

messenger clamped securely. Lashing of the optical fiber cable to the messenger must be done separately on each span of the cable installation. The optical fiber cable can be pulled onto temporary support rings and lashed, or alternately, laid along the ground under the messenger and an aerial guide in front of the lasher used to position the cable next to the messenger for lashing. Some methods also use a truck that pays out the cable and pulls the lasher. Cables with built in messengers, called figure 8 cables (not to be confused with the process of coiling cables on the ground called “figure 8-ing”,) can be installed directly as the support structure is built into the cable. The cable is supported by clamping to the strength member of the cable in a manner similar to installing a messenger strand. One can also buy aerial conduit, a small fiber conduit with a messenger attached like a figure 8 cable and then an OSP fiber optic cable can be pulled into the conduit.

There is also a category of all dielectric self-supporting (ADSS) cables that are designed with more strength members and a thicker jacket to have adequate strength to withstand the rigors of aerial installation when installed with special hardware designed to grip the cable on the jacket properly without causing damage to the cable over long term high tension loading. As each manufacturer generally has their own hardware and procedures, they should be consulted during the design stage for proper cable plant design and placement procedures.

ADSS cables have two types of mounts, ends or dead-ends where the cable is supported against the tension caused by the installed cable, and pass-throughs where the cable can be attached to a pole but allowed to move within the assembly. Ends don’t mean the end of the fiber optic cable, but a location where the cable is held firmly under tension. At a pole, two ends may be used to change directions of a cable, provide slack for tensioning or to allow ends to be brought to the ground for splicing. Tensioning can be done with a chain hoist with gage to set tension.

Another type of aerial cable is optical power ground wire (OPGW.) OPGW is a high voltage conductor with a hermetically sealed tube in the center which contains optical fibers. This cable is widely used throughout the world to provide communications as well as power. OPGW is installed in the same manner as high voltage cable but ends are brought to the ground and spliced or terminated, the coiled up on the tower. If communications equipment is required at that location, fiber optic cables are brought from the splices into a local facility housing the equipment. Installation of OPGW should be left to experienced utility personnel except for splicing which may be done by fiber installation personnel.

With all aerial cable installations where splicing or termination is required, an extra 30-60 feet (10-20 meters) of cable should be left for splicing. Even more may be required if splicing is done on the ground on cable installed on tall poles.

Whenever installing aerial cabling, careful planning is very important. Working high above the ground can be dangerous and working on poles may mean working in proximity to electrical power lines. If at all possible, have the power cables shut down before installing any other cables on utility poles. Be especially careful when installing metallic support hardware for fiber cables; the fiber cables may not be conductive but the hardware can be. Install the longest cables you can to reduce the number of locations for splicing. Have proper equipment and adequate numbers of properly trained personnel on the job site, and, if possible, local authorities who may have responsibility for the installation on their property.

Submarine/Underwater Cabling



Fiber optic cables sometimes need to be installed underwater. The best known of these installations are probably the transoceanic cables that provide worldwide telecom and Internet communications. Installing those cables is a very specialized process that requires special cable designs and custom cable-laying ships to pay out the cable over thousands of kilometer runs and place it on the ocean floor at great depths. Those applications, while interesting, are beyond the scope of this book.

Other underwater installations involve river or lake crossings where it is more cost effective to lay fiber cable under water than detour around the water, place the cable in conduit lashed to bridges or other structures or run the cable

aerially. Underwater crossings may require special permits because of the jurisdiction of various environmental groups.

When cables are run underwater, there is always danger of the cable being snagged. For relatively shallow water, the cable should, if at all possible, be buried several feet under the bottom of the river or lake. For deeper water, special armored cables with one or more layers of wire armor should be used to prevent damage to the cable if snagged. Due to the specialized splice housings needed for underwater cables, running a single length across the water will be much easier and less costly.

Underwater installation brings its own safety hazards also. Experienced divers may be needed to assist in placing the cable and troubleshooting problems.

Hardware and Equipment



OSP installations may require installation of supporting structures before the cable installation can begin. New conduit or innerduct may need to be buried or conduit already in place may need to be checked, old cables removed and new innerduct installed. Some buried cables may even require the installation of pedestals, manholes or controlled-environment vaults for equipment as well as conduit.

