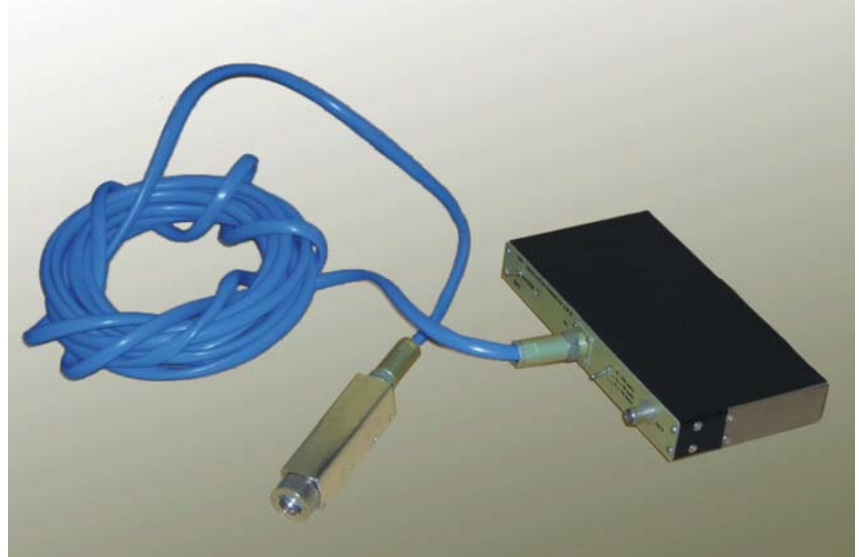


Laser vibration meter LV-2

Data sheet

- **Uses:** the laser vibration meter LV-2 is designed for measurement of longitudinal projection of vibration velocity of an investigated surface. The investigated surface can be any kind and does not require special treatment.



- **Composition**
 - Measurement head
 - Electronic block
 - Flexible cable
 - Adapter for camera tripod

Schematic diagram of the device is shown in Fig. 1.

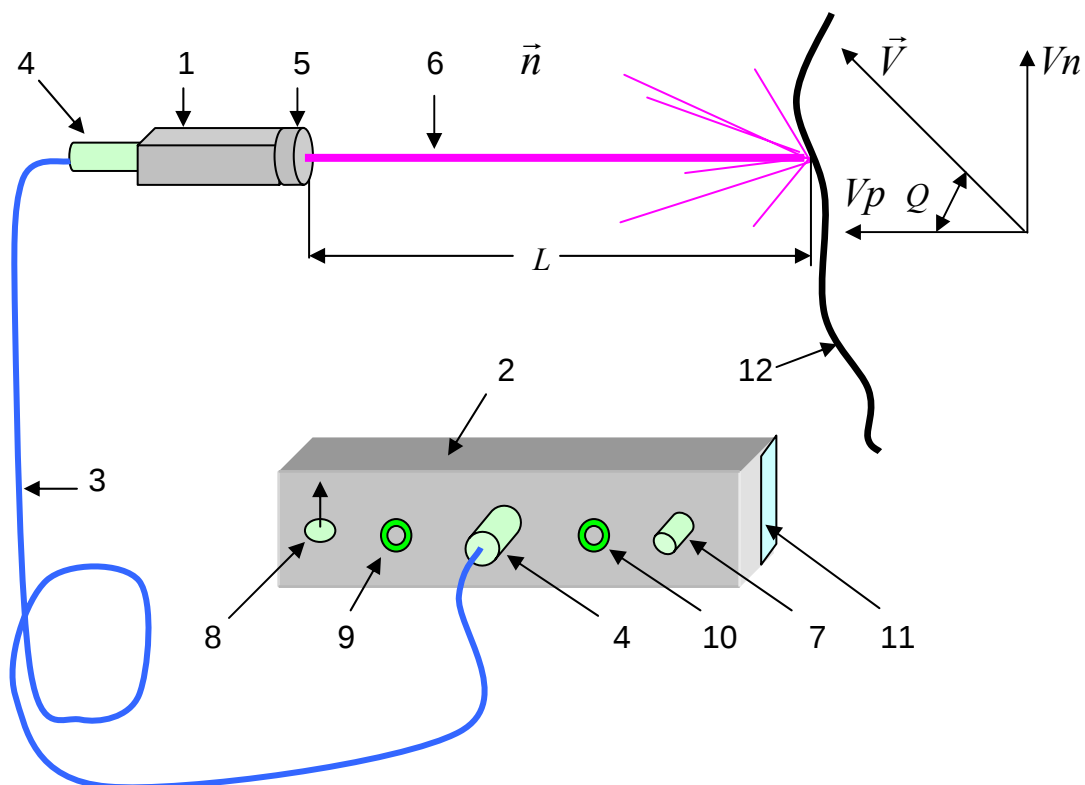


Fig. 1; Schematic diagram of the laser vibration meter LV-2: 1- measurement head; 2- electronic block; 3- connecting cable; 4- connector MP-10; 5- objective; 6- laser beam; 7- analogue output (BNC); 8- power switch; 9- LED indicator work/battery charge; 10 - LED indicator optical signals strength; 11- power compartment cover; 12- investigated surface; $\vec{V}(t)$ - vibration velocity vector; $\vec{n}$ - laser beam direction; Q - angle between $\vec{V}(t)$ and $\vec{n}$; $Vp = |\vec{V}(t)| \times \cos(Q)$ - vibration velocity projection on laser beam direction; $Vn = |\vec{V}(t)| \times \sin(Q)$ - orthogonal to laser beam projection of vibration velocity; L - distance to object.

