

Application News

No. i263

Dynamic Ultra Micro Hardness Tester

Hardness Test of Mechanical Pencil Leads

The writability of mechanical pencils differs depending on the hardness of the pencil lead. Writing becomes darker as the lead becomes softer and it is possible without breaking the lead as it becomes harder. Therefore, leads are used in different applications depending on their hardness. For example, softer leads are used in sketching and harder leads are used in drafting technical drawings.

The leads of mechanical pencils are made by compounding graphite and resin. After extrusion molding, the compound is baked at approximately 1200 °C and then impregnated with an oily material to impart depth of color and lubricity.

The symbols B and H mean “black” and “hard,” respectively, and HB means “hard & black,” an intermediate quality between H and B. Accordingly, the order of hardness of mechanical pencil leads is 2H > H > HB > B > 2B.

Although the symbols B and H are defined by the density drawn on drawing paper by a density measurement machine, there is no scientific definition of pencil lead hardness. Therefore, the following introduces an example of a hardness test of mechanical pencil leads. The hardness of mechanical pencil leads was confirmed by using a SHIMADZU DUH-211 Dynamic Ultra-micro Hardness Tester.

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Specimens

Table 1 shows the specimens used in the measurements, and Fig. 1 shows a schematic diagram of the test method. As specimens, 2H, H, HB, B, and 2B leads were selected from commercial mechanical pencil leads. These leads were inserted in a mechanical pencil, and the tip was flattened by polishing the end surface by drawing lines on paper (Fig. 1 (a)). Air was then blown on the tip of the lead to remove the dust resulting from polishing, and the test was performed with the pencil secured in a vise (Fig. 1 (b)).

Table 1 Specimens

Specimen Name	Mechanical Pencil Lead				
	2H	H	HB	B	2B
Specimen No.	No.1	No.2	No.3	No.4	No.5
Specimen Shape	Diameter: 0.5 mm, Length: 60 mm				

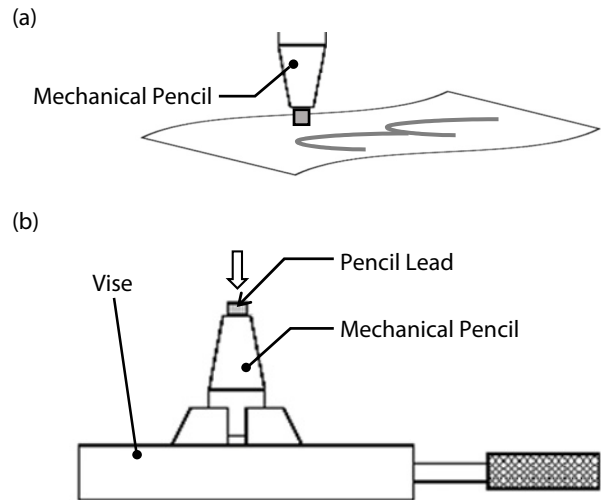


Fig. 1 Schematic Diagram of Test Method
(a) Polishing by Line Drawing
(b) Holding Method

Test Conditions and Instrument

Table 2 shows the test conditions, and Fig. 2 shows the SHIMADZU DUH-211 Dynamic Ultra-micro Hardness Tester. Although many types of characteristic values can be obtained with this instrument, it was used here to evaluate hardness by Martens hardness.

Table 2 Test Conditions

Instrument	: SHIMADZU DUH-211 Dynamic Ultra-micro Hardness Tester
Top Indenter	: Berkovich indenter (diamond)
Test Mode	: Load - Unload Test
Maximum Force (mN)	: 49.00
Loading Speed (mN/sec)	: 4.4413
Holding Time (sec)	: 15



Fig. 2 SHIMADZU DUH-211 Dynamic Ultra-micro Hardness Tester

