7. User Guide

This user guide is intended to assist a skilled user setup and operate the PMC. GLO Photonics will be pleased to provide additional support and assistance should it be required.

7.1. Description

This PMC-OEM is intended to be used as a flexible hose to delivery light from certain laser sources. The PMC is shipped with metallic protective caps – the principle purposes of these caps are to prevent contamination entering the fiber.

7.2. Fiber unpacking & preparation

PMC-OEM is delivered in an original packaging as shown on figure 1.1. Prior the use of PMC-OEM it should be unpacked and prepared following procedures described below.

7.2.1. Fiber unpacking procedure

- Remove the tape which hold the caps to the spool
- Carefully remove bubble wrap from the spool
- Unroll entirely the fiber from the spool

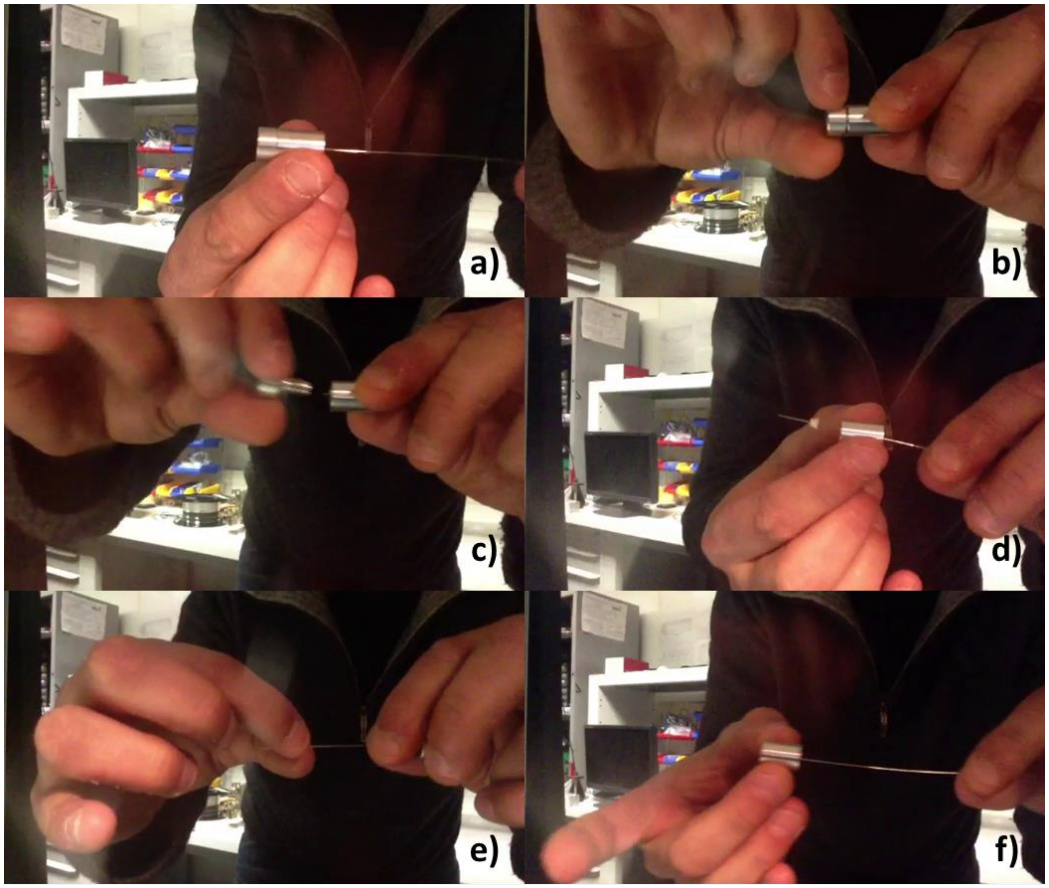


Fig 7.1 : caps releasing procedure

- Hold the metallic cap in one hand (Fig 7.1.a)
- Unscrew metallic cap head (Fig 7.1.b)
- Remove metallic cap head (Fig 7.1.c)
- Push the fiber through metallic cap body (Fig 7.1.d)
- Gently pinch the fiber in one hand and white gasket in the other and pull the gasket away (Fig 7.1.e)
- Remove metallic body from the fiber (Fig 7.1.f)

7.2.2. Fiber preparation procedure

Preparation of fiber tips is primordial to reach optimal capability of PMC-OEM. Please follow carefully the procedure describe below for each fiber end.

