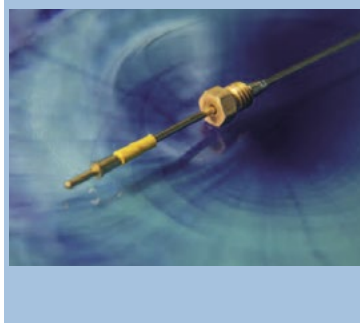
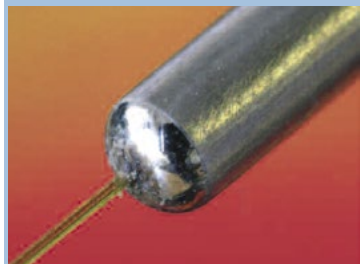




## Applications



# Hermetic Feedthroughs

## Connectable and Monolithic

- Singlemode or Multimode fibers
- Hermeticity, Hermeticity and pressure
- Custom devices

### Fiber Optic Hermetic Feedthroughs

A growing number of fiber optic applications require hermetic feedthrough. The problems to be solved vary considerably from simple hermeticity to hermeticity combined with high pressure. Consequently products must be adapted to each specific case going from a few millibars vacuum to pressure up to 1000 bars and 10<sup>-2</sup> to 10<sup>-9</sup> torr hermeticity. Feedthrough products can be separated in two main families according to the possibility or not to disconnect the fibers on each side of the panel through which the fiber optic link is made.

### Connectable products

The technology derives from standard fiber optic feedthrough each end being designed as a bulkhead where any patchcord can be connected using SMA, FC or ST connectors. Hermeticity must be obtained in two different places. First between the body of the feedthrough and the panel. This is relatively easy with a classical flange and gasket solution. Second and less trivial is the hermeticity along the optical line itself. To solve the problem one solution is a short length of fiber glued with a special composite inside the body of the feedthrough making a fiber link between the two connectable ends. The inserted fiber will of course be adapted to match the optical characteristics of the patchcords used on each side.

This family of products offers a number of interesting features: the possibility to use a large variety of standard products for almost all types of fibers including singlemode PM fibers. Also the possibility to differentiate between the patchcord situated inside the chamber where a harsh environment construction may be necessary and the external patchcord which may be simpler.

### Monolithic fiber products

Connectable products inherently induce insertion losses which can rule them out of some applications where photon budget is tight. In that case products without fiber discontinuity are to be considered. These products are mechanical components through which one or several fibers are glued or sealed without discontinuity. They can be made on fibers of any type with the possibility to mix different fiber types.

The mechanical design will be made according to the chamber panel and the level of hermeticity required. Solutions range from simple inox cylinder with cable gland to sophisticated flanged parts with gaskets.

An other concept is to have one or several fibers sealed into a steel needle with different procedure according to the level of pressure and hermeticity required. The hermeticity with the chamber wall is very simply obtained by a screw system into a female part fixed to the panel. A drawing of this female part is given to the customer so that he can easily adapt it to his chamber mechanical design. Such construction is particularly convenient for electro-optic feedthrough. The intrinsic insertion loss is below 0.1 dB and the design can be very small and compact particularly in the case of multifibres links.



# Hermetic Feedthroughs

## “Connectable” products

- Connectable products
- FC feedthroughs
- SMA feedthroughs



### Hermetic feedthroughs : Connectable products

A number of fiber optic links have to go through a panel separating two volumes hermetically isolated (vacuum, liquid, gas, temperature, radiations, etc.) A fiber optic connexion is generally made of two male connectors with a female coupling part. It is this coupling part, with FC or SMA interface, which will be the base of this range of hermetic feedthrough.

#### Description

A standard coupling part between two connectors is a precision part which allows the alignment of the connectors ferrules. In the hermetic feedthrough this coupling part is made longer and a piece of fiber is glued inside to obtain an hermetic optical path. This fiber is chosen to match the fibers to be connected at each end of the feedthrough. The hermeticity between the feedthrough itself and the panel is obtained by a classical flange and gasket solution.

#### FC Hermetic feedthroughs

This feedthrough with FC interface is used for singlemode or graded index multimode fibers. These small diameter fibers require a high precision which is obtained by ceramic ferrule centering parts. A large flange allow the integration of two O-ring gaskets. for the external hermeticity.

