Bending of a leaf spring (Item No.: P0999200)

Curricular Relevance

Area of Expertise: Physik
Education Level: Klasse 7-10
Topic: Mechanik
Subtopic: Kräfte, einfache Maschinen
Experiment: Biegung einer Blattfeder

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Easy	10 Minutes	10 Minutes	2 Students

Additional Requirements:

- Scissors

Experiment Variations:

Keywords:

Task and equipment

Information for teachers

Additional Information

1. The students should investigate the behaviour of a leaf spring under load, make a graph of the measuring results and – most importantly – determine the spring constant D (see also Experiment P0999100).
2. In the course of the same experiment, the (tractive) force should be determined at different angles for the same deflection and an explanation of the results should be attempted.

Remark

This experiment can serve as preparation for Experiment P0999500 (parallelogram of forces).

Bending of a leaf spring (Item No.: P0999200)

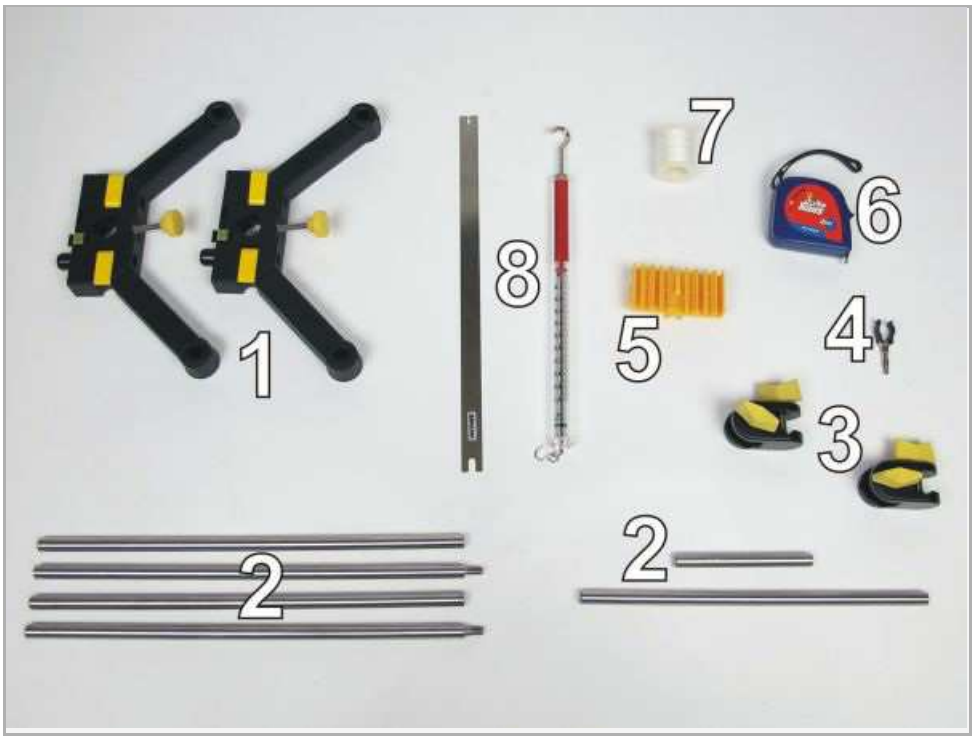
Task and equipment

Task

How does a leaf spring behave under load?

You will investigate the behaviour of a leaf spring under load, make a graph of the measuring results and determine the spring constant D.
In the course of the same experiment you will determine the force at different angles for the same deflection.

Equipment



Position No.	Material	Order No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, stainless steel, l = 250 mm, d = 10 mm	02031-00	1
2	Support rod, l = 600 mm, d = 10 mm, split in 2 rods with	02035-00	2
2	Support rod with hole, stainless steel, 10 cm	02036-01	1
3	Boss head	02043-00	2
4	Spring balance holder	03065-20	1
5	Glass tube holder with tape measure clamp	05961-00	1
6	Measuring tape, l = 2 m	09936-00	1
7	Fishing line, l. 20m	02089-00	1
8	Leaf spring	02228-00	1
8	Spring balance,transparent, 1 N	03065-02	1

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Set-up and procedure

Set-up

First screw the split support rods together (Fig. 1). Connect the two halves of the support base to both ends of the long support rod (Fig. 2 and Fig. 3). By moving the locking lever up, you will be fixing the support rod to the support base.
Set the 600 mm support rod and the 250 mm support rod into the support base halves and fix them with the locking screws (Fig. 4).


Fig. 1


Fig. 2


Fig. 3


Fig. 4

Fix one bosshead to the 600 mm support rod, and the other one to the 250 mm support rod (Fig. 5).

Fig. 5

Insert the spring balance holder into the short rod (Fig. 6) and clamp it to the bosshead of the 600 mm support rod (Fig. 7).

