TECHNICAL REPORT WRITING FOR ENGINEERS

CHARPY IMPACT TEST: AN EXAMPLE PROCEDURE SECTION

Dr Andrew Garrard, Senior University Teacher, Multidisciplinary Engineering Education, The University of Sheffield: This experiment involves breaking six samples at varying temperatures using a Charpy machine, as shown in figure 3.1, and measuring the energy absorbed by the sample during impact.

[Figure 3.1 is labelled 'Typical stress-strain curves of ductile and brittle materials' and shows a basic diagram of the Charpy impact test. The pendulum's starting position is at approximately 45 degrees, swinging down to impact the notched steel sample held by the machine's anvils at 180 degrees, with the pendulum's final position being 270 degrees.]

The experiments were conducted at sample temperatures of -196°C, -80°C, 0°C, room temperature of about 20°C, 100°C, and 200°C. The availability of equipment and materials capable of maintaining these temperatures, and into which the sample can be immersed, was the reason for their selection.

To fabricate the six samples required for testing in the Charpy machine, 3mm steel was cut in a vertical milling machine to a rectangular section of 25mm by 10mm. A V-shaped notch measuring 2mm by 1mm is ground into the 25mm length of the sample. To allow later identification, each sample was labelled.

Two thermostatically controlled ovens were preheated to 100°C and 200°C. Using heat resistant gloves and tongs, one sample was placed in each oven and left for sufficient time to reach equilibrium temperature. A further two samples were immersed into iced water at 0°C, and dry ice, -80°C, using the tongs. Room temperature was determined using an alcohol thermometer located in the laboratory.

Before conducting the first experiment, the operation of the Charpy machine and interlockers on the protective doors were checked. A sample at room temperature was loaded between the anvils of the Charpy machine, with the notch facing away from the hammer. The precise location of the sample was adjusted using the locating prong and the protective doors were closed. Instrumentation built into the Charpy machine was zeroed, and the hammer released, breaking the sample. The impact energy was recorded from the digital display. In order to later examine the fracture

surface, the broken sample was allowed to return to room temperature to avoid the risk of burning, carefully removed from the machine and stored.

For safety reasons, heat resistant gloves and tongs were used to remove the sample from the oven at 200°C, and it was placed in the Charpy machine. The time taken to move the sample from the hot and cold environments was minimised to reduce the heat loss from the sample during transit, which would reduce the temperature of the sample from its known value.

The impact test on the Charpy machine was conducted following the same procedure adopted for the room temperature sample. This was then repeated for the sample in the 100°C oven, the sample immersed in the iced water, and the sample immersed in the dry ice.

To perform the final test, heat resistant gloves and a face mask were used to ensure protection from the risk of burns. The remaining sample was lowered, using tongs, into a dewar of liquid nitrogen until the production of white vapour ceased. This indicated the sample had reached a temperature of -196°C. The sample was then placed into the Charpy and tested using the same method as the other samples. The fracture surface of all six samples were examined and recorded.