MACROMET 1 OPERATION

This document contains a step-by-step procedure for performing a hardness test using the (semi-automatic) Macromet 1 hardness tester. Familiarity with hardness testing in general is assumed. Also, your first few hardness tests should be done under the supervision of your instructor. Finally, it is important that you read through this whole procedure before attempting to perform a hardness test.

Figure 1 The Buehler Macromet 1 semi-automatic Rockwell-type hardness tester in the materials science teaching laboratories.

About the Macromet 1 Hardness Tester

There are two types of Macromet hardness testers in the teaching laboratory. The Macromet 1 is a semi-automatic Rockwell-type hardness tester which features motorized test loading and unloading, dial selectable test loads and digital readout of the hardness value. The measurement process is electronically controlled and takes over after the pre-load has been applied. The Macromet I is a manual Rockwell-type hardness tester which is functionally equivalent to the semi-automatic Macromet 1. Like the Macromet 1 the test load is selected using a dial but the measurement process is completely manual and the readout is displayed on a dial gage.

Both hardness testers are in excellent condition, include the same fixtures and indentors and produce the same results. They differ only in the convenience of the semi-automatic testing which is possible with the Macromet 1.

Safety Issues

Hardness testing poses very little hazard to the operator other than the possibility that a brittle specimen may shatter. Therefore it is recommended that you wear safety glasses when performing hardness tests on brittle materials. Other than that, it is more likely that operator errors and misuse of the equipment will damage the hardness tester itself. The best way to prevent this and to ensure that you obtain accurate results is to become completely familiar with the operating procedure and pitfalls before attempting to perform a hardness test. If you have any questions about hardness testing in general or this equipment in particular please don't hesitate to ask your instructor for help.

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Operating Precautions

1. Indentor

- Use the proper indentor. The indentor can easily be damaged by testing materials which are too hard. The steel balls can be flattened and the diamond can be fractured.
- Be careful to avoid striking the indentor when installing it, changing anvils, or installing a specimen.
- Store unused indentors properly.

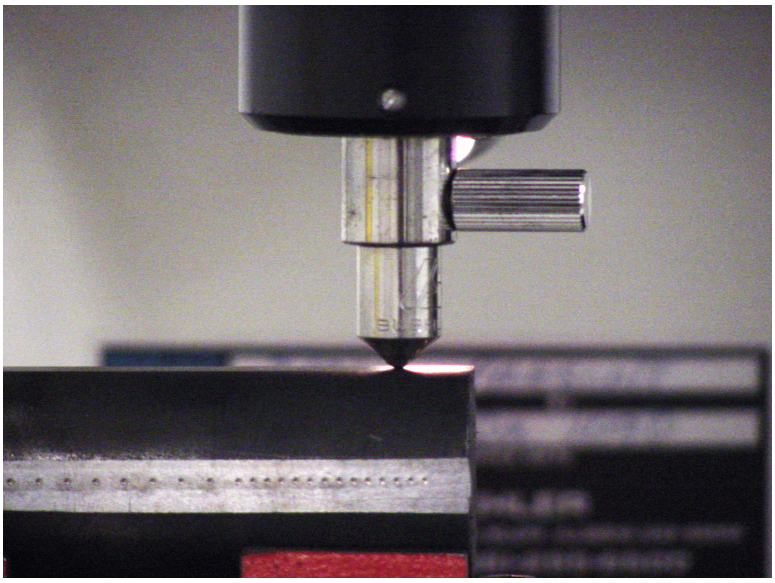

Figure 2 Close-up of the diamond brale indentor during a hardness test of a Jominy specimen.

2. Test Blocks

- Do not make hardness measurements on the "back" of the test blocks.
- Store the test block properly: safe, clean and dry. Don't let them rust.
- Do not grind the test blocks to remove existing indentations.

3. Anvils

- Do not hardness test the anvils.
- Always use the proper anvil for the size and shape of the specimen you are testing.
- Keep the anvils clean.
- Store the anvils properly.

4. Specimen

- Specimens should be clean.
- Large or long specimens should be properly supported.
- The thickness of the specimen or of the hardened layer to be tested should be at least 10 times as deep as the indentation when a diamond indentor is used and 15 times as deep when a ball indentor is used.

5. Other

- Low hardness readings should be expected for the first few tests after the indentor or anvil have been changed.
- Errors in hardness readings should be expected when testing specimens which are not flat. For cylindrical specimens or for tubes there are procedures for applying corrections to these readings.
- It is a good idea to check the calibration of the hardness testers before conducting a series of hardness tests. Test blocks covering a range of hardnesses are available.
- Take your time, be careful, and think about what you are doing.

Procedure for Performing a Hardness Test

1. Preliminary

- The hardness tester should be clean and appear to be in good working condition.
- The hardness tester should be installed on a solid, flat and level surface.
- A copy of the operator's manual should be close by.
- Turn on the power and the light for the specimen stage area.

2. Select a Hardness Scale

- Select a hardness scale which is appropriate for the type of material you are testing and for the thickness of the specimen.
- Dial in the appropriate test load.
- Carefully install the appropriate indentor.

3. Install the Anvil

- Select and carefully install the anvil which is most appropriate for the shape of your specimen.
- Make sure that this anvil is clean.

4. Install the Specimen

- Make sure the specimen is clean and that the back of the specimen is free of all grit, scratches, dents and burrs.
- Place the specimen on the anvil, being careful to avoid striking the indentor.

5. Select an Indentation Site

- Position the specimen on the anvil in such a way that <u>all</u> of the following criteria are met:

1. The tested and back surfaces of the specimen must be parallel.
2. The test surface must be perpendicular to the indentor.
3. The indentation will be made at least 3 diameters from the nearest indentation or 2½ diameters from the edge of the specimen.

6. Configure the Hardness Tester

- Press the button on the control panel to specify which indentor is installed.
- Note the hardness scale which is displayed on the control panel.
- Select a dwell time of 2 seconds by pressing "Dwell Time", then the up or down buttons until a "2.0" is displayed, and then "Dwell Time" again to set this as the dwell time.
- Put the hardness tester in automatic operation by pressing the "Auto" button. The red LED in this button should come

Figure 3 Hardness testing a Jominy specimen. A special Jominy fixture is being used to hold the specimen.

on.

7. Apply the Pre-load

- Carefully raise the stage until the specimen contacts the indentor.
- Continue raising the stage until the green "Set" LED is lit. The digital display will indicate a number between 290.0 and 299.0.
- Note that if the value displayed exceeds 299.0 the "Over" indication will light and the automatic start function will not activate. The best thing to do at this point is to skip to step 9 and retest the specimen in another area.

8. Automatic Hardness Measurement

- Approximately 1 second after the pre-load is applied the green "Start" LED will light and the test will begin. If this doesn't happen (automatic start was disabled) then press the "Start" button which is located on the base of the hardness tester.
- The gradual application of the load is controlled by electric motors.
- After the test load is fully applied and the dwell time has passed then the test load is automatically removed.
- When the test is finished the green "Start" LED will go out.
- The hardness reading can be read on the digital display.

9. Make Another Hardness Measurement

- Lower the stage until the specimen is clear of the indentor.
- Loop back to step 5 to make another measurement on the same specimen.
- Loop back to step 4 to begin testing another specimen.

10. End of Hardness Testing

- Remove the specimen from the hardness tester.
- Return all anvils, indentors and test blocks to their proper storage places.
- Turn off the light which illuminates the stage area.
- Turn off the hardness tester.
- Put the cover back on the hardness tester.