

REPUBLIC OF RWANDA



RWANDA UTILITIES REGULATORY AUTHORITY

GUIDELINES FOR FIBER OPTIC CABLES UNDERGROUND INSTALLATION

DOCUMENT CONTROL

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Abbreviations

dB: Decibel

FOC: Fiber Optic Cable

FTTH: Fiber To The Home

ITU-T: International Telecommunication Union -Telecommunication Standardization Sector

MHz : MegaHertz

MMF : MultiMode Fiber

ps : Pico second

RURA: Rwanda Utilities Regulatory Authority

SMF: Single Mode Fiber

TIA: Telecommunication Industry Association

Background

The law n° 44/2001 of 30/11/2001 governing telecommunications, especially in its article 47 stipulates that It is forbidden to install any telecommunications infrastructure or terminal equipment on, over or under any public or private land other than in accordance with this law,

Therefore all telecommunications operators wishing to install telecommunications infrastructure and terminal equipment on, over or under public land must make a request in conformity with the law in force.

Furthermore, article 49 of the same law stipulates that If, when installing telecommunications infrastructure or terminal equipment, any telecommunications network provider (or anyone employed or contracted by him/her) damages or destroys any telecommunications infrastructure or terminal equipment belonging to another network provider or any cables, pipes, conduits, poles, ducts, masts, aerials or transmitters, belonging to broadcasting companies or other utility companies must pay compensation to the affected company.

Usually application to install telecommunications infrastructure or terminal equipment apply are made based on what is provided for by Ministerial order 6/dc/04 of 07/06/2004 requests for installation of telecommunications facilities and terminal equipment of public and private property,

Unfortunately, this Ministerial order doesn't respond to preoccupations leased by this article 49 of the n° 44/2001 of 30/11/2001 governing telecommunications related to restriction of the damage or destruction of any other infrastructure during the installation of telecommunications infrastructure or terminal equipment.

These Guidelines for Fiber Optic Cables Underground Installation have been developed with an aim of avoiding damages to existing underground infrastructure such as existing Fiber Optic Cables, sewage or water pipes, electrical cables or other telecommunications cables.

They also intend to insure that the installation of Fiber Optic Cables is done in accordance with telecommunication standards.

The methodology used during the exercise of drafting and validation of these guidelines followed the following steps:

It has been a step of Data collection/Benchmarking done by the technical Unit, after collecting data; the same Unit initiated the draft of a kind of Regulations. When this document was at the stage of zero draft, its legal framework had the nature of regulations. RURA decided to redraft it in the form of Guidelines; the change of the legal nature did not affect the content of the document, only these guidelines have been given an appropriate legal writing.

During the consultation process, operators have been asked to provide inputs which have been considered by RURA and the document has been modified accordingly.

The draft guidelines into appropriate legal drafting have been finalized by the legal Unit and submitted to the board for approval.

AND AFTER its deliberations in its meeting of

HEREBY issues the following guidelines on Fiber Optic Cables Underground installation

I: GENERAL PROVISIONS

I.1: Purpose

These guidelines on fiber optic cables underground installation aim at avoiding any damage to existing underground infrastructure such as existing FOC, sewage or water pipes, electrical cables or other telecommunications cables. They also intend to insure that the installation of FOC is done in accordance with telecommunication standards.

I.2: Scope

These guidelines apply to all Fiber optic infrastructure underground installation and show the mostly used materials specifications for FOC network.

These guidelines shall apply to any Telecom Operators and Service Providers operating within the territory of the Republic of Rwanda.

I.3: Definitions

In these guidelines the terms hereunder shall have the following meaning:

- a) **Fiber Optic or Optic Fiber:** the medium and the technology associated with the transmission of information as light pulses along a glass or plastic strand or fiber;
- b) **FOC:** Fiber Optic Cable which means a telecommunication cable in which one or more fiber optic are used as the propagation medium to transmit large amounts of information at the speed of light;
- c) **Hand hole:** a top opening hole with small size than manhole for pulling and splicing cables only;
- d) **ITU-T:** International Telecommunication Union -Telecommunication Standardization Sector;
- e) **Manhole:** top opening large and deep hole where a man can get inside for installation, making connections or performing maintenance on underground and buried FOC and other services including sewers, telephone, electricity, storm drains and gas ;
- f) **Permit:** refer to the document issued by the Regulatory Authority which authorizes the permit holder to carry out the activity specified under the conditions prescribed in these guidelines;
- g) **Regulatory Board:** the supreme management and decision making organ of Rwanda Utilities Regulatory Authority ;

