

Hooks law - lab report example

[Science](#), [Physics](#)



Hooks law

Hooke's Law Laboratory Report Background Hooke's Law is a basic physics principle that opines that the force required to extend or compress a spring by some distance is proportional to that distance. (Bueche, 1980)

Robert Hooke, a British physicist, was the first to report on the relation between the force exerted on a spring and its deformation. He defined the relation as " the extension is proportional to the force".

If a weight, $W = mg$, is hung from one end of an ordinary spring, causing it to stretch a distance x , then an equal and opposite force, F , is created in the spring which opposes the pull of the weight. If W is not so large as to permanently distort the spring, then this force, F , will restore the spring to its original length after the load is removed. The magnitude of this restoring force is directly proportional to the stretch in the relation below.

$$F = -kx$$

The constant k is called the spring constant. To emphasize that x refers to the change in length of the spring we write the relation as follows.

$$F = mg = -k \Delta l \quad (1)$$

From the relation it is evident that if a plot of F as a function of Δl has a linear proportion. This provides confirmation that the spring conforms to Hookes Law and enables us to find k mathematically. (Sears, 1981)

Thus we can assume an equation $k = y = mx + c$equation 1

Objective

The objective of this experiment is to study the behavior of ordinary springs in static and dynamic situations. We will determine the spring constant, k , (K which is the stiffness of the spring), for an individual spring using both

Hookes Law and the properties of an oscillating spring system.

Apparatus

2 Extension Springs (long, short)

Compression spring

Load to be used for long springs

2 Long Screws

2 Short Screws

Experimental Set up

Figure 1

Procedure

1. Load a spring with different weights (5 different weights) and measure the displacement associated with each weight as shown in figure 1.
2. Repeat for different springs.
3. Document your readings and use them to derive a conclusion

Results

Table 1

Long Spring(5N - 9N)

F (N)

5

6

7

8

9

dX (mm)

4

6

13

20

25

dX (m)

0.004

0.006

0.013

0.02

0.025

Table 2

Short Spring (2.5N - 10N)

F (N)

2.5

3.5

5.5

7.5

10

dX (mm)

3

14

35

56

82

dX (m)

0.003

0.014

0.035

0.056

0.082

Table 3

Compression (0 -5N)

F (N)

1

2

3

4

5

dX (mm)

2

5

11

16

23

dX (m)

0.002

0.005

0.011

0.016

0.023

Data Analysis and Discussion

Figure 2

Figure 2 indicates that for forces greater than about 4.5 N (notice intercept of best fit), there is a linear relation between force and extension. For small loads such a relationship fails, since the fit curve does not intercept the y axis at zero. It is assumed that this is caused by an initial "set" in the spring which requires some initial load to overcome. This is apparent if one stretches the spring manually and then releases it. It seems to snap shut at the last moment.

For this reason, 0 and 4.5 N were ignored and the rest of the data were treated by a least squares analysis to determine the coefficients of first degree polynomial best fit.

These were used to plot the line on the graph. The slope of the line, ignoring loads of less than 4.5 N, was found to be 147.36 N/m. From Equation 1, we see that we need to multiply this quantity by g to calculate a value for the spring constant of $k = 217.4 \pm 1.8$ N/m.

Using the equation $k = y = mx + c$ where m is the slope of the graph and c is the y intercept. We find that;

$$k = 147.36 \text{ N/m}$$

A graph of force versus the magnitude of displacement resulted in the expected straight line in the range of forces examined and is consistent with Hooke's law. The slope of this line, 147.36 N/m, is the spring constant, which agrees with value found by taking the average of the calculated spring constant. The intercept for the best fit straight line intersects close to the origin, which is also consistent with Hooke's law.

The potential sources of error in this experiment are due to the precision of the location measurement using the meter rule and the accuracy of the slotted masses used. The meter rule was mounted vertically and behind the spring. The location was measured relative to the base of the mass hanger. The measurements are viewed directly; however, due to parallax it is measured at a slight angle. However, this sighting was required for each measurement, and the displacement was the difference between the location and the reference. Thus, this systematic error from parallax should be minimized. Consequently, a motion sensor to measure distance would increase the precision for small displacements.

Conclusion

Ultimately Hooke's law was verified as per the initial objective. The linear relationship between incremental loads against extension of the spring is observed in figure 2.

Works Cited

Bueche, F. J (1980), Introduction to Physics for Scientists and Engineers, Third Edition, McGraw-Hill, N. Y.

Sears, F. W., Zernansky, M. and Young, H. D.(1981), University Physics, 5th Edition, Addison-Wesley, N. Y. as cited in Yost, S. A., " The effect of spring mass on the oscillation frequency", <http://homework.phys.utk.edu/courses/spring2002/phys221/spring.pdf>.

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