

Premises cables are not as vulnerable, except for damage caused by clumsy personnel or during the removal of abandoned cables. Any network is susceptible to damage so every installation needs a restoration plan. Efficient fiber optic restoration depends on rapidly finding the problem, knowing how to fix it, having the right parts and getting the job done quickly and efficiently. Like any type of emergency, planning ahead will minimize the problems encountered.

Documentation for Restoration

Documentation is the most helpful thing you can have when trying to troubleshoot a fiber network, especially during restoration. Start with the manufacturer's datasheets on every component you use: electronics, cables, connectors, hardware like patch panels, splice closures and even mounting hardware. Along with the data, one should have manufacturer's "help line" contact information, which will be of immense value during restoration.

During installation, mark every fiber in every cable at every connection and keep records using cable plant documentation software or a simple spreadsheet of where every fiber goes. When tested, add loss data taken with an optical loss test set (OLTS) and optical time domain reflectometer (OTDR) data when available. Someone must be in charge of this data, including keeping it up to date if anything changes.

Equipment For Restoration

Testing and Troubleshooting

You must have available proper test equipment to troubleshoot and restore a cable plant. An OLTS should also have a power meter to test the power of the signals to determine if the problem is in the electronics or cable plant. Total failure of all fibers in the cable plant means a break or cut in the cable. For premises cables, finding the location is often simple if you have a visual fault locator or VFL, which is a bright red laser coupled into the optical fiber that allows testing continuity, tracing fibers or finding bad connectors at patch panels.

For longer cables, an OTDR will be useful. Outside plant networks should use the OTDR to document the cable plant during installation, so during restoration a simple comparison of installation data with current traces will usually find problems. OTDRs can also find non-catastrophic problems, for example when a cable is kinked or stressed, so it only has higher loss, which can also cause network problems.

Tools and Components

Once you find the problem, you have to repair it. Repair requires having the right tools, supplies and trained personnel available. Besides the test equipment needed for troubleshooting, you need tools for splicing and termination, which may include a fusion splicer for outside plant cables. You also need components necessary for restoring the cable plant. For every installation, a reasonable amount of excess cable and installation hardware should be set aside in storage for restoration. Some users store the restoration supplies along with documentation in a sealed container ready for use. Remember that the fiber optic patchcords that connect the electronics to the cable plant can be damaged also, but are not considered repairable. Just keep replacements available.

One big problem in restoring damaged cables is pulling the two cable ends close enough to allow splicing them together. You need several meters of cable on each end to strip the cable, splice the fibers and place them in a splice closure. Designing the cable plant with local service loops is recommended. If the cable ends are too short, or the damaged cable is underground or buried, you will have to splice in a new section of cable. Since the restoration cable must match the damaged cable or at least have a greater number of fibers, the best source of cable for restoration is cable leftover from the original installation. Manufacturers also can supply cable restoration kits that include cable and splice closures.

What else besides cables and cable plant hardware should be in a restoration kit? You should have a termination or mechanical splice kit and proper supplies. For splices, you need splice closures with adequate space for a number of splices equal to the fiber count in the cable. All these should be placed in a clearly marked box with a copy of the cable plant documentation and stored in a safe place where those who will eventually need it can find it fast.

Preparing Personnel

Personnel must be properly trained to use this equipment and do the troubleshooting and restoration. And, of course, they must be available on a moments notice. The biggest delay in restoring a fiber optic communications link is often the chaos that ensues while personnel figure out what to do. Having a plan that is known to the responsible personnel is the most important issue.

Major users of fiber optics have restoration plans in place, personnel trained and kits of supplies ready for use. It's doubtful that most premises users are ready for such contingencies. Users may find that the cost of owning all this expensive equipment is not economic. It may be preferable to keep an inexpensive test set consisting of a VFL and OLTS at each end of the link and having an experienced contractor on call for restoration.

Managing A Fiber Optic Project





Managing a fiber optic project can be the easiest part of the installation if the design and planning have been done thoroughly and completely, or, if not, the hardest. But even assuming everything has been done right, things will still probably go wrong, so planning for the unexpected is also very important. Here are some guidelines for managing the project that can minimize the problems and help in their speedy solution.

On Site Management and Supervision

First, someone has to be in charge, and everyone involved must know they are the boss, including them. During the project, they must be readily available for consultation and updates. While this may sound obvious, sometimes the network user's representative has other responsibilities (like managing an IT department) and may not be able or willing to direct full attention to the project. Whoever is assigned the task of managing the project must be involved and available, preferably on the job site, full time. If necessary, delegate responsibility to the contracting construction supervisor with requirements for daily reports and personal updates.

