

Some applications of optical filters

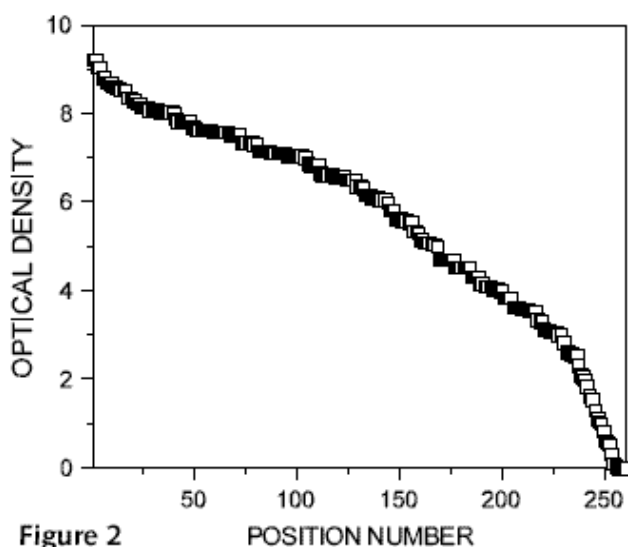
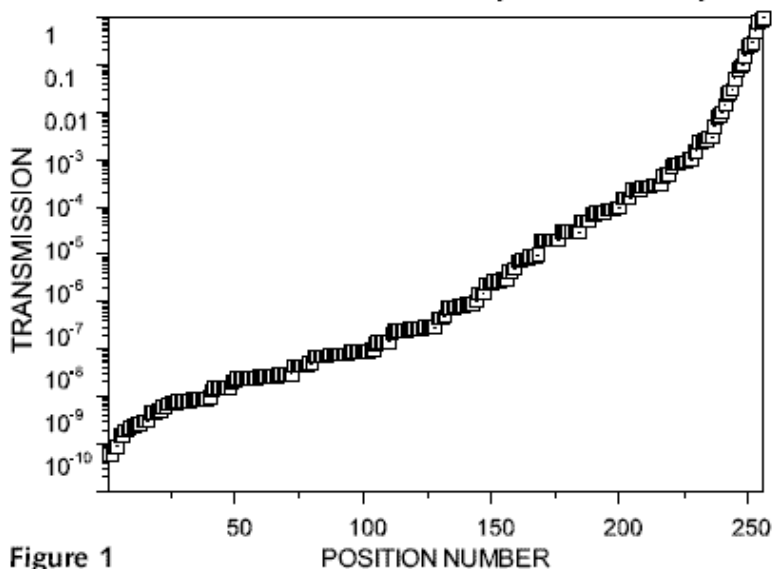
- In systems for laser beam diagnostics with CCD-cameras.
- Measurement of laser power, pulse energy and pulse duration.
- Spectroscopy.
- We can offer a set of bandpass filters for mercury lamp, laser lines, and for other your needs.

A choice of filters is available for our standard 4- wheel attenuators, allowing 256 relative positions of wheels, rendering 99 different transmission values, of which you can find a very close match to the desired value. Discrete filters permit to establish accurate optical density. Also we can offer designs with 1, 2, 3 and more wheels. Variable wheel attenuators come with a standard, most popular, set of filters listed in table standard filters are made of neutral grey glass spectral characteristics according to figure Alternatively, attenuators (wheels and could be manufactured to individual orders. could supply variable wheel attenuators filters, which you can fit by yourself.

Transmission		Filter #1	Filter #2	Filter #3	Filter #4
Wheel #1	T	1.00	0.90	0.80	0.50
	dB	0.00	0.46	0.97	3.00
Wheel #2	T	1.00	0.30	0.10	0.03
	dB	0.00	5.20	10.00	15.20
Wheel #3	T	1.00	0.01	0.003	0.001
	dB	0.00	20.00	25.00	30.00
Wheel #4	T	1.00	0.0003	0.0001	0.00003
	dB	0.00	35.00	40.00	45.00

Table 1. List of a standard filter-set

Charts for the standard filter-set: possible filter positions versus resulting transmission/density.