- h) **Right of way:** the right to pass through over someone's land and to have the reasonable use and enjoyment of their property as long as it is not inconsistent with the network provider's use and enjoyment of the land;
- i) **RURA:** Rwanda Utilities Regulatory Authority as defined by the Law n° 09/2013 of 01/03/2013 establishing Rwanda Utilities Regulatory Authority (RURA) and determining its mission, powers, organisation and functioning;
- j) **TIA;** Telecommunication Industry Association;

II: SPECIFICATIONS FOR FIBER OPTIC NETWORK AND CABLES

Article II.1: Fiber Optic specifications

The following features should be taken into consideration while choosing fibre optic and cable :

- All fibre optics must meet the requirements of ITU-T Recommendations;
- Each cable must have traceability of the fibre optic back to the original fibre ID number and test parameters as provided by the fibre manufacturer ;
- Each fibre must be distinguishable from other fibres in the same duct by means of colour coding ink visible throughout the design life of the cable (as Defined by TIA-5987C);
- Fibre optics shall have a high level of splice compatibility with fibre optics from other manufacturers;

Performance specifications for standard single mode Fibre optic (ITU-T G.652) and recommended multimode Fibre optics (ITU-T G.651) are detailed in Appendix3 and 4.

II.2 : Cable Specifications

The cables must be circular in cross section and free from pinholes, joints, repairs and other defects.

Materials used in the construction of the cable shall not affect the physical or optical properties of the fibres and shall be compatible with each other.

The above mentioned provisions (section 2.1 and 2.2) comprise requirements for the mostly used materials for FOC network and its specifications. However, it remains the network provider responsibility to identify and procure all the required materials for the complete FOC installation work

III: FOC NETWORK ENGINEERING REQUIREMENTS

FOR PERMIT APPLICATION

III. 1: Design stages and submissions

III.1.1: Permit applicant requirement during design stage

- a. A physical pre-survey of the route for all types of installations for the purpose of establishing the exact cable routing, termination points, jointing locations and cutting lengths will be done before the commencement of any work or committing any materials. If a change in route is required for any practical reason, prior approval should be obtained from the regulatory authority.
- b. Optical power link loss budget shall be calculated for any FOC link. Parameters to be included in calculation of link losses are specified in appendix 2.
- c. The maximum length of any optical path between two fibre optic repeaters must be calculated separately, and depends on the total loss in all components used in the path, including fibre optic cable, optical connectors, star couplers, and splices.
- d. All components such as additional connectors, star couplers and splices along with cable attenuation, should be taken into account in calculating the loss.
- e. The sum of the losses in all components used in the optical path must not exceed the specified Power Loss Budget for the chosen cable type.
- f. The specified Power Loss Budget includes the loss of the two ST-type connectors connecting at the two repeater ends, and also includes the system margin of 3 dB.

III.1.2: Plan documents

Plan document should include :

- 1) One original complete copy of the plans showing the proposed work, schedule and procedures. However an additional copy will be required if there is a bridge attachment, road crossing, box culvert crossing, limited access or inter-district involved;
- 2) The route/ street name/ location where the work is to be performed;
- 3) Color highlights to show the demanded right-of-way (red) and the existing cable (blue);

- 4) A vicinity map or drawing showing the routes, total layout and locations of all manholes that will be included in the permit, and the surrounding area of the work.
- 5) Legend showing the symbols used on the plans and the color-coding used to mark the plan if more than red and blue colors are used;
- 6) A clearance distance of the minimum vertical (while crossing) and the horizontal (while in parallel) distance to the nearest affected utility and/or right-of-way object.
- 7) Section views:
 - a) Shall not include sections that are not relevant to the proposed work;
 - b) For any crossing, which might create a potential conflict including but not limited to, cable crossings over or under large storm pipes, culverts, electrical lines, water, transmission lines and other affected utilities, an individual section views must be submitted;
 - c) Any proposed work in the vicinity of a bridge or box culvert must include a section showing the distance from all features of the structure;
- 8) Labeling
 - a) Indicate the length and type of cable proposed for installation on each page;
 - b) Show distance of proposed cable from the roadway;
 - c) Identify the proposed cable installation method on each plan sheet such as hand, machine trenching, or directional bore;

