



INSTRON 8200 IMPACT TESTER

“Sid”

Operating Instructions

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Introduction

The Instron 8200 impact tester is a state-of-the-art drop weight impact testing machine that features high speed data acquisition, a variety of specimen fixtures and impact tips, and software that is loaded with data collection and analysis features.

Specimens

Although there are standardized testing techniques for measurement of impact properties, the Instron 8200 impact tester can handle a variety of specimen geometries, including complete components (bicycle helmets, etc.). We have fixtures for standard Charpy (ASTM E23) and Izod (ASTM D256) impact testing, but if you can design and fabricate appropriate test fixtures for your sample, you can probably test your sample and collect some meaningful impact property data.

Safety

Safety Hazards

- The Instron 8200 drop weight impact tester is capable of applying impact forces that may easily crush hands or other body parts, and the machine does not know or care if it's testing a steel rod or your fingers.
- Fracture of test specimens is likely to produce projectiles.

Safety Precautions

- **Always wear eye protection** when working with or around the impact tester.
- **Always use a polycarbonate safety shield** when impact testing.
- **Be aware of and avoid moving parts** of the impact tester.
- **Keep other people away** when you are positioning the impact crosshead and your test specimen. Don't let anyone near the release mechanism while you are positioning a test specimen.
- Use the safety "H-bar" while loading test specimens to prevent the crosshead from falling all the way down if it is accidentally released.

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- Keep all limbs clear of the machine when running tests. Pay particular attention to the velocity flag on the right side of the tower. The velocity flag could cause considerable harm to your body parts if it strikes you as it falls.
- Observers should stand away from the instrument while a test is running.

Background

Although the standard tensile test provides valuable information about the mechanical properties of materials, it cannot be used to predict the behavior of materials in all situations. Some normally ductile metals behave quite differently in severe fracture conditions that may result from low service temperatures, high strain rates, or a complex stress state that may be introduced by a notch or other stress concentration. Further, a tensile test does not test the behavior of a material in dynamic conditions – it applies a constant rate of strain to a sample. Impact testing was developed as a way to measure the **energy absorbed during fracture** of a material under severe impact loading conditions. In general, ductile materials absorb higher amounts of energy than brittle materials. *For more information about how impact testing can help determine fracture toughness and ductility, consult sections 6.8-6.9 of your textbook.*

Metals (The Charpy Test)

While there are many types of impact tests, the Charpy notched bar impact test is probably the most common test used for metals, and has thus become the industry standard. In a Charpy test, a notched bar is supported by two anvils and struck by the edge of a pendulum or falling weight. Charpy test specimen geometry and testing configuration are shown in Figure 1. The notch in the bar provides stress concentration to cause fracture to occur in line with the notch. The Charpy test is quick and easy to perform, a feature that helps to decrease the degree to which the metal equilibrates towards room temperature after removing it from a controlled temperature environment such as liquid nitrogen or boiling water.

