



OPTICAL FIBERS

Features:

- Huge variety of fibers available from stock
- Fibers for wavelengths from 200nm to over 2000nm
- Multimode, singlemode, polarization maintaining, and large mode area fibers
- Available uncabled and precabled

Applications:

- Telecommunications
- Life Sciences and biotechnology
- Industrial
- Sensing

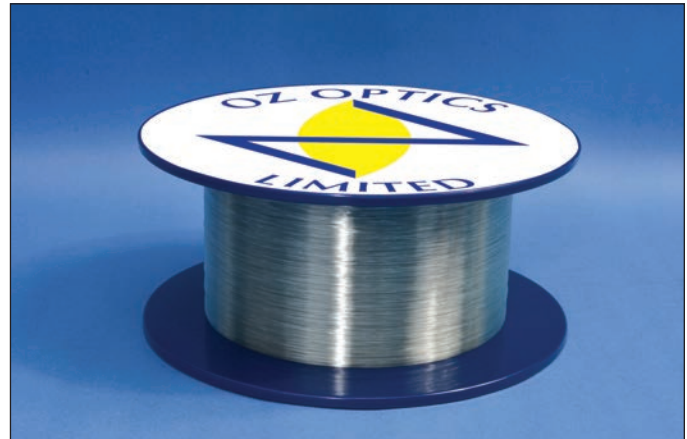
Product Description:

OZ Optics stocks a wide variety of optical fibers suitable for variety of applications these fibers come in a variety of fiber sizes operating wavelengths and fiber types, and can be assembled into patchcords or more complex fiber optic components to suit your needs. OZ Optics categorizes our fibers based on fiber type, operating wavelengths, core/cladding size, jacket diameter, and numerical aperture (NA). The fibers can be categorized as follows:

Multimode fibers: Multimode fiber have large fiber core sizes and large numerical apertures, making them well suited for collecting light from large or diffuse sources such as LEDs or white light lamps. They are also well suited for high power applications as the power is transmitted through a large cross section compared to singlemode or polarization maintaining fibers. The drawback with multimode fibers is that they do not maintain the high quality spatial properties of lasers. Instead the light is dispersed among multimode modes within the fiber, generating an out speckle pattern when the light emerges from the other end of the fiber.

Typically these fibers are suitable either for near infrared and visible wavelengths (IRVIS fibers) or for near ultraviolet and visible wavelengths (UVVIS fibers). UVVIS multimode fibers typically are built with added amounts of hydroxyl (OH) ions added to enhance ultraviolet transmission at the expense of infrared transmission. Multimode fibers can be further classified as follows:

Graded-Index multimode fibers (MMF): These fibers have a fiber core with a refractive index that varies from the center to the edge. They are mainly used for telecommunications applications, and come in three standard core/cladding sizes - 50/125, 62.5/125, and 100/140.



250 micron OD Fiber



900 micron OD Fiber



3mm OD Cabled Fiber

Step-Index silica core (QMMF) fibers: These fibers have a fiber core with a constant index of refraction. Typically the fiber core is fused silica, doped with an element like germanium, while the fiber cladding is typically undoped fused silica for fibers with numerical apertures up to 0.22, and typically a hard polymer for higher numerical apertures. These fibers are available with core sizes ranging from 10 microns to 1500 microns, and NAs ranging from 0.12 to 0.5.

