



Road proof fiber optic system

1) Essential differences between fiber optic connectors:

1.1) **Industrial direct contact connectors** ("physical contact") > The fibers within the connector hit together when mating. This type of connector is available in several different versions. Usual designs are SC, LC, ST, further more rare versions are E2000, MTRJ, SMA or else.



Advantages:

- Low insertion loss due to the direct contact of the fibers (0,2dB - 0,3dB in best condition).
- Low price
- small construction, saves space.

Disadvantages:

- Only IP 20 protection class
- Extrem sensitive against physical interference by dust, dirt, fluids or else.
- According to design more or less sensitive against mechanical burdening.
- Liable to wear (constant abraision if mated consistently) = constant raising of insertion loss.
- Maintenance and surveillance required if mated consistently.
- Inconvenient cleaning or maintenace (special tools required).
- Extension of ready made cables possible only by coupling adaptors (cables are male/male)
- Termination to road proff bulk cable (MIL TAC) only possible by using special cable divider.

1.2) **"Ruggedized" direct contact connectos** ("physical contact") > the same mating principle as 1.1), but with better protection of connectors by mechanical optimized housings (Lemo, Fischer, OSI Rosenberger, Neutrik OpticalCon, HICON Hi-Fiber or else).



Advantages:

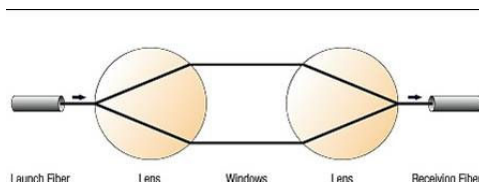
- Low insertion loss due to the direct contact of the fibers (0,25dB - 0,5dB in best condition).
- Better protection against mechanical burdening as industrial direct contact connectors.
- Depending from design up to IP 68 (only when mated !).

Disadvantages:

- Depending from manufacturer/version only IP 20 - IP 42 in open status.
- More or less sensitive against physical interference by dust, dirt, fluids or else..
- Liable to wear (constant abraision if mated consistently) = constant raising of insertion loss.
- Maintenance amd surveillance required if mated consistently.
- Inconvenient cleaning or maintenace (special tools required).
- Depending from manufacturer cables need couplers for extension.
- Not compatible to other systems/manufacturers



1.3) **Lens connectors (EBC = expanded beam connector)** > The light beam is enlarged by a lense within the connector. A small space of air rests between the lenses. The fibers or lenses do not touch each other. Manufacturers are FIBERFOX, Stratos, Amphenol, Tyco and more.



Advantages:

- IP 68 in open status (FIBERFOX)
- Insensitive against physical interference by dust, dirt, fluids or else.
- Extrem resistant against mechanical burdening.
- Wear-free, steady insertion loss even if mated constantly (FIBERFOX > 5.000 mating cycles).
- Free of maintenance or surveillance.
- Simple and fast cleaning (washing out with clear water or medical alcohol and drying with a lint free cloth).
- Hermaphroditic connector (in case of extension no coupler/adaptor required). Also no need to think about the direction when laying the cable.
- Compatible to other systems according MIL-DTL-83526

Disadvantage:

- Slightly higher insertion loss as physical contact connector ; FIBERFOX typically about 0,7db to 1,0dB.

2) Applications:

Regarding fiber applications there are three different parameters:

- A) **Indoor application** with only **few mating cycles** (e.g. fixed installations, internal wiring in cases/racks/housings ; connectors are mated only once and stay connected or have very few matings).
- B) **Indoor application** with **several mating cycles** (e.g. floor or wall mount boxes to connect moving devices).
- C) **Outdoor application** (e.g. "Rock'n Roll"/concerts ; sport live transmission, OB van application).

For application A) normally standard computer fiber patchcords with industrial direct contact connectors are sufficient. Here normally a connection is done only once and will stay fixed for a long time. (e.g in installation cupboards, closed housings etc., but too within 19" racks or cases). If the receptacle is exposed connectors with ruggedized housings should be used. This avoids damaging the connection by accident.

Application B) demands higher challenges for the design of the connector. Indeed in indoor application the risk of soiling by dust or fluids are not as same as in outdoor applications. Therefore physical contact connectors may be used but should be fitted with a robust housing.

Another important issue is the amount of mating cycles (= life time) of a connector. Direct contact connectors normally give a life time of about 500 to 1.000 mating cycles. Certainly these connectors require constant maintenance and cleaning to avoid a fast and high increasing of the insertion loss. This has to be done for both sides of a connection (receptacle + plug).

Over a medium to long-term use this increasing insertion loss is not possible to avoid at all. Each physical contact of the fiber and each cleaning or maintenance cause abrasion to it, it wears off. Although it's only a very tiny abrasion the fiber surface declines each time.



The maintenance and cleaning of direct contact connectors has to be done by using special tool and cleaning kits. They are available in several different version and price range. The maintenance has to be done carefully and properly. If this is not guaranteed a direct contact connector may fail already after some few mating cycles.

So if a reliable and durable fiber connection is required EBC connectors should be used. They distinguish by their high mating cycles (FIBERFOX > 5000) by constant insertion loss. There is no physical contact of the fibers and so no abrasion or interference of them. Normally it's not needed to clean the connectors. Even if they are soiled by a lot of dirt, dust or else they can be cleaned by dipping into clear water (the enemy of each other fiber connection system !) or by using medical alcohol. After this the connectors still need to be whipped out with a clean lint free cloth. This complete cleaning takes only some few seconds and needs no special training.

