Name: ______________________________ Date: _______________

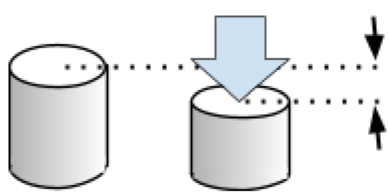
Results from other materials tests

Engineering students at a university used a machine to test how forces deformed different metals. The machine they used to do this was called a compression testing machine. The students tested samples of aluminum and steel. Each sample was a cylinder that was about the same size before going into the machine.

Here is a photo of the aluminum cylinder that they tested. The one on left has not been tested yet. The one on the right has been tested using the machine. What do you notice about the cylinders after testing?

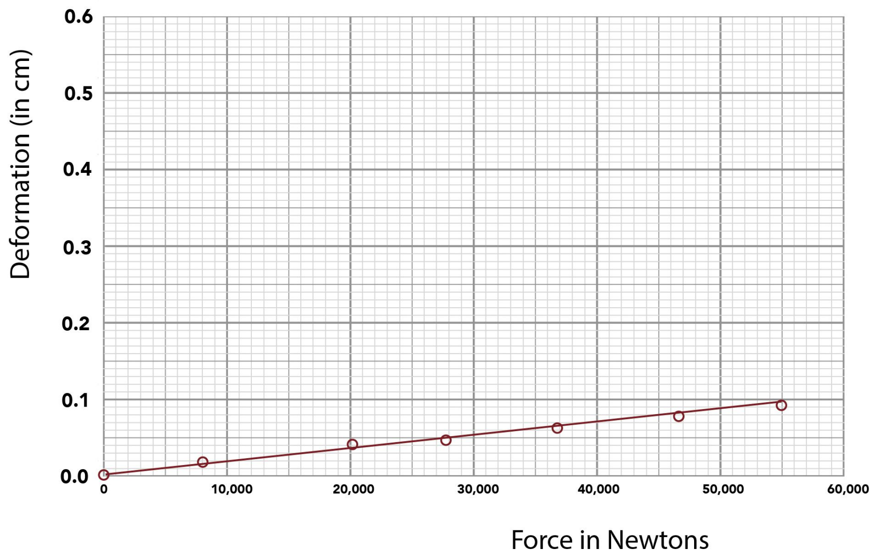
This is the compression testing machine they used to test their samples:

The students measured the length of each sample when it was being compressed, and the force being applied by the machine. Then they took the cylinder out of the machine and made note of whether or not the cylinder returned to its original shape.

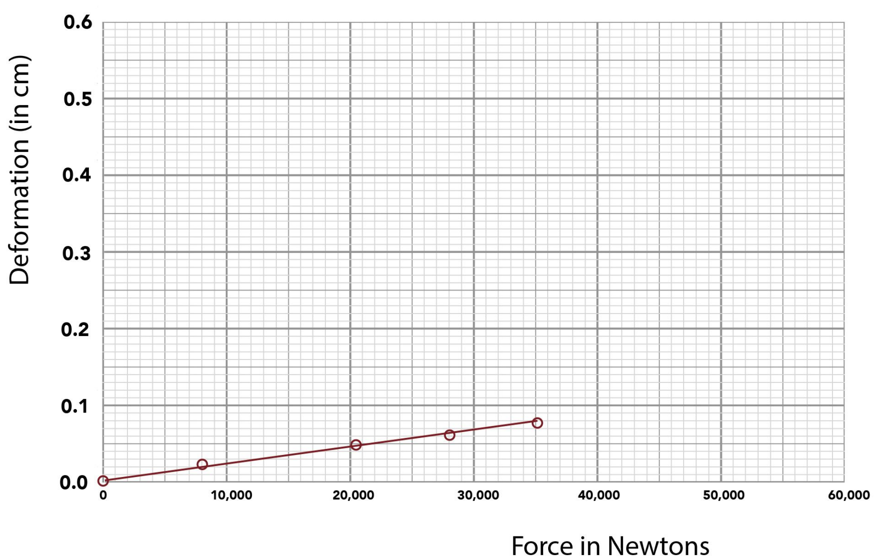


Each material that they tested returned to its original shape after being removed from the machine when they applied lower amounts of force to them. Here are their results from those tests.

Steel



Aluminum

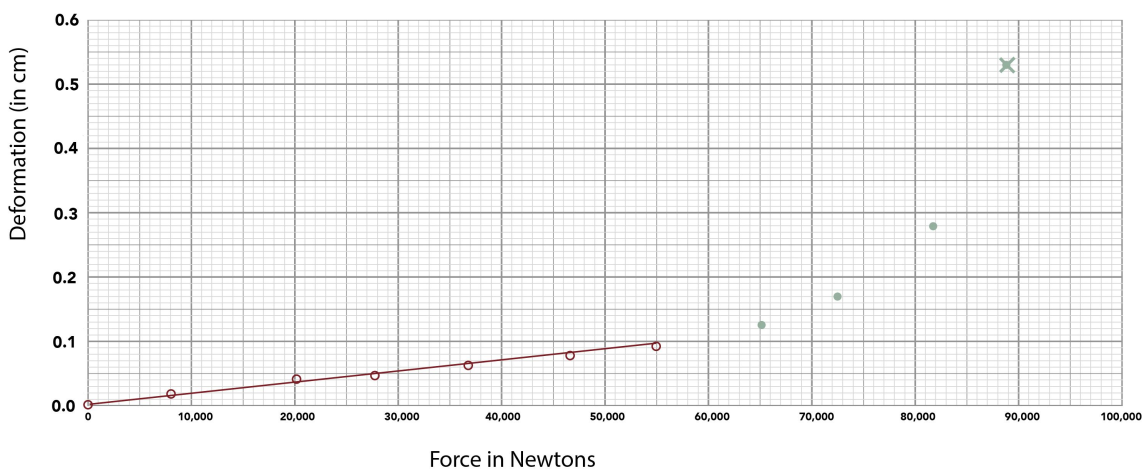


On each graph, the last point on the straight line is the **elastic limit.** This was the furthest amount the object could be deformed and still return to its original shape when the force on it was removed.   Which material has a higher elastic limit, aluminum or steel?____________

The samples were tested again, this time with even more force applied to them. Now the cylinders deformed so much that they no longer returned to their original shape when they were removed from the machine. The highest point on the graph is the assumed **breaking point** of the object (when cracks first appeared).

O	Anywhere the sample returned to its original shape after the weight was removed, use this symbol	●	Anywhere the sample was permanently deformed, use this symbol	X	The assumed breaking point

Steel



If you compare these results to those reported by engineers for materials like rubber, glass, steel, concrete, and diamond, you will find that all materials produce similarly shaped graphs.

How steep the line that appears on the first part of the graph can described mathematically by its ***slope.*** The slope of the line in the first part of each graph tells us about the relationship between force and deformation, but only before the material reaches its elastic limit. The table below shows how this slope compares for some different materials. What patterns do you notice?

____

____

Do you think these materials have the same elastic limit?

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Do you think they have the same breaking point?

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How do the results from your lab and the data in these graphs and tables help answer this question: **How much do you have to push on any object to get it to deform (temporarily or permanently)?** Add this question to your individual Progress Tracker and summarize what you figured out.

Material	Amount of deformation per 1000 lb of force in the elastic region*
rubber	0.1 inches
aluminum	0.00001 inches
steel	~ 0.005 inches
diamond	~ 0.00000006 inches

*All values reported are calculated for cube-shaped samples, one cubic inch in volume.