Determining the Surface Hardness of Paint Coatings – Pencil Testing vs. Instrumented Indentation Testing

Until recently, quick scratch testing with pencils to determine the hardness of paint coatings has been commonplace. However, the reliability and reproducibility of this method is questionable. Because of the stringent quality standards in the coating industry, it is necessary to be able to test the hardness of paint coatings reliably.

Determining the 'pencil hardness' – or better put, the scratch resistance by means of marking with pencils – according to Wolff Wilborn or DIN ISO 15184 is a method commonly used in the coating industry. With this method, pencils of different hardnesses are moved at a certain angle and with a certain force across the paint surface to be tested. The 'pencil hardness' of the coating is defined by two consecutive levels of pencil hardness, where the softer one leaves only a writing track, while the harder one actually causes a tangible deformation of the paint coating.

Fig. 1: FISCHERSCOPE® HM2000 S for the determination of the Martens Hardness

The shortcomings of this procedure lie in the poor reproducibility of the measurements. For one, the material under test will not always manifest the same properties, since pencil hardness is not clearly defined in any standard and there are distinct differences between individual manufacturers. Furthermore, the operator influence is significant. Thus, it is often impossible to interpret the results unambiguously.

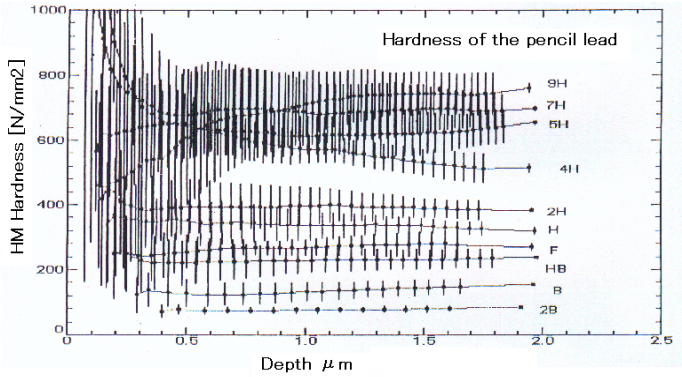

Fig. 2: Comparison of the Martens Hardness of pencils of different hardneses, shown with the standard deviation of the measurements

If one correlates the various pencil hardnesses with their Martens Hardness, the limitations of the method become even more obvious. Fig. 2 shows the results of multiple measurements on pencils of various hardness levels. Broad overlapping is apparent when one considers the standard deviations of the individual test series. In fact, especially in the upper range, the nominal hardness (B, HB, F, H, etc.) of pencils is not a dependable indicator of their actual hardness.

The FISCHERSCOPE® HM2000 S can measure the hardness of paint coatings directly and accurately. In addition, other characteristics can be determined, such as creep and relaxation behavior, as well as the modulus of elasticity. All of these hardness parameters provide a true indication of the paint quality.

FISCHERSCOPE® hardness measurement systems demonstrate that the actual hardness of a pencil can vary significantly from its nominal hardness, meaning *the pencil is not a dependable measuring device*. Therefore, a method employing a pencil as its key instrument cannot be expected to reliably assess the hardness of anything. For directly determining the surface hardness of e.g. paint coatings, the FISCHERSCOPE® HM2000 S, for example, will give you the same accurate, precise results – every time. Your local FISCHER partner will gladly provide additional information.