



# OZ Optics

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## COLLIMATORS AND FOCUSERS – RECEPTACLE STYLE

### FEATURES:

- High power handling
- Rugged and compact design
- Low insertion loss
- Wide wavelength range 250 - 2050 nm
- Wide range of beam diameters
- GRIN, aspheric, achromatic, plano-convex, and biconvex lenses available
- Singlemode, multimode, and polarization maintaining fiber versions
- Diffraction limited optics
- Dual lens focuser
- Adjustable focuser with FC or SMA receptacle and male adjustable connectors.
- **LOW COST!**

### APPLICATIONS:

- Fiber optic device packaging, including WDM's Splitters, and integrated optics
- Source to fiber coupling
- Fiber to detector coupling

### SPECIFICATIONS:

- **Available Wavelengths:** 250 - 2050 nm
- **Polarization**
- **Extinction ratios:** 20, 25, or 30dB
- **Beam Diameters:** 0.2 to 22mm
- **Spot size:** As small as <5 microns
- **Wavefront distortion:**  $\lambda/4$  to  $\lambda/10$
- **Insertion Loss:**  $\leq 0.6$  dB for 60mm separation

OZ Optics offers a complete line of fiber collimators and focusers with low backreflection, designed to collimate or focus light exiting a fiber to a desired beam diameter or spot size. By utilizing diffraction limited lenses, spot sizes of a few microns can be achieved. These devices can be used with laser diodes, photodiodes, acousto-optic modulators and other fiber optic devices. Collimators and focusers can be used as matched pairs to couple light in and out of optical devices. This makes them ideal for fiber packaging of devices.

For collimators, the collimated beam diameter (**BD**) and full divergence angle (**DA**) depends upon the focal length of the lens (**f**), the core diameter (**a**), and the fiber numerical aperture (**NA**). The collimated beam characteristics are given by:

$$BD(mm) = 2 \times f(mm) \times NA \quad DA(mrad) = a(\mu m) / f(mm)$$

When using the above formulae, please exercise caution. Different definitions for the numerical aperture are used by fiber manufacturers. For instance, definitions based on 50 percent, 13.5 percent ( $1/e^2$ ), 5 percent, and 1 percent intensity levels are all used.

OZ Optics standard tables list the definitions used for each fiber type, as well as conversion factors to convert values to  $1/e^2$  values. OZ Optics uses  $1/e^2$  definitions for its calculations of the beam diameter wherever possible.



Collimators/Focusers With 20mm and 33mm Flanges



Fiber Collimators/Focusers with adjustable FC or SMA male connectors



Dual Lens Focuser with ST Receptacle



For fiber focusers, the exact calculation of the spot diameter (**SD**), magnification factor (**M**), and working distance (**WD**) is more difficult and depends on the properties of the lenses being used. As a first approximation, one can calculate the desired focuser characteristics using the geometric optics lens formulae:

$$\frac{1}{i} + \frac{1}{o} = \frac{1}{f} \quad M = -\frac{i}{o}$$

$$SD = M \times a \quad WD \cong i$$

Where **o**, **i** are the object and image distances respectively. Use the above formulae to determine what focal lens you require. Standard focal lengths and lenses are listed in the Standard Tables data sheet.

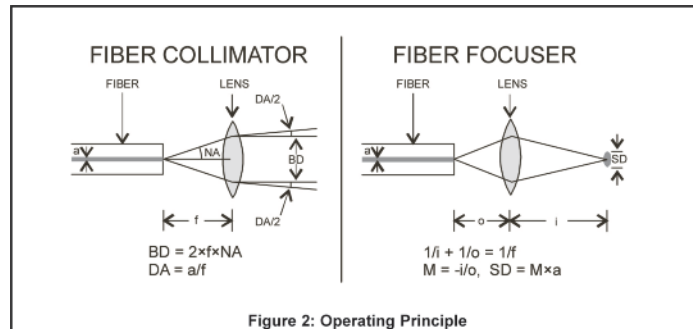


Figure 2: Operating Principle

## Specifications:

**Note:** The following specifications are typical values, and may vary, depending on the exact model selected. Contact OZ for detailed specifications for your exact model.

**Temperature Range:** Operating: -15°C to 55°C with 0.2dB deviation in loss.  
Storage: -45°C to +75°C with less than 0.05dB residual loss.

