

# Introduction

## Hardness

The definition of hardness has, in the past, caused misunderstandings within the paint industry. Most coatings are viscoelastic, and hence will indent to some extent. Therefore, DIN 55 945 defines hardness as follows:

Hardness is the resistance of a coating to a mechanical force, such as pressure, rubbing or scratching.

In practice, different testing methods are used:

### Pendulum Hardness

– In accordance with methods described by König and Persoz

### Indentation Hardness

– Buchholz Indentation Testers

### Scratch Hardness

– Hardness Meter Dur-O-Test

– Pencil Hardness

For clear communication of test results, the technician needs to document the type of test method used, for example, "Indentation Resistance in accordance with ISO 2815" or "Damping Time in accordance with ISO 1522".

BYK-Gardner offers instrumentation needed to perform various hardness tests.



# HARDNESS

## Pendulum Hardness

This method evaluates hardness by measuring the damping time of an oscillating pendulum. The pendulum rests with 2 stainless steel balls on the coating surface. A physical relationship exists between oscillation time, amplitude and the geometric dimensions of the pendulum. The viscoelastic behavior of the coating determines its hardness.

When the pendulum is set into motion, the balls roll on the surface and put pressure on the coating. Depending on the elasticity, the damping will be stronger or weaker. If there are no elastic forces, the pendulum will damp stronger. High elasticity will cause weak damping.

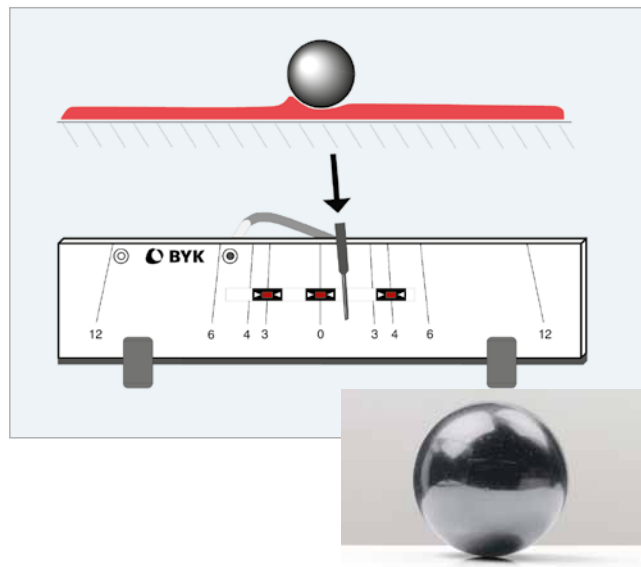
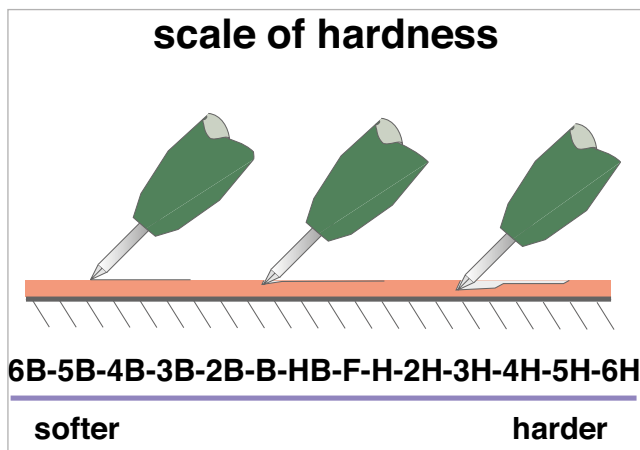
Two types of pendulums were standardized for this test method:

	König	Persoz
<b>Weight</b>	200 g ± 0.2	500 g ± 0.1
<b>Diameter</b>	0.2 in (5 mm)	0.3 in (8 mm)
<b>Deflection Start</b>	6°	12°
<b>Deflection End</b>	3°	4°
<b>Period of Oscillation</b>	1.4 s	1 s
<b>Damping Time on Glass</b>	250 ± 10 s	430 ± 10 s

## Scratch Hardness

An ideal test for the quick evaluation of finished products. The results do not correlate with any of the other methods of hardness measurement.

The scratch can be performed with either a metal pin (Dur-O-Test) or pencils. Pencils of various degrees of hardness are drawn over the coating surface to determine which pencil causes indentation. This method is only applicable for smooth surfaces.



## "Buchholz" Indentation Hardness

This test method is suitable for coatings with plastic deformation behavior. Coatings with elastic deformation behavior should not be evaluated with this test method, because after removal of the instrument an elastic coating will show no or very little indentation.

The instrument consists of a double cone block, which is placed on the coating for 30 seconds. Indentation is measured with the help of a precision microscope and is then calculated according to the following equation:

$$\text{Indentation Resistance (Buchholz)} = \frac{100 \text{ mm}}{\text{Indentation Length}}$$

