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

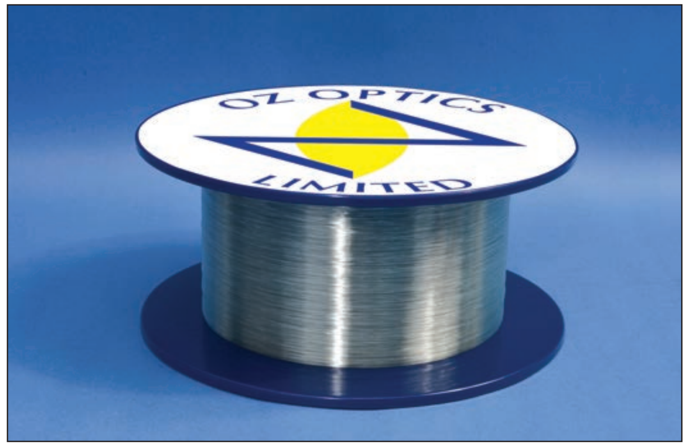
Product Description:

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.

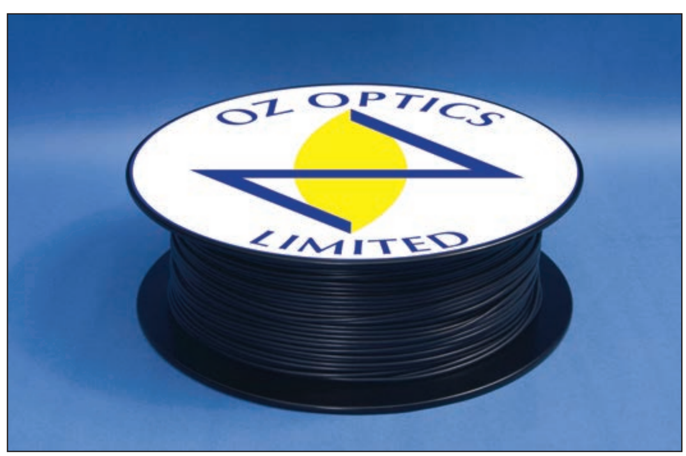
Typically these fibers are suitable either for near infrared and visible wavelengths (IRVIS fibers) or for near ultraviolet and visible wavelengths (UVVIS fibers). UVVIS multimode fibers typically are built with added amounts of hydroxyl (OH) ions added to enhance ultraviolet transmission at the expense 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 Fibers[1]

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:

1 The attenuation of these fibers is 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.

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 (Manufact-urer's Specs)[3]	Effective Numerical Aperture (1/e²)[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:

1 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.

2 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.

3 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 $1/e^2$ 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.

4 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.

5 These fibers feature pure fused silica fiber cores for improved optical power handling.

6 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 Fibers[1]

Bar Code	Part Number	Operating Wavelength Range[2] (nm)	Cutoff Wave-length (nm)[3]	Core Diameter (µm)	Cladding Diameter (µm)	Mode Field Diameter (µm)	Attenuation (dB/km)	Numerical Aperture (Manufact-urer's Specs)[4]	Effective Numerical Aperture (1/e²)[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 $NA_{eff} = 2\lambda/\pi MFD$. 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.

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 Fibers[7]

Bar Code	Part Number	Operating Wavelength Range[2] (nm)	Cutoff Wave-length (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.