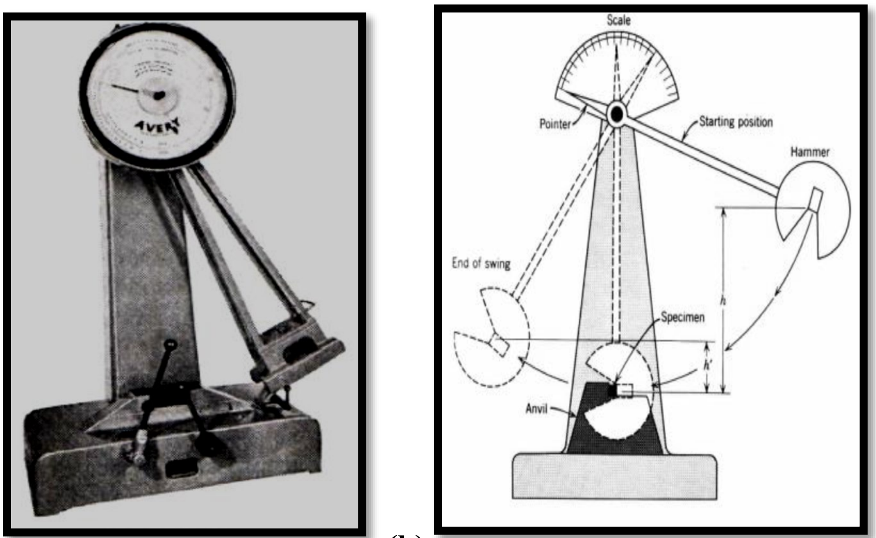
Mechanical Testing

Impact Test (Toughness Test)

Impact tests consist of striking a suitable specimen with a controlled blow (shock) and measuring the energy absorbed in bending or breaking the specimen. The energy value indicates the toughness of the material under test.

Figure 1(a) shows a typical impact testing machine which has a **hammer** that is suspended like a pendulum, a **vice** for holding the specimen in the correct position relative to the hammer and a **dial** for indicating the energy absorbed in carrying out the test in joules (**J**).

When the heavy pendulum, released from a known height, strikes and breaks the sample before it continues its upward swing. From knowledge of the **mass of the pendulum** and the **difference between the initial and final heights**, the energy absorbed in fracture can be calculated, as shown in figure 1(b).



(a) **(b)**

Figure 1. (a) Typical impact testing machine, (b) Schematic drawing of standard impact-testing apparatus.

Figure 2 shows how a piece of high carbon steel rod will bend when in the annealed condition, after hardening and lightly tempering, the same piece of steel will fracture when hit with a different hammer.

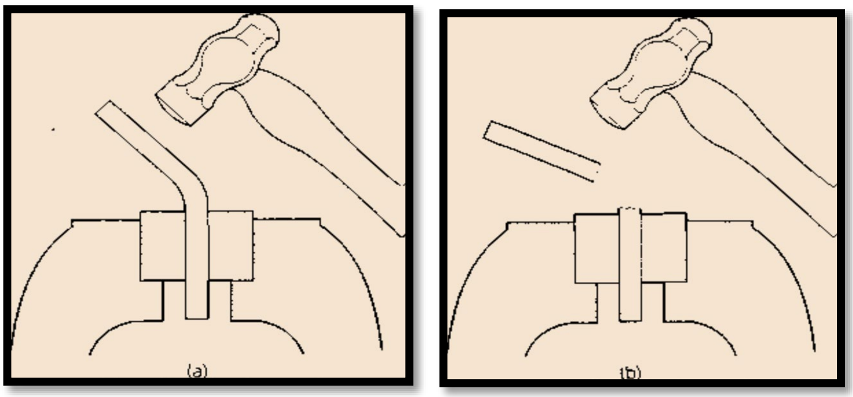


Figure 2. Impact loading: (a) a rod of high-carbon (1.0%) steel in the annealed (soft) condition will bend struck with a hammer (UTS 925 MPa); (b) after hardening and lightly tempering, the same piece steel will fracture when hit with a hammer despite its (UTS 1285 MPa).

There are several types of the impact tests and the most famous type is the **Izod test**. In the Izod test, a **10mm** square, notched specimen is used, it is preferred to use a specimen that have a more than one and even three notched in the same specimen. The striker of the pendulum hits the specimen with a kinetic energy of (**162.72 J**) at a velocity of (**3.8 m/s**). Figure 5 shows details of the specimen and the manner in which it is supported.

