Pressure

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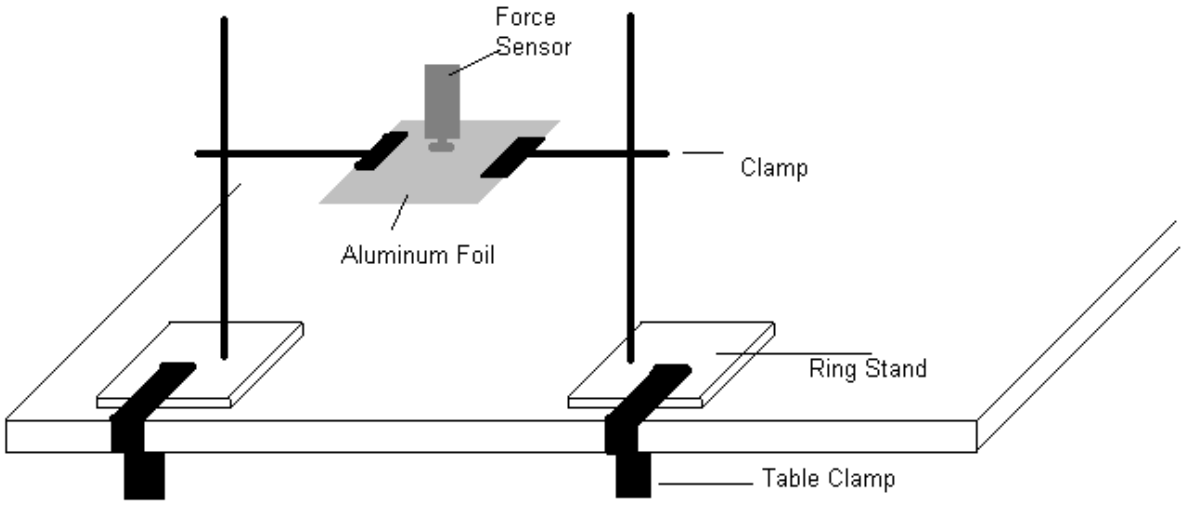
Introduction:

To this point in our study of physics we've only had systems of forces that describe balances of forces. However, what causes a board to break when it is being punched or what prevents a person from puncturing himself when he lays his back on a board full of nails? The physical concept that governs this property is pressure. Frequently, pressure is used in referrence to a fluid such as water. For example, water coming out of a hose is coming out at a certain pressure. When you place your finger over the exit the pressure seems to increase, and by the physical definition this is true as well since the force is unchanged but the area is decreased, hence the pressure increases.

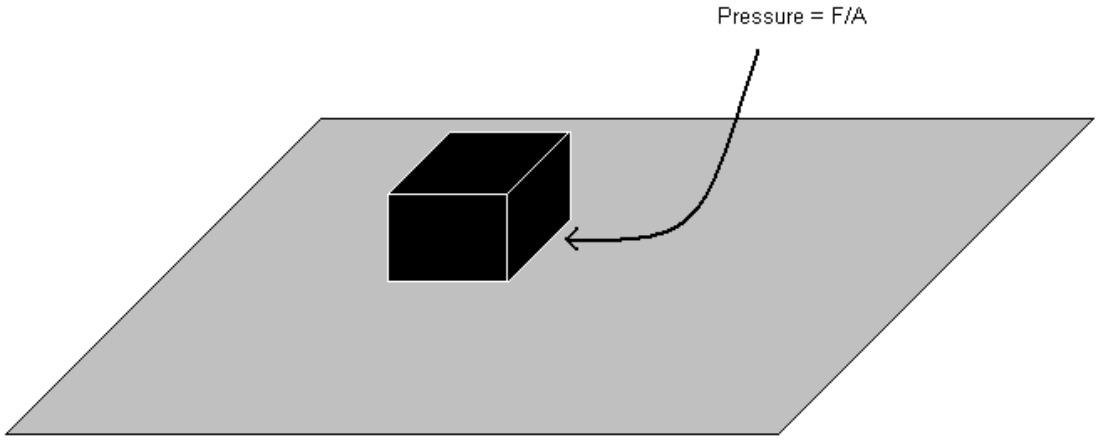
In this experiment, we are going to place aluminum foil on two clamps, after which we are going to vary the area on the force sensor and slowly apply a compressive force on the foil. By measuring the force and pressure and knowing the area of the compressive plate we can see the relationship between these variables and see at what point the aluminum foil is going to tear.



Background:

1. When the area is small, a moderate force can create a very large pressure. This is why a sharp knife is good at cutting things. When you push the very small area of the sharp blade against something, it creates a large amount of pressure.
2. Pressure is defined as the normal or perpendicular force acting at a certain area:

$$P = \frac{F}{A}$$



Therefore, to inflict damage or to prevent damage on an object, both the force and the contact area must be considered. For example, a woman with high heels can easily create enough pressure to cause a dent in the floor because the area of the heel is so small.

Equipment List:

1. Foil Paper
2. 2 sticks
3. Vernier Dual-Range Force Sensor
4. Penny, Nickel, Dime and Quarter for area variations.
5. Vernier Logger Pro
6. Vernier Lab Pro

Experimental Procedure:

Part I. – Pressure determinations.

1. Take the force sensor and replace the hook with the pushing pin.
2. Run the program to begin collecting data.
3. At approximately the center of the aluminum foil apply a continuous pushing force with the dual-range force sensor until the aluminum foil tears.
4. After it has torn press the stop button to stop collecting the data.
5. To determine the point on the graph at which the foil tore, look at the graph and observe the lowest point on the graph after which the force begins to decrease.
6. That force is the point at which the aluminum foil tore; record that value and the pressure value into the results section.
7. Repeat steps 1 through 6 except placing the different diameter object at the center of the foil and compressing the force sensor on that area rather than on the foil directly.

Results:

Trials	Diameter, [m]	Area, [m^2]	Force Reading, [N]	Pressure, [kPa]
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Analysis:

1. Plot a graph of the force as a function of the area.
2. Determine the equation for the straight line.
3. What do you suspect the slope of the straight line represents?
4. Does the pressure at which the aluminum cracks vary above the experimental error?
5. Explain in your own words, why or why not, to the above question?

References:

http://www.darvill.clara.net/enforcemot/pressure.htm