

# Rockwell Hardness HR45N Scale Definition

Reference values for HR45N				
Symbol	Test parameter	Reference value	Start measurement	Stop measurement
$F_0$	Preliminary test force	29,419 95 N <sup>1</sup>	-	-
$F$	Total test force	441,299 25 N <sup>1</sup>	-	-
$\alpha$	Included angle of the indenter cone (between surface axial-plane line segments)	120°	Line segment start: $\pm 30^\circ$ (from the axis) <sup>2</sup>	Line segment end: 400 $\mu\text{m}$ on conical surface
$r$	Spherical tip radius of the indenter	200 $\mu\text{m}$	$-30^\circ$ (from the axis) <sup>2</sup>	$+30^\circ$ (from the axis) <sup>2</sup>
$t_{pa}$	Application time of preliminary test force	0,2 s $\leq t_{pa} \leq$ 2 s	$\sim 1\% F_0$	$\sim 99\% F_0$
$t_{pd}$	Duration time of constant preliminary test force before initial measurement	$(3 - t_{pa}/2)$ s	$\sim 99\% F_0$	Measurement
$t_{aa}$	Application time of additional test force	$\leq 4$ s <sup>3</sup>	$\sim 101\% F_0$	$\sim 99\% F$ (loading)
$v_{fa}$	Mean indentation velocity of final additional test force application	30 $\mu\text{m}\cdot\text{s}^{-1}$	$\sim 80\% F$	$\sim 99\% F$
$t_{td}$	Duration time of total test force	5 s	$\sim 99\% F$ (loading)	$\sim 99\% F$ (unloading)
$t_{ar}$	Removal time of additional test force	$\leq 2$ s	$\sim 99\% F$ (unloading)	$\sim 101\% F_0$
$t_{rd}$	Duration time of recovery force before final measurement	4 s	$\sim 101\% F_0$	Measurement
$T$	Temperature of test	23 °C	Start of test	End of test

<sup>1</sup> The defined values of preliminary test force and total test force are the SI equivalents of the original Rockwell hardness method-defined forces of 3 kgf and 45 kgf, respectively, converted to N by multiplying the kgf values by the conversion factor 9,806 65.

<sup>2</sup> These dimensions define the theoretical points of blend between the spherical tip and conical surface of the diamond indenter (see Figure 2). The actual points of blend are usually different; therefore, the blend areas should not be included in the measurement of the tip radius or cone angle.

<sup>3</sup> The value of  $t_{aa}$  is dependent on the hardness of the material under test. The stated range of  $\leq 4$  s is to maintain compliance with consensus standards.

Figure 1. Illustrations of the applied force and the resulting indentation-depth occurring during the HR45N test cycle.

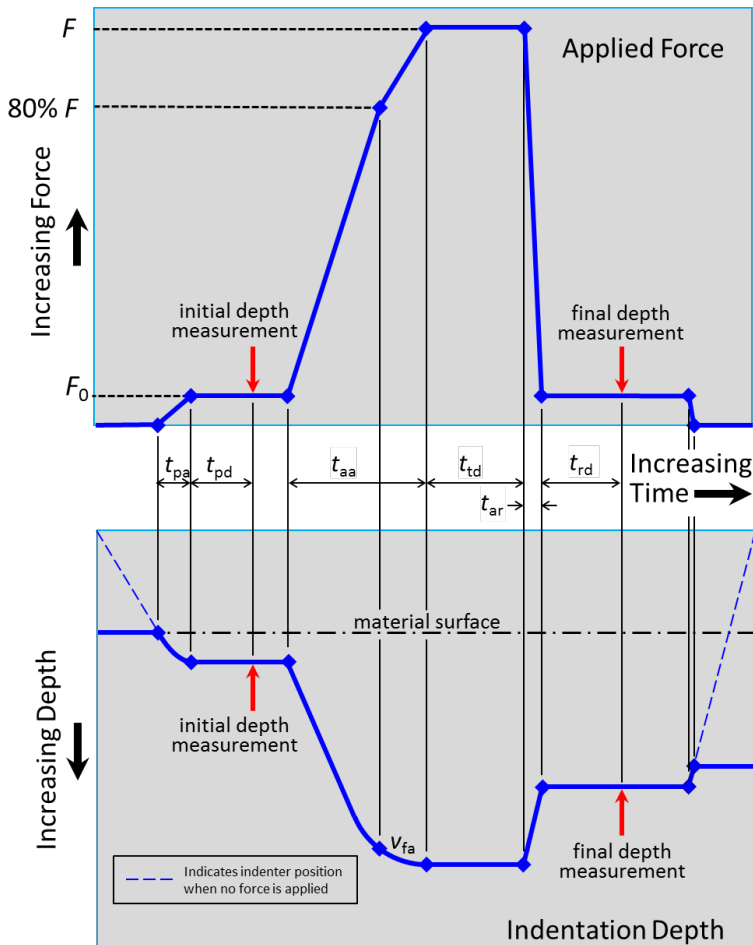


Figure 2. Illustration of the axial cross-section of an ideally-shaped diamond indenter indicating the dimensions specified above and the theoretical points of blend between the spherical tip and conical surface.

