About properties of materials

Picking the right stuff ...

When you're selecting a material for an engineered product, you need to be sure it has the right **properties** for the job.

Depending on the product, there are several things you may have to consider. Will the material be **strong** enough? Is it **waterproof**? Will it be able to **resist corrosion**? How easy is it to **cut**, **cast** or **form** into the required shape? Is it **resistant** to changes in **temperature** or **pressure**? Does it **conduct electricity**? What's its **thermal conductance** like? The list can go and on.

Three categories of properties are:

- **Chemical** (corrosion; degradation)
- **Physical** (magnetic; thermal; electrical)
- **Mechanical** (strength; toughness; elasticity; plasticity; ductility; malleability; hardness; rigidity).

So how do we find these properties?

Often we can find the properties of a material by simply looking them up in a **data book** or an **electronic database**. However, properties can only be found in this way for **pure substances** or **standard materials**.

The properties of some materials depend on the **treatments** they receive during **processing**.

Plastic is a collective name for many **polymers**. The properties of each of these will be different. What's more the properties of a particular polymer vary depending on the manufacturing process. For example,you can get **high density polythene** (HDPE) and **low density polythene** (LDPE).

Sometimes when you carry out a test you can measure an '**absolute**' value for a particular property. Other times you can only get '**relative**' or **comparative** values. You carry out the same test on a range of materials and **compare** results. A relative measurement can often give you enough information to choose between materials.

Within this pack you have a number of **Comparative Tests** to help you compare various properties of materials. The tests are in six categories: **Mechanical; Density; Thermal; Electrical resistance; Finishes; Joints**

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Limitations ...

Each test is designed to be used in a school laboratory or workshop. This means there are **limitations**.

For example, a common limitation is the way **force is applied** to a material when testing strength. In industry, using sophisticated testing machinery, the applied force is **increased steadily** - and the loads are often huge. In a school or college environment this is difficult. Generally you have to apply loads using, say, a mass hanger and weights. This can only be done in steps, limited by the masses available (perhaps 10 g at a time). Huge forces are unachievable in schools and colleges. A British Standard hardness test, for example, uses a minimum force of 3000 N to push down on a ball bearing, which in turn pushes into the material under test. If there's any indentation - and if there is, it's often very small - it has to be measured. In a school or college, it would be extremely difficult to apply 3000 N to a ball bearing (it's the same as about 3000 apples). And the equipment needed to measure a tiny indentation is rather expensive!

One way of applying a large force steadily is using a workshop vice. But even then there are problems - how do you measure the amount of force you are applying?

Despite these limitations, the comparative tests given in this pack have the main characteristic of any other standard operating procedure: **they are written to avoid ambiguity**. The instructions for carrying out tests are precise, allowing the same tests to be done by different people in a way that allows meaningful comparisons of results.

So, when you think you have an idea of the properties you want to determine, click on the link below to take you to the tests

Comparative tests