Fig. 6

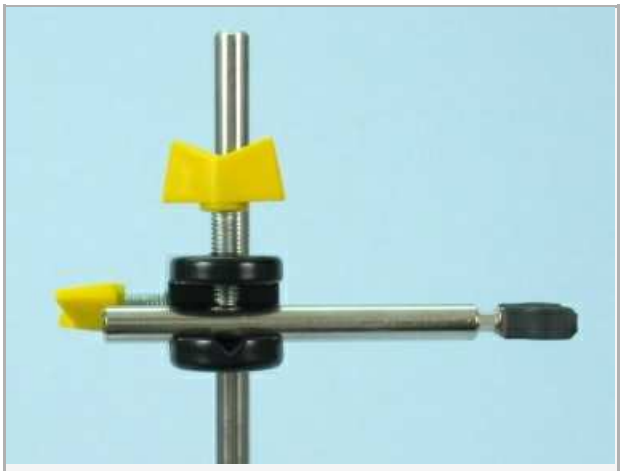


Fig. 7

Clamp the extended measuring tape into the glass tube holder (Fig. 8) and clamp both onto the base of the 600 mm support rod (Fig. 9).

Fig. 8

Fig. 9

Attach the leaf spring to the short support rod with the bosshead in such a way that a lateral edge fits tightly in the bosshead (Fig. 10 and Fig. 11).

Adjust the distance of the support base halves to reach a position as shown in Fig. 13.

Take a 12 cm length of fish line and tie a loop on one end. Attach the loop to the spring balance, and tie the other end to the free

end of the leaf spring (Fig. 12 and Fig. 13).

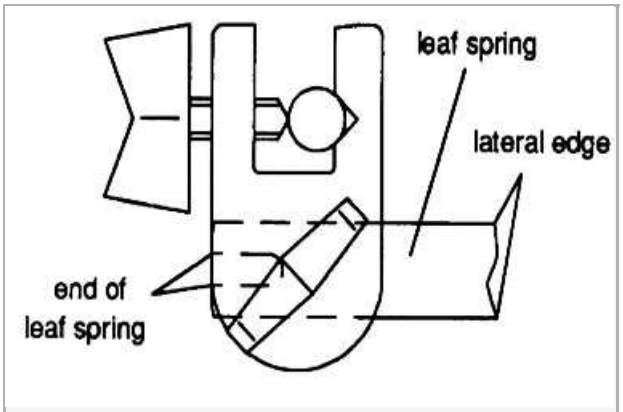


Fig. 10

Fig. 11

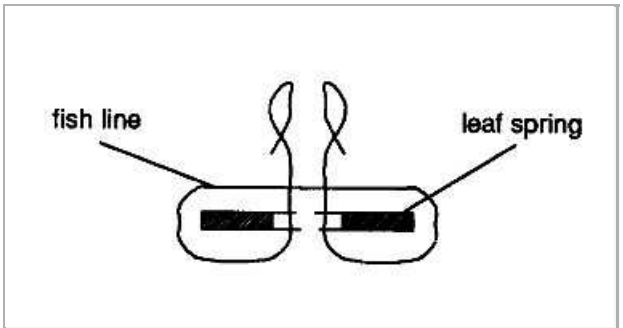


Fig. 12

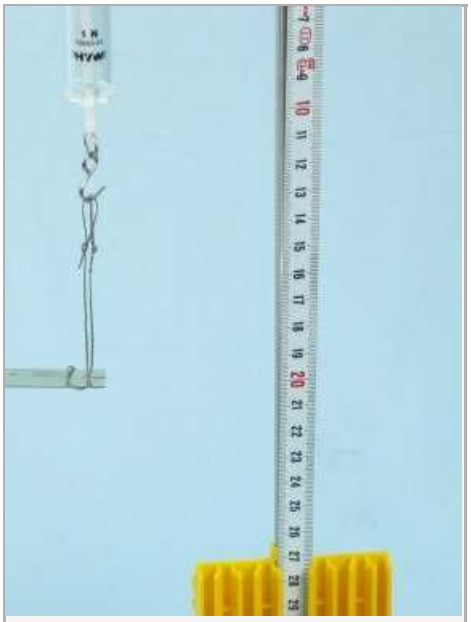


Fig. 13

Procedure

Position the measuring tape so that one division (e.g. 20 cm) is at the same level as the end of the leaf spring (Fig. 14). Then pull the spring balance upwards exactly along the axis of the support rod with forces of 0.1/0.2/0.3/.../1.0 N (Fig. 15) and note the extension Δl for each force F . Record the measured values in Table 1 in the report.