Make certain that everyone responsible for parts of the project have appropriate documentation and have reviewed the installation plan. Everyone should have toured the relevant job sites and be familiar with locations. They must also know who to contact about questions on the sites, within the network user, the contractor and any outside organizations such as local governments or utilities. Everyone needs to have contact information for each other (cell phones usually, since email may be too slow and instant messaging will probably not be available to field workers.) The onsite supervisor should have a digital camera and take plenty of photos of the installation to be filed with the documentation for future reference and restoration. Locations of components, tools and supplies should be known to all personnel. On larger jobs, managing equipment and materials may be a full time job. Special equipment, like splicing trailers or bucket trucks, should be scheduled as needed. Rental equipment should be double checked with the suppliers to ensure delivery to the job site on time. Contacts for vendor technical support should be noted on documentation for the inevitable questions arising during installation.

Contacts with Local Authorities

Outside plant installs may require local authorities to provide personnel for supervision or police for protection or traffic management on public job sites, so they must also become involved in the scheduling. If job inspections are required, arrangements should be made so that the job interruptions for inspections are minimized. Supervisory personnel must be responsible for job site safety and have appropriate contact information, including for public services like police, fire and ambulance.

If the project is large enough to last several days or more, daily meetings to review the day's progress are advisable. At a minimum, it should involve the onsite construction supervisor and the network user's person in charge of the project. As long as things are going well, such a meeting should be short. On longer projects, overnight security personnel at job sites should have contact information for the job manager who must be available 24/7 as well as public service contacts.

Continuous Inspection, Testing and Corrections

Inspection and testing of the installed cable plant should not be left until after the job is completed. Testing continually during installation can find and fix problems such as cable stresses or high termination losses before those problems become widespread. Each installer doing testing should have documentation with loss budget calculations and acceptable losses to use for evaluating the test results. Installers should be double-checking each other's work to ensure quality.

What do you do when (not if) things go wrong? Here judgment calls are important. When something happens, obviously it is the responsibility of the onsite supervisor to decide quickly if they can take care of it. If not, they must know who needs to be brought in and who needs to be notified. By reviewing progress regularly, disruptions can be minimized. Equipment failures, e.g. a fusion splicer, can slow progress, but other parts of the project like cable laying can continue, with splicing resumed as soon as replacement equipment is available. Problems with termination should be reviewed by an installer with lots of experience and the cure may require new supplies or turning termination over to more experienced personnel. Never hesitate to call vendor support when these kinds of questions or problems arise.

Following the completion of the install, all relevant personnel should meet, review the project results, update the documentation and decide if anything else needs to be done before closing the project.

References and Training

References for the fiber optic designer's bookshelf include the FOA texts, [The FOA Online Reference Guide to Fiber Optics](#), [The FOA Reference Guide to Outside Plant Fiber Optics](#), [The FOA Reference Guide to Fiber Optics](#), [The FOA Reference Guide to Premises Cabling](#), and the [FOA Tech Bulletins](#) or [NECA/FOA-301](#) installation standard. When it comes to the NEC, *Limited Energy Systems*, a textbook published by the NFPA, is very useful. There are dozens of books on communications system design, but unfortunately, the fast pace of development in communications technologies means that many textbooks are hopelessly out of date unless it's updated frequently. Better to rely on the web, especially the [FOA Reference](#) site and websites of well-established manufacturers, if you ignore the obvious hype in most white papers. (Hype is becoming so blatant and obvious that avoiding it is getting easier!)

Getting trained specifically in fiber optic network design is available through some [FOA-Approved schools](#). The material is covered in part in some advanced fiber optic courses offered by the FOA-approved schools and by large manufacturers who help you understand how to build networks using their products. The FOA has a new FOA design certification ([CFOS/D](#).)

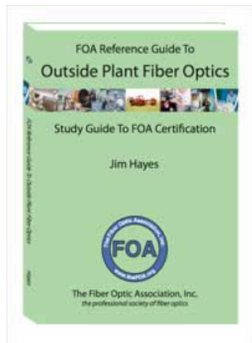
[More on fiber optic network design](#).

Test Your Comprehension

References

[The FOA Reference Guide to Outside Plant Fiber Optics](#)

[The FOA Online Reference Guide to Fiber Optics](#)



You can buy the printed version of the [The FOA Reference Guide to Outside Plant Fiber Optics](#) from the [FOA eStore](#) or [Amazon](#).

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<https://web.archive.org/web/20100826022924/http://www.thefoa.org/tech/ref/OSP/install.html>



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Reference Guide To Fiber Optics

Topic: Outside Plant Fiber Optic Installation

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OSP Fiber Optic Installation

All fiber optic applications are not the same. At the FOA, we're mainly concerned with communications fiber optics - telco, CATV, LAN, industrial, etc., but fiber optics are also used in medical or nondestructive testing inspection and [lighting](#).