**Vibration and Shock Test:** Vibration tests were performed, consisting of a 0.05 inch peak to peak displacement, sweeping from 10 to 55 Hz over 15 minutes dwell at worst resonance of 55 Hz (.02g). Each device was tested for twenty-five minutes per axis for a total of 75 minutes of vibration. Tests were conducted in each of the three major axes of the test unit. Shock tests consisting on 100g, 11 msec duration half-sine shocks, three times on each face for a total of 18 shocks, were also performed. Coupling loss deviation was 0.05dB with no hysteresis.

**Power Handling:** GRIN & C lenses: Up to 1 Watt. Aspheric lenses: Up to 10 Watts  
Achromat lenses: 5 to 10 Watts. Plano- and Bi-convex lenses: Up to 100 Watts

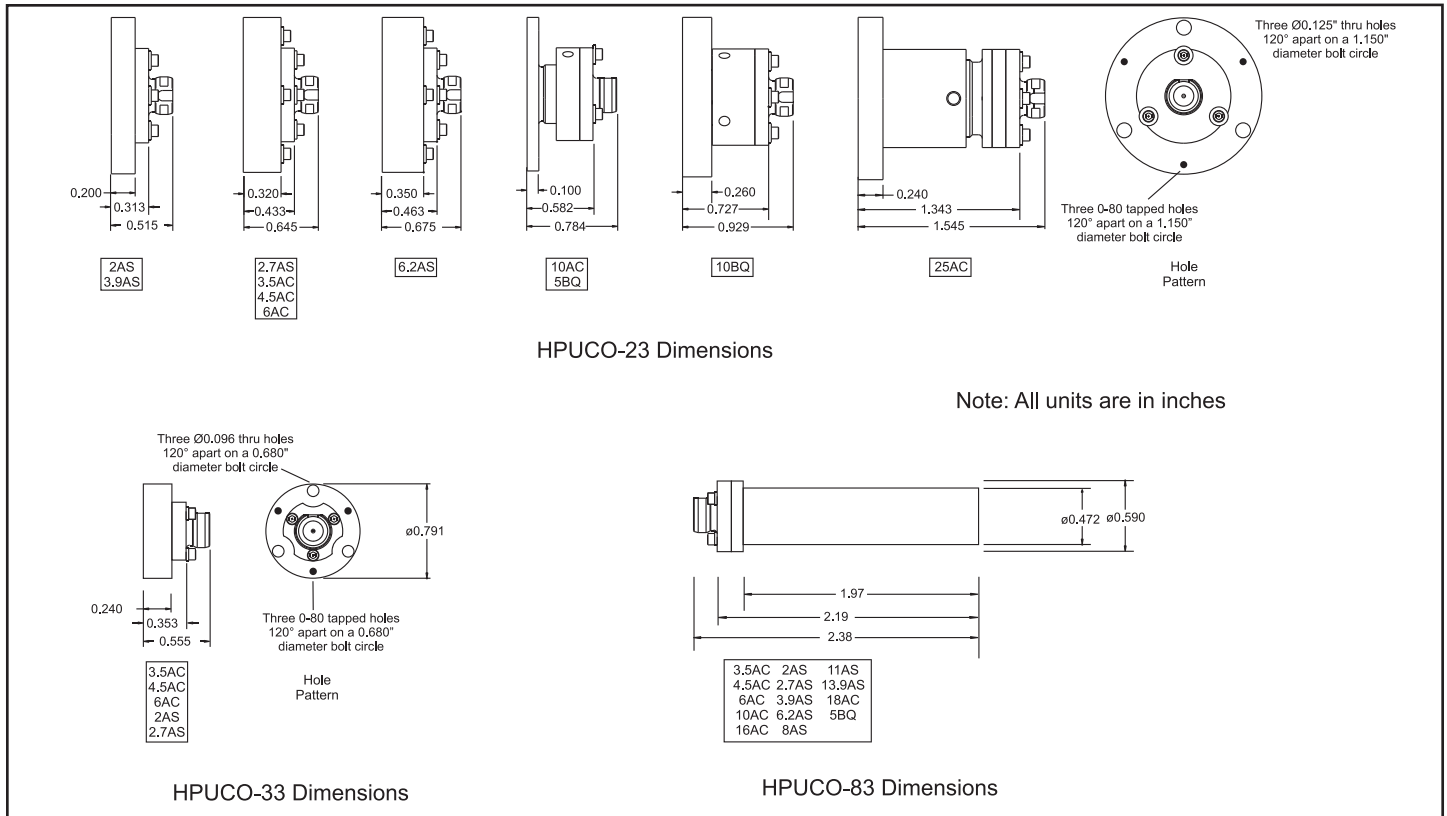
**Available Wavelengths:** GRIN & C lenses: 450-2000nm. Aspheric lenses: 390-2050nm  
Achromat lenses: 400/700nm, 700-1600nm, 1700-2050nm. Plano- and Bi-convex lenses: 250-2050nm