Table 1: Standard Graded Index Multimode Fibers¹

| Bar Code | Part Number | Operating Wavelength Range (nm) | Core Diameter (µm) | Cladding Diameter (µm) | Attenuation (dB/km) | Numerical Aperture ² | Jacket or Buffer Diameter (mm) |
|----------|---------------------------|---------------------------------|--------------------|------------------------|---------------------------------------|---------------------------------|--------------------------------|
| 16149 | MMF-IRVIS-50/125-0.25-L | 400 - 1800 | 50 ± 3 | 125 ± 2 | ≤2.5 dB @ 850 nm ≤0.8 dB @ 1300 nm | 0.200 ± 0.015 | 0.25 |
| 1235 | MMF-IRVIS-50/125-1-L | 400 - 1800 | 50 ± 3 | 125 ± 2 | ≤2.5 dB @ 850 nm ≤0.8 dB @ 1300 nm | 0.200 ± 0.015 | 0.9 |
| 1236 | MMF-IRVIS-50/125-3-L | 400 - 1800 | 50 ± 3 | 125 ± 2 | ≤2.5 dB @ 850 nm ≤0.8 dB @ 1300 nm | 0.200 ± 0.015 | 3.0 |
| 3715 | MMF-IRVIS-62.5/125-0.25-L | 400 - 1800 | 62.5 ± 3 | 125 ± 2 | ≤3.0 dB @ 850 nm ≤0.7 @ 1300 nm | 0.275 ± 0.015 | 0.25 |
| 1237 | MMF-IRVIS-62.5/125-1-L | 400 - 1800 | 62.5 ± 3 | 125 ± 2 | ≤3.0 dB @ 850 nm ≤0.7 @ 1300 nm | 0.275 ± 0.015 | 0.9 |
| 1238 | MMF-IRVIS-62.5/125-3-L | 400 - 1800 | 62.5 ± 3 | 125 ± 2 | ≤3.0 dB @ 850 nm ≤0.7 @ 1300 nm | 0.275 ± 0.015 | 3.0 |
| 1240 | MMF-IRVIS-100/140-1-L | 400 - 1800 | 100 ± 3 | 140 ± 4 | ≤6.0 dB @ 850 nm ≤3.0 dB @ 1300 nm | 0.29 ± 0.02 | 0.9 |
| 1241 | MMF-IRVIS-100/140-3-L | 400 - 1800 | 100 ± 3 | 140 ± 4 | ≤6.0 dB @ 850 nm ≤3.0 dB @ 1300 nm | 0.29 ± 0.02 | 3.0 |

Notes:

- 1 Corning graded index fibers used for 50/125, 62.5/125, and 100/140 fiber sizes.
- 2 According to Corning's definition of the numerical aperture for graded index multimode fibers (EIA/TIA-455-177A), when all modes are uniformly excited in graded index multimode fiber, then the intensity of the output light is 5% of the center intensity at the angle whose sine equals the numerical aperture. This is the definition used for our coupler, collimator, and focuser calculations when using these fibers. Assuming that the overall intensity pattern (i.e., ignoring modal noise) is Gaussian in behavior, we can calculate the Gaussian beam size as 81.7% the size calculated from the numerical aperture.

Table 2: Standard Step Index Multimode Fibers For Visible And Ultraviolet Wavelengths

| Bar Code | Part Number | Wavelength Range (nm) | Core Diameter (µm) | Cladding Diameter (µm) | Other Coatings (µm) | Attenuation (dB/km) ¹ | Numerical Aperture | Jacket or Buffer Diameter (mm) | Cladding Material |