III.1.3: Drilling Site Information to Be Submitted With Permit Demand

Exhaustive knowledge of the work site and of the subsoil, right from the first design phase is essential, both to reduce the number of failures and/or to limit possible damage to pre-existing services or structures. Information requested by Regulatory Authority to be submitted with installation permit request is following:

- Existing utilities documentation made available by local authorities and other companies;
- Site investigation equipments used such as Pipe and cable locators or Ground Penetrating Radar systems;...
- The drilling plan accompanied by obstacles;
- Infill materials (rubble, sand).

III.2: Permit application characteristics

An applicant must comply with the following:

- a) Applicant should submit filled right of way form provided in Appendix1 of these guidelines;
- b) The demand of permit should be accompanied by the documents listed in design stages and submissions part;
- c) Permit application must be in the name of the fiber optic network provider that is responsible for the installation and maintenance of the cable and the signature of applicant must appear on permit application;
- d) Permit application shall list the name, address, phone number, and emergency 24-hours phone number of the contact person for the fiber optic network provider;

Sub-contractor information may be provided separately.

- e) Permit application documents should be submitted in soft and hard copy to the Regulatory Authority office.

III.2.1: Separate Permits Required

Work on the inter-district must be submitted on separate permit applications, and the expected date of permits intersection work is to be determined.

III.2.2: Works Notification

The list of routes/street names/locations where the work is to be conducted will be communicated to other utilities providers by the Regulatory Authority. Comments from concerned utilities providers will be provided within ten(10) days from the date of the reception of works notification.

III.2.3: Limitations

Permit will be issued for applications on any exceeding distance. It is prohibited to conduct any work on additional distance out of permit scope.

III.3. Installation

III.3.1 : Manholes/ Handholes Installation

Each and only each manhole/ handhole constructor should obey the following:

- a) Manholes/Handholes shall be covered by a flat lid on which the size and the depth of the manhole/handhole are written;
- b) Manhole/Handhole lids shall be labeled with the network provider name;
- c) Manholes/ Handholes must be located outside of sidewalks and roadways;

Manholes/Handholes must be located a minimum of 2 meters off the edge of pedestrian way, and 3m from the edge of the roadway if there is no space reserved for pedestrian way. In case of unavailability of the required clearance distance due to the soil or terrain condition; the special request for shorter clearance shall be sent to the Regulatory Authority, who will assess and provide the feedback based on case specifications;

- d) Manholes/Handholes shall not be located in the ditch line;
- e) Any FOC joint shall be housed inside the manhole;
- f) The pulling of the cable shall be hand assisted at each Manhole or Handhole. The cable shall not be crushed or forced around a sharp corner. Sufficient slack shall be left at each end of the cable to allow proper cable termination;
- g) The cable shall be marked and labelled at each manhole and at all entry and end points of the fibre optic cables;
- h) The area around the manhole shall be compacted. Upon final acceptance of the conduit/duct system all manholes shall be free of debris;

III.3.2: Road /Street Labeling

Surface markers to indicate the route of the cables shall be planted by the road sides. These markings shall be placed at intervals of between 300m to 500m. Visible pole markers shall indicate the fiber network provider and cable depth. It shall be placed along the trenches 30 cm below ground surface.

III.3.3: Cable Installation along Roadway

Cable installation along Road way shall strictly observe the following requirements:

- The cables shall be laid in ducts buried to depths of not less than 80 cm or 1.5 m in road reserves. In case the soil conditions does not allow to achieve the aforementioned minimum required depths; the special request for smaller depth shall be sent to the Regulatory Authority, who will assess and provide the feedback based on case specifications;
- Comply with all provisions and guidelines established by the Regulatory Authority and concerned authorities;
- Comply with the provided schedule and not go beyond three (3) days;
- Reserve at least the horizontal distance of 1 metre between the existing underground utilities and the new cable, and if not possible use tape marking to indicate the location of fiber optic cable and make informed the network provider of existing utility five days before excavation;
- Place the barriers and road signs required by current laws during excavation works;
- If the excavation must remain open or the road will be otherwise obstructed during the night or under low-visibility conditions, road signs shall be complemented by lighting devices of the color, shape and size stipulated by the traffic code;
- Trenches should be backfilled to the original state and backfill shall be strong enough to support any kind of stresses;
- Put an identification sign (marker) stated by these guidelines to illustrate your cable route.

