Document Number: NTA-Wireline Standard-Underground-August, 2019

Draft Standard for Underground Laying of Optical Fibre Cable

Draft Version 1.0

August 16, 2019

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Change History

The following table shows the change history for this standard documentation.

	Document Revision History							
Created / Revised By	**Effective Date**	**Version**	**Change Details**	**Reviewer's Name**	**Role**	**Approver's Name**	**Approval Date**	**Role**

1. Overview

1.1 Scope and purpose

This document is intended to assist Nepal Telecommunications Authority (NTA) in designing the standards for laying of Underground cables, with the scope and purpose listed below:

Scope: This document describes the standard set of guidelines for Underground installation of optical fibre cables.

Purpose: To provide clarity and consistency on strengthening of wireline network in Nepal. This documentation is developed for the regulator, and to facilitate the telecom and broadcasting service providers for underground laying of optical fibres across regions with respect to the terrain/ geography.

Standard clauses:
Document contents shall be finalised post buy-in from the management of the regulator/ agency or office requests or the one who requires the document. However, the structure of a few clauses and annexes that appears in standard documentation shall take the form as described below.

- Clause 1. Overview shall be the first clause and shall start with scope and purpose sub clauses
- Clause 2. References shall be the second clause, edited as appropriate
- Clause 3. Definitions and notation shall be the third clause, edited as appropriate
- Clause 4. This will comprise of the main sections and sub-sections of the standard covering every aspect of scope
- Annexures- (informative) shall appear in every document

1.2 Front Page Parameters

The process of updating parameters on the cover page and on the page headers is described in Table 1.1.

Table 1.1- Front page parameters

Description	Text parameter	Update procedures
Document Number:	NTA-WirelineStandard-Underground-Aug'19	Contact XXXX team in NTA and update the "Document number" as and when required.
(title)	Draft Standard for Underground Cable Laying	Contact XXXX team in NTA and update the "Title" as and when required.
Draft	1.0:00	Contact XXXX team in NTA and update the "Subject" as and when required.
Date	August 16, 2019	Contact XXXX team in NTA and update the "Date" as and when required.
Sponsored by:	Nepal Telecommunications Authority	

Description	Text parameter	Update procedures
Abstract	This document shall be used as standard for the laying out of underground optical fibre cables for Metro Backhaul and Distribution network.	
Keywords:	Micro trenching, Flexi Duct, Blowing, Fibre test etc.	

Note that the draft number, described above, has an A.B format, where:

1. A specifies the major revision number (incremented after each set of substantial changes) and,
2. B specifies the minor revision number (incremented when enhancements are provided)

1.3 References

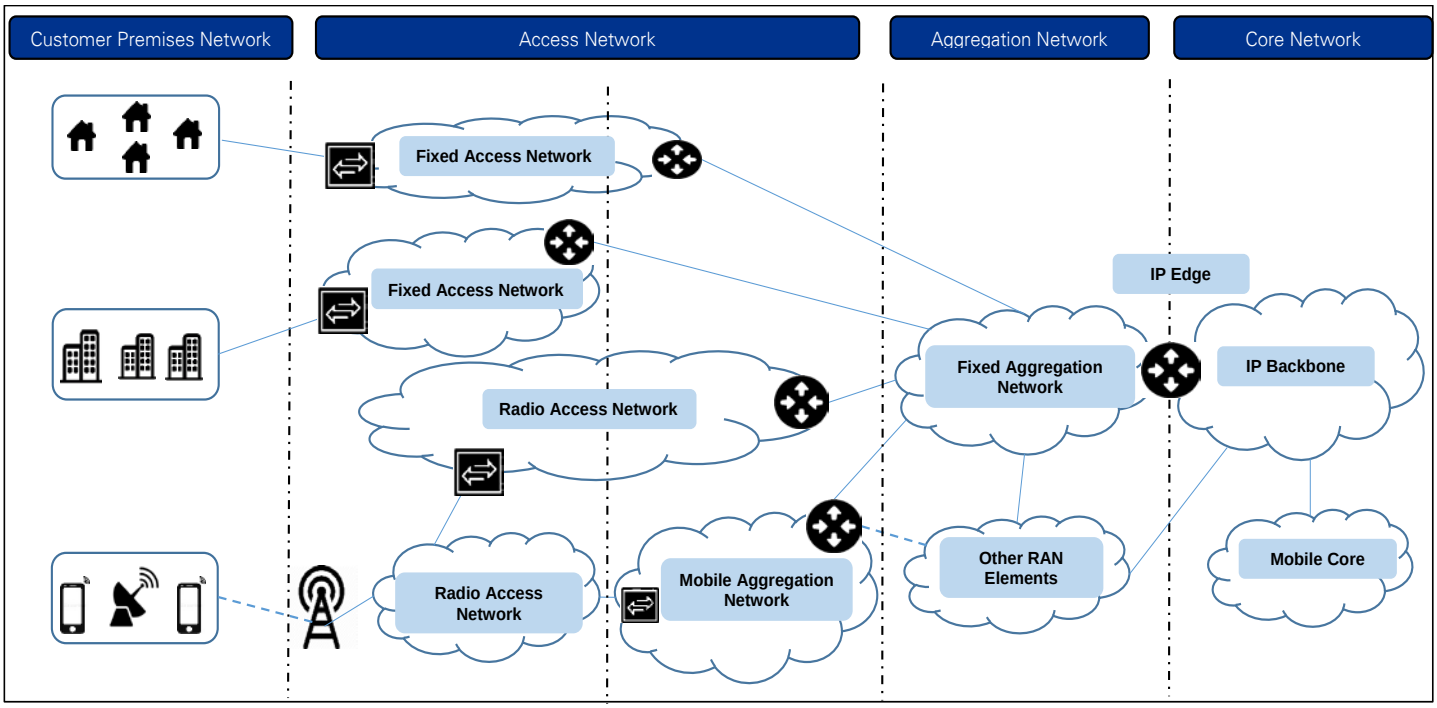
NOTE — References listed here are with normative content, and the document would be incomplete without them. Other documents that provide background but not specification material formulate part of the Annexures.

The following standards contain provisions which, through reference in this document, constitute provisions of this standard. All the standards listed are normative references. Informative references are given in Annexures. All standards are subject to revision with agreement to stakeholders involved in the project.

S. No.	References
1	ITU G.652- Characteristics of a single-mode optical fibre and cable
2	ITU G.657- Characteristics of a Bending Loss Insensitive Single Mode Optical Fibre and Cable for the Access Network
3	IEC 60793-2-50 Optical fibres - Part 2-50: Product specifications - Sectional specification for class B single-mode fibres
4	ITU X.200 Information technology – Open Systems Interconnection – Basic Reference Model: The basic model
5	IEC 61754-28 Fibre optic interconnecting devices and passive components - Fibre optic connector interfaces - Part 28: Type LF3 connector family
6	IEC 61753-131-3 Ed. 1.0: Fibre optic interconnecting devices and passive components - Performance standard - Part 131-3: Single-mode mechanical fibre splice for category U – Uncontrolled environment
7	IEC 61753-021-2 Fibre optic interconnecting devices and passive components performance standard - Part 021-2: Grade C/3 single-mode fibre optic connectors for category C - Controlled environment
8	IEC 61755-1 Fibre optic connector optical interfaces - Part 1: Optical interfaces for single mode non-dispersion shifted fibres - General and guidance
9	IS: 1678, Specification for pre stressed concrete poles for overhead power, traction and telecommunication lines