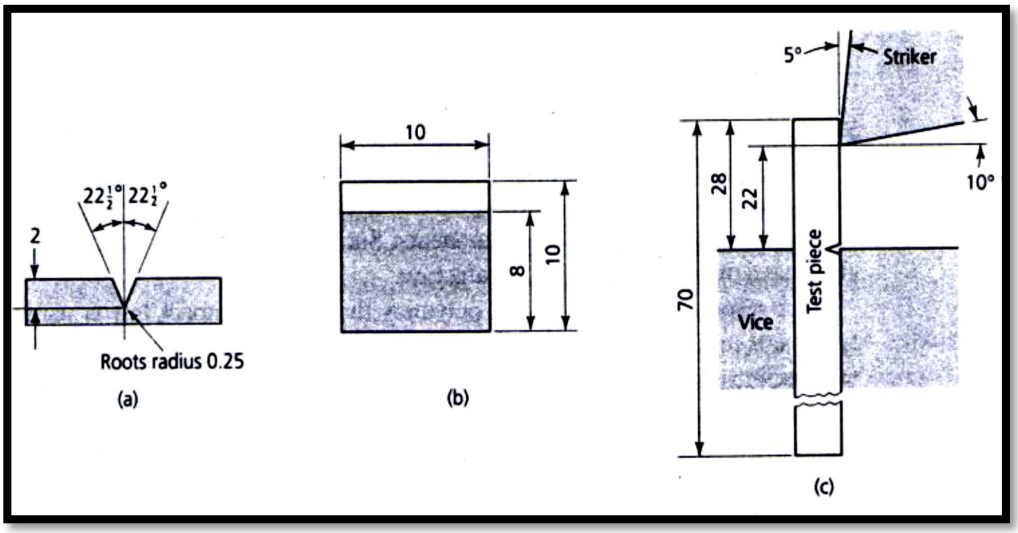


Figure 3. Izod test (a/I dimensions in millimeters); (a) detail of notch; (b) section of test piece (at notch); (c) position of strike.

Since test use a notched specimen, useful information can be obtained regarding the resistance of the material to the spread of a crack which may originate from a point of stress concentration such as sharp corners, undercuts, sudden changes in section, and machining marks in stressed components. Such points of stress concentration should be eliminated during design and manufacture.

A second type of impact test is the **Charpy test**. While in the Izod test the specimen is supported as a cantilever, but in the Charpy test it is supported as a beam. It is struck with a kinetic energy of (**298.3J**) at a velocity of (**5m/s**). The Charpy impact test is usually use for testing the toughness of polymers. Figure 4 shows details of the Charpy test manner in which it is supported.

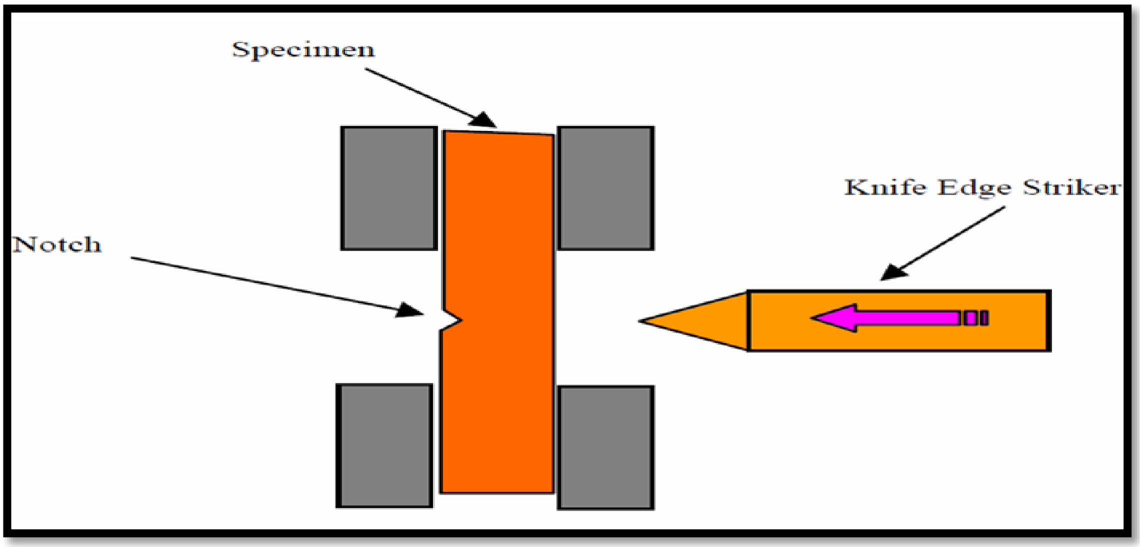


Figure 4. Charpy test.