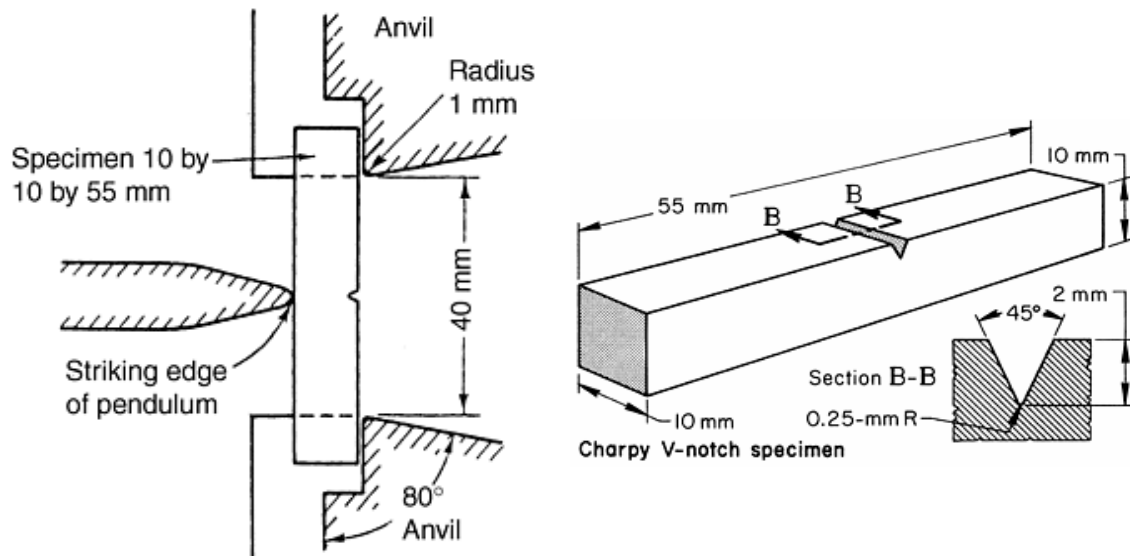


Figure 1. Standard Charpy V-Notch test setup and test specimen. Photos from ASM Handbooks Online, Vol. 8.

Certain metals will exhibit both ductile and brittle impact fracture behavior depending on the temperature at the time of loading. At high temperatures, some metals such as carbon steels will absorb a significant amount of energy during impact fracture, while at low temperatures the same metals lose just about all of their ductility and fracture in a brittle manner. The transition between the ductile and brittle behavior is termed the ductile to brittle fracture transition temperature T_c . Above T_c , fracture is predominantly by microvoid coalescence, and the fracture surface of the Charpy V-notch impact specimen appears dull and fibrous (lots of deformation). Below T_c , fracture is predominantly by brittle cleavage or intergranular cracking, and the fracture surface appears relatively flat and grainy, sometimes shiny. *More information about the fractures in metallic materials can be found in section 6-12 of your textbook.* The ductile to brittle transition temperature is somewhat arbitrarily defined, but it is usually specified as the temperature at which the impact energy assumes some value, e.g., 20 J or 15 ft lbs, or the temperature corresponding to a certain fracture appearance, e.g., 50% fibrous appearance.

Polymers (The Izod Test)

While the Charpy test is the industry standard for metals, it requires very specific dimensions for the test sample. An alternative to the Charpy test is the Izod test, which has specimen geometry constraints for two of the three dimensions. For polymers, Izod samples are slightly longer than Charpy samples, but are the same 10mm width. Importantly, the Izod specimen thickness may range from 3 to 12.7 mm. The Izod test is performed slightly differently than the Charpy test (Figure 2). Instead of resting the specimen on two anvils, Izod specimens are clamped on one end and cantilevered over a gap. The pendulum or falling weight strikes the sample on the same side as the notch.

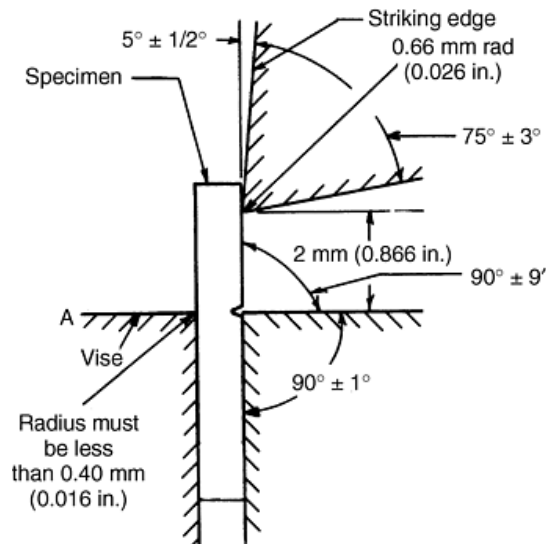


Figure 2. Diagram of a standard Izod impact test setup. Photo from ASM Handbooks Online, Vol. 8.

Many polymers undergo a ductile to brittle change in impact behavior at their glass transition temperature, T_g . A polymer tested above T_g will tend to exhibit higher energy absorption during impact fracture than the same polymer tested below its T_g .