10	ITU L.163- Recommendation ITU-T L.163 (2018), Criteria for optical fibre cable installation with minimal existing infrastructure
11	ITU-T L.154- Recommendation ITU-T L.154/L.49 (2003), Micro-trench installation technique
12	ITU-T L.261- Recommendation ITU-T L.261/L.89 (2012), Design of suspension wires, telecommunication poles and guy-lines for optical access networks.
13	ITU-T L.302- Recommendations ITU-T L.302/L.40 (2000), Optical fibre outside plant maintenance support, monitoring and testing system.
14	ITU-T L.110- Optical fibre cable for direct surface application (DSA) as the key to the realization of ultimately affordable rural connectivity
15	ITU-T L.1700- Recommendation ITU-T L.1700 (2016), Requirement for low-cost sustainable telecommunications infrastructure for rural communications in developing countries
16	ITU-T L.110- Recommendation ITU-T L.110 (2017), Optical fibre cables for direct surface application
17	Organisation for Economic Co-operation and Development, "The development of fixed broadband networks", OECD Digital Economy Papers No. 239, (Paris, OECD Publishing, 2014).
18	International cables, Gateways, Backhaul and International Exchange Points, OECD Digital Economy Papers, No. 232, OECD 2014.
19	"Installing fibre-optic cables underground", blog post by Neil Bradley in www.beyondbroadband.coop. Accessed 2 July 2014.
20	www.fiber-optics.info/articles/fiber_optic_intelligent_traffic_systems.
21	Banerjee, Anupam and Sirbu, Marvin A., Towards Technologically and Competitively Neutral Fiber to the Home (FTTH) Infrastructure (September 1, 2003). TPRC 2003. Available at SSRN: ssrn.com/abstract=2060612
22	ITU, WMO and IOC, Using Submarine Cables for Climate Monitoring and Disaster Warning: Opportunities and Legal Challenges (ITU, 2012). Available from: www.itu.int/dms_pub/itut/oth/4B/04/T4B040000160001PDFE.pdf.
23	ITS Asia-Pacific Secretariat, ITS guideline for sustainable transport in Asia-Pacific, 6 December 2013. Available from www.its-jp.org/english/its_asia/1153/.

1.4 Network Architecture



2. Introduction to Underground Optical Fibre Cable (OFC) Laying

The wireline telecommunication plan for building the infrastructure with state of art technology requires adequate skill and planning in coherence with support from government authorities and market players. The planning for setting up the infrastructure should have a life span of twenty years period in order to meet the dynamics of ever changing customer needs and usage pattern. There should be provision for sharing of assets/ infrastructure from a futuristic perspective as that would benefit the service providers and lessen the cost burden due to huge investments and increasing operating expenditures.

This document covers the wireline standards for installation of underground fibre-optic cables across regions with respect to the geography dynamics. Also, existing norms/ guidelines laid by certain organisations- public and/or private across regions such as- national, state, local and other optical fibre laying recommendations should be brought in consensus with the procedures mentioned herein. However, it is difficult to gauge and cover all possible conditions during the project execution as uncertainties might occur which may hamper the overall project completion.

An optical fibre cable (OFC) is a high capacity transport medium that is sensitive to excessive tensile force, tight bends, and crushing forces, therefore, some care must be taken during the installation procedure to respect these limitations. This document provides general information for installing fibre optic cables beneath the surface covering the aspects from planning to final deployment, however, every installation is influenced by certain external factors and local conditions.

General Requirements:

The telecom service providers operating in Nepal are providing communication facilities to end users via the already established network across different regions- highway, metros/ urban/ city, rural/ remote areas etc. wherein, optical fibre is also used for provision of services. As per the standards mentioned in this document, optical fibres in adherence to global accepted standards from ITU shall be used while laying of cable. (Refer to Annexure A-1 for more details)

The standards to-be followed for selection of cables are as- G.652.D, G.657 A1, and G.657 B3

a) In Backbone network- G.652.D,

b) In Metro Distribution/ Access/ FTTx- G.657 A1,

c) For Customer Premises- G.657.B3

***Table 1 A**- Capacity Planning for Optical Fibre Cables*

Key Parameters and Enablers for Fiber Network		
S. No.	**Parameters for Capacity Increase**	**Unit**
1	Yearly Telecom Subscriber addition	2.76 Mn
2	Internet Users (Dec 2018)	16,190,000
3	Mobile Penetration by 2022	136%
4	Internet Penetration by Mar 2019	63%
5	Broadband subscriber increase/ year	25%
6	Fixed Broadband- 2019	3.6 Mn
7	3G to 4G broadband user (in future)	11 Mn
8	4G services in 40 cities by 2018	100%
9	Universal broadband access by 2020	90%
10	Total International Bandwidth usage in Nepal	32 Gbps
11	Digitalisation	75%
12	GDP 2019	7.1
13	Projected GDP Growth 2017 - 2022	11.04
14	E-Commerce growth	41%
15	Online Government Services by 2020	80%
16	Network Expansion	4G, GPON
17	Emerging technologies (under ICT)	5G, IOT
18	Annual 1 Mbps Broadband Subscription as percent of normal GDP per capita (Vey limited)	35.50%

S. No	**Rationale for Optical Fiber Network Planning**
1	These are the parameters which drive the need of a robust fiber network
2	Fiber optics is faster than most other transmission mediums like electrical signals, etc. Fiber optics involves speed which provides signals at more than 10 GB per second and fulfils high capacity requirements.
3	OFC cable do not face any interference from EMF and other similar devices. These Transmission cables are secured and difficult to tap because it does not emit any signals which can be monitored. Moreover, the loss rate over transmission is minimal even for long distances
4	In addition to this, there are futuristic requirements of emerging technologies which trigger the need of fiber network. The increase in the connection density, higher data traffic and greater capacity will lead to requirement of backhaul network and fibre connectivity to attain denser network, increased network penetration and continuous connectivity.

Planning and Design (A-1/2)

S. No	Parameters	Planning & Design							
		Units	**No. of Private/ Commercial Buildings**	**No of rings**	**No. of nodes**	**No. of access ring in core & aggregate (Agg.)**	**No. of access node in core & aggregate (Agg.)**	**No. of households covered per node**	**Ring length (KMS)**
1	Total population (Kathmandu)	1,808,607	-	-	-	-	-	-	-
2	Households = Total population/5.72	328,838	-	-	-	-	-	-	-
3	Commercial buildings @ 5% of total premises	16,442	-	-	-	-	-	-	-
4	Total road length in Kathmandu in KMS	575	-	-	-	-	-	-	-
5	Main roads can be taken as core road for design (~20%) in KMS (including Highways and Intercity)	120	78,921	1	8	12	120	658	120
6	(Secondary)City roads aggregate the traffic (~30%) in KMS (including mainland city/ metro)	175	101,940	8	64	18	180	566	22
7	Tertiary roads are for access (~50%) in KMS (residential settlements, other road connectivity)	280	164,419	56	448	-		367	5

General Information-

Population of Kathmandu (2016)	1,699,288
As per census , Growth rate of population is @2.1% increment per year	
2017	1,734,973.05
2018	1,771,407.48
2019	1,808,607.04
Note: However considering floating population, Kathmandu valley population is 5 million leading to higher bandwidth requirement	

#	Key Assumptions for Planning & Design
1	Duct requirements for Core and Aggregate network have been kept consistent due to- a. High capacity demands catering to core-access and aggregate-access networks. b. For access routes, the connected paths towards aggregate and core network shall be considered for ring formation.
2	Wherever RCC roads are present on access network, micro-trenching shall be adopted as an exception, based on the survey report.
3	Design of Access Network may be in star topology where road dead-ends exists
4	* Generic factor of 5.72 person/ home is practice as per Indian scenario and considered as same for Nepal geography
5	The proportion of main, secondary and tertiary roads are considered basis urban and rural density and demographics
6	Clamping of DWC/ GI pipe (duct pipe encased in DWC/ GI pipe) along edge slab may be preferred than trenching method subject to owner's approval.)