**Polarization Extinction Ratios:** Typically >25dB for Aspheric lenses, >20dB for others.

## Dimensions:

The dimensions given below are representative of typical products manufactured by OZ Optics. Actual dimensions will depend on the actual model ordered. In particular, the lengths of focusers may vary considerably from the lengths of a collimator for a given lens. The choice of receptacle will also affect the overall length. However, unless noted otherwise the dimensions for the clear holes, tapped holes and outer diameters of the flanges are accurate, and do not vary within product families regardless of which specific model collimator or focuser is purchased.

The lens codes for which each version is designed for is listed below each drawing. Use the lens code to find the dimensions for your assembly.



## Standard Parts

The following items represent a small subset of the receptacle style collimator and focuser assemblies we offer. If you do not see a version that fits your immediate needs, then please contact our office, where a sales representative will be happy to quote you the exact model you require.

Standard Collimators for Visible Wavelengths		
Bar Code	Part Number	Description
2521	HPUCO-23-400/700-S-3.5AC	Non-contact receptacle style collimator for singlemode fiber, with a 33mm diameter flange and an FC receptacle (compatible with Flat, Super PC and Ultra PC finish connectors). The collimator uses an f=3.5mm achromat lens and is optimized for 400nm to 700nm wavelengths.
2522	HPUCO-23-400/700-S-6AC	Non-contact receptacle style collimator for singlemode fiber, with a 33mm diameter flange and an FC receptacle (compatible with Flat, Super PC and Ultra PC finish connectors). The collimator uses an f=6mm achromat lens and is optimized for 400nm to 700nm wavelengths.
2535	HPUCO-23-400/700-S-10AC	Non-contact receptacle style collimator for singlemode fiber, with a 33mm diameter flange and an FC receptacle (compatible with Flat, Super PC and Ultra PC finish connectors). The collimator uses an f=10mm achromat lens and is optimized for 400nm to 700nm wavelengths.
13359	HPUCO-23AF-400/700-S-3.5AC	Non-contact receptacle style collimator for singlemode fiber, with a 33mm diameter flange and an angled flat FC receptacle. The collimator uses an f=3.5mm achromat lens and is optimized for 400nm to 700nm wavelengths.
9139	HPUCO-23AF-400/700-S-6AC	Non-contact receptacle style collimator for singlemode fiber, with a 33mm diameter flange and an angled flat FC receptacle. The collimator uses an f=6mm achromat lens and is optimized for 400nm to 700nm wavelengths.
16256	HPUCO-23AF-400/700-S-10AC	Non-contact receptacle style collimator for singlemode fiber, with a 33mm diameter flange and an angled flat FC receptacle. The collimator uses an f=10mm achromat lens and is optimized for 400nm to 700nm wavelengths.
10581	HPUCO-23-400/700-P-3.5AC	Non-contact receptacle style collimator for polarization maintaining fiber, with a 33mm diameter flange and an FC receptacle (compatible with Flat, Super PC and Ultra PC finish connectors). The collimator uses an f=3.5mm achromat lens and is optimized for 400-700nm wavelengths.
4147	HPUCO-23-400/700-P-6AC	Non-contact receptacle style collimator for polarization maintaining fiber, with a 33mm diameter flange and an FC receptacle (compatible with Flat, Super PC and Ultra PC finish connectors). The collimator uses an f=6mm achromat lens and is optimized for 400-700nm wavelengths.
4146	HPUCO-23-400/700-P-10AC	Non-contact receptacle style collimator for polarization maintaining fiber, with a 33mm diameter flange and an FC receptacle (compatible with Flat, Super PC and Ultra PC finish connectors). The collimator uses an f=10mm achromat lens and is optimized for 400-700nm wavelengths.
15431	HPUCO-23AF-400/700-P-3.5AC	Non-contact receptacle style collimator for polarization maintaining fiber, with a 33mm diameter flange and an angled flat FC receptacle. The collimator uses an f=3.5mm achromat lens and is optimized for 400nm to 700nm wavelengths.
15165	HPUCO-23AF-400/700-P-6AC	Non-contact receptacle style collimator for polarization maintaining fiber, with a 33mm diameter flange and an angled flat FC receptacle. The collimator uses an f=6mm achromat lens and is optimized for 400nm to 700nm wavelengths.
15030	HPUCO-23AF-400/700-P-10AC	Non-contact receptacle style collimator for polarization maintaining fiber, with a 33mm diameter flange and an angled flat FC receptacle. The collimator uses an f=10mm achromat lens and is optimized for 400nm to 700nm wavelengths.
19464	HPUCO-33-400/700-S-6AC	Non-contact receptacle style collimator for singlemode fiber, with a 20mm diameter flange and an FC receptacle (compatible with Flat, Super PC and Ultra PC finish connectors). The collimator uses an f=6mm achromat lens and is optimized for 400nm to 700nm wavelengths.
22439	HPUCO-33AF-400/700-S-6AC	Non-contact receptacle style collimator for singlemode fiber, with a 20mm diameter flange and an angled flat FC receptacle. The collimator uses an f=6mm achromat lens and is optimized for 400nm to 700nm wavelengths.
18971	HPUCO-33AF-400/700-P-3.5AC	Non-contact receptacle style collimator for polarization maintaining fiber, with a 20mm diameter flange and an angled flat FC receptacle. The collimator uses an f=3.5mm achromat lens and is optimized for 400nm to 700nm wavelengths.
XXXX	HPUCO-83AF-400/700-P-3.5AC	Non-contact receptacle style collimator for polarization maintaining fiber, with a 12mm diameter, 50mm long housing and an angled flat FC receptacle. The collimator uses an f=3.5mm achromat lens and is optimized for 400nm to 700nm wavelengths.