III.3.4: Existing Utility Damages

In case of damages of any existing infrastructure, the owner will repair the damaged infrastructure and negotiate the cost with the applicant in a period of two weeks from the declaration of the matter. The form provided in the appendix6 will be used by the two parties to sign an agreement on restoration of damages; if the negotiations fail, the provisions stipulated by article 49 of the Law n° 44/2001 governing telecommunications will be applied.

III.3.5: Cleaning

The following operations shall be carried out after excavating the trench:

- Remove spoils from the sides of the excavation (Spoil must be transported to authorized disposal sites in accordance with local authority requirements.);

- Remove adjacent paving materials which were damaged as a result of excavation;
- Fulfill the cleaning conditions required by local authority and other concerned authorities.

III.3.6: Trenching Guidance

During the installation in trench the following should be obeyed

- a. Fiber optic cables shall be laid in trenches;

Trenches along road networks shall be sufficiently deep to provide appropriate fiber cable protection and shall be placed at least 1.5m away from the edge of pedestrian walkways or storm drainages along paved roads. In case of unavailability of the required clearance distance due to the soil or terrain condition; the special request for shorter clearance shall be sent to the Regulatory Authority, who will assess and provide the feedback based on case specifications;

- b. In the absence of pedestrian walkways, the cable must be located at a minimum distance of 2.5 meters off the roadway. In case of unavailability of the required clearance distance due to the soil or terrain condition; the special request for shorter clearance shall be sent to the Regulatory Authority, who will assess and provide the feedback based on case specifications;
- c. Road surfaces where cable crossings have been installed shall be restored to its original state in compliance with local authorities and other concerned authorities specifications;
- d. No cable installation will be permitted in a ditch line. Cable installations will be permitted along the back of the ditch line only;
- e. Where there are cable crossings along roads, ducting shall be of galvanized steel pipes buried deep enough (1m or more) for protection from vehicular or pedestrian traffic stresses. Similar galvanized steel pipe ducts shall be used at bridge crossings.

III.3.7: Trenchless Techniques

Trenchless techniques shall be used to reduce environmental damage, social costs and provide an economic alternative to open-trench methods of installation.

Trenchless or no-dig technique used for long section FOC installation should be divided into shorter sections of the work length accordingly to the characteristics of the machines and the design requirements.

The trenchless techniques after consulting the relevant institutions are only allowed by Regulatory Authority for road crossing FOC installation. The installation of optical cables inside sewer ducts is compulsory wherever the ducts are available.

For the use of inside sewer ducts, the sewer assessment is much needed and the following information shall escort the permit application:

- Applicable sewer pipe diameter;
- Position in the sewer;
- Maintenance feasibility of the sewer;
- Risk of blockage;
- Upgrading of the optical network;
- Maximum number of cables and fibres;
- Flexibility of the optical network;
- Access to optical network;
- Cable type;

Other technique than the installation of optical cables inside sewer ducts agreed by Regulatory Authority for road crossing is drilling technique which is allowed to be used in absence of constructed ducts.

In case of impossible crossing with trenchless techniques due to the soil condition that avoids the use of guided boring/directional drilling machine; the special request for road crossing by digging shall be sent to the Regulatory Authority, who will assess and provide the feedback based on case specifications.

III.3.8: Trenchless Guidance

Any person conducting trenchless excavation shall take all reasonable steps necessary to protect and support underground utility lines. These steps shall include, but are not limited to the following:

- The excavator should verify that all utility lines in the area are marked;
- The excavator shall ensure that bore equipment stakes are installed at a safe distance from marked utility lines;
- The excavator shall ensure that sufficient clearance is maintained between the bore path and any underground utility lines during pullback;
- The excavator shall give special consideration to water, electricity and sewer systems within the area that cannot be located accurately;
- The excavator shall ensure that the drill head locating device is functioning properly and within its specification.