Even within communications applications, we have applications that differ widely in usage and in methods of installation. We have "outside plant" fiber optics as used in telephone networks, CATV, metropolitan networks, utilities, etc. or "premises" fiber optics as found in buildings and campuses. We have fiber on "platforms" like cars, planes and ships (and the space station.) Just like "wire" which can mean lots of different things - power, security, HVAC, CCTV, LAN or telephone - fiber optics is not all the same. Since all these applications require different installation procedures, this section will focus on OSP installation in more detail.

The Installation

After the process of designing fiber optic networks is completed, the next step is to install it. What do we mean by the "installation process?" Assuming the design is completed, we're looking at the process of physically installing and completing the network, turning the design into an operating system. This chapter covers preparing for the installation, requirements for training and safety and then the actual installation process.

Since outside plant fiber optic networks can cover a broad range of installation types using varied components over different types of geography, it is impossible to cover the specifics of any one installation. This chapter should provide an overview of the various options available in OSP installations and general knowledge that should prepare those involved in any particular installation to understand how to proceed.

The Role of the Contractor in an Installation

To begin work on a fiber optic installation, the network owner or user must choose a contractor, perhaps the most important decision in the entire process. The fiber optic contractor should be able to work with the customer in each installation project through six stages: design, installation, testing, troubleshooting, documentation and restoration. The contractor must be experienced in fiber optic installations of the type involved and should be able to provide references for similar work.

One should be able to rely the contractor to not only do the installation but to assist in the design of the network and help choose components and vendors. Once the contractor has been given the assignment, they should be able to help the customer with the design, including choosing the right kinds of fibers, cables, connectors and hardware for the installation. The contractor should know which components meet industry standards to ensure interoperability and what state of the art components will facilitate future expandability.

The experienced contractor also should be able to help in the choice of vendors. Experience with particular product types and vendors will allow the contractor to assist the customer to choose products that make the installation faster and easier and often higher performance and more reliable. Should the customer choose components that are unfamiliar to the contractor, it is important that the contractor know early in the process so they may obtain proper training, often from the manufacturer, as well as any unique tools that may be required.

Generally, the customer is not as familiar with fiber optic technology and practice as an experienced contractor. The contractor may need to discuss certain choices with the customer where they believe alternatives may be better choices.

The actual installation process can involve more than just putting in cable, terminating and testing it. If the contractor is knowledgeable and experienced, the user may ask the contractor to purchase, receive, inspect and bring components to the work site also, which can be another good source of revenue for the contractor. Having full control of the materials process can also make life easier for the contractor, as they have a better chance to keep on schedule rather than depending on a customer who has many other priorities. Plus, they may have the latitude to choose components they are more familiar with, facilitating the actual installation process.

The technicians actually doing the installation should be trained and certified by organizations like The Fiber Optic Association (www.thefoa.org) and/or manufacturers of the products being installed. Certification provides a level of confidence that the installation techs are knowledgeable and have the skills needed for the work involved.

The final four requirements from the contractor, testing, troubleshooting, documentation and restoration, need to be discussed before the project ever begins. Every fiber optic project requires insertion loss testing of every link with a light source and power meter or optical loss test set according to industry standards. Some projects, like long outside plant links with splices, may also require OTDR testing. The contractor and customer must agree that testing includes troubleshooting problems and fixing them as well as documenting test results for every link.

Likewise, for the contractor, documentation must begin before the project starts so the scope of work is known to everyone and end only when the final test data is entered. Copies of the documentation, along with excess components left over from the installation, must be presented to the customer to facilitate future network restoration, should it be required.

The Contract

The contract for a fiber optic installation should include detailed requirements for the project, spelling out exactly what is to be installed, acceptable test results, and documentation to be provided. All this should be discussed between the customer and the contractor and agreed to in writing. They are not irrelevant details, as they are important to ensure the customer gets what they expect and the contractor knows what is expected of them when designing the network, estimating costs, doing the actual installation and providing proof of performance in order to show the work is completed and payment should be made.

Planning For The Project

Once the contracts are signed and a set of plans has been handed to the contractor, what's next? Planning the job is the first task. Proper planning is important to ensure the job is installed properly, on time and meets cost objectives, so the contractor can make a profit.

It is assumed you have a finished design for the project, know where and how everything will be installed and have any special requirements like permits ready. One can also assume you have a completion date, hopefully a reasonable one, to work toward. The first step then is to create a schedule which will be the centerpiece of the planning process. In order to schedule a job, you need a lot of information, much of which can be acquired from estimates you did when bidding the job. When buyers price the components to be used on a job, they should get delivery times as well as prices. Some items used on fiber optic projects should be stock items, like connectors, patch panels or splice closures. Cables, however, may have to be made to order.

Many fiber optic cables are custom items, depending on the cable type, number and types of fibers and color coding. Custom cables will often be less expensive because they don't have extra fibers for specifications you don't need, for example, but they will have longer lead times since they must be made from scratch. Whenever specifying a fiber