|----------|----------------------------------|-----------------------|--------------------|------------------------|-----------------------|--|--------------------|--------------------------------|-------------------|
| 1247 | QMMF-UVVIS-10/125-0.25-L | 180 - 900 | 10 ± 2 | 125 ± 3 | N/A | <100 @380-870 nm | 0.10 | 0.25 | Fused Silica |
| 1251 | QMMF-UVVIS-25/125-0.25-L | 180 - 900 | 25 ± 4 | 125 ± 3/0 | N/A | <100 @380-870 nm | 0.10 | 0.25 | Fused Silica |
| 1259 | QMMF-UVVIS-50/125-0.25-L | 200 - 900 | 50 ± 1 | 125 ± 3 | N/A | <100 @300-900 nm <1000 @220-300 nm | 0.22 | 0.25 | Fused Silica |
| 1253 | QMMF-UVVIS-50/125-0.25-L-NA=0.12 | 200 - 900 | 50 ± 1 | 125 ± 3 | N/A | <100 @300-900 nm <1000 @220-300 nm | 0.12 | 0.25 | Fused Silica |
| 1474 | QMMF-UVVIS-50/125-1-L | 200 - 900 | 50 ± 1 | 125 ± 3 | N/A | <100 @320-900 nm <1000 @220-320 nm | 0.22 | 0.9 | Fused Silica |
| 1257 | QMMF-UVVIS-50/125-3-L | 200 - 900 | 50 ± 1 | 125 ± 3 | N/A | <100 @300-900 nm <1000 @220-300 nm | 0.22 | 3.0 | Fused Silica |
| 1271 | QMMF-UVVIS-100/140-0.25-L | 200 - 900 | 100 ± 2 | 140 ± 3 | N/A | <100 @300-900 nm <1000 @220-300 nm | 0.22 | 0.25 | Fused Silica |
| 1287 | QMMF-UVVIS-200/240-0.4-L | 200 - 900 | 200 ± 5 | 240 ± 5 | Hard Coat 260 ± 5 | <100 @380-900 nm <1000 @250-380 nm | 0.22 | 0.375 | Fused Silica |
| 27638 | QMMJ-UVVIS-300/330-0.53-L | 200-900 | 300 ± 6 | 330 ± 7 | Buffer 430 ± 13 | <100 @ 300-900 nm <1000 @ 220-300nm | 0.22 | 0.53 | Fused Silica |
| 1294 | QMMF-UVVIS-365/400-0.73-L | 200 - 900 | 365 ± 10 | 400 ± 10 | Hard Coat 425 ± 10 | <100 @380-900 nm <1000 @250-380 nm | 0.22 | 0.73 | Fused Silica |
| 27639 | QMMJ-UVVIS-400/440-0.64-L | 200-900 | 400 ± 8 | 440 ± 9 | Buffer 540 ± 16 | <100 @ 300-900 nm <1000 @ 220-300nm | 0.22 | 0.64 | Fused Silica |
| 1793 | QMMF-UVVIS-550/600-0.75-L | 200-900 | 550 ± 12 | 600 ± 10 | Hard Coat 630 ± 10 | <100 @380-900 nm <1000 @250-380 nm | 0.22 | 0.75 | Fused Silica |
| 2838 | QMMF-UVVIS-600/660-1.2-L | 200-900 | 600 ± 12 | 660 ± 13 | Buffer 810 ± 25 | <100 @300-900 nm <1000 @220-300 nm | 0.22 | 1.2 | Fused Silica |
| 27640 | QMMJ-UVVIS-800/880-1-L | 200-900 | 800 ± 16 | 880 ± 18 | Buffer 980 ± 30 | <100 @ 300-900 nm <1000 @ 220-300nm | 0.22 | 1.08 | Fused Silica |
| 1302 | QMMF-UVVIS-940/1000-1.4-L | 200-900 | 940 ± 15 | 1000 ± 15 | Hard Coat 630 ± 10 | <100 @380-900 nm <1000 @250-380 nm | 0.22 | 1.4 | Fused Silica |

