

# Drop Testing

## Drop Testing of materials

One important property of materials that is relevant to our aim of stopping a bullet is its *impact strength*. This is the ability of the material to resist a sudden impact. We will be qualitatively analysing the impact resistance of a number of candidate materials for our bulletproof armour.

Drop testing has been selected as it allows high energy impacts to be created in the safest possible manner. The experiment takes place within a Perspex tube, which is transparent so we can observe the impact.

We will be dropping either a ball bearing (which is relatively light and rounded) or a wood splitting tool (which is heavy and with a sharper point). We will be observing whether each material breaks on impact, whilst also making observations of **how** the fracture occurred in each case.

## Instructions for your experiment

### You will need

Material samples (100 x 100 x 1 mm)

Drop testing kit, consisting of:

- 1 x drop testing tube
- 1 x drop testing tube base section
- 1 x wooden base
- 1 x desk clamp (wooden sheet with large hole)
- 3 x G-clamps

Safety Glasses (and gloves if available)

(Scales to measure mass – optional)

### Set-up

1. Place the wooden base on the floor with the drop testing tube base section above it.
2. Place the drop testing tube vertically above the base section, so the two wooden plates are touching.
3. Slide the desk clamp down from the top of the drop testing tube, and secure it to the desk with a G-clamp.

### Safety

Wear safety glasses throughout the duration of the experiment. Be careful when handling samples as they may have sharp edges, especially along fracture surfaces. The ball bearing and wood splitter are heavy, leave them in their box until you are ready to test. Get a teacher to assist you with the dropping of the wood splitter. Before drop testing, double check that all G-clamps are secure and that the equipment is sitting above the wooden base (otherwise damage to the laboratory floor could result!)



## Experimental Procedure

1. Place the material to be tested between the two wooden plates at the bottom of the drop testing tube.
2. Clamp the two plates together securely by using two G-clamps.
3. Drop the ball bearing down the tube onto the clamped sample.
4. Release the two g-clamps to remove the ball bearing. Reposition the material and then re-clamp.
5. Drop the wood splitter, point first, down the tube onto the clamped sample. Beware – it could make quite a bang!
6. The experiment should then be disassembled to allow retrieval of the (broken) sample. The wood splitter will need removing from the tube by gently tipping it upside down and letting it slide to the top of the tube. Do this over a soft floor to prevent damage.

## Analysis of your results

You can record your results in a table such as the one below:

Material	Mass of sheet (g)	Ball Bearing		Wood Splitter	
		Break? (Y/N)	Observations	Break? (Y/N)	Observations
Aluminium					
Card					
Cork					
Cotton					
Foam					
GFRP					
HDPE					
HIPS					
PC					
PET					
Steel					

Which material appeared to be the strongest? Which was the weakest?

Why might the strength measured by drop testing differ from that measured in conventional tensile testing?

Have a look online for the tensile strength of some of your materials. Are your stronger materials similar to those which you find online?

Describe the difference between the impacts from the ball bearing and the wood splitter. Why might the fractures appear different?

How could you improve your experiment?

Which material would you choose to make armour from? Would this change if you could only choose light-weight material? Which materials do they use in real-life armour?