

Plastic Data Sheets Explanation Impact Testing

Material data sheets display various properties, impact strength being one of them. Common impact tests include *Charpy*, *Izod*, *Dart Impact* and others. In this article we'll explore impact testing and the differences between the different types of tests.

Impact testing reveals how “tough” a material is. Toughness can be defined as the ability of a material to absorb energy without breaking¹. High molecular weight favors high toughness. Crystallinity gives higher strength, yet lower toughness; unless the material can transfer the energy through its intermolecular structure. For example, nylon is crystalline and is tough due to the molecular strength of its backbone. Toughness is often considered to be the most critical mechanical property of thermoplastics, because it relates to the service life of the part and influences product safety and liability². Due to this importance, we must understand the tests involved in determining toughness.

Impact testing is commonly done with pendulum impact tests. The two most common pendulum impact tests are Charpy and Izod. In both methods the tested piece is notched. The intention of the notch is to approximate end use conditions; the notch serves as a stress concentrator. These tests give a value for toughness, yet their respective values are not directly comparable. This is due to the differences in how they are tested.

Izod impact testing was initially developed by a metallurgist (whom the test is named after) for testing metals used for cutting tools; subsequently it was adopted for use by the plastics industry for testing plastics. The piece to be tested is held vertically and the impact contacts the piece on the notched side in a cantilever beam fashion. The unnotched Izod test occurs with the sample simply turned around so the notch is opposite the impact side. The test is then labeled “unnotched”.

<< *Izod image inserted here*>>

Charpy impact testing also utilizes a pendulum to impact the piece. Yet, the orientation of the piece is horizontal and the impact is opposite the notch side. This test simulates a high speed flexural test (three point bend) of the material. Charpy impact is particularly valuable in measuring the effect of micro cracking, flow and weld lines on the parts toughness.

<< *Charpy image inserted here*>>

Falling dart impact testing employs a ball-end dart, or tup, to be raised to a specified height then dropped onto the test sample. The weight of the tup, the drop height and size of the tup point can all be varied to accommodate different materials and sample sizes. The measure of toughness is done by noting the drop height and weight of the tup that cause sample rupture.

<< *Falling Dart image inserted here*>>

There are part attributes that influence impact strength of the tested part. A molded part with stress concentrations, such as voids or sharp corners, may reduce impact strength. Thin walls have less volume to absorb and dissipate energy, thus are more brittle than heavy cross sections. Part exposure to environmental stress, temperature, UV and chemical exposure can weaken impact resistance.

Impact strength is an important part characteristic and is achieved by obtaining a balance between part design and material type. Understanding impact testing is an important concept when evaluating product life. We hope this article helps in your understanding of impact testing.

¹ Strong, A. Brent, *Plastics: Materials and Processing*, Prentice Hall, 2000.

² Campo, E. Alfredo, *The Complete Part Design Handbook*, Hanser, 2006.