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The Effects of Temperature on the Mechanical Properties of Materials

The temperature of the specimen at the time of making the test also has an important influence on the test results. Figure 5, how the embrittlement of low-carbon steels at refrigerated temperatures, and hence their unsuitability for use in refrigeration plant and space vehicles.

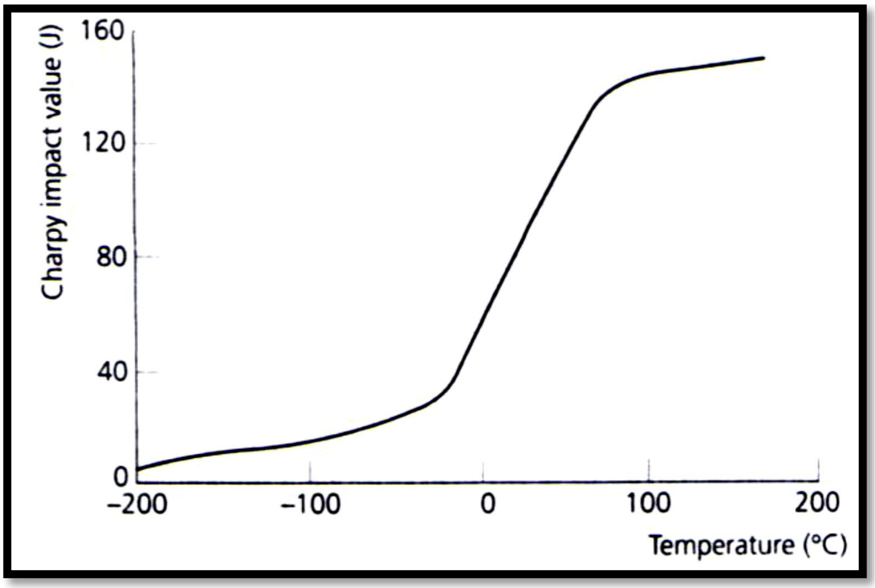

Figure 5. Effect of test temperatures on toughness.

The impact test is also useful as a production tool in comparing manufactured materials with others which have proved suitable in service. Steels, like most other BCC metals and alloys, absorb more energy when they fracture in a ductile fashion rather than in a brittle fashion. On this account the impact test is often used to assess the temperature of the transition from the ductile to brittle state which occurs as the temperature is lowered. The transition temperature is also dependent on the shape of the notch in the specimen. For identical materials, the sharper the notch, the higher the apparent transition temperature. The results of impact tests for several materials are shown in figure below.

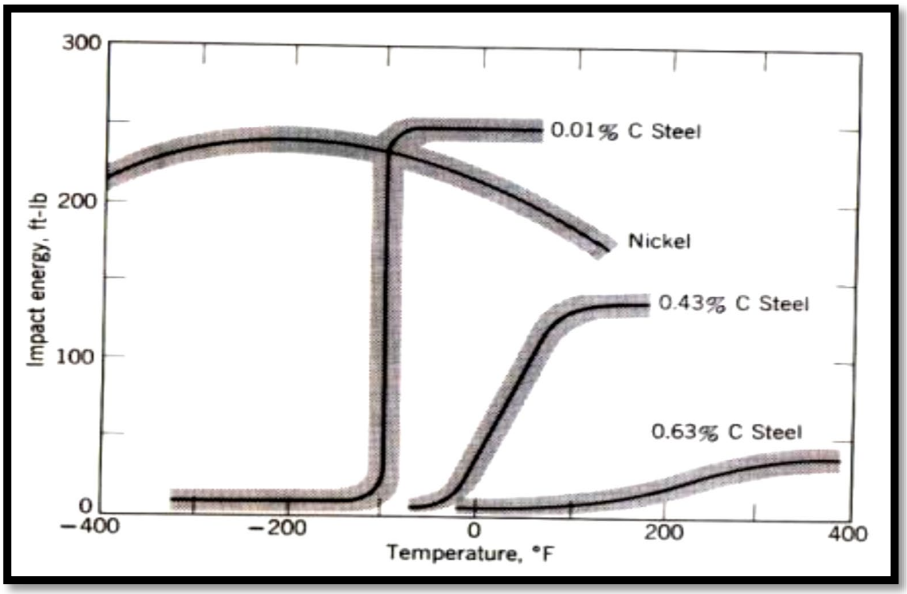

Figure 6. Impact test results for several alloys over a range of testing temperatures.