Maritime University of Szczecin

Faculty of Marine Engineering

Department of Physics and Chemistry

Physics Laboratory

Laboratory Manual

Study of string vibration by resonance method

English version written by
dr Agata Kowalska

Szczecin 2017

Equipment:

1. Measuring system (bench, steel string, electromagnet, pan on weights weighting $m_s = 0.21$ kg).
2. Micrometer screw.
3. Ruler with millimeter scale.
4. Weights.

Exercise:

1. Measure the length of the string L.
2. Using the micrometer screw measure the diameter of the string d in three different places of the string. Determine the average diameter of the string $\bar{d}$.
3. Turn on the solenoid and set it in the position corresponding to ¼ length of the string.
4. Set mass m_0 of the weights, which put on the pan, create a standing wave of length equal to the length of string ($k = 2$).
5. Selecting appropriate load of the pan, observe the standing waves of smaller lengths ($3 \leq k \leq 6$). The solenoid should always be placed in a position which corresponds to wave antinode: for odd values of k, place the electromagnet at the half length of the string; for even k values place it in the position calculated according to the equation: $\left(1 - \frac{1}{k}\right)\frac{L}{2}$.
6. Turn off the solenoid.
7. Determine the total string tension F as the sum of the weights and the pan weight:

$$F_k = m_{0k}g + m_s g$$

8. Based on the formula

$$\rho_k = \frac{k^2 F_k}{4\pi r^2 L^2 \nu^2} = \left(\frac{k}{\bar{d}L\nu}\right)^2 \frac{F_k}{\pi}$$

   calculate the string density for each k value.
9. Calculate mean value of the steel string density and its standard deviation.
10. Compare the obtained result with the table value.

Table:

L = ...m
d_1=……mm d_2 = ……mm d_3 = ……mm
$\bar{d}$ = ……m
v = ……Hz

k	m_0 [kg]	F [N]	ρ [kgm^{-3}]
2			
3			
4			
5			
6			