



**NETWORK SERVICES
FTTP SUPPORT
METHOD & PROCEDURE**

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Fiber To The Premises (FTTP) OSP Fiber Optic Safety Guidelines

Purpose To provide fiber safety guidelines for employees involved in building, operating, maintaining and restoring FTTP systems

Personnel Affected Entire Verizon Footprint

Distribution FTTP Build Teams and Staff

Related Information See FTTP web site at the following URL address:
http://ftp.verizon.com/file-storage/index?folder_id=7640&n_past_days=0

Effective Date This M&P becomes effective upon receipt.

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NOTE: The information contained in this document does not supercede existing safety practices but is intended to provide information to address FTTP-specific issues.

Introduction

The Verizon Fiber To The Premises (FTTP) technology will use a Passive Optical Network (PON) architecture to deliver voice, data and video services to customer premises. The basic PON design requires a single feeder fiber to transmit voice and data services from a central office to an FTTP Fiber Distribution Hub (FDH). Video services will typically be transported on the same fiber from the central office to the FDH but in some instances be inserted on a separate fiber that originates at a video mini-headend location closer to the fiber serving area. At the FDH, the fiber is spliced to a passive optical splitter that splits the input optical signal to 32 output ports (or 16 ports in some applications). From the FDH, dedicated distribution fibers feed as many as 32 homes.

FTTP Systems will use Wave Division Multiplexing (WDM) to transmit and receive the optical signals, utilizing the following wavelengths:

- 1490 nm (downstream voice and data)
- 1550 nm (downstream video)
- 1310 nm (upstream voice and data)

This document addresses safety issues and guidelines associated with testing, providing service and troubleshooting this new technology in Verizon.

General

Fiber optic system transmitters emit light at various optical wavelengths. These wavelengths may be in the visible spectrum or may be in the infrared spectrum, which is not visible to the human eye. Lasers transmitting at lower wavelengths are in the visible spectrum, which the human eye is able to see to approximately 780 nm. An example of a laser device that uses the visible spectrum is a Visual Fault Locator test device that is used by fiber optic technicians to locate faults or breaks in fibers. It uses a laser source at approximately 650 nm, which emits light in the red area of the visible spectrum and allows a technician to see continuity in a fiber.

The Verizon FTTP technology and associated optical test sets use lasers at 1310, 1490 and 1550 nm (nanometer) wavelengths. All three of these wavelengths are in the infrared spectrum and are therefore not visible to an FTTP technician's un-aided eye.

Viewing laser light directly at these wavelengths does not cause pain. The iris of the eye will not close involuntarily as when viewing a bright light. Consequently, damage to the eye is possible if proper safety precautions are not taken when working with an FTTP system.

The highest optical power level that should be encountered on an FTTP system in the outside plant is approximately +20 dBm, which is associated with the video signal transmitted at 1550 nm. In a normal operating system, this optical power level will be present in the outside plant near the output of the video amplifier and typically remains at a high level in the feeder fiber until it is attenuated in an FDH by the transmission loss through a Passive Optical Splitter. FTTP is therefore considered a Class 3b category Laser System (+7dBm to +27 dBm power range) based on the criteria established by the American National Standards Institute (ANSI Z136.2 - 1997). Verizon InfoPoint Document No. 7516, published by the Safety, Health and Environment Organization (see Reference Section of this document) describes Class 3 lasers (all Class 3 categories are within the range of 0 dBm to +27 dBm power) as follows based on the ANSI Z136.2 document:

(medium power) requires control measures to prevent exposure to the direct beam. This is a laser that can emit dangerous radiation levels and cause eye damage when one looks at the output directly or with an optical instrument, such as a microscope, magnifying glass, or eye loupe.

Once a central office PON card that serves an FDH splitter is turned on for service, the system is in a live (i.e., "lit") mode. For each customer that requests service, a connector at the FDH must be cleaned and inserted into the distribution bulkhead connector port assigned to that customer. Normal operations therefore requires FTTP technicians to clean the optical connectors and make optical connections at FDH's and at serving terminals on live fibers as part of providing service to customers.

In addition, fiber cables that interconnect various components in the system can also be disconnected or accidentally broken, permitting potential technician access to laser radiation. Certain test and maintenance procedures may also require direct access to a live fiber during installation or servicing. For these reasons, appropriate safety precautions are required to protect employees from accidental exposure to laser radiation.

