panel of FDF.

1.3. This patch cord and pigtail shall be designed under indoor environmental condition which used in building. The primary design consideration of the cable shall protect the optical fiber from environmental and mechanical stresses. The patch cord and pigtail required as this specification shall be in accordance with Figure 1 to 17.

1.4. Abbreviation;

FC/UPC: Fiber Connector / Ultra polished Physical Contact.

SC/UPC: Subscription channel Connector / Ultra polished Physical Contact.

LC/UPC: Lucent / ultra polished Physical Contact.

1.5. Full details of this following information shall be provided in technical bidding proposal by bidder, Failure in this Section (1.4) the proposal shall be disqualified.

- Product specification issued by manufacturer including specification of fiber cord, pigtail, connector kit etc.

- The material used and grade (or composite material) in detail for all components of product proposed.

2. Specific Requirements

The patch cord and pigtail shall compose of fiber cord (cable) and connector kit assemblies as shown in Figure 1 to Figure 17.

2.1. Fiber Cord requirements

2.1.1. Fiber Characteristics

All fiber characteristics of the fiber cord shall be, at least, in accordance with the ITU-T Recommendation G.652.D, Single Mode Optical Fiber Cable and shall be as follows.

Cladding Diameter: 125 μm ±1μm

Core-Clad Concentricity Error: $\leq$ 0.5 μm

Cladding Non-Circularity: $\leq$ 1.0%

Mode Field Diameter @ 1310 nm: 9.2 μm ± 0.4μm

Cable Cut-Off Wavelength (λcc): $\leq$ 1260 nm

Attenuation Coefficient:

$\leq$ 0.35 dB/km @1310 nm

$\leq$ 0.35 dB/km @1383 nm

$\leq$ 0.21 dB/km @1550 nm

$\leq$ 0.23 dB/km @1625 nm

Maximum Attenuation with -

macrobending 2 turns 30 mm radius: $\leq$ 0.10 dB @1550 nm

2.1.2. Fiber Cord Physicals

Structure & Materials:

Outer jacket and boot: Polymer or polyethylene (PE) filled with FR (Flame Retardant, UL94-V0),or LS(Low smoke) and ZH(Zero Halogen or Halogen Free), fiber cord jacket overall diameter of FC, SC and LC shall be 2.4 mm, 2.0 mm and 2.0 mm respectively, boot shall be designed to be applicable for cord strain relief.

Jacket color: Yellow.

Boot color: Yellow for FC /UPC, Blue for SC/UPC and Grey for LC/UPC

Strain relief: Aramid yarns (fully completely cover around the tight buffer, no adhesion to jacket or buffer tube), as Figure 1.

Tight buffer tube: Jelly free, tight buffer tube ∅ 900μm (0.9 mm), non-bucking, made from TPE (Thermo plastic elastomer) or PBT (Polybutylen

terephthalate) or PA (Polyamide) or equivalent, filled with FR (Flame Retardant, UL94-V0), in Yellow color.

2.2. Connector Kit Assembly Requirements

Connector kit assembly shall be at least composed of followings:

FC/UPC:	connector body (housing), strain relief crimp, connector key, ferrule and dust cap (cover).
SC/UPC, LC/UPC:	connector body (housing), connector subassembly, strain relief crimp, ferrule and dust cap (cover).

Note: In case of duplex connector (SC, LC), the connector body (housing) shall be duplex clip connector.

2.2.1. Materials

1) Metallic materials

All metallic parts of connector kit assembly shall be resistant to the corrosive influences they may encounter in normal use. If stainless steel used, it shall be made of 300 series stainless steel or better corrosion resistance material. The metallic part of galvanized steel or other steel materials that have corrosion resistance property lower than 300 series stainless steel are not allowable.

2) Plastic materials

All plastic parts of connector kit assembly (except dust cap) shall be made of flame retardant material.

2.2.2. Specific materials

1) FC/UPC

Connector body:	Ni (nickel) plated brass or stainless steel (300 series grade) or better corrosion resistance material.
Ferrule:	Zirconia Ceramic.