References

- ASM Handbook Online, Volume 8 → Impact Toughness Testing
- Askeland: Sections 6.8-6.12 for impact testing and failure analysis
- ASTM D256, E23

Operation

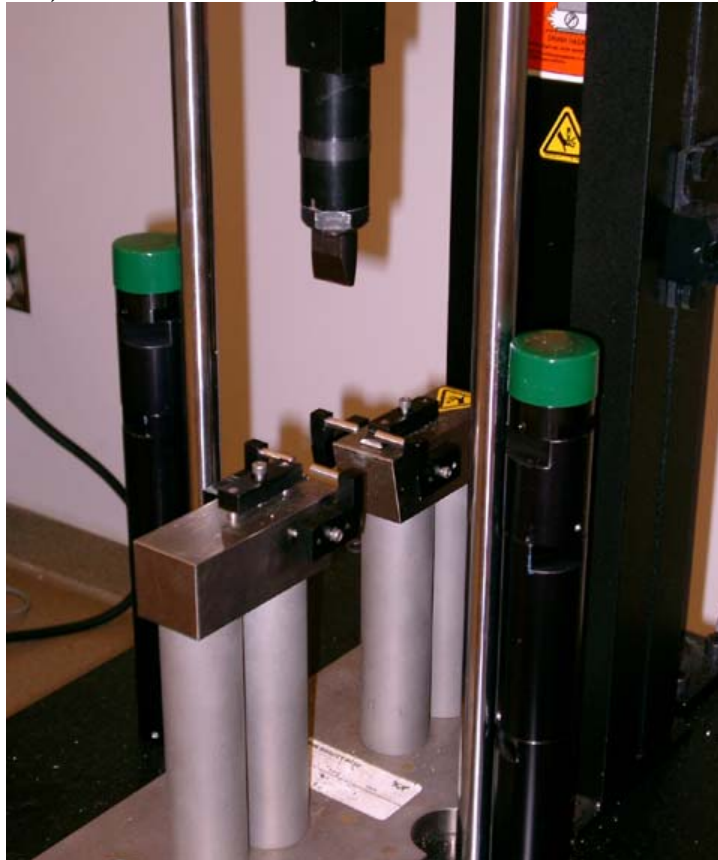
Computer Startup

1. Start the computer and log on to Windows using the following settings:
 - a. User name: Instron
 - b. Password:
 - c. Log on to: D8P9FY21 (this computer)
2. Open the impact testing software by clicking on the “Impulse Data Acquisition” icon.

Test Fixture Setup

Charpy Impact Testing

1. Using the four base plate machine screws, securely attach the double anvil support fixture (shown below) to the base of the impact tester.



2. Attach the Charpy striker tip (shown below) to the striker base. Ensure that the striker tip is aligned with the Charpy specimen notch direction.



3. Ensure that that weight stack is fully loaded with all ten 1.07 kg weights. This gives a total drop weight of 15.5 kg.
4. If necessary, adjust the height of the crosshead stop posts. For Charpy testing, the total height of the stop posts (distance from the base to the top of the green rubber cylinder) should be 13.5”.
5. If necessary, adjust the height of the crosshead release bar (the drop height).



6. If necessary, load the crosshead with the desired drop weight. For Charpy testing of metals, include all ten of the 1.07 kg weights; this gives a total drop weight of approximately 15.5 kg.

Izod Impact Testing

1. Using the four base plate machine screws, securely attach the double anvil support fixture (shown below) to the base of the impact tester.



2. Attach the Izod striker tip (shown below) to the striker base. Ensure that the lowest edge of the Izod striker tip is aligned with the Izod specimen fixture.



3. Ensure that that weight stack is completely empty (no yellow weights). This gives a total drop weight of about 5.5 kg.
4. If necessary, adjust the height of the crosshead stop posts. For Izod testing, the total height of the stop posts (distance from the base to the top of the green rubber cylinder) should be 10.5”.
5. If necessary, adjust the height of the crosshead release bar (the drop height).

6. If necessary, load the crosshead with the desired drop weight. For Izod testing of polymers, the weight stack should be empty (no yellow weights); this gives a drop weight of about 5.5 kg.