Fig. 14

Fig. 15

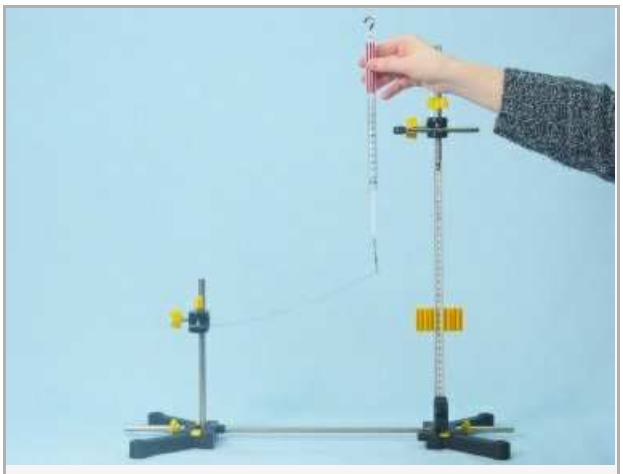


Fig. 16

Now choose a force, e.g. 0.6 N, determine Δ*l* as described above and enter it in Table 2 in the report.
Keeping the extension constant(!), change the angle between the leaf spring and the spring balance: once pull parallel to the table top (i.e., horizontally; Fig. 17) and once at an angle of 45° to the table's surface (Fig. 18).
Read the indicated force F each time and record the values in Table 2 in the report.

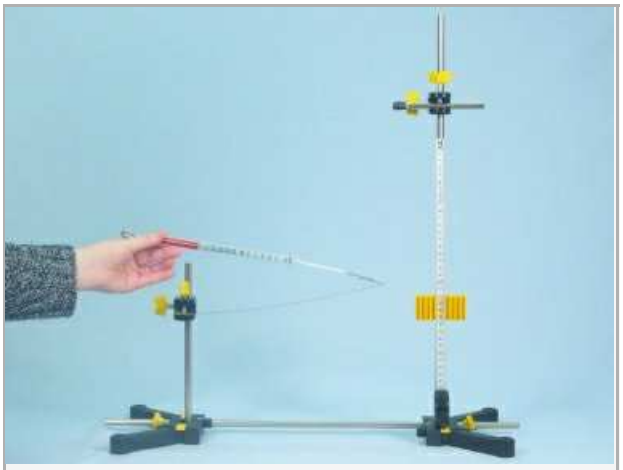


Fig. 17

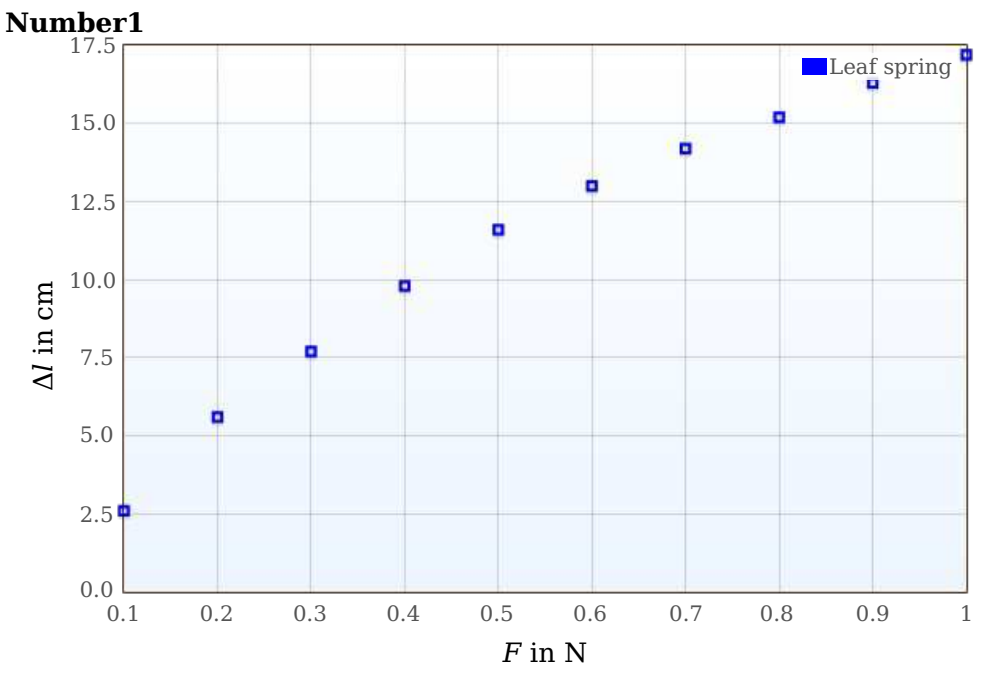
Fig. 18

Report: Bending of a leaf spring

Results – Table 1

Record all the measured values in Table 1.

F in N	Δ*l* in cm
0.1	2,6
0.2	5,6
0.3	7,7
0.4	9,8
0.5	11,6
0.6	13,0
0.7	14,2
0.8	15,2
0.9	16,3
1.0	17,2



Results – Table 2

Record all the measured values in Table 2.

Constant deflection Δ*l* =	13,0 cm 0
Direction of pulling	*F* in N
Perpendicular upwards	0,6 0
Horizontal	0,9 0
At a 45° angle	0,5 0

Evaluation – Question 1

Determine the spring constant $D = F / \Delta l$ using the first 5 measured values: D = ... N/m.

Evaluation – Question 2

Why were only the first 5 values used in the upper calculation?

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Evaluation – Question 3

With which angle is the necessary force the smallest?

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Evaluation – Question 4

Can you give an explanation for this?

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Evaluation – Question 5

Why does the curve in the graph deviate from a straight line at larger forces?

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