- **Principle of operation** is based on measurement of a shift of frequency of laser radiation $\Delta F(t)$ scattering by a moving object with velocity $\vec{V}(t)$ (Doppler's effect):

$$\Delta F(t) = 2 \times \frac{\vec{V}(t) \times \vec{n}}{\lambda} + \Omega = 2 \times \frac{Vp(t)}{\lambda} + \Omega = 2 \times \frac{|\vec{V}(t)|}{\lambda} \cos(Q) + \Omega, [\text{Hz}] \quad (1)$$

Where $\lambda = 0.78 \mu\text{m}$ – length of the laser radiation wave, $\vec{V}(t)$ - vector of the vibration velocity, $\vec{n}$ - direction of the laser beam, $Vp = |\vec{V}(t)| \times \cos(Q)$ - projection of the vibration velocity on the laser beam direction, Q - angle between $\vec{V}(t)$ and $\vec{n}$, Ω - constant shift of frequency of the back-reflected light formed by means of the optoelectronic circuit. The measurement is accomplished with the aid of an optical heterodyne and a frequency detector. Voltage of the frequency detector is proportional to $\Delta F(t) - \Omega$.

An illumination laser is included into a structure of the optical scheme for convenience of operation. Its wavelength of $0.63 \mu\text{m}$ is located in visual diapason of spectrum and its beam completely coincides with IR laser.

- **Metering error** is defined by noise spectral density of total measuring circuit, expressed in terms of velocity units and conditioned by instability of the laser radiation:

$$\overline{\delta V_\omega} = 2 \cdot 10^{-12} \cdot \omega \cdot L, [m \cdot s^{-1} \cdot \text{Hz}^{1/2}]; \quad (2)$$

ω -vibration frequency $\times 2\pi$, L - distance from lens to object.

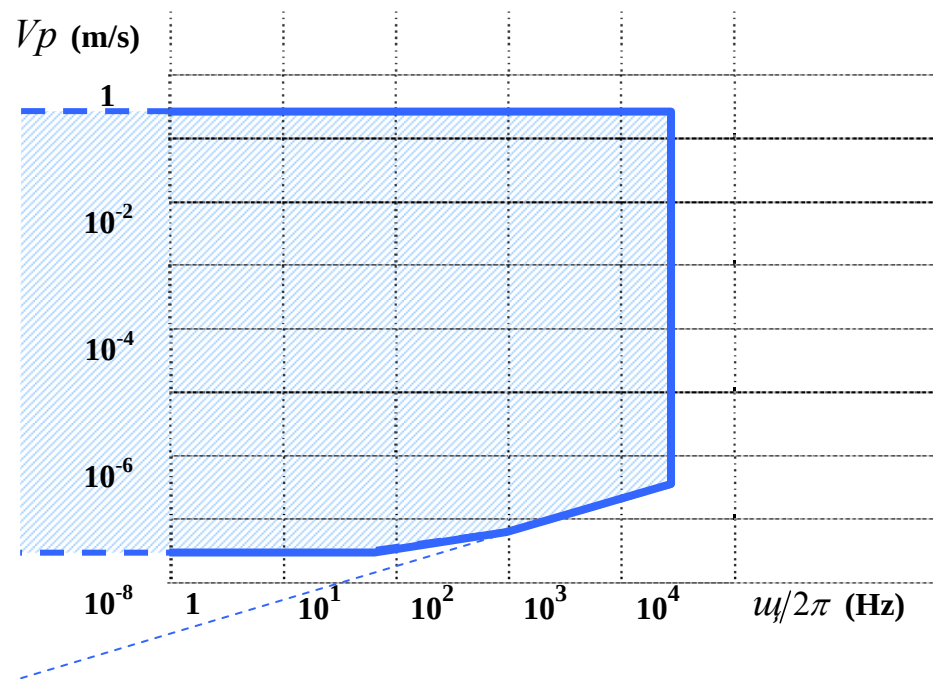
Expression (2) is empirical and has been derived from experiments with specific laser.

Furthermore, essential influence of acoustic background noise and temperature drift of a laser radiation length λ take place at the frequencies $\omega/2\pi \leq 1 \text{ kHz}$.

• **FEATURES**

● Vibration velocity, m/s		+/- 0.2
● Frequency range, kHz		up to 50
● Dynamic range over full bandwidth, dB		70
● Distance from lens to object		$L = 0.1 \div 5$ m.(Laser Safety Class III)
		$L = 0.1 \div 2$ m.(Laser Safety Class II)
● Dimensions of measuring area		Diameter, $d = 2 \times 10^{-4} \times L$ m.
		Length, $\Delta L = 4 \times 10^{-2} \times L^2$ m.
● Laser wave length, μm		0.78
● Laser power, mw/ Laser Safety Class		20/ Class III
		1/ Class II
● Power supply	AC, V/Hz	220 / 50
	lead acid battery (is mounted into electronic unit)	6V, 3.3 A./hours, no less than 8 hours active time
● Output		Analogue
Maximum vibration velocity (m/s)		+/-0.2
Sensitivity (V/m/s)		25

Fig. 2 Nomogram of working ranges for the LV-2.



The nomogram in Fig. 2 describes the working area of the LV-2 (shaded area). The lower boundary corresponds to a measuring circuit with band-pass filter of 1 Hz width and distance to object $L=1$ m.

- **Dimensions**

Measuring head with lens, mm	100×24×24
Electronic block, mm	60×100×190
Interconnect cable length, m	5

- **Operating/storage/conditions**

Temperature, °C	-30 ÷ +50
Pressure, at	0.2 ÷ 1.0
Humidity (waterproof), %	Up to 100

- **Guarantee**

Warranty assurance, years	2
Guaranteed life, hours	2000

After expiration of the guaranteed life, the device shall be exploited taking into account its technical state.