2) SC/UPC,LC/UPC

Connector body:	PBT material with Flame Retardant or equivalent plastic material.
Ferrule:	Zirconia Ceramic.

3 Marking

3.1 The patch cord shall be marked on the connector or the boot or the fiber cord (jacket) with manufacturer's name or trademark.

3.2 The patch cord jacket shall be provided length marking at intervals of approximately 1 meter along the whole patch cord length. The accuracy of the measurement of length marking shall be held within the limits of ±1%.

3.3 The patch cord jacket identification marking. Each length marking interval, the identification marking shall be permanently identified as the followings:

- Customer name
- Manufacturer name or trade mark
- Date month and year (C.E) of fiber cord manufacture or finished product manufacture
- Type of fiber and jacket, O.D. such as SMOF … PE-FR-LS-ZH, O.D. etc.

3.4 For traceability purpose, necessary information shall be placed on the patch cord for instance: - the trace label etc.

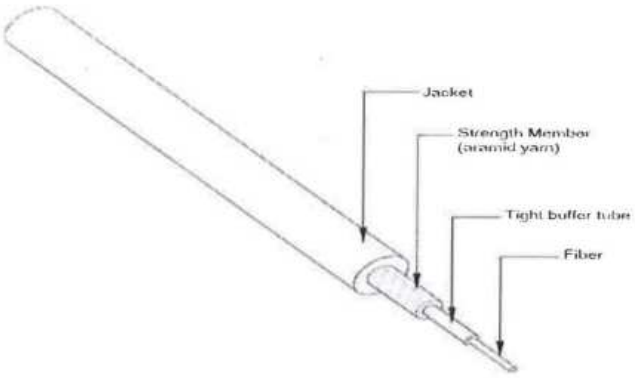

Figure 1 Cable Structure of Single Mode Fiber Patch Cord