Continued from above table: Planning and Design (A-2/2)

S. No	Parameters	Scenario 1 - Ducting & OFC specifications					Scenario 2 - Ducting & OFC specifications				
		Duct requirement for Core/ Agg.	Duct requirement for Access	OFC capacity for Core/ Agg.	OFC capacity for Access	Expansion Plan *(Duct on Need basis)*	Duct requirement for Core/ Agg	Duct requirement for Access	OFC capacity for Core/ Agg	OFC capacity for Access	Expansion Plan *(Duct on Need basis)*
1	Total population (Kathmandu)	-	-	-	-	-	-	-	-	-	-
2	Households = Total population/5.5*	-	-	-	-	-	-	-	-	-	-
3	Commercial buildings @ 5% of total premises	-	-	-	-	-	-	-	-	-	-
4	Total road length in Kathmandu in KMS	-	-	-	-	-	-	-	-	-	-
5	Main roads can be taken as core road for design (~20%) in KMS (including Highways and Intercity)	110 mm DWC & 2X40 mm HDPE	110 mm DWC & 2X40 mm HDPE	144 F	48 F	Flexible Inner Duct	110 mm DWC *(with one 3way detectable Flexi Duct)*	50 mm DWC *(with 2 way detectable Flexi Duct)*	144 F	48 F	Flexible Inner Duct
6	Secondary roads aggregate the traffic (~30%) in KMS (including mainland city/ metro)	110 mm DWC & 2X40 mm HDPE	110 mm DWC & 2X40 mm HDPE	144 F	48 F	Flexible Inner Duct	110 mm DWC *(with one 3way detectable Flexi Duct)*	50 mm DWC *(with 2 way detectable Flexi Duct)*	144 F	48 F	Flexible Inner Duct

7	Tertiary roads are for access (~50%) in KMS (residential settlements, other road connectivity)	-	2X50 mm HDPE	-	48 F	Flexible Inner Duct	-	50 mm DWC *(with 2 way detectable Flexi Duct)*	-	48 F	Flexible Inner Duct

***Table 1 B**- Specifications of Optical Fibre Cables*

S. No	Type	Cables	Applications
1	Metal Free Optical Fibre Cable (Underground Installation- Duct)	Metal Free Optical Cable (G.652 D Fibre)	Local and Trunk Network
2		High Count Metal Free Optical Fibre Cable (Ribbon Type for Access Network)	Access Network
3		Non Zero Dispersion Shifted Single Mode Metal Free Optical Fibre Cable	Long Haul Transmission- SDH and DWDM systems
4	Armoured Optical Fibre Cable (Underground Installation - Directly Buried/ Duct)	Armoured Optical Fibre Cable for Duct application	Local and Trunk Network
5		Armoured Optical Fibre Cable for Direct Burial (Underground)	Local and Trunk Network
6		High Count Armoured Optical Fibre Cable (Ribbon Type for Access Network)	Access Network
7		Non Zero Dispersion Shifted Single Mode Armoured Optical Fibre Cable	Long Haul Transmission- SDH and DWDM systems
8	Aerial Optical Fibre Cables (Aerial Installation)	Self-Supporting Metal-Free Aerial Optical Fibre Cable (For Hilly & Rural areas)	Used between two points on the aerial alignment in Hilly & Rural areas with maximum span length of 100 meters.
9		Self-Supporting Metal-Free Aerial Optical Fibre Cable (For Urban areas)	Used between two points on the aerial alignment between the poles or pole to building in the urban areas with maximum span length of 75 meters
10	Fibre-to-the-x (FTTx) Optical Fibre Cables	Outdoor Drop Optical Fibre Cable (Figure 8 Type)	Outdoor cable for installing between two poles and a pole to building
11		Flexible Optical Fibre Cable (For Indoor Applications)	Indoor cable for interconnecting/ drop/ distribution cabling purpose within a high rise building
12		Optical Fibre Drop Cable	Indoor as well as Outdoor cable for installation between two poles and inside home
13		Optical Fibre Cable for FTTx application (G.657 A Fibre)	Indoor cable for installing inside the premises/buildings for FTTx applications, employing bending loss-insensitive optical fibre
14	Optical Fibre Cables for laying over Power Lines	All-Dielectric Self-supporting (ADSS) Optical Fibre Cable for laying on power line alignments	Overhead power distribution network up to 33 KV
15		Optical Ground Wire (OPGW) Cable for laying on power lines)	High voltage Power Line alignments beyond 33 KV, up to 400 KV

16	Direct Surface Application Cable	Direct Surface Application cables with metal core tube construction (G.657 Fibre)	For fast and low cost deployment in remote areas/ disaster recovery situations

From the above listed cables we recommend armoured cable to ensure quality of execution (depth), traceability and safety against rodent/ other eventualities.

2.1 Soil Categorisation

Soil is categorized under three broad categories i.e. 'Normal', 'Soft Rock' and 'Hard Rock', to enable the decision of depth measurement at which the cable is to be laid. The soil is categorized as rocky or hard rock if the cable trench cannot be dug without blasting and/ or chiseling. All other types of soils shall be categorized as Normal or Soft Rock.

In normal soil, Horizontal Directional Drilling (HDD) method can be used, whereas for soft rock it is recommended to lay the cable through open trenching.

2.2 Detailed Survey

2.2.1 The survey shall commence post evaluation of techno-economic parameters to meet the planned objective and finalisation of routes. There are certain external factors which affect the planning and execution of survey activity. These are as –

1. Local authority development plans
2. Road widening operations
3. Water, drainage and sewage services
4. Bridges, culverts and road crossings
5. Existing communication/ utility facilities
6. Soil conditions along the proposed route
7. Seismic zone analysis while survey
8. Utility service providers future plans like- Electricity, Water, Sewer, Telecommunications

2.2.2 A detailed measurement of length of cable routes along with details of road crossings, culverts, bridges, footpath, poles, RCC, critical patches etc. shall be recorded in the survey register. The probable location of joints, terminations and repeaters may also be decided and marked while generating the road map (GIS) through a GPS embedded videography

2.2.3 During the survey, details of RoW authorities and their terms for permission should be obtained.

2.2.4 The survey report shall contain the detailed execution plan, BoM (Bill of materials), BoS (Bill of Services) and the video of survey with complete details about strata and visuals of local conditions

2.3 Important terms to be considered while Cable laying- Key Considerations

Basic parameters to be considered for defining the specifications of cable laying methodology are as follows-

1. Soil classification- this parameter is most significant for trenching and ducting

2. Town/ Area settlements- this parameter needs to be taken into account while planning of project execution for fibre deployment and risk assessment- identification, quantification, mitigation

3. Bridges, Culvert, Canals- Cable laying can be done by use of clamping, PCC and/ or as per norms of concerned authority for defining the norms/ standards to-be followed while laying of optical fibre cable

4. Road Crossings- Cable laying should be done as per the existing norms of the concerned authority, utility owner in order to ensure proper utilisation of the path and avoidance of disruption of other services

5. Rural/ Tough terrain & Disaster Management- This parameter is significantly applicable to the developing countries where existing telecommunications infrastructure is underway to bridge the digital divide and to ensure service affordability in difficult rural/ tough terrain areas comprising of high altitudes. For this critical parameter, refer to ITU-T L.163 for more information on the specifications and disaster recovery

6. Corridors- A uniform corridor shall be established from a futuristic perspective to enable cost benefit and state of art network design which has the capability to support high bandwidth demand and better service quality. This corridor shall be built at lower Capex, Opex to ensure affordable services to end users by reducing the data rates and thus, making efforts to bring down it from 35% to 5% (Refer to Table 1 A- Capacity Planning)

7. Drainage- For cable laying along the drainage, following steps need to be considered:

a) Firstly, the stones shall be removed from the path, cutting/ dismantling the water way of drain

b) Digging of earth surface shall be done at 40 cm below from the water way depth, followed by compacted RCC using iron nest on DWC pipe considering future requirements for expansion avoiding digging of such critical patches

c) Restoration of the path shall be done in the same manner as it was before digging or as per approved working methodology by RoW authority

d) For digging, the contractor/ vendor shall follow the 'Dig Once' method as it involves a large size pipe to be installed beneath the surface as a one-time activity/ single installation and ensure public convenience during the laying of cables

8. Footpath: This is also a significant parameter which plays a key role in facilitating the underground laying of cables in metros/ cities as per approved working methodology by RoW authority

9. Infrastructure Sharing- The telecom infrastructure shall be built from a futuristic perspective and in response to growing operating expenditure for catering to increasing customer demands, service providers shall opt for sharing of laid infrastructure so that it results to reduction in cost overruns

Further, below stated are the technical specification which shall be used as reference for above listed parameters.

