990-0704 CLOSED VARIABLE WHEEL ATTENUATOR

990-0704

***991-0704** with a CCD camera*

Close Variable Wheel Attenuator 991-0704
ideally suits for use with CCD cameras. Adapters 990-0000-01 or 990-0000-02 are used for connection.

- **4 wheels, each containing 3 filters & 1 empty space**
- **4 fixed positions per wheel**
- **C-mount threads on both ends**
- **Connecting adapters available**
- **Stray light fully eliminated**
- **Variable height of the optical axis**
- **Three mounting holes**

SPECIFICATIONS

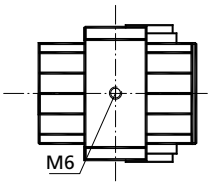
Diameter NDF	20 mm
Maximum thickness	3 mm
Non-parallel filters	(inclined by 4°)
Maximum deviation	0.09 mm
Clear aperture	Ø18 mm

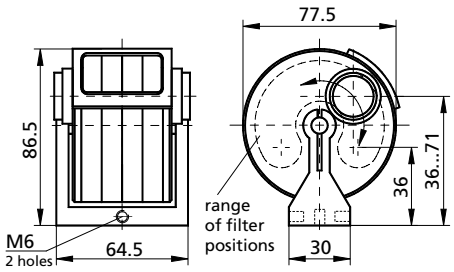
Code	Weight, kg	Price, EUR
990-0704	0.55	549

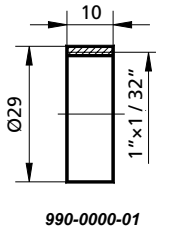
Close Variable Wheel Attenuator is used when it is necessary to fully eliminate the side background lighting when using photodetectors with high sensitivity (e.g. CCD, photomultiplier, etc.). You may order standard connecting adapters 990-0000-01 and 990-0000-02 separately. Custom adapters are available too.

Loosen the central axis and rotate the whole body of the filter to set the desired position of an optical axis at a height between 36–71 mm.

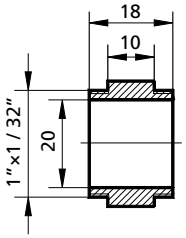
The base of the attenuator has M6 holes on 3 sides for mounting versatility.



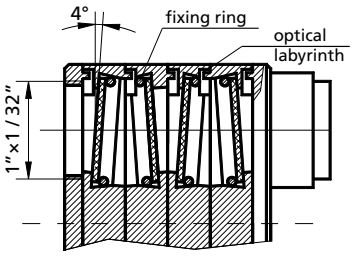




990-0000-01



990-0000-02



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 your other 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 1. The standard filters are made of neutral grey glass with spectral characteristics according to Figure 3.

Alternatively, attenuators (wheels and optics) can be manufactured according individual orders. We can also supply variable wheel attenuators without filters, which you can fit by yourself.

In most cases detectors (CCDs, photodiodes, photomultipliers, etc.), used for diagnostics of laser radiations, are too delicate for 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 working (linear) range or damage threshold of a detector. (Draft International Standard ISO/TC172/SC9/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 Optronic 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 0.05 mW/cm² at 632.8 nm and at 5.5 mW/cm² at 1.06 mm (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.

RELATED PRODUCTS

990-0604 Variable Wheel Attenuator

See page 7.27

Table 1. *List of a standard filter-set*

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

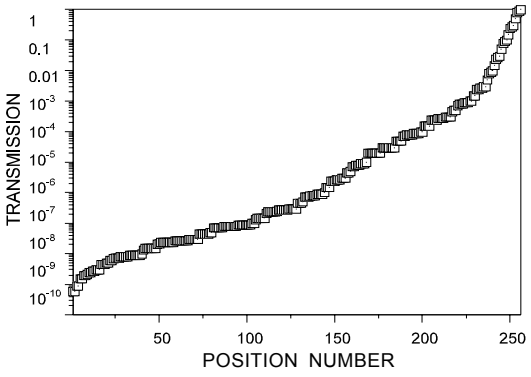


Figure 1

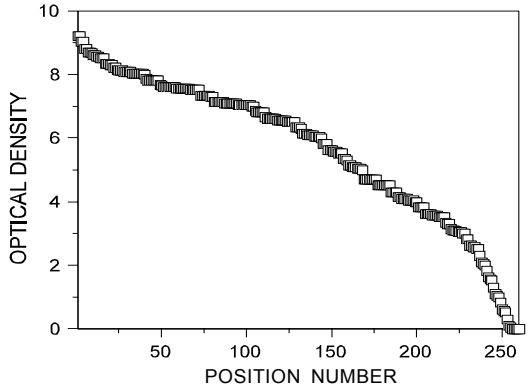


Figure 2

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

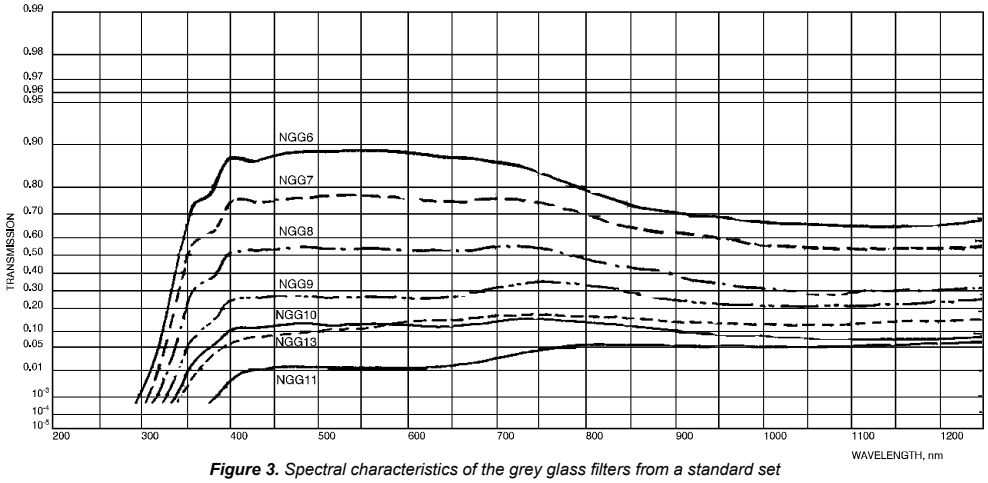


Figure 3. *Spectral characteristics of the grey glass filters from a standard set*