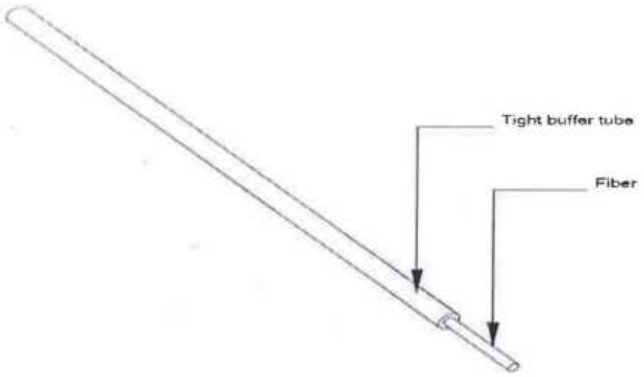

Figure 2 Cable Structure of Single Mode Fiber Pigtail

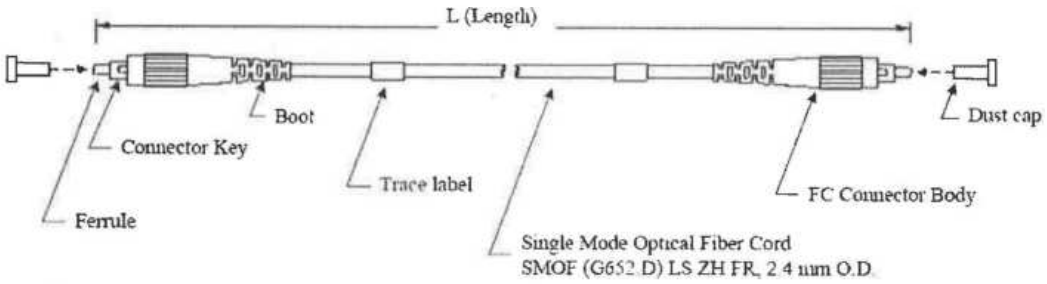

Figure 3 FC to FC Single Mode Fiber Patch Cord

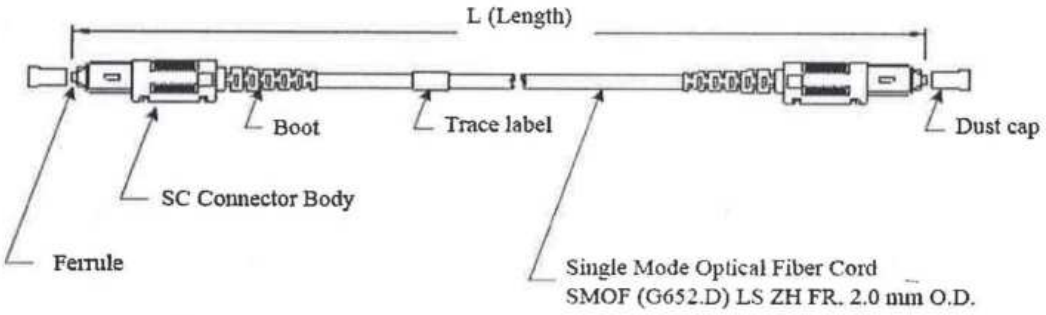

Figure 4 SC to SC Single Mode Fiber Patch Cord

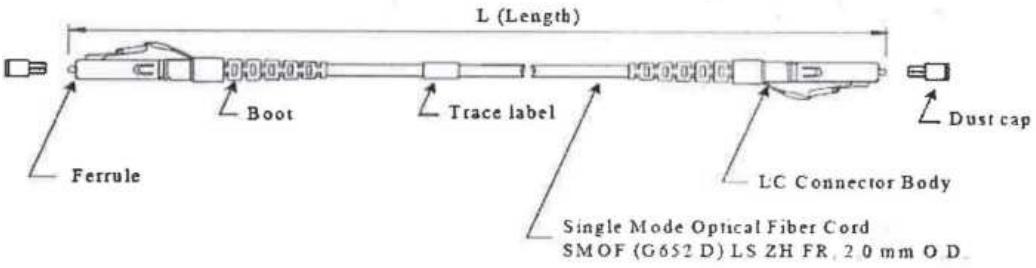

Figure 5 LC to LC Single Mode Fiber Patch Cord

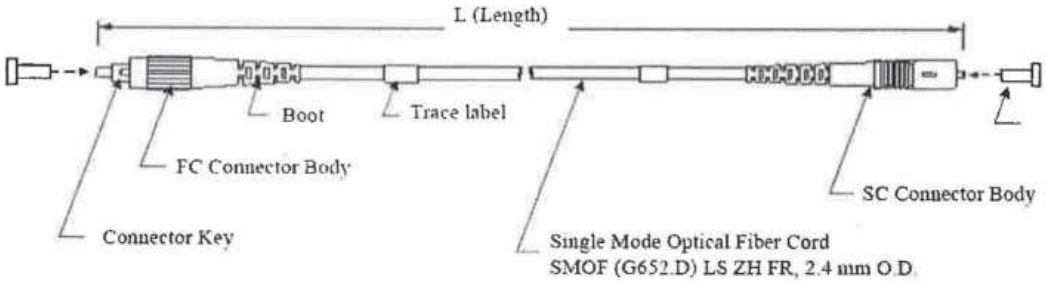

Figure 6 FC to SC Single Mode Fiber Patch Cord

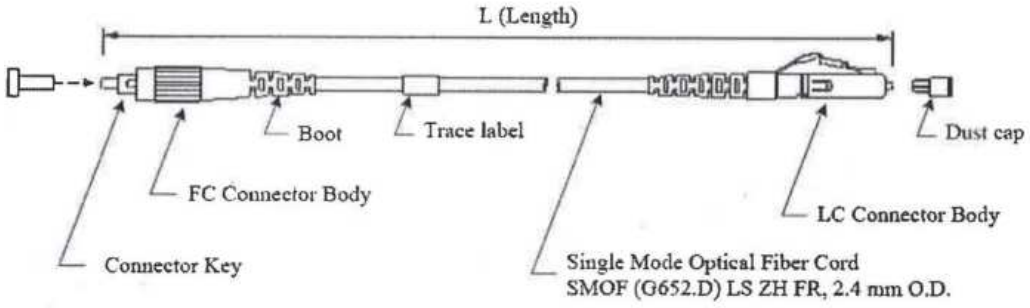

Figure 7 FC to LC Single Mode Fiber Patch Cord

