Instructions LASNIX ND Attenuator IR-VIS
Model 801

1. HANDLING. LASNIX neutral-density attenuators operate on light diffraction. The active optical elements consist of very thin, structured metal membranes.

WARNING:
The metal membranes are mechanically fragile.
Do not touch or blow air. Do not use cleaning liquids.

2. INSTALLATION. Either end of the attenuator can serve for radiation input. The attenuator function does not depend on the angular alignment within the clear aperture.
For mounting, two tapped holes, M4 and 8-32, are provided at the base.
Before operation, remove the protecting caps, and screw in a short or a long absorber tube on either side (see 8. below for their function).
Separate absorbing apertures with 9 mm clear opening can be placed distant from the attenuator (see 8. below for their function).
Either 4.5 or a 2.3 mm clear opening apertures can be screwed into the ends of the absorber tubes (see 8. below for their function).

3. WATER COOLING. Connect cooling water when you apply laser light power exceeding 30 W c.w. (or quasi-c.w.) for longer than 5 s.
handle to near the intended position. Built-in magnets then assist the exact centering.

4. UNITS. The power transmittance T of the attenuator relates to the optical density OD setting by $T = 10^{-OD}$.

5. OPERATION. Attenuation is instantly achieved by flipping in an attenuator grid. Four grids with nominal optical densities of 0.5, 1, 2, and 3 OD achieve laser-beam power transmittances of 30%, 10%, 1%, and 0.1%. Switching between them (and to a fifth position without a grid) is fast and reliably resettable. It requires tipping the handle to near the intended position. Built-in magnets then assist the exact centering.

6. POWER HANDLING. The power limit P_c (c.w. or q.-c.w.) increases with wavelength λ, and decreases linearly with the $1/e^2$ beam width as follows:

	VIS			NIR		MIR
$1/e^2$ width	500 nm	550 nm	600 nm	0.7 - 1 µm	1 - 2 µm	2 - 15 µm
≥ 6 mm	**6 W**	**9 W**	**15 W**	**20 W**	**40 W**	**100 W**
3 mm	**3 W**	**4 W**	**7 W**	**10 W**	**20 W**	**50 W**
2 mm	**2 W**	**3 W**	**5 W**	**6 W**	**13 W**	**30 W**
1 mm	**1 W**	**1.5 W**	**2 W**	**3 W**	**6 W**	**15 W**

7. PULSE ENERGY HANDLING: The pulse energy limit E_c of single laser pulses is $E_c = 0.1\text{s} \cdot P_c$ where P_c is the power limit. However, the pulse intensity must not exceed 500 MW/cm^2 to avoid plasma generation.

8. ELIMINATION OF SCATTERED BEAMS: Diffractive attenuators produce higher-order diffracted beams which are internally eliminated by absorber tubes. These tubes need to be longer when using shorter wavelengths. The "short" tubes of the basic attenuator (shown in the photograph) suppress unwanted diffracted beams for wavelengths ≥ 4 µm.

"Long" absorber tubes (supplied, easily exchanged by customer) suppress unwanted diffracted beams for wavelengths ≥ 2 µm, thereby increasing the attenuator length to 180 mm.

Separate absorbing apertures (supplied, with 9 mm clear opening) placed at 90 mm distances from the ends of long tubes extend the attenuator range by suppressing unwanted diffracted beams for wavelengths ≥ 1 µm. Placing these 9-mm apertures as far as 270 mm from the tubes suppresses unwanted diffracted beams for wavelengths ≥ 500 nm.

Alternatively, such separate absorbing apertures and with them, unpractically long overall attenuator path lengths can be avoided by restricting the beam diameter using end apertures (supplied, both with 4.5 and 2.3 mm clear openings). When these are screwed in by the customer into the ends of the long absorber tubes, they ensure suppression of unwanted diffracted beams for wavelengths ≥ 1 µm with the 4.5 mm choice, or respectively ≥ 500 nm with the 2.3 mm choice, while retaining the attenuator length at 180 mm.