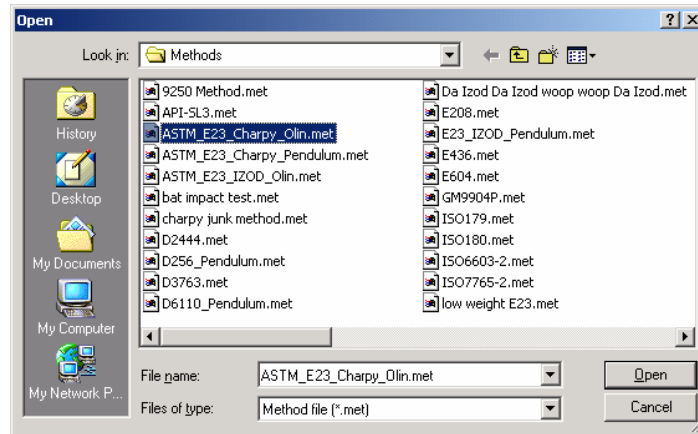
Sensor Setup

1. The velocity sensor and data acquisition trigger is located on the right side of the impact tower and shown in the picture below. The sensor height should be adjusted such that the sensor flag passes through the sensor just before the sample is impacted.

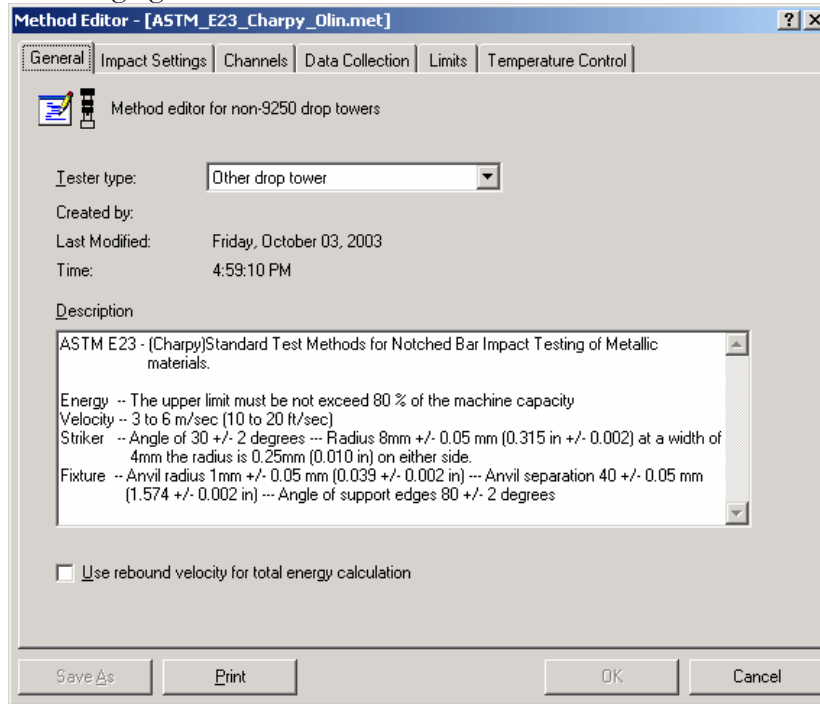


Software Startup

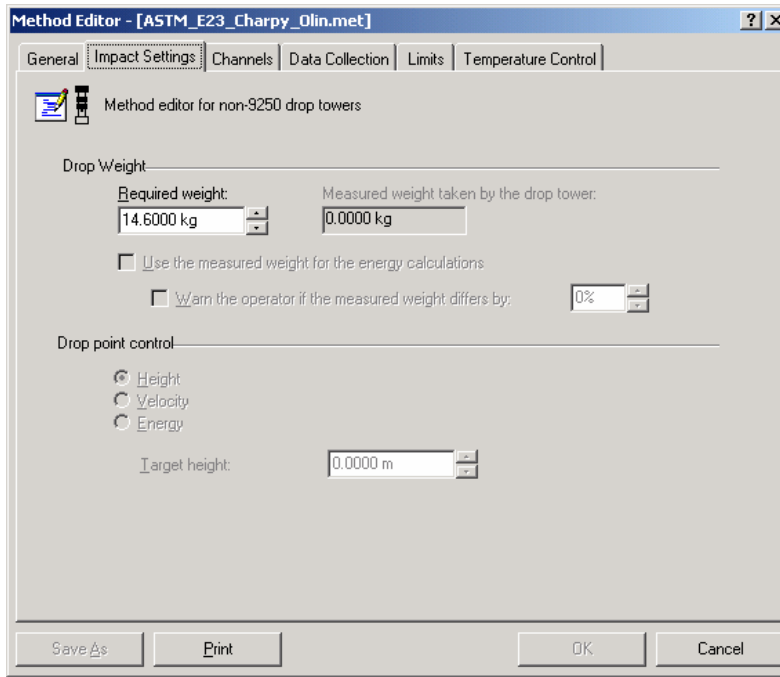
1. Log on to the impact tester computer with the following settings:
User name: instron
Password: (no password)
Log on to: D8P9FY21 (this computer)
2. Open the impact tester software by double-clicking the Impulse Data Acquisition icon on the desktop.
3. For Charpy or Izod impact testing, go to File...Open...Method to open one of the existing test methods. Select **ASTM_E23_Charpy_Olin.met** method for Charpy impact testing, or select **ASTM E256 IZOD Olin Drop Tower.met** method for Izod impact testing of polymers.