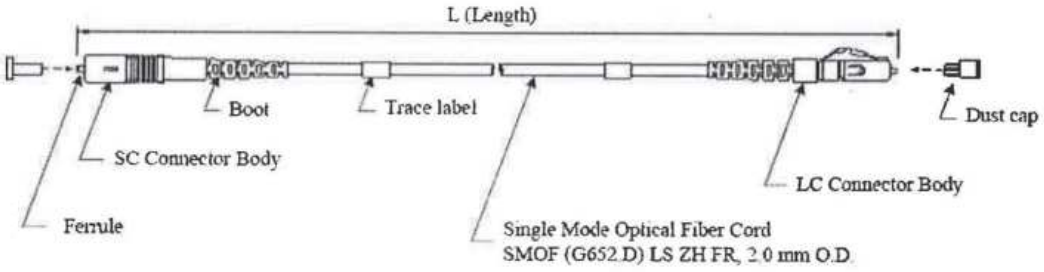

Figure 8 SC to LC Single Mode Fiber Patch Cord

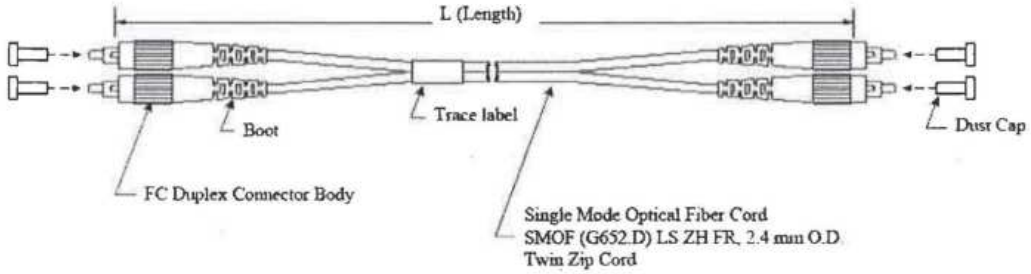

Figure 9 FC to FC Single Mode Fiber Patch Cord Duplex

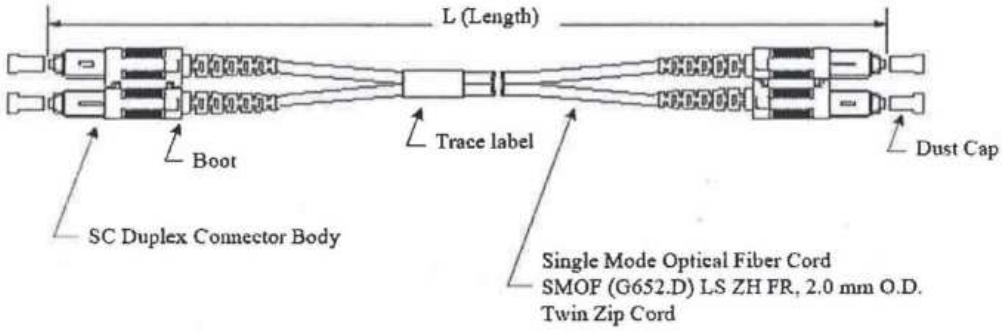

Figure 10 SC to SC Single Mode Fiber Patch Cord Duplex

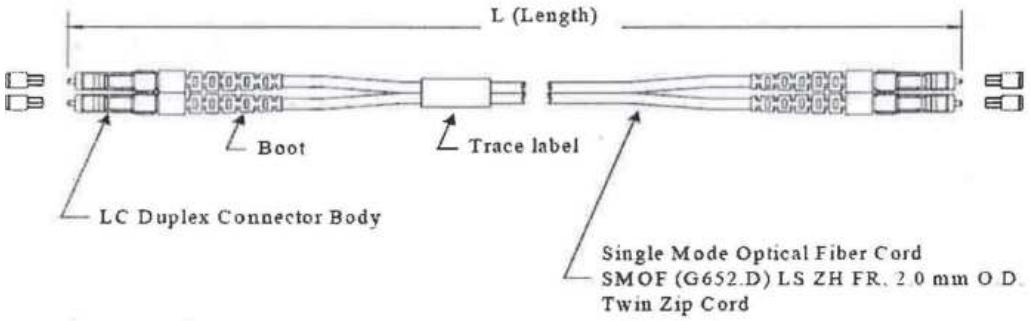

Figure 11 LC to LC Single Mode Fiber Patch Cord Duplex

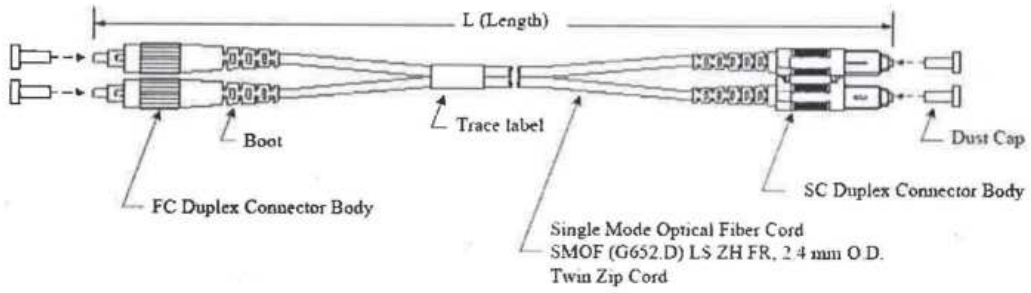

Figure 12 FC to SC Single Mode Fiber Patch Cord Duplex

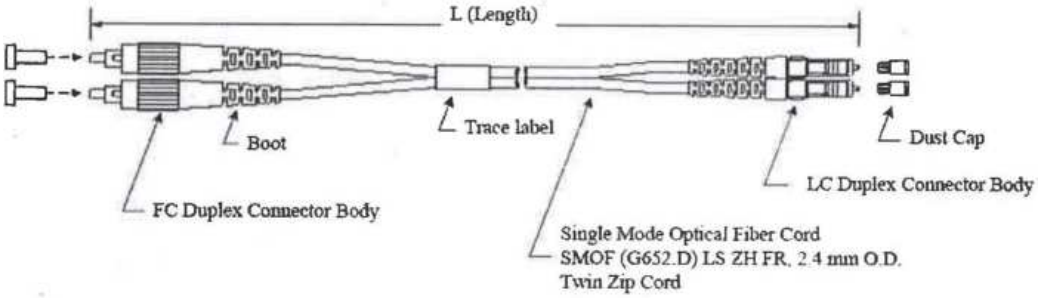

Figure 13 FC to LC Single Mode Fiber Patch Cord Duplex