- |                            |   |
|----------------------------|---|
| • Fibers                   | SM, GI, LCH105.<br>Short wavelength and PM fibers |
| • Insertion loss           | 1 dB  |
| • Hermeticity              | 10 <sup>-8</sup> torrs (helium)                   |
| • Temperature range        | -40°C +85°C                                       |
| • Pressure tests (Ifremer) | 1000 Bars   |
| • Material                 | stainless   |
| • Salted humidity          | NFC 20613 (5 / 21 days)                           |
| • SPECIAL VERSIONS         | APC   |

#### SMA Hermetic feedthroughs

These feedthroughs with SMA interfaces are used for large core silica fibers HCS type, or all-silica and silica with polyimide coating. The most common fibers integrated in these feedthrough are all silica fibers with polyimide from 100µm to 600µm and all silica ETFE coated from 100µm to 940µm. Special version with HCS200.

- |                     |                                     |
|---------------------|-------------------------------------|
| • Insertion loss    | < 3dB                               |
| • Pressure          | 100 to 1000 bars according to fiber |
| • Hermeticity       | 10 <sup>-8</sup> torrs helium       |
| • Temperature range | -40°C +85°C                         |
| • Material          | stainless                           |
| • Salted humidity   | NFC 20603 (5 / 21 days)             |

Three versions of SMA hermetic feedthroughs are existing :

- Standard version
- Compact version
- Simplified version

SMA simplified version for panel hermeticity : double O-ring gaskets. Inside hermeticity by sealed fiber piece inside the body. Very small outgasing.

**ST Hermetic feedthroughs :** On request for all silica fibers, HCS...





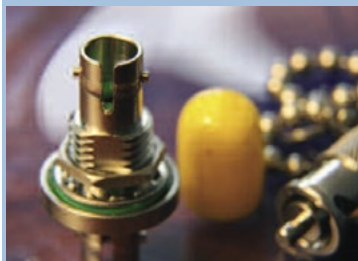
## Applications

### APPLICATIONS

- Aerospace
- Chemical processing industrial
- Applications
- Oil and gas
- Pharmaceutical production
- Security
- Telecommunications

### SOME SPECIFICATIONS

- Available for single and multimode fiber
- Tested to 688 bars with no evidence of leakage
- Typical light loss is less than 0.5dB



# Hermetic Feedthroughs

## “Simplified versions”

- SMA Standard
- ST Version
- FC Type

### Simplified Feedthroughs : SMA, ST and FC

These SMA, ST or FC designs feature an integral self-sealing design that ensures a watertight, environmentally and hermetically sealed fiber termination. The fiber is completely protected from water, humidity, vapors, gases, chemicals, etc...

This range of “simplified feedthroughs” has no integrated fiber inside. The hermeticity is obtained with gaskets. Hermeticity with the panel is obtained by a gasket in the flange. The inner hermeticity is obtained by a gasket on the connector ferrule. This offer is completed with specific ruggedized connectors and dust caps

For the **SMA version** it is necessary to use an SMA connector equipped with a special gasket on the ferrule. If not the hermeticity cannot be guaranteed which could be hazardous for security.

For the **ST version** a gasket is positioned into the feedthrough so that any standard ST connector can be used. An adapter dust cap combining a bayonet twist-lock connection with an efficient self-sealing is available to protect the feedthrough from wet and harsh environments (-55°C to 125°C).

The **FC HP serie** adapters with keyed index connection incorporated provides perfect reproducible termini alignment. For this FC version the gasket is positioned into the feedthrough, however the hermeticity is not obtained on the ferrule but on the nut when it is screwed. Since the nut is not normalized it is mandatory to use an FC HP design connector: If not the hermeticity cannot be guaranteed..

Adapters with a bulkhead seal can be utilized as feedthroughs. So one side must remain connected to maintain hermeticity.

The FC HP connectors utilize a threaded position keyed coupling in connection with a unique self-sealing design. When used with a FC HP adapter the fiber optic termination is completely protected from wet environments and can be submerged in water or subjected to rain, ice, high humidity or temperatures from -55°C to 85°C.

FC HP connectors fabricated from 316 series stainless steel and ferrules made of precision-machined zirconia have passed stringent immersion and heat/humidity tests with minimal light loss.