Not only does the contractor need to consider all the hardware that may need to be installed, but they have to schedule the specialized equipment needed: trenchers or cable plows, backhoes, bucket trucks, cable winches, etc. and ensure that personnel are well-trained in their use.

Splicing Cables



Once the infrastructure is in place and the cable placed, the fiber optic splicing work begins. Now scheduling the availability of appropriate fiber optic equipment is the concern. If the cable is to be spliced outdoors, a splice trailer is normally used, unless splices are being made on a pole or in a bucket, where a tent may be required in bad weather. The cable needs to be prepared for the splicing process. This involves processes appropriate to the cable type being installed, but usually includes removing the cable jacket, exposing proper lengths of buffer tubes to connect to splice trays, cutting back strength members to attach to the splice closure and cleaning all water-blocking gel or powder. Finally, the appropriate lengths of fiber are exposed and cleaned for splicing.

Care should be taken to ensure each fiber is carefully placed in the splice closure to prevent damage especially if the closure must be re-entered in the future and the closure needs to be sealed carefully to prevent long term degradation.

And, as we always warn splicers, careful identification marking inside the closure makes identifying fibers much easier if a later problem requires re-entry.

Each splice needs to be verified with an OTDR test. Testing is done preferably as each splice is made and placed in the splice tray, so to be efficient, a splicer will be on the job site and a test tech will be working at the other end of the cable with an OTDR to verify each splice. Splicing machines give an estimate of splice loss but it's just that, and going back later, opening a splice closure and re-splicing is an expensive proposition!

Midspan Entry



It is sometimes necessary to splice large fiber count cables to smaller cables at a location other than at the end of the larger cable. Rather than cutting the cable and splicing all the fibers, a midspan entry can be used to access only the fibers required for splicing to the smaller cable(s). In order to do a midspan entry, it is necessary to know what the manufacturer of the cable recommends for procedures and have the proper tools and other hardware required by the cable construction.

For midspan entry, the cable sheath, which includes the jacket and armor or other protective layers on the cable, must be removed from a length of the cable, typically about 2 meters (80 inches.) The sheath is first ring cut at the beginning and end of the section to be removed. Then at one end, the sheath is shaved off with a special tool or a utility knife to access the cable's rip cords. The rip cords are cut at the ringing point and used to cut the sheath all the way to the ring cut on the other end of the opening. When both rip cords are used, the cable sheath can be removed in two sections.

Next the strength members (aramid fibers) and binding tapes (and water-blocking tapes if the cable is a dry water-blocked design) are cut and removed. The central strength member and cable stiffener then needs to be cut, with ends left for securing to a splice closure as appropriate.

Entry to individual buffer tubes to access fibers to be spliced should be done with an appropriate midspan entry tool that shaves the tube for access without damaging the fibers. Inside the tube should be found a ripcord which is used to split the tube along the length required. Then the split tube is cut off at both ends.

The remaining buffer tubes can be placed in the storage section of a splice closure while the exposed fibers are spliced to other cables and stored in a splice tray. As with any splice closure, care must be taken to not damage fibers or kink buffer tubes during the process and to properly store all fibers and buffer tubes to allow reentry without harming any fibers if necessary.

Termination



Cables will be terminated inside facilities where they will connect to communications equipment. OSP cables generally do not meet NEC flammability requirements, so the cable entering a building must be terminated or spliced to indoor cables soon after entry, generally within 50 feet (16 meters) to meet fire codes. Some OSP cables have double jackets, an outer one for outdoors and an inner one rated for indoor use, so the outer jacket can be stripped off inside the building and the cable run to the equipment room. Cables terminated in pedestals or vaults do not have this requirement.

Generally singlemode OSP cables will be terminated by splicing pigtails onto each fiber and splices will be placed in a splice closure. Multimode fibers can be handled the same way or terminated directly onto the fibers. Most OSP

a splice closure. Multimode fibers can be handled the same way or terminated directly onto the fibers. Most OSP cables will require installing a breakout kit which sleeves each fiber in a tube rugged enough for direct termination.