***Table 2 A**- Technical Specs for Digging*

S. No	Parameters for Strata type/ Underground situation	Open Trench	HDD	Remarks
1	Soft Soil	Depth- 150cm	More than 165cm	
2	Soft Rock (Dis-Integrated rock)	Depth- 150cm	Not Applicable	
3	Hard Rock	Depth- 100 cm	Not Applicable	
4	Footpath (CC, tiles)	Depth- 100cm	Not Applicable	
5	Road Crossing	Depth- 120cm	Not Applicable	
6	Culvert crossing	I. Clamping ii. DWC with PCC	Not Applicable	As per RoW norms
7	Bridge Crossing	I. Clamping ii. DWC/ GI with PCC	Not Applicable	As per RoW norms
8	Drainage	i. Depth- 40cm Ii. DWC with RCC	Not Applicable	Drainage restoration needs to be done
9	Utility Corridor	Placement of DWC duct without trenching	Not Applicable	Size of duct depends on the space provided by authority
10	Joint Duct laying with other utility service provider (Interoperability)	As per the agreement between the utility owners/ parties	Not Applicable	
11	Town/ Area/ Populated/ Congested Areas	Depth- 100cm	More than 165cm (For soft soil cases)	For Open trenching, warning/ protection stones above cable needs to be laid
12	CC Road	i. Depth- 40cm ii. Restoration to be done as it was previously	More than 165cm (For soft soil cases)	For FTTx situation, Micro Trench to be considered with i. Depth- 15 to 30 cm ii. Width- 3 to 4cm
13	Trench Width for Depth-150 cm	Top- 45cm Bottom- 30cm	Not Applicable	For Hard Rock, size of trench may vary due to: i. Blasting, ii. Rock breaking, and iii. Chiseling
14	Trench Depth for 120cm or less	Top- 30cm Bottom- 30cm	Not Applicable	For Hard Rock, size of trench may vary due to: i. Blasting, ii. Rock breaking, and iii. Chiseling

Note: In case of deviation during execution due to existing utilities or any other local constraint, the process of deviation approval will be followed with GPS embedded visual proof. Also, a deviation approval format is annexed (Annexure- 3).

***Table 2 B**- Technical Specs for Cable Laying in Highway Backbone*

S. No	Particulars of Highway Backbone	Our Recommendations	Remarks
1	Fiber Network Topology: Linear/ Ring/ Mesh/ Mix	Mix	Depends on Planning
2	Optical Fibre Type (Single Mode)	ITU-T G.652D	
3	Fiber Deployment	Underground or Aerial	
4	Core Capacity (Fibre)	48 or 72 or 96	Depends on Demand

5	Trench Depth(Duct Buried)	Refer Table 2A for details	
6	Trench Width	Refer Table 2A for details	
7	Warning Tape/ Warning Stone	For Open Trench- i. Depth- 60cm	
8	Number of ducts in a trench	1 or more	Depends on Planning
9	Approx. planned Manhole distance in a straight stretch (Duct)	2 Km	
10	Length of cable drum m ,Km	2 km	
11	Number of Ducts during Road crossing	DWC/ GI Pipe of high size to cater the future demands	Subject to RoW authority norms and approval
12	Number of Ducts during Bridge crossing	DWC/ GI Pipe of high size to cater the future demands	Subject to RoW authority norms and approval
13	Number of Ducts during River/ Drain crossing	DWC/ GI Pipe of high size to cater the future demands	Subject to RoW authority norms and approval
14	HDPE Duct Size	40 mm	
15	DWC/ GI Duct Size	110mm	

***Table 2 C**- Technical Specs for Cable Laying in Metro Backbone (including Distribution Network)*

S. No	Particulars of Metro Backbone	Our Recommendations	Remarks
1	Fiber Network Topology: Linear/ Ring/ Mesh/ Mix	Mix	Depends on Planning
2	Optical Fibre Type (Single Mode)	ITU-T G.652D	
3	Fiber Deployment	Underground or Aerial	
4	Core Capacity (Fibre)	48 or 72 or 96 or 144	Depends on Demand
5	Trench Depth(Duct Buried)	Refer Table 2A for details	
6	Trench Width	Refer Table 2A for details	
7	Warning Tape/ Warning Stone	For Open Trench- i. Depth- 60cm	
8	Number of ducts in a trench	1 or more- HDPE duct in DWC Pipe of higher size for Core and Aggregate routes	Depends on Planning
9	Approx. planned Manhole distance in a straight stretch (Duct)	200- 250m	
10	Length of cable drum m ,Km	2 km	
11	Number of Ducts during Road crossing	DWC/ GI Pipe of high size to cater the future demands	Subject to RoW authority norms and approval
12	Number of Ducts during Bridge crossing	DWC/ GI Pipe of high size to cater the future demands	Subject to RoW authority norms and approval
13	Number of Ducts during River/ Drain crossing	DWC/ GI Pipe of high size to cater the future demands	Subject to RoW authority norms and approval
14	HDPE Duct Size	40mm	
15	DWC/ GI Duct Size	110mm	

***Table 2 D**- Technical Specs for Cable Laying in FTTx*

S. No	Particulars of FTTx	Our Recommendations	Remarks
1	Fiber Network Topology: Linear/ Ring/ Mesh/ Mix	Linear	Depends on Planning
2	Optical Fibre Type (Single Mode)	ITU-T G.652D and G.657 A/ B	
3	Fiber Deployment	Underground, Aerial, Micro Trench in RCC road	
4	Core Capacity (Fibre)	6 or 12 or 24	Depends on demand
5	Trench Depth(Direct Buried, Duct Buried)	Refer Table 2A for details	
6	Trench Width	Refer Table 2A for details	
7	Warning Tape/ Warning Stone	For Open Trench- i. Depth- 60cm	
8	Number of ducts in a trench	1 or more	Depends on Planning
9	Approx. planned Manhole distance in a straight stretch (Duct)	-	Depends on location, survey results and other external factors
10	Length of cable drum (m ,Km)	2 Km	
11	Length of drop cable (m ,Km)	500m- 2Km	Depends on location, survey results and other external factors
12	HDPE Duct Size	40mm	

***Table 2 E**- Technical Specs for Rural/ Tough Terrain and Disaster Recovery*

S. No	Particulars of Rural/ Tough Terrain and Disaster Recovery	Our Recommendations	Remarks
1	For faster deployment of optical fibres at lower cost in rural areas and disaster recovery	Follow the specifications and guidelines mentioned in ITU-T L.163	Refer to ITU-T L.163

3. Underground Cable Installation Detailed Methods

There are certain methods for laying of optical fibre cable beneath the ground surface. The general guidelines to be followed are as under-

1. When the OFC is laid along the National Highways, cable should run along the road land boundary or at a minimum distance of 15 meters from the center line of the road where the road land is wider.
2. In special cases, where it may be necessary to avoid burrow pits or low lying areas, the cable may run underneath the shoulders at a distance of 0.6 meter from the outer edge of the road embankment provided the same is located at least 4.5 meters away from center line of road and 1.2 meter below the road surface.