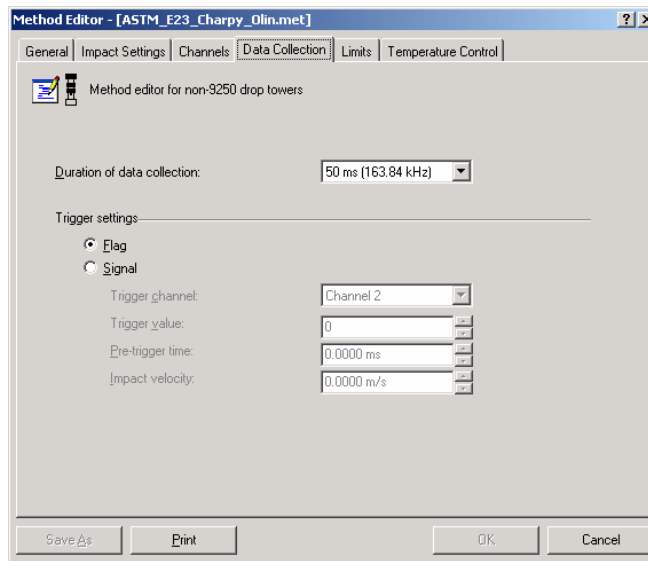
This should open the Method Editor and display a description of the test method, as shown in the following figure:



4. In the Impact Settings tab of the Method Editor dialog box, check that the drop weight is set correctly. The fully loaded weight stack used with Charpy testing is approximately 15.5 kg. The completely empty weight stack used with Izod testing is about 5.5 kg. If the weight setting is incorrect, please change it and save the method under the same file name.



5. In the Data Collection tab of the Method Editor dialog box, check that the data collection time is set to 50 ms or 100 ms. A higher data collection time (e.g., 100 ms) provides lower resolution data but allows for more room for error in placement of the velocity sensor flag. A time of 50 ms typically works well.



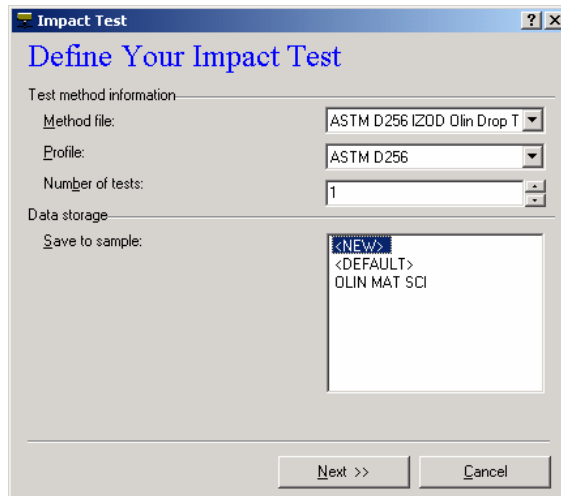
Velocity Test

1. Click the “V” icon on the toolbar to open the Velocity Test Preparation dialog box.
2. Prepare the impact tester by raising the drop weight and removing the sample. Press **Next**.
3. Within 30 seconds, release the weight.

- Once the weight has been released, you should see a velocity value on the screen. If the measured value looks good, press **Finished**.

