
Charpy Impact Test

Standards

- *ASTM E23: Test Methods for Notched Bar Impact Testing of Metallic Materials*

Purpose

- To determine the energy required to fracture a v-notched specimen. This energy translates into the toughness of the material.

Equipment and Materials

- Charpy V-notch impact testing machine (figure 1.3.1)
- Specimens: 1018 CR steel & 6061-T6 aluminum
- Thermometer
- Water
- Dry ice
- Hot plate
- Oven
- Bowls, tongs
- Heavily insulated gloves,
- Safety glasses

SAFETY WARNING

- Extreme caution should be used with the Charpy impact machine.
- The pendulum is very heavy and will easily break bones!
- Only one person should be around the machine at a time.
- Use the safety catch until ready to test.
- Make sure the doors are closed before releasing the pendulum.

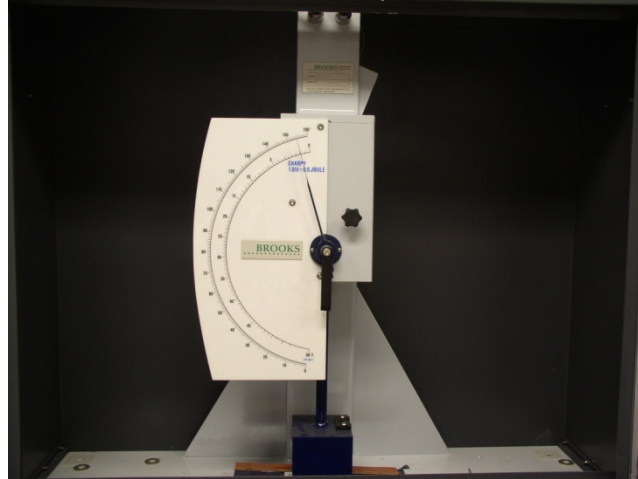


Figure 1.3.1. Charpy impact testing machine.

Experimental Procedure

1. Place specimens into the available temperature media:
 - Dry ice (-78.5°C)
 - Ice bath ($\sim 0^{\circ}\text{C}$)
 - Ambient room temperature ($\sim 20^{\circ}\text{C}$)
 - Boiling water (100°C)
 - Oven ($\sim 300^{\circ}\text{C}$)
2. Setup Charpy machine by lifting the pendulum up to and securing it into the notch. Place the safety catch into the keyhole until ready to test.
3. Remove the desired specimen its temperature medium using the tongs and place it onto the anvil on the Charpy impact machine as quickly as possible.
4. When ready to test, **carefully** remove the safety catch and close the doors. Pull the two levers at the top of the machine apart to release the pendulum. (*The time it takes to remove the specimen from its temperature medium and complete the test should be ~ 5 seconds.*)
5. Record the energy required to fracture the specimen by reading the gauge mark. [*See worksheet at the end of this lab.*]
6. Observe and note the fracture surface appearance. [A digital camera would be a great idea!]
7. Measure the lateral expansion of the specimen using a caliper. [*See worksheet at the end of this lab.*]

Analysis and Results

- For each type of material, plot the fracture energy versus the temperature. (All data)
- For each type of material, plot the lateral expansion versus the temperature. (All data)
- If possible, discuss the ductile-to-brittle transition temperature.
- Describe the fracture surface appearance for each type of specimen and for each temperature.
- What is the effect of temperature on the fracture of metal?

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Charpy Worksheet

Group: _____ Date: _____

1018 CR Steel

Group [†]	Fracture Energy, J				
	T ₁ = -78.5 °C	T ₂ = 0 °C	T ₃ = 21.5 °C	T ₄ = 100 °C	T ₅ = 300 °C

Group [†]	Lateral Expansion, mm				
	T ₁ = -78.5 °C	T ₂ = 0 °C	T ₃ = 21.5 °C	T ₄ = 100 °C	T ₅ = 300 °C

6061-T6 Aluminum

Group [†]	Fracture Energy, J				
	T ₁ = -78.5 °C	T ₂ = 0 °C	T ₃ = 21.5 °C	T ₄ = 100 °C	T ₅ = 300 °C

Group [†]	Lateral Expansion, mm				
	T ₁ = -78.5 °C	T ₂ = 0 °C	T ₃ = 21.5 °C	T ₄ = 100 °C	T ₅ = 300 °C