III.3.9: Crossings

- All crossings are to be made perpendicular to the roadway.
- Road crossing machines should be used with a depth of not less than 1m.
- Any cables should be protected with appropriate ducts along the whole crossing length.

III.3.10: Duct Sharing

Fiber Optic installation conductor shall install at least two (2) pipes with a minimum of twelve (12) cores on access network and 4 ducts on backbone network in order to facilitate fiber and duct sharing. The payment of these reserved pipes and cores by a new operator will follow the Guidelines for fiber and duct sharing.

III.3.11: Sharing Point and Shared Building Cabling

The shared building cabling and sharing point for fiber installation in building with multiple operators is mandatory in order to:

- Reduce fiber installation and maintenance costs in the building
- Reduce disturbance (noise, infrastructure works, dust...) for inhabitants
- Avoid cabling duplication if more than one Fiber to the home (FTTH) operators are in a building

The Shared building cabling combined with the sharing point should support both Point to Point and Point to Multipoint access network topologies.

The first applicant to connect a building should provide a sharing point that might support sharing of four operators in case of need to share the cable.

IV: AS BUILT SITE VISIT AND REPORTING

IV.1: As- Built Site Visit

After completion of each section, after installation completion either by trench or trenchless, the fiber optic network provider should prepare a site visit with concerned authorities and RURA delegates in order to check the excavated area status before commencing the following section and each visit should be accompanied by its report.

If the work is composed in sections, the permit of following section shall be given by RURA after previous section site visit report acceptance.

The site visit by the Regulatory Authority shall consist with conformance to the engineering plans, codes, guidelines, and general accuracy.

It should be made at the completion of each section including the last section of installation works.

The site visit of the constructed areas shall focus on the following:

- Restoration has been accomplished;
- Permanent markers have been installed immediately beside the cables;
- Road bores, if used, are properly completed and will not collapse a portion of the road;
- Debris and trash have been removed from the site;
- Other instructions specific to the installation have been completed to the drawing's specifications and to the related institutions requirements.

As stipulated by Article 135 of the law n° 12/2007 of 29/03/2007 Public Procurement, the fiber optic network provider will provide a guarantee of at least one(1) year to be counted from the date of the as built site visit. The fiber optic network provider will be held responsible of any infrastructure damage that will happen on the site during the period of guarantee, and will also be responsible for all damages caused due to no respect of the Technical Specifications during works implementation.

IV.2: Final As-Built Reporting

The as-built drawings and documents shall identify the actual apparatus units at each structure and other information such as the structure type and dimensions, cumulative distance to each termination point from the structure, any grounding or bonding detail, etc. These drawings and documents are typically the construction detail sheets that have been corrected to reflect any changes during construction.

As-built drawing shall record all deviations, removals and additions with respect to the original scope.

Referring to the schedule provided by an applicant, the Fiber optic network provider shall provide an accomplishment report to the Regulatory Authority within 5 working days and an as-built documentation containing the following information not later than 30 working days from the accomplishment of the installation works:

- Position of the installed pipes;
- locations of installed cables;
- Soil conditions;
- Network loss link budget.

IV.3: Active Permits

1. Permit holder is required to maintain accurate records of each and every permit status and deliver any record at any time to the Regulatory Authority when it is demanded. All work being performed on District right-of-way must be with an active permit.
2. The right of way permit validity before works commencement is limited to 3 months from the date of permit delivery by the Regulatory Authority.
3. The permits that are expired are not legally valid.
4. If the permit holder desires a re-instatement of the permit, it is his/her responsibility to request the same in writing to the Regulatory Authority.
5. The installation project should be considered as completed after validation of inspection report.
6. In case of unsuccessful installation works, all non-accomplished tasks indicated by site visit team must be handled within 10 working days from the date of issuing inspection report. If the applicant does not complete non-accomplished tasks in the requested time, a warning letter is issued to him/her by the Regulatory Authority.
7. Failure to complete non-accomplished items in 5 working days after the reception of warning letter shall be subject to placing a hold on processing new permit applications.