Running the Impact Test

- Press the yellow impact toolbar button to set up the impact test. This will open the following dialog box:



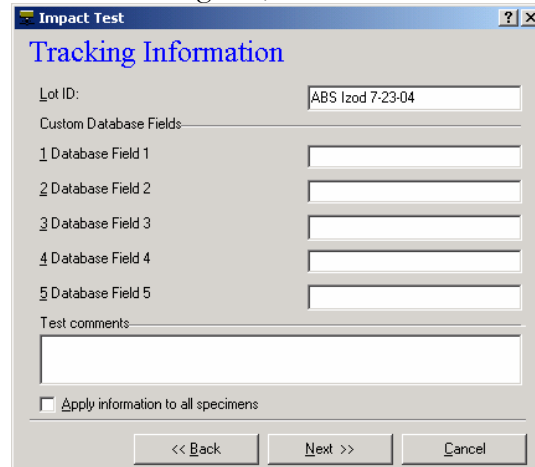
Test Method Information

- Select the appropriate method file. Use **ASTM D256 IZOD Olin Drop Tower.met** for Izod impact testing of polymers, and use **ASTM_E23_Charpy_Olin.met** for Charpy impact testing of metals.
- Select the appropriate ASTM standard profile.
- Select the number of tests.

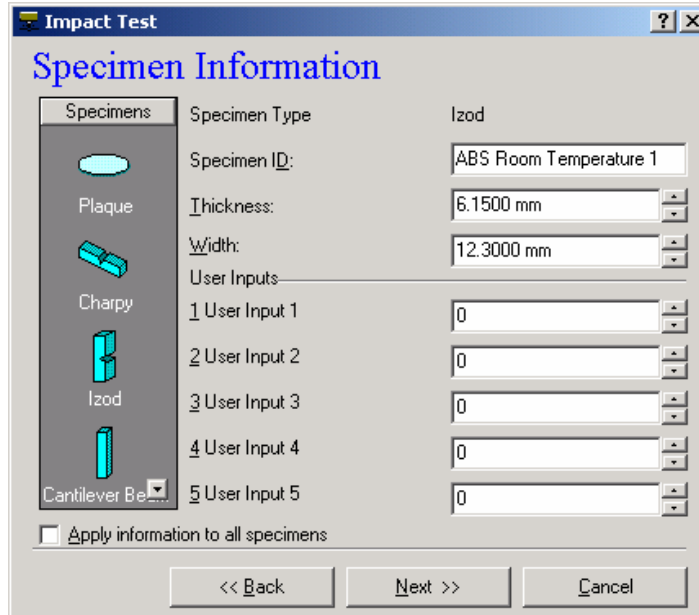
Data storage

- The sample name you entered earlier should appear in the **Save to sample:** box. Select the sample name and press **Next**. If you did not enter a sample name earlier, select **<NEW>** and press **Next**. Enter a sample name and press **Create**.

- In the Tracking Information dialog box, enter a Lot ID and desired comments. Click **Next**.