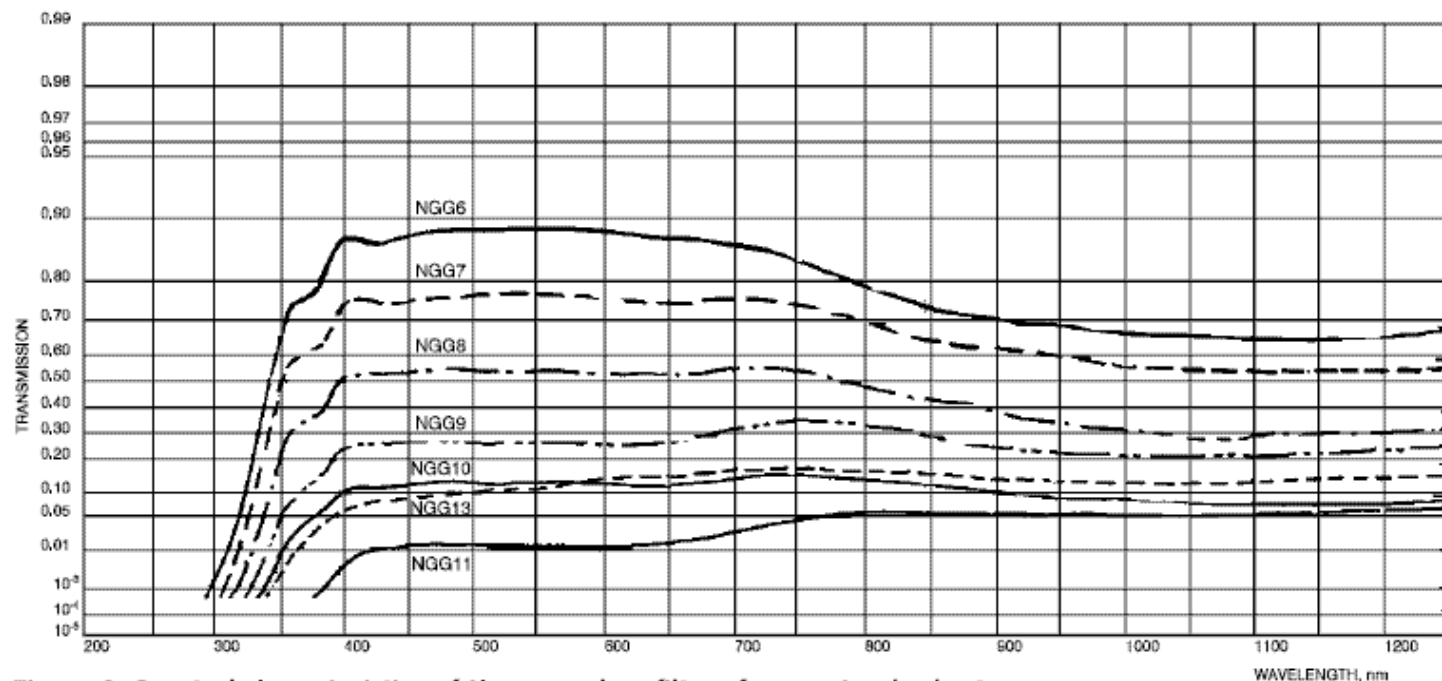


Figure 3. Spectral characteristics of the grey glass filters from a standard set

In most cases the detectors (CCDs, photodiodes, photomultipliers, etc.), which are used for diagnostics of laser radiations, are too delicate for the direct measurement of high powers, such as from ion lasers or pulsed solid-state lasers. An attenuator may be required to reduce laser power density at the surface of detector. Optical attenuators must be used when the laser output-power or power density exceeds the working (linear) range or the damage threshold of the detector. (Draft International Standard ISO/TC172/SC 9/WG1) For example, the damage threshold for a typical commercially available CCD is about 100 mW/cm², for the ultra high speed photodetectors series AR-S (Antel Optronics Inc.) it is about 200 mW/cm². On the other hand, laser power must be adjusted to the optimum point, which is typically just below the saturation level of the detector. For example, a typical commercially available CCD saturates at only 10 W/cm². According to your request we may design an attenuator with any number of wheels. 10CWA168 with a CCD camera Close Variable Wheel Attenuator 10CWA168 is ideally suited for use with CCD cameras. Adapters 10R168 and 10A168 are used for connection. 0.05 mW/cm² at 632.8 nm and at 5.5 mW/cm² at 1.06 μm (see R. Rypma "Dimming the Light ...", in Photonics Spectra N.10, 1995, p.145). For preliminary attenuation of very high power lasers the simplest approach is to use just the first surface reflection of an uncoated laser-grade substrate. It is useful to have an intensity adjustment range of at least 1000:1 or more in this final stage. Even when working with a single-wavelength laser, operated at one power level, this range may be encountered when making measurements at different points in the optical train. After major reduction in intensity by reflection off an uncoated substrate is achieved, some of the low-power neutral density filters of the high optical quality can bring the beam power to the exact level necessary for optimum measurement by detection system.

Set of wheel edge filters for 10WA168EF

Set of wheel edge filters is used when it is necessary to reject the shorter or the longer wavelengths. Also, a combination of short and long wavelength filters allows to construct band pass filters with variable bandwidth (for fluorescence analysis, etc.) As standard 10WA168EF of 4 wheels comes with 6 long-wave pass filters and 6 short-wave pass filters. One hole in each wheel is left open. Long-wave pass filters are made of absorbing color glass. Shortwave pass filters are interference filters.

Wheel number	Type of edge filters	Filter number	Cut-on/off wavelength, nm
1	Short wave pass	1	550
		2	650
		3	750
2	Short wave pass	1	500
		2	600
		3	700
3	Long wave pass	1	450
		2	550
		3	650
4	Long wave pass	1	500
		2	600
		3	700

Table 2