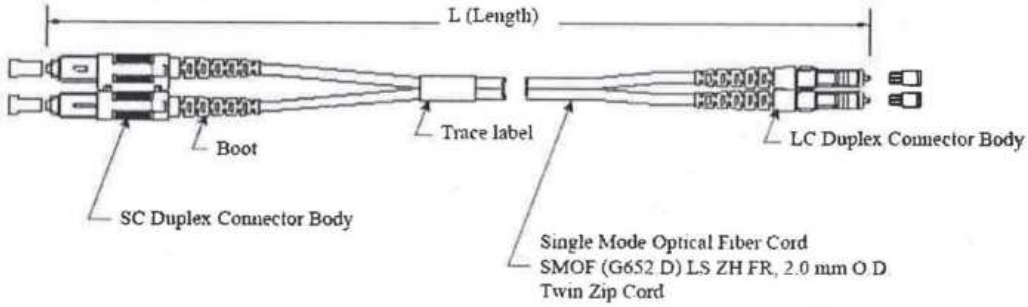

Figure 14 SC to LC Single Mode Fiber Patch Cord Duplex

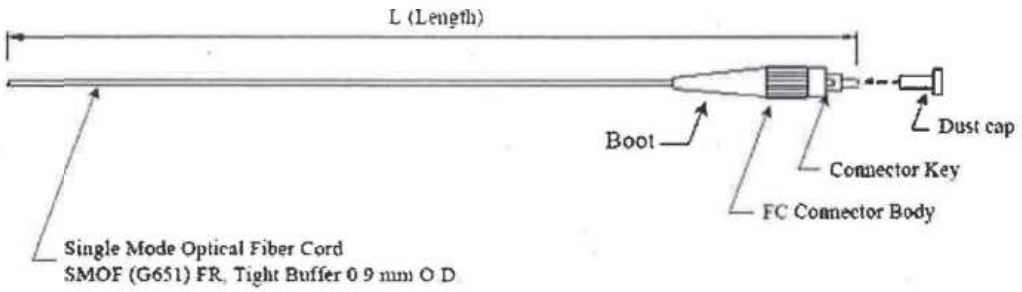

Figure 15 FC Single Mode Fiber Pigtail

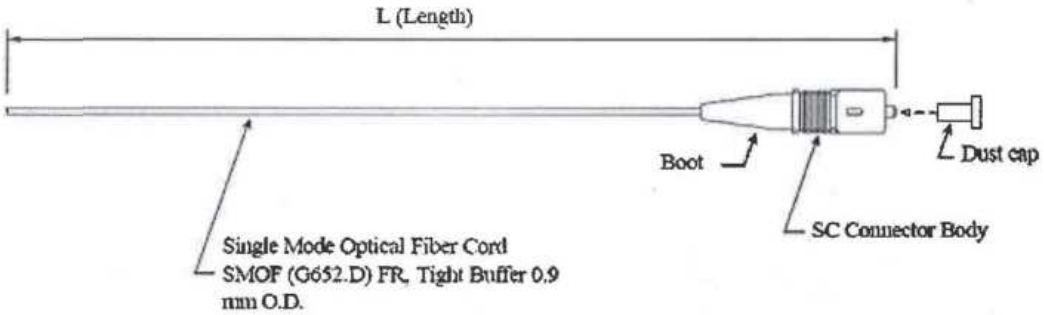

Figure 16 SC Single Mode Fiber Pigtail

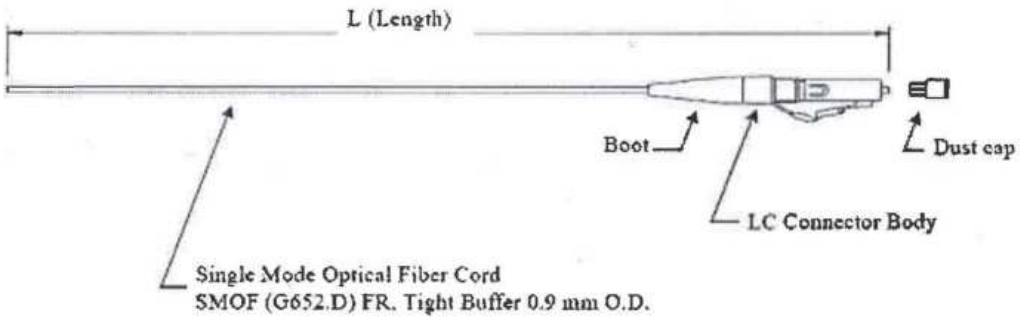

Figure 17 LC Single Mode Fiber Pigtail

เอกสารแนบ 4 ข้อกาหนดการบำรุงรกษาส่วนสนบสนุนการบริหารจดการบำรุงรักษาโครงข่าย

บริหารเทคโนโลยีสารสนเทศเพอพฒนการศึกษา (UniNet)

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