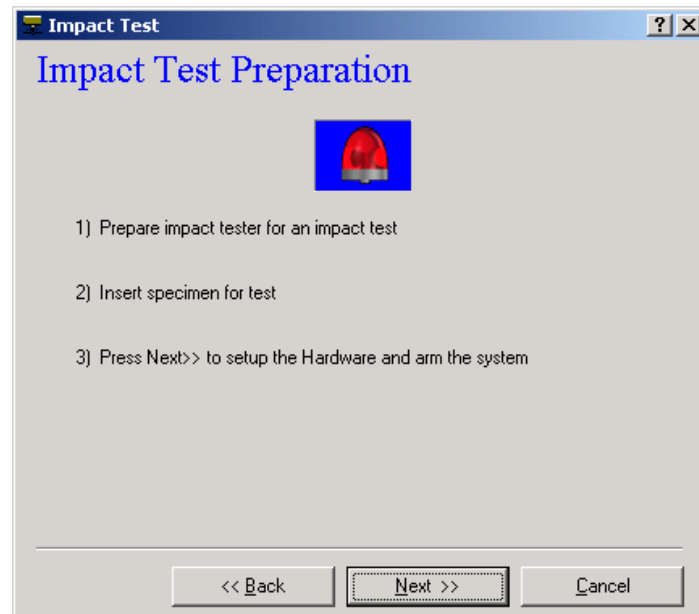


3. In the Specimen Information box,



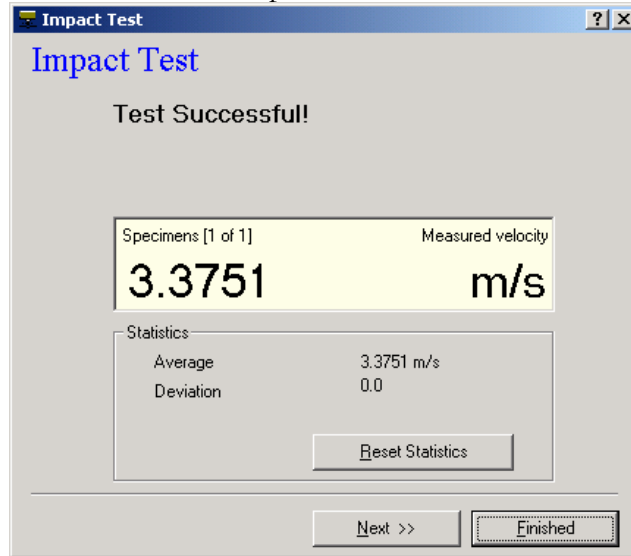
- Select the Specimen Type from the graphical representations on the left.
- Enter the Specimen ID and appropriate dimensions.
- Click **Next**.

4. Prepare the tower for the impact test, and place your specimen in the fixture. Charpy specimens should be placed in the fixture with the notch side facing down (see Figure 1). For Izod testing, the notch should face upward and be aligned with the edge of the fixture (see Figure 2). Press **Next**.

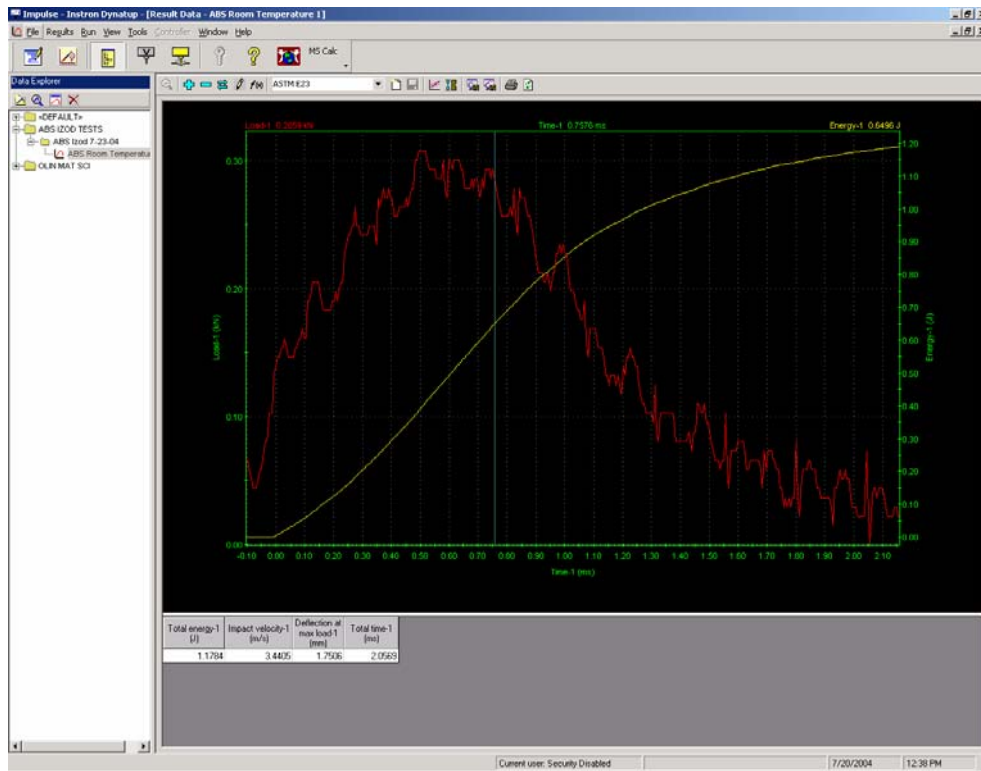


5. Perform the impact test. Release the weight by pressing down on the release mechanism lever. Note that you may need to apply significant downward force on the lever.

- After the test, you should see a velocity value and “Test Successful!” in the Impact Test dialog box. Click **Finished** to view the impact test data.



- Typical Izod impact specimen data are shown in the following graph:



The red curve in the graph represents the load or force versus time. The yellow curve shows the energy absorbed by the specimen during fracture. Tabular data are shown below the graph.