

# Rockwell Superficial Hardness Test

The Rockwell Superficial hardness test method consists of indenting the test material with a diamond cone (N scale) or hardened steel ball indenter. The indenter is forced into the test material under a preliminary minor load  $F_0$  (Fig. 1A) usually 3 kgf. When equilibrium has been reached, an indicating device that follows the movements of the indenter and so responds to changes in depth of penetration of the indenter is set to a datum position. While the preliminary minor load is still applied an additional major load, is applied with resulting increase in penetration (Fig. 1B). When equilibrium has again been reached, the additional major load is removed but the preliminary minor load is still maintained. Removal of the additional major load allows a partial recovery, so reducing the depth of penetration (Fig. 1C). The permanent increase in depth of penetration,  $e$ , resulting from the application and removal of the additional major load is used to calculate the Rockwell Superficial hardness number.

$$HR = E - e$$

$F_0$  = preliminary minor load in kgf

$F_1$  = additional major load in kgf

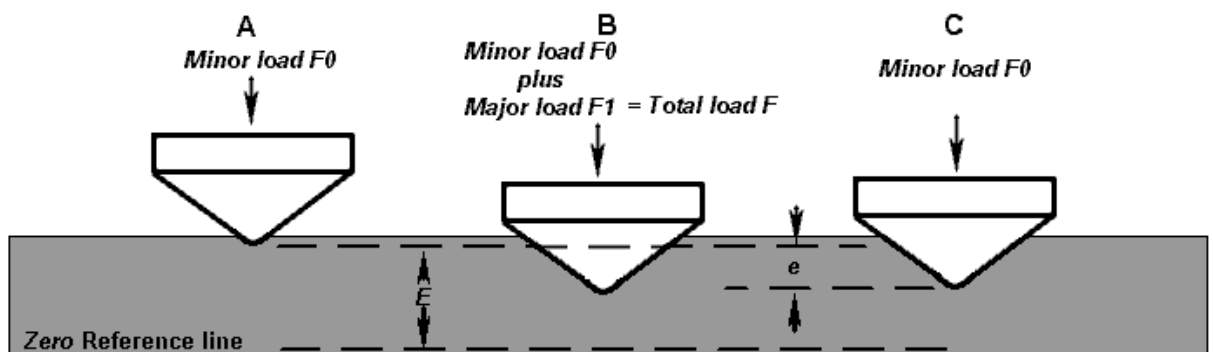
$F$  = total load in kgf

$e$  = permanent increase in depth of penetration due to major load  $F_1$ , measured in units of 0.001 mm

$E$  = a constant of 100 units for diamond and ball indenters

HR = Rockwell hardness number

$D$  = diameter of steel ball



**Fig. 1. Rockwell Superficial Principle**

**Rockwell Superficial Hardness Scales**

Scale	Indenter Type	Minor Load <i>F</i> <sub>0</sub> kgf	Major Load <i>F</i> <sub>1</sub> kgf	Total Load <i>F</i> kgf	Value of E
HR 15 N	N Diamond cone	3	12	15	100
HR 30 N	N Diamond cone	3	27	30	100
HR 45 N	N Diamond cone	3	42	45	100
HR 15 T	1/16" steel ball	3	12	15	100
HR 30 T	1/16" steel ball	3	27	30	100
HR 45 T	1/16" steel ball	3	42	45	100
HR 15 W	1/8" steel ball	3	12	15	100
HR 30 W	1/8" steel ball	3	27	30	100
HR 45 W	1/8" steel ball	3	42	45	100
HR 15 X	1/4" steel ball	3	12	15	100
HR 30 X	1/4" steel ball	3	27	30	100
HR 45 X	1/4" steel ball	3	42	45	100
HR 15 Y	1/2" steel ball	3	12	15	100
HR 30 Y	1/2" steel ball	3	27	30	100
HR 45 Y	1/2" steel ball	3	42	45	100