Notes:

- 1 The attenuation of these fibers is highly wavelength dependent. For detailed attenuation versus wavelength data contact OZ Optics.
- 2 For maximum power handling, the input light must be focused such that the focused spot size is about 70% of the fiber core size, while the NA of the focused rays should be between 30% and 90% of the NA of the fiber. We strongly recommend using high power, air gap design connectors for very high power coupling applications.
- 3 Power handling for pulsed laser light is dependent on the pulse energy, duration, and wavelength. Contact OZ for power handling for pulsed laser applications.
- 4 While OZ Optics believes this information to be reliable, it is only provided as a general guide, and can be greatly affected by individual circumstances. OZ Optics offers no warranties as to its accuracy, and disclaims any liability in connection to its use.

Table 3: Standard Step Index Multimode Fibers For Infrared And Visible Wavelengths

| Bar Code | Part Number | Wavelength Range (nm) | Core Diameter (µm) | Cladding Diameter (µm) | Other Coatings (µm) | Attenuation (dB/km) ¹ | Numerical Aperture | Jacket or Buffer Diameter (mm) | Cladding Material |
|----------|----------------------------|-----------------------|--------------------|------------------------|---------------------|---|--------------------|--------------------------------|-------------------|
| 13460 | QMMF-IRVIS-50/125-0.3-L | 350-2400 | 50 ± 2 | 125 ± 3 | N/A | 20dB peak @1390 nm <10 @630 - 1800 nm | 0.22 | 0.3 | Fused Silica |
| 1260 | QMMF-IRVIS-50/125-1-L | 500 - 2100 | 50 ± 3 | 125 ± 3 | N/A | <10 @ 600 - 1200 nm <100 @ 500 - 2100 nm | 0.2 | 0.9 | Fused Silica |
| 1263 | QMMF-IRVIS-50/125-3-L | 350 - 2100 | 50 ± 2 | 125 ± 3 | N/A | 20dB peak @1390 nm <10 @ 630 - 1800 nm | 0.22 | 3.0 | Fused Silica |
| 1268 | QMMF-IRVIS-100/140-0.25-L | 350 - 2100 | 100 ± 2 | 140 ± 3 | N/A | 20dB peak @1390 nm <10 @630 - 1800 nm | 0.22 | 0.25 | Fused Silica |
| 1282 | QMMF-IRVIS-200/230-0.5-L | 500 - 1500 | 200 ± 4 | 230 +0/-10 | N/A | ≤20 @ 530 - 1100 nm 29 @ 1300 nm | 0.37 | 0.50 | Polymer |
| 1283 | QMMF-IRVIS-200/230-3-L | 500 - 1500 | 200 ± 4 | 230 +0/-10 | N/A | ≤20 @ 530 - 1100 nm 29 @ 1300 nm | 0.37 | 3.0 | Polymer |
| 1288 | QMMF-IRVIS-200/240-0.4-L | 400 - 2100 | 200 ± 5 | 240 ± 5 | Hard Coat 260 ± 5 | <10 @630 - 1900 nm | 0.22 | 0.4 | Fused Silica |
| 1289 | QMMF-IRVIS-200/240-3-L | 400 - 2100 | 200 ± 5 | 240 ± 5 | Hard Coat 260 ± 5 | <10 @630 - 1900 nm | 0.22 | 3.0 | Fused Silica |
| 2512 | QMMF-IRVIS-300/330-0.65-L | 500 - 1500 | 300 ± 6 | 330 +5/-10 | N/A | ≤20 @ 530 - 1100 nm 29 @ 1300 nm | 0.37 | 0.65 | Polymer |
| 3297 | QMMF-IRVIS-365/400-0.73-L | 400 - 2100 | 365 ± 14 | 400 ± 8 | Hard Coat 425 ± 10 | 20dB peak @1390 nm <10 @630 - 1800 nm | 0.22 | 0.73 | Fused Silica |
| 1809 | QMMF-IRVIS-400/430-0.73-L | 500 - 1500 | 400 ± 8 | 430 +5/-10 | N/A | ≤20 @ 530 - 1100 nm 29 @ 1300 nm | 0.37 | 0.73 | Polymer |
| 2739 | QMMF-IRVIS-400/440-0.6-L | 350 - 2100 | 400 ± 8 | 440 ± 9 | Buffer 540 ± 17 | 20dB peak @1390 nm <10 @630 - 1800 nm | 0.22 | 0.64 | Fused Silica |
| 1298 | QMMF-IRVIS-550/600-0.75-L | 400 - 2100 | 550 ± 12 | 600 ± 10 | Hard Coat 630 ± 10 | <10 @630 - 1900 nm | 0.22 | 0.75 | Fused Silica |
| 1299 | QMMF-IRVIS-600/630-1-L | 500 - 1500 | 600 ± 10 | 630 +5/-10 | N/A | ≤20 @ 530 - 1100 nm 29 @ 1300 nm | 0.37 | 1.04 | Polymer |
| 1300 | QMMF-IRVIS-600/630-3-L | 500 - 1500 | 600 ± 10 | 630 +5/-10 | N/A | ≤20 @ 530 - 1100 nm 29 @ 1300 nm | 0.37 | 3.0 | Polymer |
| 1790 | QMMF-IRVIS-940/1000-1.4-L | 400 - 2100 | 940 ± 15 | 1000 ± 15 | Hard Coat 1035 ± 15 | <10 @630 - 1900 nm | 0.22 | 1.40 | Fused Silica |
| 1303 | QMMF-IRVIS-1000/1035-1.4-L | 500 - 1500 | 1000 ± 15 | 1035 ± 15 | N/A | ≤20 @ 530 - 1100 nm 29 @ 1300 nm | 0.37 | 1.40 | Polymer |

Notes:

- The attenuation of these fibers is wavelength dependent. For detailed attenuation versus wavelength data contact OZ Optics.
- For maximum power handling, the input light must be focused such that the focused spot size is about 70% of the fiber core size, while the NA of the focused rays should be between 30% and 90% of the NA of the fiber. We strongly recommend using high power, air gap design connectors for very high power coupling applications.
- Power handling for pulsed laser light is dependent on the pulse energy, duration, and wavelength. Contact OZ for power handling for pulsed laser applications.
- While OZ Optics believes this information to be reliable, it is only provided as a general guide, and can be greatly affected by individual circumstances. OZ Optics offers no warranties as to its accuracy, and disclaims any liability in connection to its use.

Singlemode fibers: Singlemode fibers have core sizes small enough that only one single path exists in the fiber for the light to travel. As a result they maintain the high spatial coherence and constant Gaussian profiles of high quality lasers. This makes them ideal for many applications where the goal is to generate a high quality beam or focused spot. However the output polarization of the light from the fiber will change as one bends, twists, squeezes or change the temperature of the fiber. They do not preserve polarization.

Singlemode fibers have an operating wavelengths determined by their cutoff wavelength and core diameter. At wavelengths shorter than the cutoff wavelength the fiber is no longer singlemode in nature and instead starts to act like a multimode fiber, generating a beam that is not Gaussian and that changes as one bends the fiber. At long wavelengths the core becomes too small to trap the light well. The transmission becomes more and more sensitive to bending the fiber and eventually the light is no longer transmitted by the fiber. OZ Optics offers special broadband RGB singlemode fibers for visible light applications, able to transmit light from 400nm to 650nm.