Safety Procedures

Normal Operations Safety Procedures

It is appropriate that some procedures normally associated with maintenance of a non-FTTP fiber optic system apply to the normal day-to-day operation of FTTP systems, given that the technician must routinely work with live fibers. This includes the following procedures and / or precautions:

- Only authorized, trained personnel shall be permitted to perform service and/or maintenance on FTTP transmission systems.
- Only authorized, trained personnel shall be permitted to use the laser-powered test equipment during installation and/or servicing.
- Employees should not disconnect any fiber optic cables and stare into bare fibers or fiber connectors that terminate a cable.
- Employees should not view fiber optic emission directly with an optical instrument such as a microscope, magnifying glass or eye loupe. An indirect image device should always be used for this purpose. Fiber Inspection Probe kits are approved and available from EXFO and should be used for any indirect viewing of fiber connectors. The 400 X magnification Inspection Probe is available in four configurations. It allows a technician to look at the image of a fiber end-face without ever having to look into the fiber, eliminating the risk of harmful laser light reaching the eyes. Please see the Reference Section of this document for a URL address for more detailed information on the Probes.
- Protect all exposed optical connectors with clean dust caps at all times or store them in FDH “parking lots” that are specifically designed for that purpose. This protects the fiber from dust and dirt and also provides a safer work environment.
- Observe all other rules, procedures and practices that are established for the safe operation of FTTP systems.

Repair / Restoral Safety Procedures

FTTP lasers do not automatically shut off when faults occur in a fiber cable. Technicians that are dispatched and engaged in the repair of FTTP systems therefore have the following responsibilities in addition to the guidelines specified above:

- Do not examine or stare into broken, severed, or disconnected fibers or fiber cables.
- Move a safe distance away from a damaged system. It should always be assumed that a laser signal is present until verified otherwise.
- Place warnings or barricades around the damaged location to protect the public or other workers from exposure.
- Notify the supervisor immediately of conditions or practices that may cause potential injury or property damage or of any known or suspected accidental exposure to laser radiation.
- Do not view broken cables with any optical instruments unless it can be determined that there is no laser energy present.

Safety Procedures (Cont'd)

It may be possible to determine if a laser signal is present by using a live fiber identifier probe, but this is only possible if there is clear access to the fiber and the jacket is not ribbonized or greater than 3 mm in thickness.

A broken or exposed fiber can exist in various configurations such as loose tube, ribbon, 250 micron buffer, 900 micron buffer or 3 mm jumper cable. It is desirable to have a single technique that can be used to detect the presence of a laser signal for all of these situations. The following steps are suggested as one method to accomplish this:

- Using any Fiber Optic power meter that has a removable SC (or other) adapter cap and remove the adapter cap.
 - Allow the meter reading to stabilize with respect to the ambient light.
 - Hold the broken end of the fiber 1-3 inches in front of the detector disk.
 - Look for a rapid fluctuation of the power meter readings. This indicates the presence of a live fiber.
- If it is determined that laser energy is present, have the laser light sources removed from each affected fiber and re-verify that this has been completed before proceeding with restoration work.

In general, it is probably not feasible to turn off the video amplifier laser source in the central office or other location that powers the 1550 nm optical signal. Each video amplifier has six output ports that can not be turned off independently and all ports may not serve fibers for the same OSP feeder route. The most effective way to ensure that the laser power is removed from FTTP fibers is to identify and disconnect the fiber optic jumper that feeds each affected fiber. For feeder applications, these are the Fiber Distribution Frame (FDF) fiber jumpers and for distribution fibers they are the distribution bulkhead connectors in the FDH that are associated with the faulted distribution fiber cable.

Additional types of equipment that may aid in a maintenance or repair effort include, but are not limited to, OTDRs, visual fault locating test sets (which use safe red light beams to illuminate and locate a fiber) or the fiber identifier type of probe referenced above that identifies a fiber by detecting either a specific wavelength sent at a termination point or the presence of an active system. In addition, Fiber Inspection Probes (also detailed above) are available for this purpose as appropriate where connectors are involved.

Testing Safety Procedures

The following procedures should be followed when testing an FTTP system:

- Establish and maintain communications from end-to-end or end-to-splice location.
- Verify that no fibers to be worked on have equipment connected.