**Standard Collimators for Infrared Wavelengths**

<b>Bar Code</b>	<b>Part Number</b>	<b>Description</b>
19100	HPUCO-23-1300/1550-S-2AS	Non-contact receptacle style collimator for singlemode fiber, with a 33mm diameter flange and an FC receptacle (compatible with Flat, Super PC and Ultra PC finish connectors). The collimator uses an f=2mm aspheric lens and is optimized for 1300nm to 1550nm wavelengths.
21399	HPUCO-23-1300/1550-S-2.7AS	Non-contact receptacle style collimator for singlemode fiber, with a 33mm diameter flange and an FC receptacle (compatible with Flat, Super PC and Ultra PC finish connectors). The collimator uses an f=2.7mm aspheric lens and is optimized for 1300nm to 1550nm wavelengths.
11170	HPUCO-23-1300/1550-S-3.9AS	Non-contact receptacle style collimator for singlemode fiber, with a 33mm diameter flange and an FC receptacle (compatible with Flat, Super PC and Ultra PC finish connectors). The collimator uses an f=3.9mm aspheric lens and is optimized for 1300nm to 1550nm wavelengths.
11867	HPUCO-23-1300/1550-S-11AS	Non-contact receptacle style collimator for singlemode fiber, with a 33mm diameter flange and an FC receptacle (compatible with Flat, Super PC and Ultra PC finish connectors). The collimator uses an f=11mm aspheric lens and is optimized for 1300nm to 1550nm wavelengths.
8063	HPUCO-23A-1300/1550-S-2AS	Non-contact receptacle style collimator for singlemode fiber, with a 33mm diameter flange and an FC/APC receptacle. The collimator uses an f=2mm aspheric lens and is optimized for 1300nm to 1550nm wavelengths.
10781	HPUCO-23A-1300/1550-S-2.7AS	Non-contact receptacle style collimator for singlemode fiber, with a 33mm diameter flange and an FC/APC receptacle. The collimator uses an f=2.7mm aspheric lens and is optimized for 1300nm to 1550nm wavelengths.
15188	HPUCO-23A-1300/1550-S-6.2AS	Non-contact receptacle style collimator for singlemode fiber, with a 33mm diameter flange and an FC/APC receptacle. The collimator uses an f=6.2mm aspheric lens and is optimized for 1300nm to 1550nm wavelengths.
11022	HPUCO-23A-1300/1550-S-11AS	Non-contact receptacle style collimator for singlemode fiber, with a 33mm diameter flange and an FC/APC receptacle. The collimator uses an f=11mm aspheric lens and is optimized for 1300nm to 1550nm wavelengths.
9294	HPUCO-23AF-1300/1550-S-2.7AS	Non-contact receptacle style collimator for singlemode fiber, with a 33mm diameter flange and an angled flat FC receptacle. The collimator uses an f=2.7mm aspheric lens and is optimized for 1300nm to 1550nm wavelengths.
11243	HPUCO-23AF-1300/1550-S-11AS	Non-contact receptacle style collimator for singlemode fiber, with a 33mm diameter flange and an angled flat FC receptacle. The collimator uses an f=11mm aspheric lens and is optimized for 1300nm to 1550nm wavelengths.
10122	HPUCO-23-1300/1550-P-2.7AS	Non-contact receptacle style collimator for polarization maintaining fiber, with a 33mm diameter flange and an FC receptacle (compatible with Flat, Super PC and Ultra PC finish connectors). The collimator uses an f=2.7mm aspheric lens and is optimized for 1300-1550nm wavelengths.
8869	HPUCO-23-1300/1550-P-6.2AS	Non-contact receptacle style collimator for polarization maintaining fiber, with a 33mm diameter flange and an FC receptacle (compatible with Flat, Super PC and Ultra PC finish connectors). The collimator uses an f=6.2mm aspheric lens and is optimized for 1300-1550nm wavelengths.
