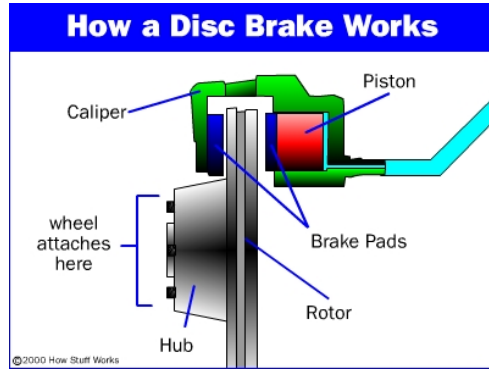


OBJECTIVE

To determine which material will make the best brake pad for your car.

BACKGROUND



The disc brake is a lot like the brakes on a bicycle. The force of you pressing on the brake pedal is transmitted hydraulically to the caliper, which squeezes the brake pads against the rotor (the disc which is connected to the wheel). Friction between the pads and the disc slows the disc down.

Definitions

Static Friction

Friction between two objects at rest.

Kinetic Friction

Friction between two objects sliding past each other.

How do you calculate static friction (F_s) or kinetic friction (F_k)?

$$F_s = \mu_s \cdot F_N$$

F_N = Normal force

μ_s = coefficient of static friction

$$F_k = \mu_k \cdot F_N$$

μ_k = coefficient of kinetic friction

The coefficients depend on how “sticky” the objects are to each other.

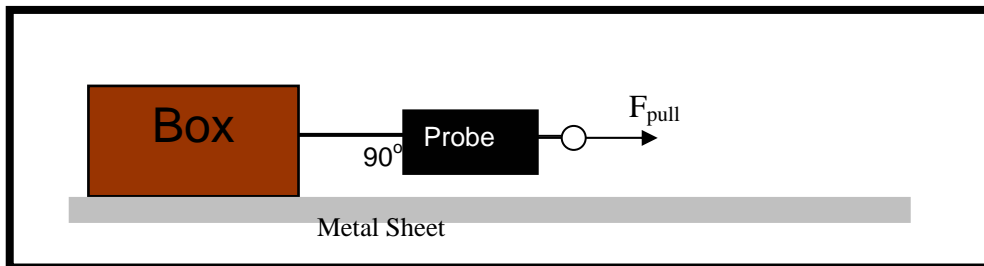
PROCEDURE

Choose the Best Material for Brake Pads

You are the engineering team responsible for the brakes on the company’s new car. The business side of the company has chosen four surfaces that they would like you to test and compare as brake pads. It is up to you to test each one and decide which will make the best brake pad.

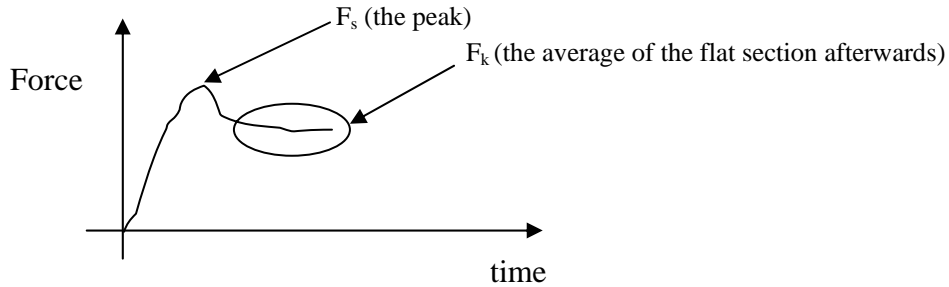
General Instructions for Finding F_s and F_k

1. Measure the mass of your wooden box using the force probe. Record. (Don’t worry about the additional mass of the materials you will tape on the bottom).
2. Tape your test material onto the bottom of the wooden box. Please use tape sparingly.
3. Remove the force probe from the stand and hold it like a handle, (see picture).



4. Hit COLLECT. Start with the string slack, then pull PARALLEL TO THE TABLE and *slowly*, increasing the strength of the pull *very gradually* until the box slips. Once the box is moving, adjust your pull so that the box continues to move at constant speed. This takes some practice – keep in mind that you are trying to get the graph shown above.
5. To find maximum F_s , left-click and drag a box around the peak value of the graph, just before it slips.

6. Select Statistics on the Analyze menu and *record* the MAX value as F_s in your data table. (This info will NOT be saved in your file; you have to write it down). Below is an example graph. Note that each material produces a unique graph.



7. To find the F_k , click and drag a box around the steady horizontal portion of the graph.
8. Select Statistics on the Analyze menu and *record* the MEAN value as your F_k in your data table. (This info will NOT be saved in your file unless you do a Analyze, Statistics)
9. Double Click on the graph to give it a title: YOUR NAMES and THE MATERIALS IN CONTACT, e.g. Edna – Sandpaper on Metal -*NOTE: You can cut and paste the graph into a word document to make a nice, neat professional report.*
10. Calculate μ_s and μ_k
11. CLEAN UP!!! Please make it neat.

CONCLUSION & DISCUSSION

Explain your choice for the best brake pad. Be sure to back up your claims with data and your graphs. You are making this decision based solely on your data, NOT on other factors that you may think of, (i.e., no B.S. please).

LAB REPORT CHECKLIST

Write your lab report as a memo from your engineering team to the car company you work for – have fun with it – name the new car you’re working on, etc. Include in your typed report:

1. Abstract (a 3-5 sentence summary of the work contained in your paper including the main results and conclusions)
2. Introduction (Explain how disc brakes work and what are the important pieces of data to look at, and how you are doing the testing)
3. Data
 - a. Mass of box (kg)
 - b. F_s and F_k of each material (as calculated by the computer from your graph)
 - c. Labeled graphs of each material
4. Calculations
 - a. F_N of the box
 - b. μ_s and μ_k for each brake pad material
5. Conclusion – concise and based solely on the background and your data, not on any other factors.
6. Discussion – include two sources of error (your miscalculations aren’t one!) and how you could improve the experiment to fix them

For instructions on how to write a physics Lab/Engineering report see <http://www.siprep.org/faculty/dann/labwriteup.html>