Instrument Operation Instructions

Department of Materials Science & Engineering

Equipment:	**Buehler Rockwell Hardness Tester**
Location:	**3362 Hoover Hall**
Access:	**Open for undergraduate coursework**
Contact:	**Zhongyuan Qian**

Test Precaution

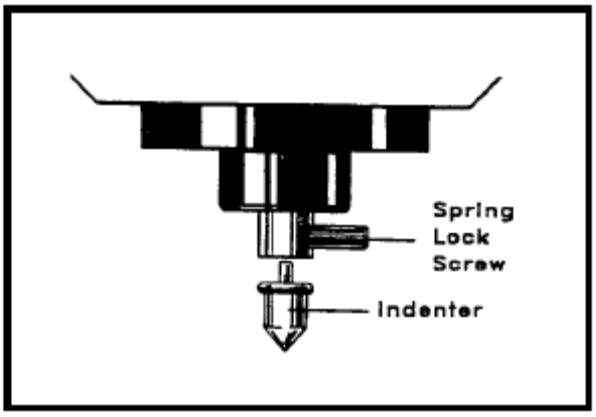
1) At least two preliminary tests should be performed before beginning any measuring, in order to acclimatize the indenter, raising/lowering screw, and specimen platform.
This is necessary at the start of work each day and after the raising/lowering screw has been substantially moved.
Preliminary tests are performed with the same procedures as normal tests.
2) Ensure that contact surfaces such as the indenter attachment face, between the specimen and specimen platform, and between the specimen platform and raising/lowering screw are continually maintained in a clean state.
Accurate hardness values may not be obtained if foreign matter such as dust, rust, or oil is included on contact surfaces.
Wipe all contact surfaces thoroughly with a clean cloth before performing tests.
3) The specimen measurement location must be spaced at least *4d* (where ***d*** is the indentation diameter) from the center of indentations already present.
The measurement location must also be separated at least *2d* from the edge of the specimen.
4) The surface (test face) and reverse face of the specimen must be kept as horizontal as possible.
When measuring specimens which are not horizontal, maintained the test face perpendicular to the indenter axis using special jigs.
Care is also needed in providing a satisfactory finish to the reverse face of the specimen, and not just the test face.
Correct hardness values will not be obtained if the specimen surface is concave, as deformation will occur under the load.
5) If a minus is indicated on the data display, the hardness value of the specimen is less than 0.
6) The specimen thickness or hardened layer thickness must be at least 8 times the indenter penetration depth.
Correct hardness values will not be obtained if below this and so either the test load must be reduced or else measurements must be performed using a different type of hardness tester.
Otherwise, try measuring with a different scale having a large steel ball indenter.
7) The condition of the indenter greatly affects the hardness value.
Caution is recommended as long-term use or impacting the indenter due to operating errors may cause cracking, scratching, or defects.

Problems such as indenter damage can be relatively easily detected using a 20 to 25 magnifying glass.

Tip damage will normally gives higher hardness values. Side face damage will normally gives lower hardness values.

Test Procedure

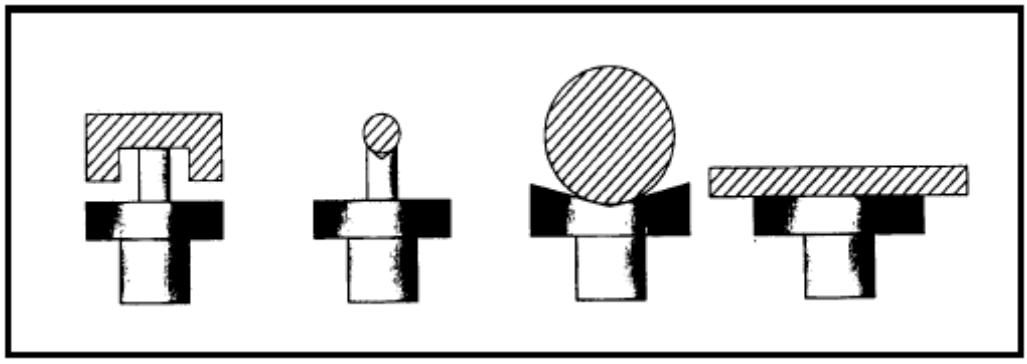
1) First decide which scale is appropriate. Some of the limitations to consider are:
   - Size and depth of the indent in comparison to the feature of interest.
   - Spacing between indentations should be a minimum of 4 times the diameter of the indentation.
2) Select the proper test force with the load selector dial.
3) Verify that the correct indenter is in place. If necessary replace it with the appropriate indenter. The indenter neck surface is flat on one side, which faces the spring-lock screw.



Indenter Replacement

4) Verify that the correct indenter is selected in the ***Measurement Condition*** screen. *Dia* corresponds to the diamond or brale indenter. The diameter measurements are listed for the selection of the ball indenters. The selected indenter will be displayed in the top row of the ***Measurement Condition*** screen. This screen can be accessed from the test screen by selecting the ***Main Menu*** screen, followed by ***Utility*** and then ***Measurement Condition*** screens.

5) Select the correct anvil. Typically the shape of the test piece will determine which anvil to use. The most important aspect is that the test piece is secured and can not shift during the course of the test and that it is perpendicular to the indenter. The followings are several typical anvils.



From left to right: spot anvil, small v-anvil, large v-anvil and standard flat anvil

6) Set the dwell time on the ***Load Time Setting*** screen located within the ***Set Up Mode*** screen. If a dwell time of longer than 3 seconds is required due to the material having excessive creep, the time should be recorded after the result.

The routine typically followed by the operator:

- Place the test piece and test block on the anvil.
- The preliminary test force is applied by bringing the test piece into contact with the indenter until the SET point is reached. If too much force has been applied, the OVER light will be on. Should the OVER light appear it is necessary to start the test on a new position of the test piece.
- At this point, if the tester is semi-automated, the remainder of the test force will be applied. Otherwise it will be necessary to press START. The level of automation can be selected within the ***Utility*** and then ***Measurement Condition*** screens. Either Auto or Manual will appear in the top line of the touch screen depending on your selection.
- The result is displayed by the testing machine. The larger the e-value (displacement), the smaller the HR value observed.