15819	HPUCO-23-1300/1550-P-11AS	Non-contact receptacle style collimator for polarization maintaining fiber, with a 33mm diameter flange and an FC receptacle (compatible with Flat, Super PC and Ultra PC finish connectors). The collimator uses an f=11mm aspheric lens and is optimized for 1300-1550nm wavelengths.
17043	HPUCO-23A-1300/1550-P-2AS	Non-contact receptacle style collimator for polarization maintaining fiber, with a 33mm diameter flange and an FC/APC receptacle. The collimator uses an f=2mm aspheric lens and is optimized for 1300-1550nm wavelengths.
15105	HPUCO-23A-1300/1550-P-11AS	Non-contact receptacle style collimator for polarization maintaining fiber, with a 33mm diameter flange and an FC/APC receptacle. The collimator uses an f=11mm aspheric lens and is optimized for 1300-1550nm wavelengths.
14388	HPUCO-23AF-1300/1550-P-2.7AS	Non-contact receptacle style collimator for polarization maintaining fiber, with a 33mm diameter flange and an angled flat FC receptacle. The collimator uses an f=2.7mm aspheric lens and is optimized for 1300nm to 1550nm wavelengths.
18577	HPUCO-23AF-1300/1550-P-6.2AS	Non-contact receptacle style collimator for polarization maintaining fiber, with a 33mm diameter flange and an angled flat FC receptacle. The collimator uses an f=6.2mm aspheric lens and is optimized for 1300nm to 1550nm wavelengths.
17181	HPUCO-23AF-1300/1550-P-11AS	Non-contact receptacle style collimator for polarization maintaining fiber, with a 33mm diameter flange and an angled flat FC receptacle. The collimator uses an f=11mm aspheric lens and is optimized for 1300nm to 1550nm wavelengths.
20912	HPUCO-33A-1300/1550-S-2AS	Non-contact receptacle style collimator for polarization maintaining fiber, with a 20mm diameter flange and an FC/APC receptacle. The collimator uses an f=2mm aspheric lens and is optimized for 1300nm to 1550nm wavelengths.

## Ordering Information For Custom Parts:

OZ Optics welcomes the opportunity to provide custom designed products to meet your application needs. As with most manufacturers, customized products do take additional effort so please expect some differences in the pricing compared to our standard parts list. In particular, we will need additional time to prepare a comprehensive quotation, and lead times will be longer than normal. These points will be carefully explained in your quotation, so your decision will be as well-informed as possible. We strongly recommend buying our standard products.

## Questionnaire For Custom Parts

1. Do you require a fiber optic collimator, or a fiber optic focuser instead?
- 2a. For fiber collimator users only:
  - What is the desired collimated beam diameter (in mm)?
  - What is the desired collimated divergence angle (mRad)?
- 2b. For fiber focuser users only:
  - What is the desired spot diameter (in microns)?
  - What is the desired working distance (in mm)?
3. What is your operating wavelength range, in nanometers?
4. Will you be using singlemode, multimode, or polarization maintaining fibers?
5. What type of connector is on your fiber?
6. What is the output power through your fiber?
7. What is the desired flange size? 33mm, 20mm, 12mm, 11mm, or something else?