V: FINAL PROVISIONS

V.1: Enforcement notice

In case of non compliance with these guidelines, the Regulatory Authority may issue an enforcement notice to remedy the failure within a specific period of time.

V.2: Commencement

These guidelines shall come into force on the date of its signature by the Chairperson of the Regulatory Board.

RUHAMYA Coletha

The CHAIRPERSON

APPENDIX

Appendix1. Application form for right-of -way authorization/foc installation (To be completed in duplicate)

Name of Applicant

Address of offices
.....
.....

Phone Fax E-mail

Contact person

Contact telephone number

Planned district or town of installation:
.....

Localities where Application for Right-of-way is required:
.....
.....

- | | | | |
|-------------------------------------|----------|---------|------------|
| Attach network diagram(s): | Yes..... | No..... | (Tick one) |
| Attach design drawing(s) | Yes..... | No..... | |
| Attach time plan for fiber rollout: | Yes..... | No..... | |
| Enclose copy of specifications: | Yes..... | No..... | |

Name and address of cable supplier and/or manufacturer:
.....
.....
.....
.....

Proposed services application:

.....
.....
.....

Declaration by the applicant

I certify that the information provided in this application form including the attachments is true and correct.

Signature and stamp of applicant

Date of application:

Appendix2. Recommended parameters to be included in the link losses calculation.

Link losses	dB (Maximum loss)
Cable loss (for standard SMF)	0.5dB/km
Splice loss (for standard SMF)	0.1
Connectors loss	0.5

Appendix3. Optical performance for standard (ITU-T G652) Single Mode Fibres

PARAMETER	REQUIREMENT
Attenuation at water peak	≤ 2.1 dB/km
Attenuation coefficient at 1310 nm	≤ 0.5 dB/km
Attenuation coefficient at 1550 nm	≤ 0.4 dB/km
Optical discontinuities at 1310 and 1550 nm	< 0.1 dB
Chromatic dispersion between 1285 and 1330 nm	≤ 3.5 ps/nm·km
Chromatic dispersion at 1550	≤ 18 ps/nm·km
Cable cutoff wavelength	≤ 1260 nm

Appendix4. Optical Performance for Multimode fibres (ITU-T G651.1)

PARAMETER	REQUIREMENT
Attenuation coefficient at 850 nm	≤ 3.0 dB/km
Attenuation coefficient at 1300 nm	≤ 0.7 dB/km
Optical discontinuities at 1310 and 1550 nm	< 0.1 dB
Bandwidth Distance Product at 850 nm	≤ 160 MHz.km
Bandwidth Distance Product 1300 nm	≤ 500 MHz.km

Appendix5. Summary of Values Recommended by These Guidelines

No	Item	Value
1	Excavation and backfilling duration	≤3days
2	Excavation notification to the other utilities operators	≥ 5 days before commencement
3	Distance of cable from the edge of shoulder	1.5m
4	Minimum distance of the cable from the off of roadway	2.5metres
5	Interval distance between FOC and existing underground infrastructure	1m
6	Trench depth	≥80cm
7	Trench depth while road crossing	≥1meter
8	Visible tape along the trenches below ground surface.	30 cm
9	Interval distance between two visible tape marker indicating cable route	300m to 500m
10	Distance of Manhole/Hand hole from the edge of shoulder	2metres
11	Minimum distance of the Manhole/Hand hole from the off of roadway	3m
12	Accomplishment report submission	≤5 working days from the date mentioned on the schedule
13	As-built documentation report submission	≤30 working days from the date mentioned on the schedule
14	Right of way permit delivery	10 working days
15	Right of way permit validity	3months

Appendix6. Incident Report Template

Location (District/sector/cell):	
Date (Day/Month/Year/time if possible):	
Damaged Infrastructure:	
Owner of Infrastructure:	
Source of incident:	
Responsible for Damage:	
Damage Severity:	Critical <input type="checkbox"/> Major <input type="checkbox"/> Medium <input type="checkbox"/> minor <input type="checkbox"/>
Affected sites (clients):	
Immediate Solution:	
Recommendations for the Permanent solution:	
Owner's Comment : (Affected Institution Representative)	
Responsible Comment: (Source of the Damage)	
Prepared by: Name:	Approved by Name: Name:

Title:	Title:
Tel:	Tel:
Signature:	Signature: