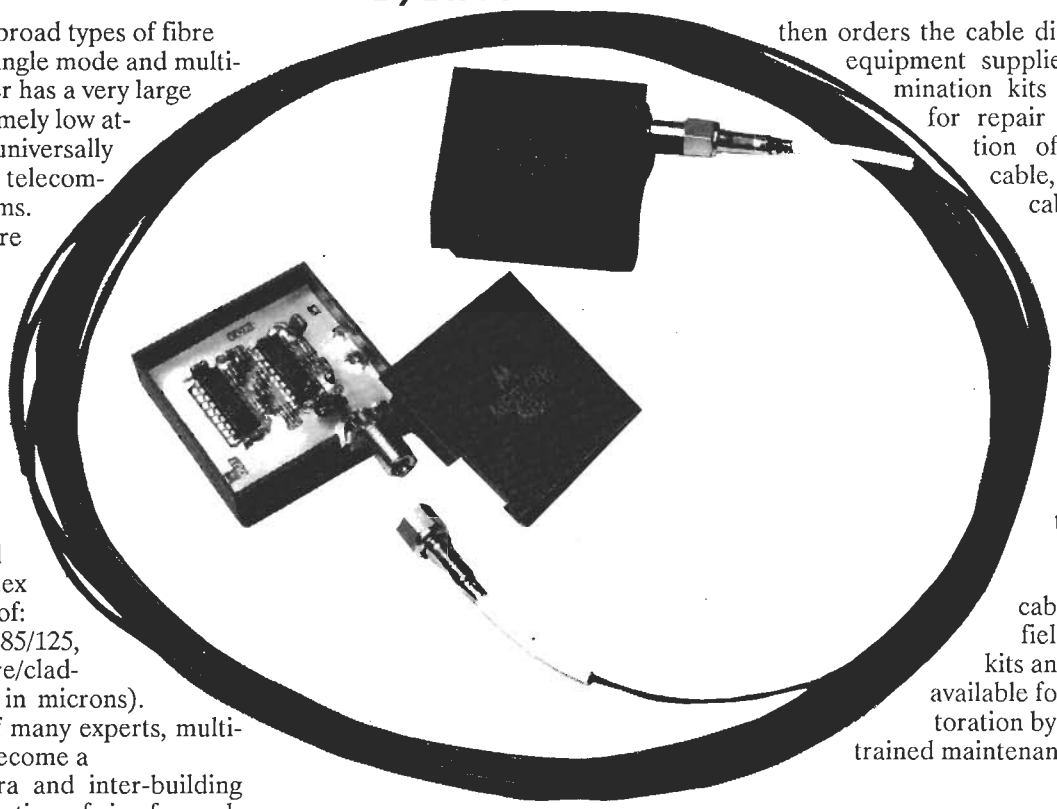
Fibre Optics

The ins and outs of installing fibre optic assemblies.

By Dr. H. Virani



There are two broad types of fibre optic cable: single mode and multimode. The former has a very large bandwidth, extremely low attenuation and is universally used in long-haul telecommunication systems. Multimode is more appropriate for short-haul data/-voice communication requirements.

There are various types of multimode fibre. The predominant type being all glass, grade-index fibre in sizes of: 50/125, 62.5/125, 85/125, and 100/140 (core/cladding dimensions in microns). In the opinion of many experts, multimode fibre will become a standard for intra and inter-building installations. Selection of size for multimode fibres is not critical to a successful installation. Like the choice between 25, 24 or 22 gauge copper wire for twisted pairs, there are customer preferences and performance distinctions but fibre size is not a major installation decision. In fact, of the two most popular connector types, the same connector can be used on 50, 62.5 and 85 micron core fibres, and only an insert change is required to accommodate the 100/140 size. These fibres are available in all types of cable: indoor and outdoor; single fibre (simplex); dual fibre (duplex); and up to hundreds of fibres within a single cable sheath (Fig. 1).

Outdoor cable is available with special jell filling; steel jacketing for rodent protection; for aerial, buried or duct installations; and with a variety of sheath materials.

Connectors

There are basically two popular types of connectors used on multimode cable: SMA type and BICONICAL (Fig. 2).

Despite advances in the art of fibre optic connectors, the problems involved in properly terminating this thin filament of glass should not be underestimated. Because of th difficulty of field termination with either of the standard connectors, it is highly desirable to have connectors factory installed. This is easily handled and has worked quite successfully.

The customer typically "walks off" the distance between the two devices to be interconnected (either through the use of blue prints or physically walking this distance), adds a safety factor of perhaps 10% (to permit circumventing obstructions, etc.), and then orders the cable direct from the equipment supplier. Field termination kits are available for repair and restoration of a damaged cable, however, a cable disruption is highly unlikely.

Once installed, fibre optic cable is no more likely to be damaged than the common, copper, twisted-pair cables. However, field termination kits and training are available for on-site- restoration by relatively untrained maintenance personnel.

Test Equipment

There is a large variety of test equipment available for fibre optic systems. Some of these devices are extremely sophisticated and used primarily by telecommunication carriers where attenuation and bandwidth are highly critical to the proper functioning of a system. For short-haul fibre optic cable installations, relatively inexpensive fibre optic test equipment is available. A standard attenuation test may by all that is required to install and maintain a link. In the event that an installed fibre optic cable develops a break or discontinuity, instruments are available for locating the fault. Such instruments are quite expensive even for short-haul multimode systems but it is also possible to obtain assistance from a fibre optic supplier or rent such equipment in the unlikely event that it is needed.

Installation

One thing should be made clear about the installation of fibre optic cable. Although it is glass, it need not be handled like fine crystal glasses. The fibre is quite flexible and many fibres are available that can be tied into a loose knot without any permanent damage to the fibre.

Furthermore, fibre optic cables are provided with a high strength member (that is also dielectric) that allows the cable to be subjected to heavy pulling tension during installation. Perhaps the only caution that need be exercised is that the fibre should not be pulled around very sharp corners.

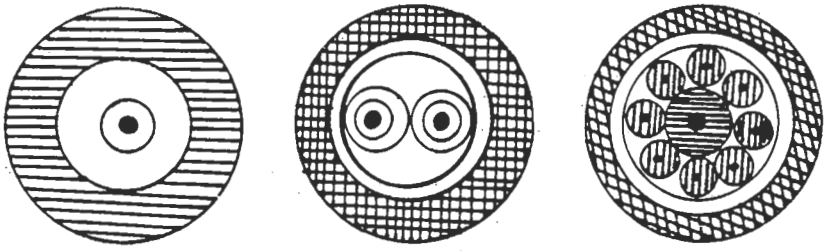


Fig. 1 A graphic representation of some various fibre configurations.

By comparison with pulling in copper cables, either multi-twisted pair or coaxial cables, fibre is much easier to install. Because of its small size it can be pulled through relatively small openings with ease. Also because of its small size, it has a small surface and thus creates very little friction when pulled in relatively confined space. It is extremely light so the reel of cable may be easily handled in one hand as opposed to the heavy and cumbersome copper cables.

In most indoor fibre optic cable installations, which are typically less than a thousand feet in length, it is usually recommended that the customer installs it themselves. The customer can order a factory terminated cable supplied on a light-weight reel (which allows it to be air expressed for emergency delivery at relatively low cost) and install it with no previous experience.

The cable may be laid in a raceway which contains either communication or power cables (remember that fibre optic cable is immune to EMI/RFI). The fibre optic cable may also be installed under a raised floor where the only precaution is that the cable may require crush protection and the use of a split plastic conduit may be recommended. The conduit also will aid in the "pulling- in" and more importantly protect the fibre against subsequent rearranging of large cumbersome copper cables. Finally, the fibre could be laid in a cable tray with other fibres and is preferably left loose, not attached to other cables or to the tray itself.

Perhaps the easiest installation method for fibre optic cable is to simply lay the fibre over a dropped ceiling providing almost a line-of-sight direct connection between the two pieces of equipment. When installing the fibre optic cable over a dropped ceiling some care must be taken to avoid pulling around sharp corners, ceiling hangers, metal studs and around areas of continuous maintenance activity (for example, away from heating vents or lighting fixtures).

In some installations where there is a great deal of activity in the above ceiling area, a split-plastic conduit may be desirable. Fibre optic cable laid on a dropped ceiling meets building code requirements without the expense of metallic duct, trays, or conduit.

In vertical installations, fibre optic cable may be installed in an elevator shaft or a pipe chase. Since an elevator shaft is typically filled with electromagnetic energy from the rotating electrical motors that are used to move the elevator, fibre optic cables are ideal for installation without the large expense of shielded copper cable. Cable ties may be desirable to maintain the cable in an out-of-the-way position. Ties should not be crimped too tightly. Most fibre optic cables can be self-supported (without any hangars to relieve the weight of the cable itself), for a distance of up to 300 ft. or approximately 30 stories in a highrise building.

The installation of fibre optic cable outdoors is a more complex situation. In the first place, most outdoor cable installations involve greater distances, multiple buildings, and thus more planning and support. Of course, the user must have the right- of-way to install the cable. While it is the responsibility of the user to obtain such right-of-way, many local contractors can assist the user in dealing with the proper authorities. The actual physical installation of the cable may be done on telephone poles, buried, or run in ducts or conduits.

In the planning for installation of cable outdoors, the three methods of laying the cable as described above will largely determine the type of cable to

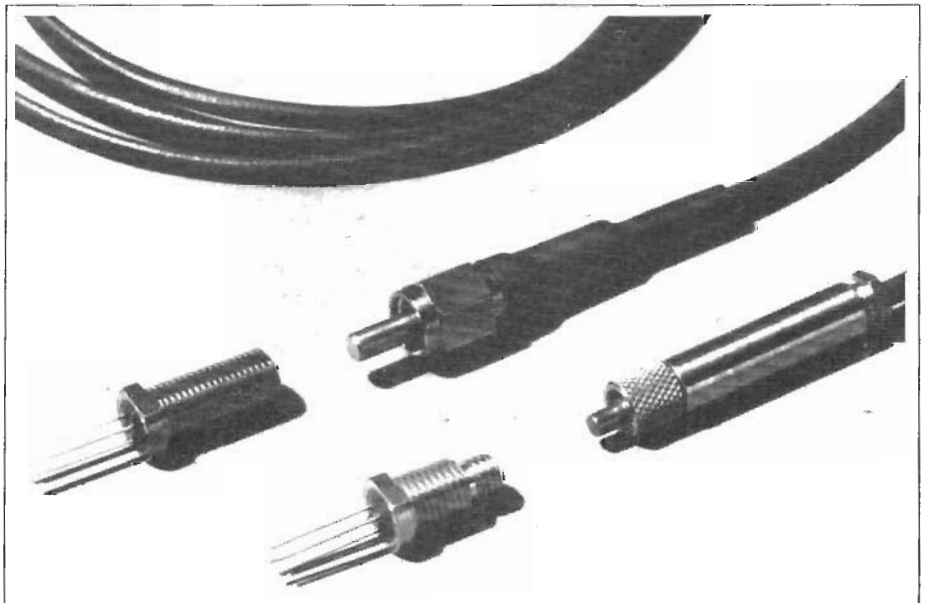


Fig. 2 The two types of popular connectors: SMA and biconical.

be selected. This selection should be done with the assistance of experienced fibre optic cable specialists. They can assist in selecting the right

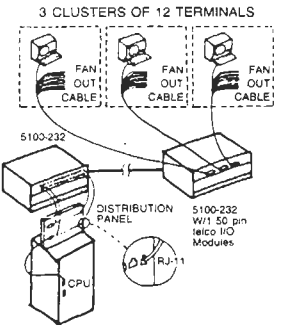


Fig. 3 Terminal clusters linked together with fibre technology.

type of fibre, cable, sheathing, diameter, connectors, splicing, and all accessories. In many "campus" fibre optic installations, it is desirable to terminate the outdoor cable at a patch panel providing manual recon-

Cable splicing is simplified using specialized test equipment, such as the LLD-220 from Performed Line Products.

figurability for restoration or rearrangement. Patch panels, patch cords, termination panels and termination boxes are available through most cables and equipment suppliers.

A typical indoor installation of fibre optic cable would be used to inter-connect a pair of RS232 fibre optic multiplexers. In this system, one multiplexer would be mounted in the computer or data processing room within a 19 in. rack. Each individual asynchronous channel on the rear panel of the multiplexers would be connected through a DB25 connector and a standard RS232 cable to a port on the computer distribution panel (see Figure 3).

This portion of the installation is similar to that of a standard statistical multiplexer operating on copper cable. The fibre optic cable would be connected on the real panel of the multiplexer. The multiplexer is then provided with a standard SMA-type connector which mates with the SMA connectors that are factory installed on the cable. It is desirable to provide a fairly large radius, say 10 ins., of the fibre after connection to the multiplexer to prevent any undue stress or inadvertent pulling on the fibre which may disturb or damage the connection. The fibre could then be run down beneath the raised computer floor to a suitable riser that would provide access to the space above the dropped ceiling. Alternatively, the fibre could be run upward directly through an opening in the dropped ceiling. It is also possible to run the fibre optic cable, together with copper cables, through a suitable conduit that is terminated at the equipment rack to provide access out of the computer room and into a cable tray, raceway, or continuation of the conduit. Once the cable is pulled in, it is simply attached to the multiplexer at each end taking care that the transmit fibre at one end is connected to the receiver at the opposite end. In general, most fibre optic systems will have a sufficient system gain, so that the short distances normally traversed within a building will provide excess loss margin.

Summary

The installation of fibre optic cable is neither difficult nor time consuming. There are many suppliers for all of the system components, Motorola, GTE, Corning, HP to name a few, required for a complete turnkey installation. Training courses for personnel are readily available and experienced installation companies are available for large system requirements. Fibre optic systems are widely used throughout the telephone industry and accumulated experience with fibre optics is mounting fast. Leading edge users have committed themselves and are enjoying the benefits of this highly attractive technology.

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