### Description

### Part Number

Non-Contact Receptacle Style Collimator:

**HPUCO-A-X-W-F-f**

**A** = Collimator Size  
 2 for 33mm OD flange  
 3 for 20mm OD flange  
 8 for 12mm diameter by 50mm long housing  
 T for 11mm diameter housing

**X** = Connector code:  
 3 = FC (Compatible with Flat, Super PC and Ultra PC finishes)  
 3A = Angled NTT-FC/PC  
 3AF = Angled Flat FC  
 8 = AT & T-ST  
 SC = SC

See table 6 of the OZ Standard Tables data sheet for other connectors.

**f** = Lens focal length and type:  
 See Tables 9 to 12 of the standard tables data sheet for a list of available lenses and the collimator housings they fit.

**F** = Fiber Type: M = Multimode  
 S = Singlemode  
 P = Polarization maintaining

**W** = Wavelength in nm:  
 (Example: Specify 633 for 633nm)  
 For achromat lenses at visible wavelengths specify 400/700

### Description

### Part Number

Non-Contact Receptacle Style Focuser:

**HPUFO-A-X-W-F-M-WD-f**

**A** = Collimator Size  
 2 for 33mm OD flange  
 3 for 20mm OD flange  
 8 for 12mm diameter by 50mm long housing  
 T for 11mm diameter housing

**X** = Connector code:  
 3 = FC (Compatible with Flat, Super PC and Ultra PC finishes)  
 3A = Angled NTT-FC/PC  
 3AF = Angled Flat FC  
 8 = AT & T-ST  
 SC = SC

See table 6 of the OZ Standard Tables data sheet for other connectors.

**f** = Lens focal length and type:  
 See Tables 9 to 12 of the standard tables data sheet for a list of available lenses and the collimator housings they fit.

**WD** = Working Distance, in mm

**M** = Magnification Factor

**F** = Fiber Type: M = Multimode  
 S = Singlemode  
 P = Polarization maintaining

**W** = Wavelength in nm:  
 (Example: Specify 633 for 633nm)  
 For achromat lenses at visible wavelengths specify 400/700

## Application Notes:

### MAINTAINENCE

When not in use, the ends of the collimator should be covered with the supplied caps. This will protect the connectors from dirt and contamination. In addition, the following actions should be performed on a routine basis to ensure that your laser to fiber coupler remains in serviceable condition.

#### Cleaning the receptacles on collimators and focusers

The receptacles on collimators and focusers should be inspected periodically and cleaned if necessary. This will ensure that the receptacles and fiber mate together properly. It will also prevent damage from occurring to either the coupler or the fiber.

1. Remove the coupler from the laser before cleaning.
2. Use a can of compressed air to blow any dust or dirt off the connector. Do not blow air directly into the receptacle.
3. Take a round toothpick, and cut one end of the toothpick with a pair of scissors, to make the end flat.
4. Wrap a small (about one inch square) piece of lint free tissue around the end of the toothpick, as shown below. Apply one or two drops of pure acetone, isopropanol, or methanol to the tip of the tissue paper.
5. Hold the coupler so that the receptacle is pointing down. Insert the toothpick and tissue into the receptacle of the coupler. Rotate the toothpick and tissue two or three turns. Remove the toothpick and tissue.
6. Inspect the tissue. If there is dirt visible on the tissue, then repeat steps 3 to 5
7. Attach the collimator to the fiber. Turn on the source, and inspect the output on an opaque screen. The output should look circular, with little or no scattering.

When not in use, the ends of the fiber and the connector receptacles should be covered with the supplied metal caps. This will protect the connectors from dirt and contamination. **DO NOT USE PLASTIC CAPS ON THE RECEPTACLES.** Plastic caps often are contaminated with mold release agents, which can get onto the fiber ends. This contamination is extremely difficult to see, and resists cleaning.

#### About focusers for magnifications close or less than 1

A common request is to build a fiber focuser that focuses to a spot size about the same as the fiber core, or even smaller. For instance one might want to focus light from a standard singlemode to a spot size less than half of the mode field diameter of the fiber, in order to improve coupling from a laser diode.

While at first glance, it might seem that this can be done with a single lens, usually this introduces too much aberration, producing a spot size significantly larger than the desired size. Often one even overfills the aperture of the lens, clipping the beam in the process. Obviously such behavior is not desired.

For such applications OZ Optics can provide dual lens focusers, where two lenses, one with focal length  $f_1$ , the other with focal length  $f_2$ . The lenses are mounted in the housing front to front. Together the two lenses produce a spot with a magnification equal to  $f_2/f_1$ . For instance a 6.2AS lens with a 2.7AS lens can be used together to produce a focused spot with magnification  $M_{2.7/6.2} = 0.44$