3.1 Trenching

3.1.1 Micro Trenching: This method is applicable for cable laying along short stretch/ sections/ areas of road. It is also applicable for FTTx and in-building solutions where RCC road is already present

3.1.2 Trenching wherever possible, should be at the road boundary and as far as possible in a straight line

3.1.3 Whenever curves or deviations are encountered it should be a very smooth curve, the radius of curvature should be more than 50cm. at least

3.1.4 For hard rock terrain, open trenching technique should be chosen while laying of underground optical fibre cables. In open trenching, certain methods are used with respect to regions/ areas, which are as follows-

a. Blasting: Blasting for excavation shall not be performed without written permission obtained in advance, from the concerned authority. Procedures and methods of blasting shall conform to all local laws and protocols across regions. It is the responsibility of the vendor/ service provider to establish appropriate safety and health practices and determine the applicability as per regulatory norms prior to blasting.

b. Rock Breaker

c. Chiseling

3.1.5 For soft rock, open trenching technique shall be used with the involvement of machines, manpower/ laborer's (strictly for congested areas). Trenching of the road can be done with machines along highways and by use of labor in metro regions/ congested areas

3.1.6 Bottom of the trenches should be at uniform level without any abrupt ups and downs. Post completion of trenching, the bottom leveling should be inspected by GPS embedded videography for uniformity to ensure that pipe is laid without sharp bends

3.1.7 When trenching is done close to power cables, precautions should be taken as directed by the utility owner

3.1.8 Caution sign boards should be provided at each end of the trench to caution/ notify the traffic. Red flags may also be planted at suitable intervals throughout the trench. If the trench is to remain open at night, red lamps or luminous caution boards on either ends should be provided

3.1.9 In water logged area, digging should be done in short patches/ sections and dewatering should be done before laying of pipes

3.1.10 Horizontal Directional Drilling Method: HDD method can be used wherein normal soil is present in city/ Metro areas (Tarai). Deployment of HDD may be the choice in congested roads where open trenching is not possible

3.1.11 Further, deployment may be as per the local requirement. The HDD deployment may be justified financially with reference to the right of charges to be paid to the local authorities for the open trenching and other associated expenditure

3.1.12 While using HDD method for trenching, normal depth of the drilled portion should be more than 165 cm and normally below 250cm. This depth may be achieved at a distance of 10 meters from the leading edge of the proposed Manhole

3.1.13 Multiple ducts used in HDD should essentially have different colors. More than twelve different colors are prescribed for laying in the Overlay Access Network

The advantages over conventional cable-laying technologies lie essentially in its speed of execution, major reduction in infrastructure deployment costs, and significantly lower impact on the environment and on road traffic.

3.2 Ducting

Duct laying shall be done in accordance with the following technical specifications.

3.2.1 Types and sizes of ducts: Ducts shall be made of HDPE, DWC (Double Wall Corrugated) pipe or galvanized iron (G.I). The standard duct to be used for laying of wireline cable across regions shall be HDPE pipe with 40 mm diameter

3.2.2 Line of ducts: The line of ducts shall be kept as straight as possible. Where deviations are necessary they can be achieved, by "setting" the joints of the ducts and/or using "bends" duct

3.2.3 Optical Fibre cables shall be laid through HDPE pipes at a depth of 150cm in normal soil.

3.2.4 Duct formation shall be uniform along the entire route and shall be neatly arranged as close as possible with the first layer at the bottom of the jointing chamber to allow space for future expansions.

3.2.5 Flexi Ducts shall be used for laying of optical fibres in metro regions in order to establish the infrastructure from a future-readiness perspective. Flexi ducts shall help to cater the growing demands, exponential increase in data consumption and need of extra bandwidth for provisioning of services at greater quality.

Figure 1A- Generic representation for a Flexi Duct in 100mm DWC Pipe (Sample)

3.2.6 Warning tape/ protection stones should be laid as per the technical specifications (Depth- 60cm in normal soil/ case)

3.3. Back Filling and Restoration

3.3.1 Backfilling should be done with well compacted excavated material after ensuring of soft material padding. Before conducting the crowning, an adequate dry compaction shall be done

3.3.2 To carter for the soil settlement, a crown of 25cm (height) shall be made at the top of the back filled trench. Crowning shall be confined over width of trench only

3.3.3 No surplus soil shall be left outside of the trench

4. Manhole

4.1 Making manhole of size (2.0 m length x 1.0 m width x 1.4 m Depth) at every cable pulling/ blowing/ jointing location for housing the optical fibre cable loop & pulling optical fibre cable using proper tools and accessories. Sealing of both ends of the PLB HDPE pipe in manhole by hard rubber bush of suitable size to avoid entry of rodents into the PLB HDPE Ducts, putting split PLB HDPE Ducts with proper fixtures over cable in the manhole to protect the bare cable

4.2 Digging of pit of size 2 meter x 2 meter x 1.8 meter (depth) for fixing of Jointing chambered-cast RCC cover or stone of suitable size on jointing chamber to protect the Joint and backfilling of chamber with excavated soil

4.3 In case of highways, man-holes shall be installed along the route at a spacing not exceeding 2km.

4.4 In case of metros/ city areas man-holes shall be installed not exceeding a distance of 200-250m

4.5 The mandatory points for installation of man-hole in metro areas should be part of planning process. Road crossings, traffic lights and turnings should be considered in priority during cable installation

5. Route Marker

5.1 Digging of pits 5 m (500 cm) to 10 m (1000 cm) towards jungle side at every manhole and jointing chamber along the route to a depth of 0.75m (75 cm) fixing of route Indicator/ joint indicator, concreting and backfilling of pits. Painting of route indicators and joint indicator by bright colors and sign writing denoting route/ joint indicator number, distance (kilometer), and shall be done as per construction specification and authorised norms

5.2 A route marker needs to be placed at an interval of 200m along the route

5.3 The joint indicators shall be embedded in concrete structures buried in the ground with at-least 30cm above the ground surface

5.4 The joint indicators may be kept along the road side clearly visible from road and may be painted bright color such that it gets easy attention. In future, electronic markers shall be used for joint indicators

5.5 In metro regions, only if authority allows and inconvenience to public is not there, then route marker shall be placed along the route

6. Duct Integration Test (DIT) for HPDE Ducts

The DIT shall be conducted after the pipes are laid either in open trench method or in the HDD method for verifying the continuity of the pipe. The DIT involves two tests-

6.1 In one test, one side of the PLB pipe laid is sealed using the end plug. On the other side air compressor/ blower is used to hold the 5 Kg/cm-cm pressure inside the pipe under test. The pressure should be held for 1 hour without any leakage

6.2 In the second test, a wooden bullet having 80% of the diameter of inner diameter of PLB pipe and having a length of 2 inches may be blown from one side of the PLB pipe. The other side of the pipe shall be left open. The bullet should fly out without any blockage. Then the PLB pipe laying is successful. Care should be taken by covering the end of the PLB pipe with a nylon/wire mesh so that the flying bullet shall not hit anyone

A sample report format for filling the test results are attached in the Annexure B.2.

7. Cable Blowing/ Pulling Methods

For cable placement, blowing method is to be used. Only in exceptional cases, with permission of competent authority pulling is to be done.

I. Cable drum should be kept approximately at the center of two adjacent chambers. (I.e. if drum length is 2 Km, placement should be done at 1 Km) so that on either side of the route (1 Km) blowing can be performed.
II. Cable drum should be mounted on jack which should be kept on a plain surface.