Standard singlemode fibers (SMF) normally have a germanium doped core with a pure silica cladding. For wavelengths shorter than 600nm we instead use fibers with a pure fused silica core with a fluorine doped cladding (QSMF fibers).

Table 4: Standard Singlemode Fibers

| Bar Code | Part Number | Operating Wavelength Range ¹ (nm) | Cutoff Wavelength (nm) ² | Core Diameter (μm) | Cladding Diameter (μm) | Mode Field Diameter (μm) | Attenuation (dB/km) | Numerical Aperture (Manufacturer's Specs) ³ | Effective Numerical Aperture (1/e ²) ³ | Jacket or Buffer Diameter (mm) ⁴ |
|----------|--------------------------------------|--|-------------------------------------|--------------------|------------------------|---|------------------------------------|--|---|---|
| 1197 | QSMF-320-2/125-0.25-L ⁵ | 320-400 | <300 | 2 ± 1 | 125 ± 3 | 2.2 (Typical) | 200 @ 340 to 360 nm | 0.12 ± 0.03 | 0.093 @ 320 nm | 0.25 |
| 14579 | QSMF-400-3/125-0.25-L ⁵ | 400-450 | <380 | 2.5/3.0 | 125 ± 2 | 4.0 (Typical) | <60 @ 400 nm | 0.10 ± 0.01 | 0.065 @ 400 nm | 0.25 |
| 1202 | QSMF-488-3.5/125-0.25-L ⁵ | 450-650 | <440 | 3.5 ± 0.5 | 125+3/-1 | 4.2 (Typical) | <30 @ 488 nm | 0.11 ± 0.015 | 0.074 @ 488 nm | 0.25 |
| 1204 | QSMF-488-3.5/125-3-L ⁵ | 458-650 | <440 | 3.5 ± 0.5 | 125 +3/-1 | 4.2 (Typical) | <30 @ 488 nm | 0.11 | 0.074 @ 488 nm | 3.0 |
| 17333 | SMF-633-4/125-0.25-NF-L | 600-850 | <600 | 4 | 125 ± 2 | 4.0 ± 0.5 | <12 | 0.13 | 0.10 @ 633 nm | 0.25 |
| 10106 | SMF-633-4/125-1-L | 630-850 | <620 | 4.0 | 125 ± 2 | 4.0 ± 0.5 | <12 | 0.12 | 0.10 @ 633 nm | 0.9 |
| 10108 | SMF-633-4/125-3-L | 630-850 | <620 | 4.0 | 125 ± 2 | 4.0 ± 0.5 | <12 | 0.12 | 0.10 @ 633 nm | 3.0 |
| 1215 | SMF-780-5/125-0.25-L | 780-980 | <770 | 4.9 | 125 ± 1 | 5.4 ± 1.0 | <4 | 0.11 | 0.092 @ 780 nm | 0.25 |
| 1217 | SMF-780-5/125-3-L | 780-980 | <770 | 4.9 | 125 ± 1 | 5.4 ± 1.0 | <4 | 0.11 | 0.092 @ 780 nm | 3.0 |
| 1224 | SMF-1060-6/125-0.25-L | 980-1550 | <970 | 6.0 | 125 ± 0.5 | 5.9 ± 0.3 @ 980 nm 6.2 ± 0.3 @ 1060 nm | 2.1 @ 980 nm 1.5 @ 1060 nm | 0.14 | 0.11 @ 1060 nm | 0.25 |
| 1230 | SMF-1300-9/125-0.25-L ⁶ | 1290-1650 | <1260 | 8.2 | 125 ± 0.7 | 9.2 ± 0.4 @ 1310 nm 10.4 ± 0.8 @ 1550 nm | <0.22 @ 1310 nm <0.35 @ 1550 nm | 0.14 | 0.090 @ 1300 nm 0.095 @ 1550 nm | 0.25 |
| 1232 | SMF-1300-9/125-1-L ⁶ | 1290-1650 | <1260 | 8.2 | 125 ± 0.7 | 9.2 ± 0.4 @ 1310 nm 10.4 ± 0.8 @ 1550 nm | <0.22 @ 1310 nm <0.35 @ 1550 nm | 0.14 | 0.090 @ 1300 nm 0.095 @ 1550 nm | 0.9 |
| 11788 | SMF-1300-9/125-2-L ⁶ | 1290-1650 | <1260 | 8.2 | 125 ± 0.7 | 9.2 ± 0.4 @ 1310 nm 10.4 ± 0.8 @ 1550 nm | <0.22 @ 1310 nm <0.35 @ 1550 nm | 0.14 | 0.090 @ 1300 nm 0.095 @ 1550 nm | 2.0 |
| 2749 | SMF-1300-9/125-3-L ⁶ | 1290-1650 | <1260 | 8.2 | 125 ± 0.7 | 9.2 ± 0.4 @ 1310 nm 10.4 ± 0.8 @ 1550 nm | <0.22 @ 1310 nm <0.35 @ 1550 nm | 0.14 | 0.090 @ 1300 nm 0.095 @ 1550 nm | 3.0 |
| 45429 | SMF-2000-7/125-0.25-L | 1850-2200 | <1800 | 7 | 125 ± 1 | 8 μm @ 1950 nm | N/A | 0.2 | 0.155 @ 1950 nm | 0.25 |