Application C) finally requires EBC connectors absolutely. At any outdoor event dust, dirt, soiled water or else occurs aplenty and in numerous variations. Technicians, who are responsible for laying of cables or establishing racks, are used to handle things very rough and careless.

Also at OB van applications matings have to be done often very fast. So it happens that connectors are handled lax and get in touch with dirt. The connections must resist in case of heavy showers, sometimes they are laying for hours in deep puddles. When disconnecting systems connectors may fall down to the ground. Here direct contact connectors are a constant risk in operation, independent from manufacturer. Lens connectors however are designed especially for exact these applications.

As already told above a cleaning is done fast and easy. No special tools or trained technicians are required. If an EBC connector is soiled only slightly it may work under these circumstances further. This is excluded for all physical contact connectors at all..

Applications at OB vans or in the event business also require lot of mating cycles over the year (average about 300 - 500 matings). Under this circumstance direct contact connectors reach the end of their life time very fast. EBC connectors on the other hand work reliable over several years. So they give a much better return of invest.

Cleaning and polishing tools for direct contact connectors



Cleaning tool for FIBERFOX EBC



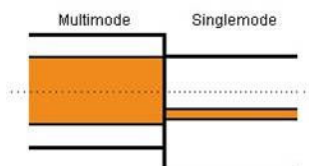
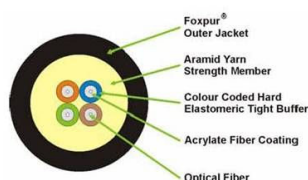
3) Bulk cable:

Regarding the bulk cable used with fiber connectors also several different qualities exist. In the event and broadcast business mainly road proof TD-MIL cables or more rarely central tube cables are used (except short simplex or duplex patchcords with industrial connectors). From fixed installation known types as riser- or breakout cable normally are not used in the event and media business. Multi mode cable with 50/125µm should be at least OM3 or better to transmit GigaBit data. For very high data rate or bandwidth (e.g. HD-SDI video) single mode cable are recommended to assure a proper transmission over long distances. Normally the existing hardware defines the type of fiber by their fiber ports.

An important point regarding bulk cables are tensile load and flexibility because in the event and broadcast business cables are moved very often. To assure this by a small outer diameter (normally 5-6mm) TD-MIL cable are fitted with a thick aramid yarn (Kevlar) under the outer jacket (normally PUR). Through these extrem resistant filaments, which are e.g. also used to manufacture bullet-proof vests, good cables can be burdened up to 1.500N without any problem.



The quality of a cable is hard to judge by its outer appearance for most of them look nearly the same. Differences appear at the mechanical construction which are quite invisible to the naked eye. Normally lot of the common products work over an acceptable life time. One risk in operation may be that fibers within the cable may move in a different way than the outer jacket. Depending from connectors and their workmanship this may lead to broken or stressed fibers. This happens often to so called "loose tube" cables. Here the the aramid yarn is not worked into the jacket which leads to free moving fibers within the cable. The FIBERFOX MIL-TD Ultrabend bulk cable does not show this so called "microbending" effect for due to its mechanical construction jacket and fibers move the same way every time. So it offers a better performance and higher safety in operation.



4) Where to pay attention to:

If planing fiber optic systems the above listed different parameter should be considered. Any application should be analyzed carefully to define the best fitting system. In some cases this is affected by a low budget, e.g. projects required by public institutions or authorities. Indeed they also should take in mind different reliability and life time of the several options.

So generally customers have to think twice about any application. Industrial direct contact connector systems as simple patchcords or else are cheap mass-produced goods. The same connector system but with robust housing is appreciably more expensive. EBC lens connectors finally may be once more a little bit expensive again.

Otherwise the performance of the different systems vary a lot. Only to pay attention to the price of a system may be fatal. It may be at least more expensive to use a cheap system if it fails after a short life time and has to be maintained, repaired or even substituted. A long durable system on the opposite may be more economical because costs for maintenance, surveillance and technicians disappear.

Also failure in live applications (TV transmission, video/audio transmission in concerts or else) may cause claims for damages or lead to cutting of payments. This too has to be considered if planing a system.

A further important point is compatibility of systems. More and more contractors in the event and broadcast business are asked to work together in certain projects. If companies rely on isolated applications this could lead in some cases to exclusion from projects or requires adaption which means spending more money. EBC lens connector systems of several manufacturers are compatible to each other. Roadproof direct contact connector systems (as e.g. Lemo, OpticalCon, HiFiber or else) on the opposite dont match together. It's even known that manufacturer changed products. Caused by this revision systems based on the same connector type have been compatible to themselves anymore! The EBC system on the opposite exists now for more than 15 years without changes and assures full compatibility even to military or industrial applications.

5) Conclusion:

FIBERFOX EBC fiber optic systems are fitting all conceivable application. Sure cheaper solutions exist but it's doubtful if they have a comparable cost-benefit ratio. Therefore all requirements to an application and all expected environmental influences have to be checked absolute exact. Even if systems are named "road proof" there are differences in reliability, maintenance and life time. Most important for the decision for a system should be its safe work, compatibility and easiest handling. If customers save on the wrong thing there may be a certain risk of spending much more money at all as if purchasing a more expensive product in the beginning.