

## DEFINITIONS

### Center Wavelength and Bandpass

Coupler performance is usually specified over a wavelength window, or in some cases, multiple windows. The center wavelength is the nominal wavelength of operation of the coupler, while the bandpass is the range of wavelengths over which the specifications are guaranteed. In many cases, couplers will perform adequately over a range outside their bandpass, but adherence to specifications is not guaranteed in this region.

### Coupling Ratio

Coupling ratio or splitting ratio is defined as the ratio of the optical power from one output port of the coupler to the sum of the total power from all output ports. The coupling ratio is measured at the specified center wavelength and is normally expressed as a percentage.

### Excess Loss

Excess loss is the ratio of the optical power launched at the input port of the coupler to the total optical power measured from all output ports, expressed in dB.

### Insertion Loss

Insertion loss is the ratio of the optical power launched at the input port of the coupler to the optical power from a single output port, expressed in dB. The insertion loss includes the coupler splitting loss and excess loss and is the most useful parameter for system design. The maximum and minimum insertion loss is the upper and lower limit, respectively, of the insertion loss of the coupler and applies over the entire wavelength range specified in the bandpass. The typical insertion loss is the expected value of the insertion loss measured at the specified center wavelength. Multimode couplers are measured with an equilibrium mode fill.

### Uniformity

Uniformity is a measure of how evenly power is distributed between the output ports of the coupler. Uniformity applies to couplers with a nominally equal coupling ratio and is defined as the difference between the highest and lowest insertion loss between all of the coupler output ports, expressed in dB. Uniformity is a typical value across the entire bandpass.

### Directivity, Return Loss and Reflectance

Directivity is the ratio of the optical power launched into an input port to the optical power returning to any other input port. Directivity has been referred to as near-end isolation or near-end crosstalk. Return loss is the ratio of optical power launched into an input port to the optical power returning to the same input port. Both directivity and return loss are expressed as positive dB and are measured with all other ports optically terminated. Reflectance is the negative of return loss. In many instances, reflectance and return loss are used synonymously. Minimum directivity and return loss are the lower limits which apply over the entire wavelength range specified in the bandpass.

### Wavelength Isolation

Wavelength isolation is a measure of how well different wavelengths are separated at the output of a wavelength division demultiplexer. It is defined as the ratio of the optical power at the two output ports of the demultiplexer at a given wavelength, expressed in dB. The minimum wavelength isolation is the lower limit to the wavelength isolation measured over the entire wavelength range of the specified bandpass. Wavelength isolation has also been referred to as far-end crosstalk.

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## Polarization Dependent Loss

The performance of a coupler can vary slightly depending on the direction of polarization of light in the fiber. Polarization Dependent Loss (PDL) is the maximum change in the insertion loss of a coupler as the input polarization to the coupler is varied through all states of polarization (SOP).

## Polarization Maintaining Couplers and Extinction Ratio

Polarization Maintaining Couplers (PMC) are made from Polarization Maintaining Fiber (PMF) and are designed to maintain the polarization state between the input and the output fibers of the coupler. The extinction ratio of a PMC is a measure of how well the polarization state is maintained and is the ratio between the slow and the fast polarization axes on an output port of the coupler. Extinction ratio is measured when the input polarization is aligned to the slow axis of the input fiber and is usually expressed in dB.

Extinction ratio is sometimes called Polarization Crosstalk.

## ENVIRONMENTAL AND MECHANICAL TESTING

AOFR fused fiber components and assemblies are periodically re-qualified to a variety of existing and developing standards to ensure their long-term reliability in field use. These tests include qualification to the principal coupler specifications used in the United States, the United Kingdom and Europe. The following series of standards are used as references for the development of test regimes: EIA/TIA 455, GR1209, GR1221, CECC 81000 and IEC 68. Qualification programs are regularly reviewed to ensure that the testing specifications of all customers are satisfied. Contact AOFR to discuss your special test requirements. A summary of some standard tests is presented below.

Type of Test	Severity	Reference
High Temperature Storage	85°C for 2,000 hours	EIA/TIA 455-4B, IEC 68-2-2 CECC 81000 Part 4.6.18
Low Temperature Storage	-40°C for 2,000 hours	EIA/TIA 455-4B, IEC 68-2-2 CECC 81000 Part 4.6.18
Damp Heat	85°C , 85% Relative Humidity for 2,000 hours	EIA/TIA 455-4B, IEC 62-2-3 CECC 81000 Part 4.6.19
Temperature Cycling	-40°C to 85°C, 500 cycles	EIA/TIA 455-3A, IEC 68-2-14
Change of Temperature (Condensation)	-40°C to 75°C, 85% relative humidity 10 cycles over 10 days	IEC 68-2-38 CECC 81000 Part 4.6.21
Water Immersion	43°C for 7 days	EIA/TIA 455-12A, IEC 68-2-17 CECC 81000 Part 4.6.24
Vibration	3 orthogonal axes at 1.52mm double amplitude below crossover, 10g peak acceleration above, for 120 cycles of 10Hz to 2000Hz	EIA/TIA 455-11A, IEC 68-2-6 CECC 81000 Part 4.6.1
Impact	24 drops (3 orthogonal axes) from 1.8 meters onto a concrete surface	EIA 455-2A
Bump	1000 bumps, peak acceleration of 245m/s <sup>2</sup> pulse duration of 6ms	IEC 68-2-29 CECC 81000 Part 4.6.8
Cable retention	Tensile pull of 0.5kg (unjacketed fiber) or 1kg (jacketed fiber)	EIA 455-6A CECC 81000 Part 4.6.4
Flex	300 cycles with 0.5kg load (jacketed fiber only)	EIA 4558-1A
Twist	10 cycles with 1.36kg load (jacketed fiber only)	EIA 4558-36A