Notes:

- While the fibers will work over the entire operating range listed, it is recommended that one selects the fiber with the longest wavelength specifications that still operates at your wavelength of interest. For instance, for 780 nm work we recommend selecting SMF-780-5/125 fiber over SMF-633-4/125 fiber.
- If the fiber is used at wavelengths less than the cutoff wavelength, the fiber will still transmit light. However it will begin to behave like a multimode fiber. This is not desired in most applications.
- Most fiber manufacturers define the numerical aperture of their fibers based on the refractive indices of the core and cladding (i.e., $NA = [N_{CO}^2 - N_{CL}^2]^{1/2}$). While this definition is useful for step index multimode fibers, it is not a very accurate way to predict the far field behavior of light from singlemode fibers. A more accurate technique is to use the Mode Field Diameter (MFD) for the light within the fiber to determine the far field. We can treat the output from the fibers as being essentially Gaussian in behavior. If we then define the effective numerical aperture (NA_{eff}) of the fiber as being the sine of the angle from the center to where the intensity drops to 1/e² of the original value then one can show that $NA_{eff} = 2λ/πMFD$. We have listed NA_{eff} for each fiber at typical values for the mode field diameter and wavelength in the table.
- The jacket diameters listed are for those fibers that come from the manufacturer pre-cabled. For short lengths of fibers OZ Optics can cable the fibers in a loose tube cable. For instance, SMF-780-5/125-0.25-L fiber, which has a 0.25 mm coating diameter, can be cabled with a 0.9 mm diameter loose tubing to provide extra protection.
- These fibers feature pure fused silica fiber cores for improved optical power handling.
- Corning SMF-28 fiber is used for both 1300 nm and 1550 nm singlemode applications unless otherwise specified.

Polarization Maintaining (PM) fibers: PM fibers are a special variety of singlemode fibers, designed to maintain the polarization properties of linearly polarized light sources, provided that the light is launched along either the slow or fast axes of the fiber. The most common method to do this is by adding two stress applying parts (SAP) on either side of the fiber core. Our standard PM fibers use a PANDA fiber geometry, with two circular stress rods. We can provide fibers with other geometries, such as Bow-tie PM fibers.

Like our singlemode fibers, the wavelength range is limited by their cutoff wavelengths and bend sensitivity at long wavelengths. OZ Optics offers special broadband RGB PM fibers for visible light applications, able to transmit light from 400nm to 650nm. Standard PM fibers (PMF) normally have a germanium doped core with a pure silica cladding, while for wavelengths shorter than 600nm we instead use fibers with a pure fused silica core with a fluorine doped cladding (QPMF fibers).