III. Cable blowing should be conducted with the help of compressor, hydraulic power pack and blowing Machine. Anti-twist tool can be used to avoid twisting of cable while blowing.
IV. It shall be ensured that during the blowing/ pulling of cable, the tension is minimum and there is no damage to the cable/ optical fibres
V. After pulling of the cable from drum is completed, both ends of the PLB HDPE Duct pipe in each manhole should be sealed by hard rodent resistant rubber bush, to avoid entry of rodents/ mud into PLB HDPE Ducts
VI. The manholes are prepared by providing 40 mm split PLB HDPE Duct pipe of 2.5 to 3m length and closing the split PLB HDPE Ducts by providing necessary clamps/ adhesive tape
VII. For manual pulling, the rope is attached to the pulling eye which is fixed to the cable end.
VIII. As soon as 1km cable or so is pulled towards one side of the route, sufficient overlap of cable may be kept at splicing location. A 20 meter cable may be the maximum requirement for this activity

8. Earthing pits (For armoured cable only)

8.1 Highway/ Inter City Routes: Earthing pits shall be placed at the joint pit closest to the interval of 8 Kms (Normally at every alternative joint)

9. Splicing of cables

I. Optical fibre cable Joints will be at varying distances depending upon the fibre to be laid. The all core of fibres are to be spliced at every Joint & at both ends (Terminations) in the equipment room
II. The Optical fibre cable thus jointed end-to-end will be tested for splice losses and transmission parameters.

10. Fibre termination

I. All OFC at their extreme ends shall be terminated into fibre distribution management system (FDMS) provided for the fibre termination and distribution
II. Cable shall be brought into the termination facility (building/container/Shelter/Cabinets) housing the FDMS through duct/GI pipe between the facility and the Man-Hole near the facility
III. No mixing of the fibres in the trays and no mixing of the cables should be allowed
IV. Fibre termination shall be done on the nodes/ equipment rooms
V. Cable is routed as per the map/diagram of the termination room
VI. Bending radii are in accordance with cable specifications
VII. All the cables should be properly labelled in the termination site/room
VIII. Fibres shall ne neatly arranged in a fibre tray

11. Installation safety practices

11.1 Cable drums: The optical fibre cable drums should be handled with utmost care. The drums should not be subjected to shocks by dropping etc. The drum should not be rolled along the road for long distances and when rolled, should be in the direction indicated by the arrow. The covering planks should be removed only at the time of actual laying

11.2 Preparation of tools and materials: Materials, tools and equipment's required for the installation of optical fibre cable beneath the earth's surface must be checked physically in prior, before drawing of the cable into duct

11.3 Protection of existing cable: The existing cables and other utilities should be checked and adequately protected before laying

11.4 Cable bending radius:

I. When setting cables, the bending radius shall be kept to more than 8 times the outer diameter of metallic cables and not less than 15 times the outer diameter of optical fibre cables
II. While installing cables, the bending radius of the cable shall be kept to more than 100cm

11.5 Trenches shall not be left open at night unless suitably protected with barricades, flashing lights, and other methods

11.6 The bottom of the trench shall be covered with screened earth or sand before laying the cable to avoid the cable coming in contact with rocks, stones and other heavy and sharp objects in the trench

11.7 Where it is necessary to pull the cable over the ground or in the trench, avoid dragging over abrasive obstructions that might damage the outer jacket

12. Tools and Equipment's requirements

Refer Annexure A1 for the general list of equipment's used for underground optical fibre installation.

13. Acceptance Testing (AT) - Civil AT and Optical AT

13.1 Quality Assurance is required to be done for 100% Civil works (including MH), DIT and Splicing with GPS embedded visual system

13.2 Refer to the annexure for the following reports formats to be followed for testing of the cable

S. No	Test Report	Annexure
1	Civil AT Report	B.1
2	DIT Report	B.2
3	Drum Test Report	B.3
4	OFC Blowing Report	B.4
5	OTDR Test Report	B.5
6	LSPM Test Report	B.6

Table 1.2

13.3 In AT trace of depth by cable locator is to be attached

13.4 In case of HDD the HDD profile of shots to be attached

14. Documentation

Following are the key considerations during handover to the operations before contract closure.

1. All AT sheets should be duly signed by contractor and clients supervisor/third party auditor appointed by client
2. Traces of HDD shot profiles should be maintained
3. Cable locator traces should be maintained
4. Single line diagram showing route details, MH locations, joint locations, landmarks, route indicator locations
5. KMZ/ KML files shall be maintained for loading on GIS in order to perform a central monitoring at NOC
6. Video as Build Drawings with GPS coordinates encompassing complete details of route including manholes, offset from road center at regular interval of 200m, change of road, MH location, HDD profiles, cable locator profiles, loop details in MH for ease of operation (team). This should be system compatible w.r.t laptop or mobile with modification rights to update the documents (as part of change management)

15. Definitions

NOTE: These sub clauses contain examples of specifications that shall be included in this Standard and are highly recommended for use.

15.1 Conformance levels

15.1.1 Expected: A key word used to describe the behavior of the hardware or software in the design models assumed by this specification. Other hardware and software design models may also be implemented

15.1.2 May: A key word indicating flexibility of choice with no implied preference

15.1.3 Shall: A key word indicating a mandatory requirement. Designers are required to implement all such mandatory requirements

15.1.4 Should: A key word indicating flexibility of choice with a strongly preferred alternative. Equivalent to the phrase is recommended

NOTE: These conformance definitions are used throughout the standards and should therefore never be changed.

16. Glossary of Terms

Attenuation	The loss of optical power, whether caused intrinsically (absorption, scattering and micro bends), or by extrinsic components such as connectors, splices, splitters and other optical components. External stresses such as micro bends and macro bends result in fiber attenuation.
Bend Radius	The smallest radius an optical fiber or fiber cable can bend before excessive attenuation of breakage occurs.
Cladding	Material that surrounds the core of an optical fiber. Its lower index of refraction compared to that of the core causes the transmitted light to travel down the core.

Coating	The material surrounding the cladding of a fiber. Generally a soft plastic material that protects the fiber from damage.
dB/km	The ratio of loss of power per kilometer distance.
Fiber	A single optical transmission element characterized by a core, a cladding, and a coating.
Fiber to the home (FTTH)	The distribution of communications services by providing fiber-optic links all the way to each house.
Loss	The portion of energy applied to a system that is dissipated and performs no useful work. Also called attenuation.
Macro bending	In a fiber, all macroscopic deviations of the fibers axis from a straight line that will case light to leak out of the fiber causing signal attenuation.
Quality of service (QoS)	A measure of the telephone service quality provided to a subscriber.

17. Acronyms and Abbreviations

A list of acronyms and abbreviations are stated as below:

NTA Nepal Telecommunications Authority

NEA Nepal Electricity Authority

MOCIT Ministry of Communication and Information Technology

KVDA Kathmandu Valley Development Authority

DoR Department of Roads

DUDBC Department of Urban Development & Building Construction

DWSS Department of Water Supply and Sewage

KMC Kathmandu Metropolitan Corporation

QoS Quality of Service

FTTX Fibre to the x

OFC Optical Fibre Cable

GI Pipe Galvanised Iron Pipe

OTDR Optical Time Domain Reflectometer

GIS Geographic Information System

HDPE High-density Polyethylene

HDD Horizontal Directional Drilling

MH-HH ManHole- HandHole

PLB Permanently Lubricated

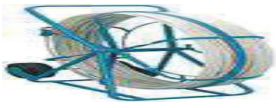
18. Annexures

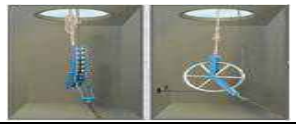
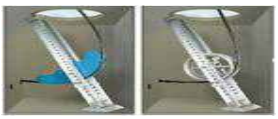
Annexure A1- Fibre Optic Cables for underground laying across highway, metro, distribution/ access networks