**Safety
Procedures
(Cont'd)**

- When generating an optical test signal with a test set, ensure that no splicing operations are being performed and that no one is working on the fiber under test at any location. Maintain positive employee communications between the fibers under test during the measurements.
- Should a fiber be left unattended by craft during field work, fibers being worked on shall be tagged at the terminal to prevent inadvertent connection of a light source.
- After the work activity is complete, remove the test equipment.

Administrative Safety Procedures

The first level supervisor is responsible for maintaining safe working conditions for all employees engaged in the installation, operation or repair of FTTP systems. The supervisor's responsibilities include the following:

- Maintain a work environment that assures safe and healthful conditions for employees.
- Instruct employees periodically on the precautions, procedures and practices that are applicable to FTTP systems.
- Ensure as much as possible that FTTP systems and associated test equipment are properly operated and controlled to protect transient or uninformed personnel.

Detailed information addressing a variety of Verizon administrative and technical procedures associated with restoring damaged OSP fiber cables are beyond the scope of this document. They can be found in Verizon Method & Procedure No. 2002-0467-OSP, Fiber Optic Restoration Plan, January 2003 (see Reference Section of this document).

**Cleaning Live
Fiber
Connectors**

FTTP systems will utilize SC/APC fiber connectors in the outside plant. This includes standard type APC connectors in the FDHs and also includes Corning OptiFit APC connectors at terminal locations and at the Optical Network Terminals (ONTs) at the homes. The OptiFit APC Connectors are recessed inside of a hardened plastic environmentally protected shell which provides protection against the outside elements.

As referenced earlier in this document, normal work operations requires cleaning connectors on live fibers. Methods are currently being reviewed to address the cleaning process for both types of connectors that will be both safe and effective. They will be summarized and referenced in this section when completed.

Glass Fiber Precautions

The transmission medium used in fiber optic systems consists of fibers that are hair thin filaments of silica glass. When the outer coating is removed down to the bare fibers, the following precautions should be observed:

- Safety glasses should be worn when working with bare fibers or fiber connectors.
- Avoid rubbing eyes when handling fiber cuttings since small fragmented pieces of glass may adhere to the hand and be transmitted to the eyes. If a fiber cutting is suspected to be lodged in an eye, seek medical help immediately.
- Do not handle pieces of optical fiber with bare fingers. Use tweezers or the sticky side of a piece of vinyl tape to pick up and discard any loose fiber ends.
- All fiber / fiber cuttings must be disposed of properly (per local instructions) since fibers are small, very sharp and can pierce the skin easily.
- Wipe clean or wash hands after handling optical fibers. Small bits of glass are almost invisible and can cause injury and damage eyesight.

Glossary

<u>Abbreviation</u>	<u>Definition</u>
ANSI	American National Standards Institute
FDH	Fiber Distribution Hub
FTTP	Fiber To The Premises
ONT	Optical Network Terminal
OSHA	Occupational Safety and Health Administration
PON	Passive Optical Network
SC/APC	Subscriber Connector / Angled Physical Contact
WDM	Wave Division Multiplexing

References

Verizon InfoPoint Document No. 7516, Lasers (Optical Fiber Communications Systems). Located at the following Verizon Intranet URL address:
<http://hr.verizon.com/lib/infopoints/7516.shtml>

Verizon Doc. No. 2002-00517-OSP, Issue B, Video Inspection Scope for Fiber Connectors. Located the following URL Address:
<http://vids.verizon.com/network/osp/newdocs/docfiles/2002/0200517/pdf/0200517.pdf>

Verizon Doc. No. 2002-00467-OSP, Fiber Optic Restoration Plan. Located at the following Verizon Intranet URL address:
<http://vids.verizon.com/network/osp/newdocs/docfiles/2002/0200467/pdf/0200467.pdf>

OSHA STD 01-05-001 – PUB 8-1.7 – Guidelines for Laser Safety and Hazard Assessment. Located at the following Internet URL address:
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=DIRECTIVES&p_id=1705

ANSI Doc. Z136.2 – 1997, American National Standard for Safe Communications System Utilizing Laser Diode and LED Sources (available for purchase only).

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Attachment A - FTTP PON Architecture