Table 5: Standard Polarization Maintaining Fibers¹

| Bar Code | Part Number | Operating Wavelength Range ² (nm) | Cutoff Wavelength (nm) ³ | Core Diameter (μm) | Cladding Diameter (μm) | Mode Field Diameter (μm) | Attenuation (dB/km) | Numerical Aperture (Manufacturer's Specs) ⁴ | Effective Numerical Aperture (1/e ²) ⁴ | Jacket or Buffer Diameter (mm) ⁵ | Jacket Material | Polarization Crosstalk (dB/100m) |
|----------|------------------------------------|--|-------------------------------------|--------------------|------------------------|--------------------------|---------------------|--|---|---|------------------|----------------------------------|
| 27626 | QPMF-350-2/125-0.25-L | 350-440 | <340 | 2 | 125 | 2.3@350 nm 2.6@405 nm | <200 | 0.12 | 0.097 | 0.25 | Dual Acrylate | <-20 |
| 29228 | QPMF-400-3/125-0.25-L ⁶ | 405-480 | <400 | 3.0 | 125 | 3.1 (Typical) | <100 | 0.11 | 0.082 @ 400 nm | 0.9 | Dual Acrylate | <-20 |
| 1170 | QPMF-488-3.5/125-1-L ⁶ | 480-630 | <470 | 3.5 | 125 | 3.8 (Typical) | <50 | 0.11 | 0.082 @ 488 nm | 0.9 | Acrylate / Nylon | <-25 |
| 1172 | PMF-633-4/125-0.25-L | 630-820 | <620 | 4 | 125 | 4.5 (Typical) | <12 | 0.11 | 0.089 @ 633 nm | 0.25 | Dual Acrylate | <-25 |
| 1174 | PMF-633-4/125-1-L | 630-820 | <620 | 4 | 125 | 4.5 (Typical) | <12 | 0.11 | 0.089 @ 633 nm | 0.9 | Acrylate / Nylon | <-25 |
| 1181 | PMF-850-5/125-0.4-L | 810-980 | <750 | 5 | 125 | 5.5 ± 1 | <3 | 0.11 | 0.098 @ 850 nm | 0.40 | Dual Acrylate | <-25 |
| 2813 | PMF-850-5/125-0.25-L | 810-980 | <750 | 5 | 125 | 5.5 ± 1 | <3 | 0.11 | 0.098 @ 850 nm | 0.25 | Dual Acrylate | <-25 |
| 3382 | PMF-980-6/125-0.4-L | 980-1300 | <970 | 6 | 125 | 6.6 ± 1 | <3 | 0.11 | 0.095 @ 980 nm | 0.40 | Dual Acrylate | <-25 |
| 8574 | PMF-980-6/125-0.25-L | 980-1300 | <970 | 6 | 125 | 6.6 ± 1 | <3 | 0.11 | 0.095 @ 980 nm | 0.25 | Dual Acrylate | <-25 |
| 4570 | PMF-1300-7/125-0.25-L | 1290-1550 | <1280 | 7 | 125 | 9.5 ± 1 | <1.0 | 0.11 | 0.088 @ 1310 nm | 0.25 | Dual Acrylate | <-25 |
| 1194 | PMF-1550-8/125-0.4-L | 1460-1625 | <1450 | 8.7 | 125 | 10.5 ± 1 | <0.5 | 0.11 | 0.094 @ 1550 nm | 0.40 | Dual Acrylate | <-25 |
| 4550 | PMF-1550-8/125-0.25-L | 1460-1625 | <1450 | 8.7 | 125 | 10.5 ± 1 | <0.5 | 0.11 | 0.094 @ 1550 nm | 0.25 | Dual Acrylate | <-25 |
| 44065 | PMF-2000-7/125-0.25-L | 1850-2200 | <1800 | 7.0 | 125 ± 1 | 8.0 | NA | 0.2 | 0.155 @ 1950 nm | 0.25 | Dual Acrylate | <-20 |

Notes:

- ¹ All standard polarization maintaining (PM) fibers are based on the PANDA PM fiber structure. Other types are available on request.
- ² While the fibers will work over the entire operating range listed, it is recommended that one selects the fiber with the longest wavelength specifications that still operates at your wavelength of interest. For instance, for 820 nm work we recommend selecting PMF-850-5/125 fiber over PMF-633-4/125 fiber.
- ³ If the fiber is used at wavelengths less than the cutoff wavelength, the fiber will still transmit light. However it will begin to behave like a multimode fiber. It will no longer work like a polarization maintaining fiber.
- ⁴ Most fiber manufacturers define the numerical aperture of their fibers based on the refractive indices of the core and cladding (i.e., $NA = [N_{CO}^2 - N_{CL}^2]^{1/2}$). While this definition is useful for step index multimode fibers, for singlemode fibers, it is not a very accurate way to predict the far field behavior of light from the fiber. A more accurate technique is to use the Mode Field Diameter (MFD) for the light within the fiber to determine the far field. We can treat the output from the fibers as being essentially Gaussian in behavior. If we then define the effective numerical aperture (NA_{eff}) of the fiber as being the sine of the angle from the center to where the intensity drops to $1/e^2$ of the original value then one can show that $NA_{eff} = 2/\pi MFD$. We have listed NA_{eff} for each fiber at typical values for the mode field diameter and wavelength in the table.
- ⁵ The jacket diameters listed are for those fiber that come from the manufacturer pre-cabled. For short lengths of fibers OZ Optics can cable the fibers in a loose tube cable. For instance, PMF-1550-8/125-0.4-L fiber, which has a 0.4 mm coating diameter, can be cabled with a 0.9 mm diameter loose tubing to provide extra protection.
- ⁶ These fibers feature pure fused silica fiber cores for improved optical power handling.