ITU-T (G - Standard)		Applications
G.651 fibre	50/125 µ m multimode graded index fibre	
G.652 optical fibre	Non dispersion shifted fibre	LAN, MAN, access networks and CWDM transmission.
G.652.A	Attenuation Less than 0.5 / 0.4 at 1310 / 1550nm	
G.652.B	Attenuation Less than 0.4 / 0.35 / 0.4 at 1310 / 1550 / 1625nm	
G.652.C	Attenuation Less than 0.4 from 1310 to 1625nm, less than 0.3 at 1550nm and at 1383nm, it must be less than that specified at 1310nm, after hydrogen aging.	
G.652.D		
G.653 optical fibre	Dispersion shifted fibre DSF	Long-haul single-mode transmission systems using erbium-doped fibre amplifiers (EDFA).
G.654 optical fibre	Cut-off wavelength shift fibre	Higher bandwidth submarine systems and back haul systems.
G.655 optical fibre	non zero dispersion shift fibre	Long-haul systems that use Dense WDM (DWDM) transmission.
G.656 optical fibre	Non-zero dispersion for wideband optical transport	Long-haul systems that use CWDM and DWDM transmission over the specified wavelength range
G.657.A	Bend-insensitive single-mode fibres for access networks	Fibre-to-the-home (FTTH) networks.
G.657.B	Fibres for short distances at the end of Access networks in bending-rich environments (e.g. buildings)	

S.No	Parameters	Standard per ITU-T G.652D IEC 60793-2-50 B1.3 (Max/Typical)	NZDS per ITU-T G.655 IEC 60793-2-50 B4 (Max/Typical)	Bend-Insensitive ITU-T G.657.A1 IEC 60793-2-50 B6_a1 (Max/Typical)	Bend-Insensitive ITU-T G.657.A2 IEC 60793-2-50 B6_a2 (Max/Typical)	ITU-T G.657.B2	ITU-T G.657.B3	Unit
1	**Attenuation, Loose Tube Cables:**							
1.1	@1310 nm	0.35/0.34	NA	0.35/0.34	0.35/0.34	0.3/0.4	0.3/0.4	dB/Km
1.2	@1550 nm	0.25/0.20	0.23/0.20	0.23/0.20	0.23/0.20	0.3/0.4	0.3/0.4	
1.3	@1625 nm	0.25/0.22	0.26/0.23	0.25/0.22	0.25/0.22	0.3/0.4	0.3/0.4	
2	**Attenuation, Tight Buffer Cables:**							
2.1	@1310 nm	≤ 0.40	-	≤ 0.40	≤ 0.40			dB/Km
2.2	@1550 nm	≤ 0.30	-	≤ 0.30	≤ 0.30			
3	**Dispersion:**							
3.1	between 1285 and 1330 nm (O band)	≤3.5	NA	≤3.5	≤3.5			ps/(nm . Km)
3.2	between 1460 and 1530 nm (S band)	-	Non Standard Range	-	-			
3.3	between 1530 and 1565 nm (C band)	≤ 18	2 - 6	≤ 18	≤ 18			
3.4	between 1565 and 1625 nm (L band)	≤ 22	4.5 - 11.2	≤ 22	≤ 22			
3.5	Zero Dispersion Wavelength	1312 ± 12	< 1520	1312 ± 12	1312 ± 12			nm
3.6	Zero Dispersion Slope	≤ 0.092	-	≤ 0.092	≤ 0.092			ps/(nm . Km)
4	**Mode Field Diameter**							
4.1	@1310 nm	9.2 ±0.4	NA	9.2 ±0.4	8.6 ± 0.4	8.6-9.2 ± 0.4	8.6-9.2 ± 0.4	µm
4.2	@1550 nm	10.4 ± 0.6	9.6 ± 0.6	10.4 ± 0.5	9.6 ± 0.5			
5	Cable Cut-Off Wavelength	≤1260	≤1480	≤1260	≤1260	≤1260	≤1260	nm
6	PMD (Individual Fiber)	≤0.2	≤0.1	≤0.2	≤0.2	≤0.5	≤0.5	ps/Km
7	Cladding Diameter	125 ± 0.7	125 ± 0.7	125 ± 0.7	125 ± 0.7	125 ± 0.7	125 ± 0.7	µm
8	Core/Cladding Concentricity Error	≤0.5	≤0.5	≤0.5	≤0.5	≤0.5	≤0.5	µm
9	Cladding Non-Circularity	≤1.0	≤1.0	≤1.0	≤1.0	≤1.0	≤1.0	%
10	Coating Diameter (un-dyed)	245 ± 5	245 ± 5	245 ± 5	245 ± 5			µm

Annexure A2- Fibre Optic Cable Placing Equipment

Fibre Optic Cable Placing Equipment (Underground)		
Pulling Winches	Portable Capstan Winch (GMP)	
	Trailer mounted Capstan Winch (GMP)	
	Pushing and Air Winch	
	Cable Reel Trailer (Plumett)	
	Cable Placing Truck	
	Side take-off winch with slip clutch (Condux)	
Associated Materials and Equipment	Pull Line	
	Rodding Cord	
	Duct Cutter	
	Fibreglass Duct Rodder	
Underground Standard Fibre Optic Cable Placing	Duct Lubricant	
	Pulling Eyes for Sub-Ducts	

	Duct Plugs	
	Pneumatic Missiles ("Pigs" or "Birdies")	
	Ball Bearing Swivel	
	Manhole Sheave and Quadrant Block (GMP)	
	Large Diameter Splittable Sheave	
	Intermediate Cable Storage Device (GMP)	
	Sheaves and quadrant block in manhole	
	Pulling frame in manhole	
Micro-Duct Cable Placing Equipment	Arnco Dura-Line Plumett Cable Jet	
	GMP Air Stream	
Fibre Optic Cable Placing Equipment	Dura-Line Air-Trak MD	
	Arnco Dura-Line Plumett SuperJet	
	Arnco Dura-Line Plumett Mini Jet	

	Arnco Dura-Line Plumett Maxx-Trak	

Annexure B.1: Civil AT Report Format (Sample)

Civil Acceptance Test Report															
S No	Route Location		R-Kms	Date	Chainage (Mtrs)		Test Pit Results (M)	Warning Tape Depth (M)	Culvert Crossing	Bridge Crossing	Road Crossing	Man hole	Route Marker	Backfilling	Remarks
	Start Location	End Location			From	To									
1															
2															
3															
4															
5															

Culvert / Bridge /Road / Railway Crossing Acceptance Report										
S No	Culvert / Bridge /Road Crossing No.	Chainage (Mtrs)		Length (Mtrs)	Depth (Mtrs)			Warning Tape (mtrs)	Offset of the Road (mtrs)	
		Start Point	End Point		Trench	HDD	GI/DWC /RCC		Centre	Edge
1										
2										
3										
4										
5										
6										

Test Pit Acceptance Report												
S No	Route Location		Chainage of the Test Pit	Duct Depth (mtrs)		W' Tape Depth (mtrs)		Offset (mtrs) * Against RoW Specification				Road Width in mtrs.
	Start Location	End Location		as per MS	as per AT	as per MS	as per AT	MS offset from		AT offset from		
								Centre of Road	Edge of Road	Centre of Road	Edge of Road	
1												
2												
3												
4												
5												
6												
7												

Annexure B.2: DIT Report Format (Sample)

Date	Road ID	Duct No.	Duct Color	From Lat-Long	To Lat-Long	DIT Length (Mtr)	Pressure Value	Ok/Not Ok	Shuttle Test (Ok/Not Ok)	Proper Safety Yes/No	Supervisor Name	TPA Field Rep.	Remark Ok/Not Ok	Phase

Annexure B.3: OFC Drum Test Report Format (Sample)

FORMAT B							
OFC Drum Test Report							
DRUM NO:		Bill No.		Name of Supplier			
Physical Length (OSE) :		……m		Physical Length (OSE) :		……..m	
Length (OSE - ISE):		……m		Date:			
	Identification Color		**Physical Check**	**Optical Length**	**Attenuation (dB / km)**		**Remarks**
Fibre No.	**Tube / Thread**	**Fibre**	**OK/Not OK**	**(m)**	**@1310nm**	**@1550nm**	
1	BLUE	BLUE					
2		ORANGE					
3		GREEN					
4		BROWN					
5		SLATE					
6		WHITE					
7		RED					
8		BLACK					
9		YELLOW					
10		VIOLET					
11		AQUA					
12		PINK					
13	ORANGE	BLUE					
14		ORANGE					
15		GREEN					
16		BROWN					
17		SLATE					
18		WHITE					
19		RED					
20		BLACK					
21		YELLOW					
22		VIOLET					
23		AQUA					
24		PINK					
25	GREEN	BLUE					
26		ORANGE					
27		GREEN					
28		BROWN					
29		SLATE					

30		WHITE					
31		RED					
32		BLACK					
33		YELLOW					
34		VIOLET					
35		AQUA					
36		PINK					
37	BROWN	BLUE					
38		ORANGE					
39		GREEN					
40		BROWN					
41		SLATE					
42		WHITE					
43		RED					
44		BLACK					
45		YELLOW					
46		VIOLET					
47		AQUA					
48		PINK					
49	SLATE	BLUE					
50		ORANGE					
51		GREEN					
52		BROWN					
53		SLATE					
54		WHITE					
55		RED					
56		BLACK					
57		YELLOW					
58		VIOLET					
59		AQUA					
60		PINK					
61	WHITE	BLUE					
62		ORANGE					
63		GREEN					
64		BROWN					
65		SLATE					
66		WHITE					
67		RED					
68		BLACK					
69		YELLOW					

70		VIOLET					
71		AQUA					
72		PINK					
73	RED	BLUE					
74		ORANGE					
75		GREEN					
76		BROWN					
77		SLATE					
78		WHITE					
79		RED					
80		BLACK					
81		YELLOW					
82		VIOLET					
83		AQUA					
84		PINK					
85	BLACK	BLUE					
86		ORANGE					
87		GREEN					
88		BROWN					
89		SLATE					
90		WHITE					
91		RED					
92		BLACK					
93		YELLOW					
94		VIOLET					
95		AQUA					
96		PINK					
97	YELLOW	BLUE					
98		ORANGE					
99		GREEN					
100		BROWN					
101		SLATE					
102		WHITE					
103		RED					
104		BLACK					
105		YELLOW					
106		VIOLET					
107		AQUA					
108		PINK					
109	VIOLET	BLUE					

110		ORANGE					
111		GREEN					
112		BROWN					
113		SLATE					
114		WHITE					
115		RED					
116		BLACK					
117		YELLOW					
118		VIOLET					
119		AQUA					
120		PINK					
121	AQUA	BLUE					
122		ORANGE					
123		GREEN					
124		BROWN					
125		SLATE					
126		WHITE					
127		RED					
128		BLACK					
129		YELLOW					
130		VIOLET					
131		AQUA					
132		PINK					
133	PINK	BLUE					
134		ORANGE					
135		GREEN					
136		BROWN					
137		SLATE					
138		WHITE					
139		RED					
140		BLACK					
141		YELLOW					
142		VIOLET					
143		AQUA					
144		PINK					

	CONTRACTOR	COMPANY
SIGNATURE		
NAME		
DATE		

Annexure B.4: OFC Blowing Report Format (Sample)

OFC BLOWING REPORT

Project Name	
Master route	
Section Name	
Date	

Maint. Area:		**Contractor:**		**Report No:**		**Drawing No.:**			
Rev. No.:		**Clarity Fault No. / Job no. :**		**Cable type:**	**G 652D**	**No. of fibers:**			
SPREAD DETAILS : (From / To)		**Link No.**		**Armoured / Unarmoured OFC**		**Uni Tube / Loose tube type OFC:**			

Sr. No.	Chainage From	Chainage To	MH / Splice From	MH / Splice To	Actual Duct Length in Kms (MH to MH)	Duct Clearance Rep. No. (For cable blowing)	OFC Cable Id (Identification #)	OFC Cable Drum Id (Identification #)	Cable length on drum in: Mtr Mark at Start	Mtr Mark at End	OFC Length as per meter marking	Actual Length of OFC Consumed in Field (As per Meter marking)	OFC meter Marking		
														Cable entry	
														Duct Entry	
													MH	Slack (Meters)	
														Duct Entry	
														Duct Exit	
													HH1	Slack (Meters)	
														Duct Entry	
														Duct Exit	
													HH2	Slack (Meters)	
														Duct Entry	
														Duct Exit	
													HH3	Slack (Meters)	
														Duct Entry	
														Cable End	
													MH	Slack (Meters)	

Cable end Plug fixed			Yes / No
MH, HH deployed in field			Yes / No
Manhole / HH covers			Yes / No

Remarks, if any:		**CONTRACTOR**	**COMPANY**
	NAME		
	SIGNATURE		
	DATE		

Annexure B.5: OTDR Test Report Format (Sample)

Section loss measurement with OTDR														
Section														
From			To											
Location Name	Lat	Long	Location Name	Lat	Long	Route length(km)	OF cable type	Number of fibers	Unitube/loose tube/ribbon	Armoured/ Unarmoured	Date of testing	Acceptable value db/km 1310 nm	Acceptable value db/km 1550 nm	Number of splices
OTDR testing result	dB loss(A to B)		dB loss(B to A)		dB loss(Av)		Result(ok/Not Ok)	Remarks						
Fiber no.	1310nm	1550nm	1310nm	1550nm	1310nm	1550nm								
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														

16														
17														
18														
19														
20														
21														
22														
23														
24														
Prepared By														
Checked By														

Splice loss measurement with OTDR																									
Section																									
From				To																					
Location Name	Lat		Long	Location Name	Lat	Long	Route length(km)	OF cable type	Number of fibers	Unitube/loose tube/ribbon	Armoured/Unarmoured	Date of testing	Splice loss acceptable value db 1310 nm	Number of splices											
OTDR testing result	Fiber number																								
	1		2		3		4		5		6		7		8		9		10		11		12		

Splice no.(Loss in dB)	A to B	B to A	A to B	B to A	A to B	B to A	A to B	B to A	A to B	B to A	A to B	B to A	A to B	B to A	A to B	B to A	A to B	B to A	A to B	B to A	A to B	B to A	A to B	B to A

Annexure B.6: LSPM Test Report Format (Sample)

FORMAT D

LSPM TEST REPORT - LINK LOSS MEASUREMENT WITH LIGHT SOURCE AND POWER METER

Project Name					
Master route					
Section Name					
Cable Vendor :	Cable Type :	No.of Fibers:		Date of Testing:	
Section from :	To :	Link No:		Contractor:	

Test Instrument Details

Sr No	Description	Make		Model		Sr. No.	Caliberation Date		No. of Splices		
		Side A	Side B	Side A	Side B	Side A	Side B				
1	Light Source								Fiber Length		
2	Power meter										

Test Output reference power level at 1550nm

Fiber No.	dB loss (F)		dB loss (R)		dB loss (Av)		Results	Remarks		
	1550 nm	1310 nm	1550 nm	1310 nm	1550 nm	1310 nm	Acceptable/ Not Acceptable			
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

At 1550 nm	db			CONTRACTOR	COMPANY
At 1310 nm	db	NAME			
		SIGNATURE			
		DATE			

Annexure 3: Deviation Approval Format (Sample)

Deviation Approval Note													
Route Name:									Approval Authority			Limit	
Section Name :		**From-**			**To-**							From	To
	No of expected deviation Mentioned in survey report												
	Mtrs of expected deviation Mentioned in survey report												
	No of deviation requested so far												
	Mtrs of deviation requested so far												
	No of deviation approved so far												
	Mtrs of deviation approved so far												
	Mtrs of deviation requested in this case												
Specification Required: 1. Photographs (DISL APP) 2. Markings on Single Line diagram with Red-GI Pipe, Green-DWC with mesh concrete, Blue-RCC full rounds													
S. No.	Chainage		Length (Mtrs)	Depth (Mtrs)	Reason for Deviation:	Type of Protection given							
	From	TO											
Cost implication:													
Remarks													
* Normally only following exceptional cases of deviation should be part of reasons (Authorities not allowing - should be part of survey report; Utilities - HDD not possible; Hard Rock - blasting not allowed)													