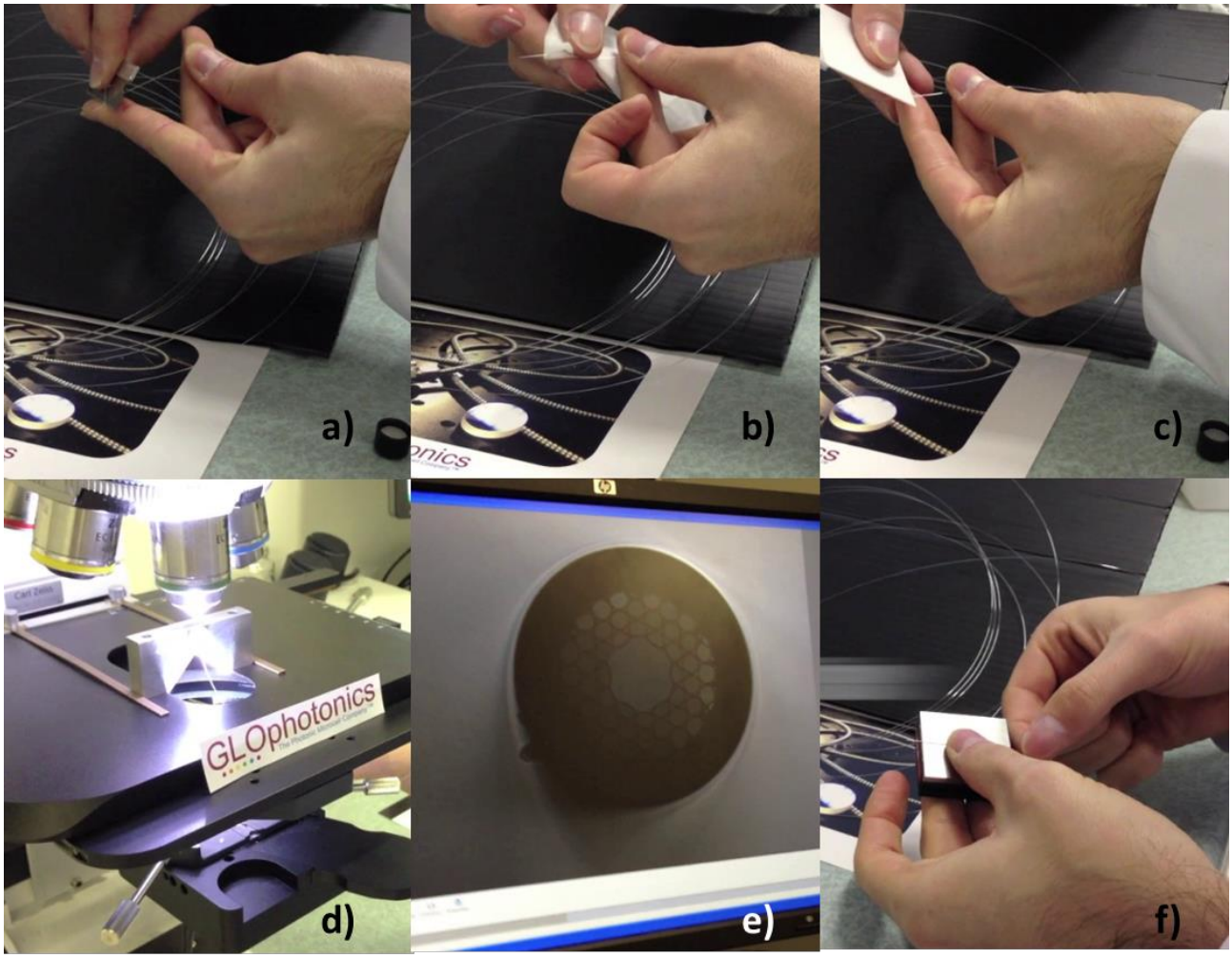


Fig. 7.2 : Fiber tip preparation

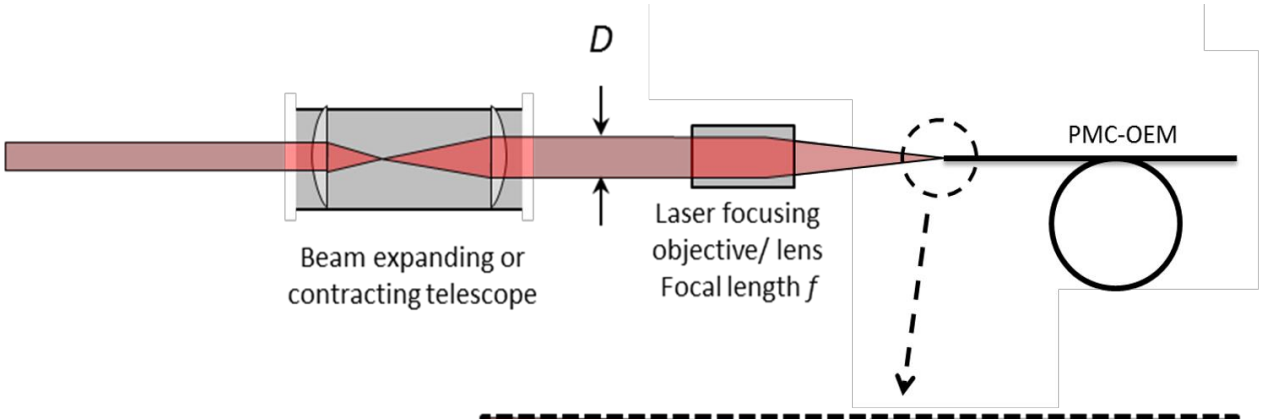
- Strip out fiber coating with a razor blade (Fig 7.2.a)
- Clean the stripped fiber section with a single pass of fiber optic cleaning wipe soaked with isopropyl alcohol (Fig 7.2.b)
- Scratch the fiber with a ceramic blade or a diamond-tip scribe and slap the tip to break it (Fig. 7.2.c)
- Carefully site fiber end facet under a microscope or a binocular (Fig. 7.2.d) and check fiber end facet is flat and free of any dust (Fig. 7.2.e)
- Place the fiber on a V-groove or other stress less maintaining system (Fig. 7.2.f)

7.3. Optical input and output

7.3.1. Design of Launch Optics

Correct launch of light into the PMC is critical to achieve optimal performance. Incorrect launch may result in damage to the PMC.

Launch of light into the PMC is achieved by using a lens system to focus the laser beam to a waist and placing the input facet of the Kagome optical fiber in that waist. It is critical that the stability of the beam waist relative to the fiber end facet is sufficient to maintain launch into the fundamental mode – typically this will require a tolerance on positioning the fiber and stability of the laser beam or less than 0.5µm. The beam waist should be the same diameter (measured at 1/e intensity) as the Mode Field Diameter of the PMC (see sect. 3). The focusing lens system should be chosen so that the NA of the beam as it is focused matches (or is no greater than) the NA of the PMC (see sect. 3). To achieve this with the available laser beam and lenses, it may be necessary to adjust the beam diameter before the focusing lens. For focusing into the fiber we recommend used specifically designed laser focusing objectives available from a number of optical component suppliers.



$$(1)\ f = \frac{\pi \omega D}{4\lambda}$$

$$(2)\ \alpha \approx \frac{D}{2f} = N.A.$$

Fig 7.1. Schematic of a typical launch set-up

7.3.2. Procedure for Alignment of Launch Optics

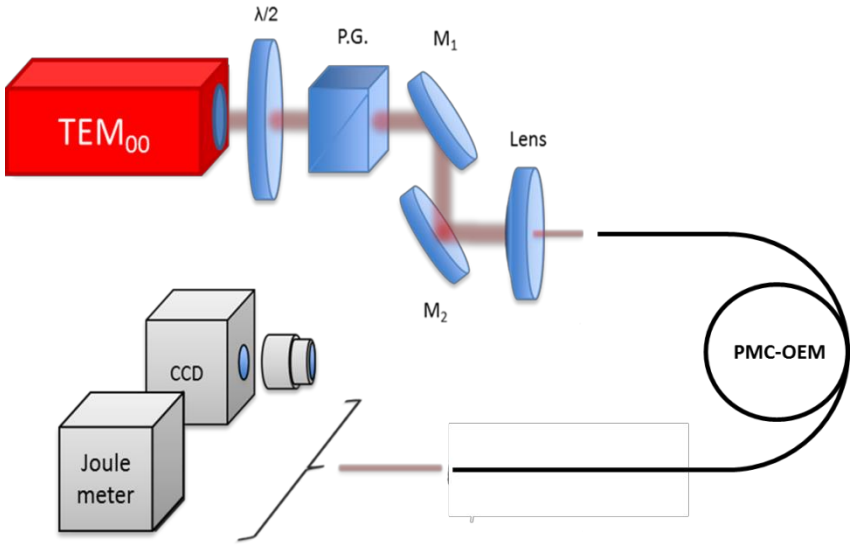


Fig 7.2 Typical Launch Setup

Please note: The user is responsible for ensuring safe use of lasers – this alignment procedure is a guide only and doesn't attempt to cover any laser (or other) safety issues.

PLEASE ensure that the laser specifications are within those specified in section 3 – in particular, the laser beam must remain properly aligned to the fibre to otherwise at higher powers the end of the fibre will be burned and the PMC will not work

1. Calculate the optimal focal length for the lens, using the information given in 7.2.1 above. Note: the NA and MFD of this PMC-OEM is given in section 3. Bear in mind that it may be necessary the adjust the beam diameter of the laser beam (the components to do this are not shown in fig 7.2 above)
2. Arrange for the power/pulse energy of the laser beam to be attenuated without introducing any movement to the beam. A suitable way of doing this is to use a half-waveplate (λ/2) and polariser (P.G.) as shown in fig 7.2. To adjust the power, rotate the wave-plate and not the polariser, since polarisers for high energy laser beams often steer the beam as they are rotated.
3. Reduce the laser power/pulse energy so that it is low enough to avoid damage to the fibre when it is placed at the focus of the laser beam. Assuming a 10ns laser with rep rate of up to 50Hz, this would mean a pulse energy of less than 0.1mJ
4. With the laser set to low power, arrange for the beam waist to approximately hit the end face of the fibre and for the axis of the laser beam to be parallel to the optical axis of the PMC-PL.
5. Image the output near-field of fibre in the Output tip of PMC-OEM with a camera.
6. Adjust the position of the Input tip in both transverse (X, Y) and focus (Z) directions so that at the output of the fibre the light is contained within in a single mode at the centre of the fibre core and there is minimal light seen in the cladding. Note it may be necessary to adjust the gain of the camera so that the light in the cladding is visible despite there being very much more light in the core.
7. If optimisation of the position of the Input tip (X, Y & Z) has not resulted in a single mode in the centre of the fibre core and no light in the cladding, then it is likely that the laser beam is not traveling along the optical axis of the fibre – Adjust M1 & M2 to correct this, then redo step 8.
8. Replace the camera by a power/joule meter and make fine alignment changes to maximise the amount of light transmitted by the PMC-PL. When the alignment is good, transmission of appox 80 % should be achieved – a higher value is preferred. Power not being transmitted through the fibre may be absorbed by the fibre and so will

reduce the damage threshold, therefore to get the highest possible damage threshold the transmission should be optimised to the highest value possible.

9. Increase gradually the power/pulse energy whilst monitoring the power transmission. Should the power transmission drop, fine adjust the lens-fibre tip distance to retrieve the initial transmission ratio.

7.3.3. Design of Output Optics

The output optics can be designed in the same manner as for conventional optical fibre, bearing in mind that the NA of the fibre and the Mode Field Diameter. This subject is covered extensively in the literature – should you require any assistance please contact GLO Photonics.