An specific adapter dust cap with a self-sealing design can be used so the fiber optic termination is completely protected from wet. This FC HP adapter dust caps have passed stringent immersion and heat/ humidity tests.

# Hermetic Feedthroughs

## “UV” and “UHV”

- Singlemode or Multimode fibers
- Core diameter from 125µm to 1500µm
- HV and UHV environments

### Fiber Optic Hermetic Feedthroughs HV & UHV

This specific range of singlemode or multimode hermetic feedthroughs is ideally suited for HV (High Vacuum) or UHV (Ultra High Vacuum) environments in medical, industrial and research applications.

All of these products include a fiber that keeps the continuity of the light transmission from inside a vacuum system to external instrumentation or energy source, allowing a low insertion loss and maintaining the hermeticity when disconnected.

### High Vacuum (HV) hermetic feedthrough

A standard hermetic feedthrough with a short length of optical fiber inside the body is mounted on a KF flange. This flange design currently used in vacuum chambers is made of stainless steel and is offered in DN 40 size (other sizes available on request). The inserted fiber will of course be adapted to match the optical characteristics of the patchcords used on each side (singlemode, PM, Launch, large core UV-Vis or Vis-IR multimode, etc...).

The HV hermetic feedthroughs can be delivered in SMA, ST, FC/PC or APC configurations. This design gives the possibility to differentiate between the patchcord situated inside the chamber where a harsh environment construction may be necessary and the external patchcord which may be simpler.

- Leak rate :  $10^{-3}$  to  $10^{-8}$  mb.L/s Hélium
- Insertion loss max : Singlemode Fiber  $\leq 1$  dB (1550 nm)  
Multimode Fiber  $\leq 2$  dB
- Temperature range :  $-40 / +105^{\circ}\text{C}$  (other on request)

### Ultra High Vacuum (UHV) hermetic feedthrough

This design without fiber discontinuity is made from a stainless steel tube welded on a common

CF flange. A short length of fiber is glued or welded inside and equipped with any connector types. The flange device currently used in vacuum applications is made in stainless steel and offered in DN 16 size (other sizes on request). Multi-fibers solutions are available on request.

The UHV hermetic feedthroughs can be delivered in SMA, ST, FC/PC or APC, Nanoptic and Microptic configuration.

Leak rate :  $10^{-7}$  to  $10^{-10}$  mb.L / s Hélium ( $0,76 \times 10^{-10}$  Torr. L / s)



## Applications





## Applications



# Hermetic Feedthroughs

## “ATEX” Qualification

- SMA Atex version
- FC Atex version
- ATEX qualification

### ATEX Feedthroughs

These hermetic feedthrough are specially designed for explosive environment according to European norm NFEN 60079. This product is compliant for Zone 2, category 2.

Qualification report: RQ085010

**Main differences with the standard products :**

The hermeticity of the inner tube which contains the fiber element and it's epoxy sealing is not made by gaskets but by brazing the tube in the feedthrough's body.

The dimensions of the ATEX feedthrough are bigger than the standard version ( 59.6mm length and 28mm flange diameter).

### SMA version

SMA ATEX feedthroughs are designed for large core fibers from 200µm to 1000µm core (HCS fibers, All Silica low OH or high OH) for transmission from 200nm to 900nm or from 500nm to 2000nm.

- Max insertion loss : < 3 dB @ 850 nm
- Typical insertion loss with an HCS1000 fiber at 850nm : 2dB

### FC version

- For singlemode fibers
- For graded index fibers: 50/125 and 62.5/125
- For step index fibers (Vis+IR): LCH 50/125 and LCH 105/125
- Max insertion loss: < 1dB @ 1550nm
- Typical insertion loss for SMF28e at 1550nm : 0.3dB

### Common specifications for SMA and FC versions

- Temperature range: -40°C / +105°C
- Hermeticity :  $10^{-9}$  mb.L/s Helium test
- Pressure test : 100 bars with ATEX qualification procedure (after 95°C and 95% RH / 14 days, 105°C / 14 days, -40°C / 24 h)
- Maximum pressure : 1000 bars (tested on HCS1000 version)

These products are delivered with a serial number and an hermeticity test certificate