Preparing For Premises Fiber Optic Installations

Every outside plant cable project will include some premises cabling where the OSP cables are terminated, so every OSP contractor needs to be familiar with premises installation. Most building codes will require OSP cable, which is not fire-retardant, to be terminated a short distance after entering a building or be run in approved conduit. Before beginning installation of fiber optic cables and hardware in a premises installation, the site must be properly prepared for the installation of fiber optic cables, hardware and transmission equipment. During the design and planning stages, the site should have been inspected and all the hardware necessary for the cable plant included in the design.

Premises Support Structures



There are numerous structures used for the securing of fiber optic cable in premises installations making generalizations difficult. Cable may be hung on appropriate hangers, laid in cable trays or pulled into conduit or innerduct. Termination of the cables can be at racks in telecom rooms, in wall-mounted boxes or even wall outlets. Preparing for an install includes planning for storage of cable service loops behind racks such as shown here. You must install support structures for fiber optic cable installations before the installation of the fiber optic cable itself. These structures should follow the guidelines of appropriate standards such as TIA/EIA 569-A and NECA/BICSI 568-2001. Allow for future growth in the quantity and size of cables when determining the size of the pathways. Follow all cable bend radius requirements and avoid pulling cables around hazards if possible. Sometimes new cables can be laid in existing cable trays. Do not install a fiber optic cable in a conduit or duct that already contains cabling, regardless of the cable type to prevent damage. Existing or new empty ductwork can be modified to accept several different installations by the proper placement of innerduct. Premises support structures also include patch panels for terminations. They may be wall- or rack mounted and must be chosen appropriately for the cable types being used. Terminated simplex or zipcord cables can be terminated on open panels, but 900 micron tight-buffered fibers from distribution cables require closed termination panels for protection. If possible, the design of support structures should be such that adequate space is provided for termination of the cables and storage for service loops.

Fire Stopping



Premises cabling requires firestopping at all penetrations of walls and floors. Telecommunications firestopping must always comply with applicable codes and standards. All penetrations should be protected by type-approved firestops. In most areas the breaching of a fire separation will require physical monitoring until it has been repaired. Check with the “Authority Having Jurisdiction” for specific requirements on the project before commencing work.

Electrical Systems

All fiber optic equipment will require proper power at the locations of the equipment. Power must be high quality power, protected for surges and spikes, and generally must have appropriate backup capacity to prevent loss of communications during power loss. Data equipment will require a separate ground and adequate power for year-round air conditioning. Consideration should be given to efficiency in cooling to reduce power consumption. Consult with the site owner, customer and appropriate user personnel to plan electrical power installation.

Grounding and Bonding



All conductive cabling and components must be grounded and bonded. Ground systems must be designed as specified by the NEC or other applicable codes and standards. Although most fiber optic cables are not conductive, any metallic hardware used in fiber optic cabling systems (such as wall-mounted termination boxes, racks, and patch panels) must be grounded. All conductive cables require proper grounding and bonding for applicable conductors.

Marking and Identifying Cables

Fiber optic cables should be specified with colored jackets per industry standards which identify the cables as fiber optic cables and indicate the type of fiber in the cable. All fiber optic cable terminations should be marked on racks or boxes where the cables terminate. Cables should be tagged with identification that they are fiber optic cables and proper handling is required.

Particular care should be taken in premises cabling upgrades. For nearly two decades, 62.5/125 micron multimode fiber has been the primary fiber for premises cabling. With the emergence of gigabit networks, laser-optimized 50/125 fiber has become more popular. Mixing the two fibers can result in excessive loss at connections that may cause systems to not operate properly. Color coding, marking and even using incompatible connectors (SC or ST on 62.5/125 and LC on 50/125 fiber) should be used whenever possible.

Removal of Abandoned Cables

Unless directed by the owner or other agency that unused cables are reserved for future use and the cables are marked accordingly, it may be required to remove abandoned optical fiber cable (cable that is not terminated at equipment other than a connector and not identified for future use with a tag) as required by the National Electrical Code or local codes.

At the discretion of the owner of the site, the contractor may be requested to remove other cables (e.g. copper communications or power cables) in addition. Removal of cables is much more time consuming than installation, as each cable must be identified and carefully removed to prevent damaging other cables. No cable should be cut for removal unless it is positively identified as one to be removed.

All cables removed should be recycled properly. Most communications cable has significant scrap value, not only for any copper conductors but for other metallic elements and even some plastics.

Equipping Installation Personnel

Equipping The Installer With Tools