Large Mode Area (LMA) fibers: For many high power applications transmitting tens of Watts of optical power, standard single-mode fibers are not suitable because of their small core size. On the other hand multimode fiber suffer from speckle patterns and large beam sizes. LMA fibers offer a compromise by giving a large core size for high power handling at the expense of a lower numerical aperture, making them more sensitive to bending losses. In many cases, these fibers are not truly singlemode, but are better described as low order multimode fibers. However by carefully controlling how light is launched in these fibers and how much they bend, one can transmit nearly singlemode light, thus generating output beams that can be focused to the small spot sizes needed for laser marking, welding and machining operations.

Table 6: Large Mode Area Fibers

| Bar Code | Part Number | Operating Wavelength (nm) | Core Diameter (µm) | Cladding Diameter (µm) | Attenuation (dB/km) | Numerical Aperture | Buffer Diameter (mm) | Buffer Material |
|----------|----------------------------|---------------------------|--------------------|------------------------|---------------------|--------------------|----------------------|-----------------|
| 36269 | SMF-1060-20/125-0.25-L-LMA | 1064 | 20 | 125 | <10dB/km | 0.10 | 0.25 | Acrylate |
| 35688 | SMF-1060-25/125-0.25-L-LMA | 1064 | 25 | 125 | <10dB/km | 0.10 | 0.25 | Acrylate |
| 34564 | SMF-1064-20/130-0.25-L-SP | 1064 | 20 | 130 | <10dB/km | 0.08 | 0.25 | Acrylate |
| 35689 | SMF-1060-25/250-0.4-L-LMA | 1064 | 25 | 250 | <10dB/km | 0.06 | 0.40 | Acrylate |

Table 7: PM Large Mode Area Fibers⁷

| Bar Code | Part Number | Operating Wavelength Range ² (nm) | Cutoff Wavelength (nm) ³ | Core Diameter (µm) | Cladding Diameter (µm) | Attenuation (dB/km) | Numerical Aperture (Manufacturer's Specs) ⁴ | Jacket or Buffer Diameter (mm) ⁵ | Jacket Material | Polarization Crosstalk (dB/100m) |
|----------|-----------------------------|--|-------------------------------------|--------------------|------------------------|---------------------|--|---|-----------------|----------------------------------|
| 37895 | PMF-1064-10/125-0.25-L | 980-1100 | <980 | 10 | 125 | <5.0 | 0.085 | 0.25 | Dual Acrylate | <-30 |
| 50553 | PMF-1064-20/125-0.25-L-PLMA | 920-1100 | <900 | 20 | 125 | <5.0 | 0.08 | 0.25 | Dual Acrylate | <-30 |

Notes:

- ¹ All standard polarization maintaining (PM) fibers are based on the PANDA PM fiber structure. Other types are available on request.
- ² While the fibers will work over the entire operating range listed, it is recommended that one selects the fiber with the longest wavelength specifications that still operates at your wavelength of interest. For instance, for 820 nm work we recommend selecting PMF-850-5/125 fiber over PMF-633-4/125 fiber.
- ³ If the fiber is used at wavelengths less than the cutoff wavelength, the fiber will still transmit light. However it will begin to behave like a multimode fiber. It will no longer work like a polarization maintaining fiber.
- ⁴ Most fiber manufacturers define the numerical aperture of their fibers based on the refractive indices of the core and cladding (i.e., $NA = [N_{CO}^2 - N_{CL}^2]^{1/2}$). While this definition is useful for step index multimode fibers, for singlemode fibers, it is not a very accurate way to predict the far field behavior of light from the fiber. A more accurate technique is to use the Mode Field Diameter (MFD) for the light within the fiber to determine the far field. We can treat the output from the fibers as being essentially Gaussian in behavior. If we then define the effective numerical aperture (NA_{eff}) of the fiber as being the sine of the angle from the center to where the intensity drops to $1/e^2$ of the original value then one can show that $NA_{eff} = 2\lambda/\pi MFD$. We have listed NA_{eff} for each fiber at typical values for the mode field diameter and wavelength in the table.
- ⁵ The jacket diameters listed are for those fiber that come from the manufacturer pre-cabled. For short lengths of fibers OZ Optics can cable the fibers in a loose tube cable. For instance, PMF-1550-8/125-0.4-L fiber, which has a 0.4 mm coating diameter, can be cabled with a 0.9 mm diameter loose tubing to provide extra protection.
- ⁶ These fibers feature pure fused silica fiber cores for improved optical power handling.
- ⁷ Single clad passive PM fiber.