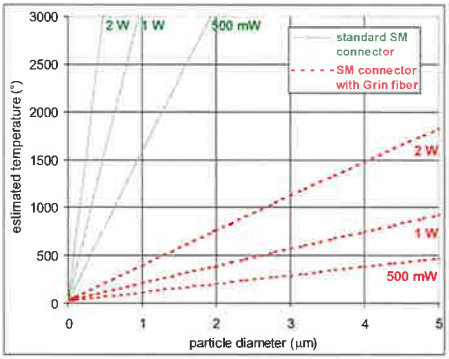
Safety Information for Power Solution connectors

The Power Solution (PS) connector takes advantage of the expanded beam technology to reduce the density of the optical power at the interface of the connection. This way the connector results to be less sensitive to contaminations, and the bearable maximum power that can be transmitted without consequences is greater.

Cleaning

Cleanliness still remains the key word using high power. A standard SM connector, if perfectly cleaned, can withstand light power up to some Watts without problems, while a dirty PS connector could collapse with a power lower than 1 Watt. The target of the PS connector is simply to reduce the possible sources of failure at the fiber interface. While for a standard connector, with power up to 1 W, contaminations with a dimension of approx. 1 µm (therefore not necessarily visible with a standard field microscope) are already dangerous, for the PS connector the problematic begins with particles of a diameters of 5 µm and above.

The next figure clearly displays this situation, where a PS connector still shows uncritical temperatures by contaminations up to 5 µm, which are very easy to detect even with simple inspection microscopes.



Comparison of the estimated contamination's temperatures between PS and standard connectors when operated with high optical power up to 2 Watt.

This rule is to be seen as a general principle. The diameter is not the only parameter that defines the effectiveness of a dust particle, but also its thickness, its nature and its position. The basic concept using PS connectors is therefore the following: " before each mating procedure, the connectors must be absolutely clean and inspected with a microscope ". The ferrule's surface inspection should be operated using an optical microscope with a magnification of at least 200x.

Because of cleaning being a critical issue, it is impossible to define a specific power value within every single application, which a PS connector will withstand with absolute guarantee. The user shall grant the level of cleanliness, which is necessary to maintain a reliable fiber optic connection. The connector is normally affected by contaminations during handling and mating procedures; the degree of cleanliness of the overall installation is also another critical parameter to be taken into consideration. Once the two connectors are in connection, the fiber will be protected from any external contaminants and therefore ensures the expected performance (excluding extreme environmental conditions, which should be analyzed individually).

Handling

The Power Solution connectors should be operated with high power only when connected. When unmated, the light source must absolutely be switched off. If not there is a risk of damaging the connector as well as putting the operator in danger. In an active system with power up to 1 W, the protective cap that closes over the ferrule of an unmated connector will resist, but the ferrule of the

connector will overheat so that the fiber will withdraw and may be ruined. Working with optical power above 1 W, the protective cap will heat to a temperature that the plastic parts of the connector melt and the protective cap falls out of its guiding tracks, inducing a serious safety problem. When a connector is inserted into a mating adapter without its counter piece, the mating adapter, with or without high power dust cap, overheats absorbing additional energy. However if the power is less than 1 W the connector will not be ruined.
Aiming to increase the global equipment safety, it is recommended to employ E-2000™ PS with electrical contact (E-2000™ PS LED), improving installation security with an active safety measure.

Safety
Using standard as well as high power PS connectors with optical power of tens or hundreds of mW, the knowledge and respect of the safety standards is essential.
Due to their lower numerical aperture (NA≤0.04), PS connectors are more dangerous and can generate negative effects at greater distances, being more collimated than standard connectors (NA=0.13). At the same power level, the safety standards requirements for PS connectors are much more restrictive than for standard connectors. In the safety classification of IEC standards the optical power and the general working conditions are in fact taken into account simultaneously. A laser source emitting 1 Watt at 1550 nm in a SM fiber is for instance recorded as a class 3B (IEC 825-1 and 825-2 standards), while the same laser with a collimated output will be classified as a class 4. If the same equipment is installed in a closed box with a security system, ensuring automatic laser switch off when open, it could be classified as a class 1, where additional safety measures are not required.

The main safety precautions that have to be considered working with class 4 lasers are summarized as follows:

- Usage in restricted area, access only for authorized and qualified personnel;
- Use protective glasses, skin protective measures recommended;
- Optical behavior under control: eliminate reflections (also diffuse), close unused optical channels, avoid light beams on eye level;
- Switch on/off system with remote control or interlock and additional automatic switch off safety system;
- Warning signal when sources are active;
- Laser classification markings and danger indications.

A detailed listing of the worldwide laser classifications and related safety measures is reported in the above-mentioned IEC standards. Furthermore there are some national safety publications available (e.g. SUVA or CFSL documents).

Because of safety considerations, the employment of E-2000™ PS connector system with electrical contact (E-2000™ PS LED) is to be recommended, improving installation security with an active safety measure.