

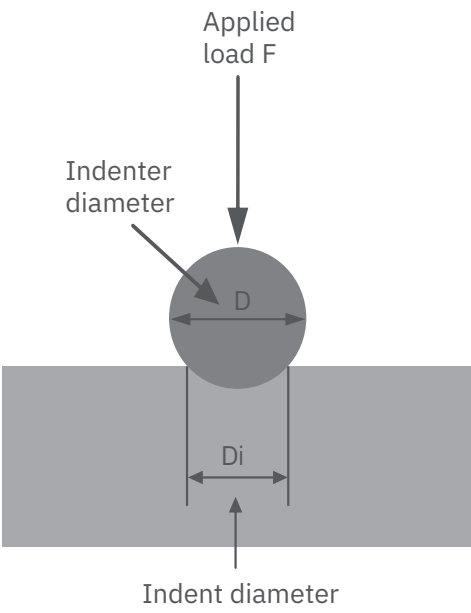
HARDNESS TESTING ON METALLIC MATERIALS

BRINELL EN ISO 6506

Brinell Hardness HBW

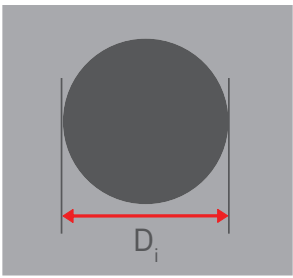
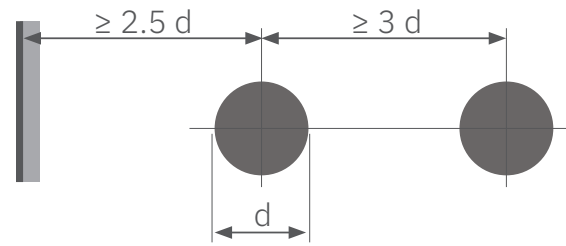
HBW (HB): Brinell hardness
F: Test load (kgf)
D: Ball (indenter) diameter (mm)
D_i: Indent diameter (mm)

$$HBW = \frac{F}{\pi D \sqrt{D^2 - D_i^2}}$$



Impression- and edge distance

In order that the results will not be affected, the following distances have to be kept:



Material	Hardness- abbreviation	Penetrator carbide ball	Load	Load factor 0.102 x F / D ²	Hardness range HBW
Steel/iron	HBW 1/30	1 mm	30 kp	30	95-650
	HBW 2.5/187.5	2.5 mm	187.5 kp		
	HBW 5/750	5 mm	750 kp		
	HBW 10/3000	10 mm	3000 kp		
Light metal: copper / aluminium aluminium alloy copper alloy	HBW 1/10	1 mm	10 kp	10	32-220
	HBW 2.5/62.5	2.5 mm	62.5 kp		
	HBW 5/250	5 mm	250 kp		
	HBW 10/1000	10 mm	1000 kp		
Light metal: copper / aluminium aluminium alloy without heat treatm.	HBW 1/5	1 mm	5 kp	5	16-110
	HBW 2.5/31.25	2.5 mm	31.25 kp		
	HBW 5/125	5 mm	125 kp		
	HBW 10/500	10 mm	500 kp		
Light metal: smaller 35 HBW	HBW 1/2.5	1 mm	2.5 kp	2.5	8-55
	HBW 2.5/15.625	2.5 mm	15.625 kp		
	HBW 5/62.5	5 mm	62.5 kp		
	HBW 10/250	10 mm	250 kp		

Minimum thickness of the sample in relation to the mean indentation diameter

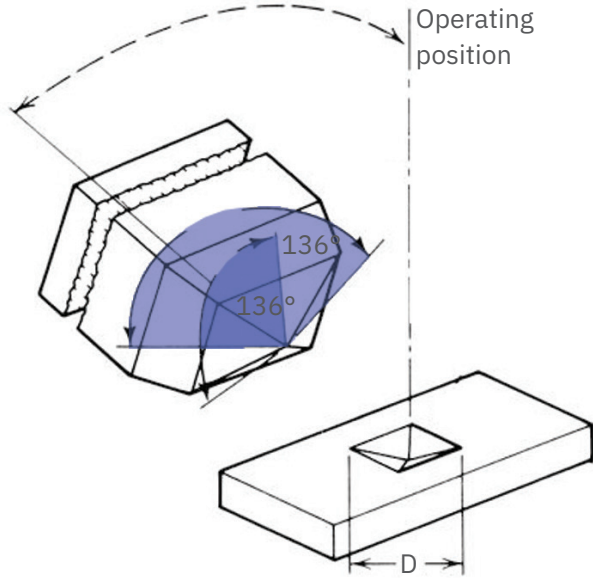
Mean indentation Ø mm	Min. thickness of sample mm				Mean indentation Ø mm	Min. thickness of sample mm			
	Ball diameter mm					Ball diameter mm			
	1	2.5	5	10		1	2.5	5	10
0.2	0.12				2.4			2.45	1.17
0.3	0.18				2.6			2.92	1.38
0.4	0.33				2.8			3.43	1.60
0.5	0.54				3.0			4.00	1.84
0.6	0.80	0.29			3.2				2.10
0.7		0.40			3.4				2.38
0.8		0.53			3.6				2.68
0.9		0.67			3.8				3.00
1.0		0.83			4.0				3.34
1.1		1.02			4.2				3.70
1.2		1.23	0.58		4.4				4.08
1.3		1.46	0.69		4.6				4.48
1.4		1.72	0.80		4.8				4.91
1.5		2.00	0.92		5.0				5.36
1.6			1.05		5.2				5.83
1.7			1.19		5.4				6.33
1.8			1.34		5.6				6.86
1.9			1.50		5.8				7.42
2.0			1.67		6.0				8.00
2.2			2.04						

VICKERS EN ISO 6507

Vickers Hardness HV

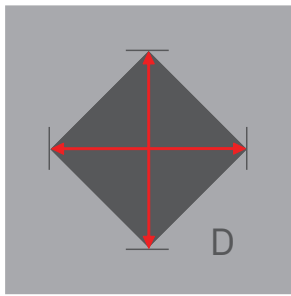
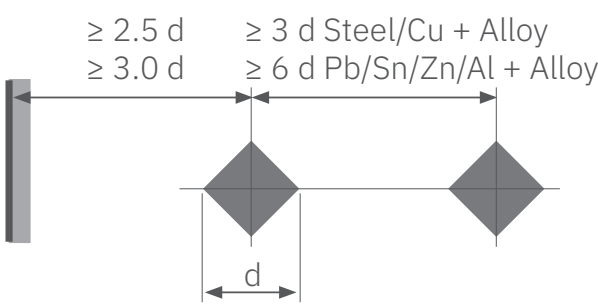
HV: Vickers hardness
F: Test load (gf)
D: Average diagonal length (µm)

$$HV = 1854.4 \frac{F}{D^2}$$



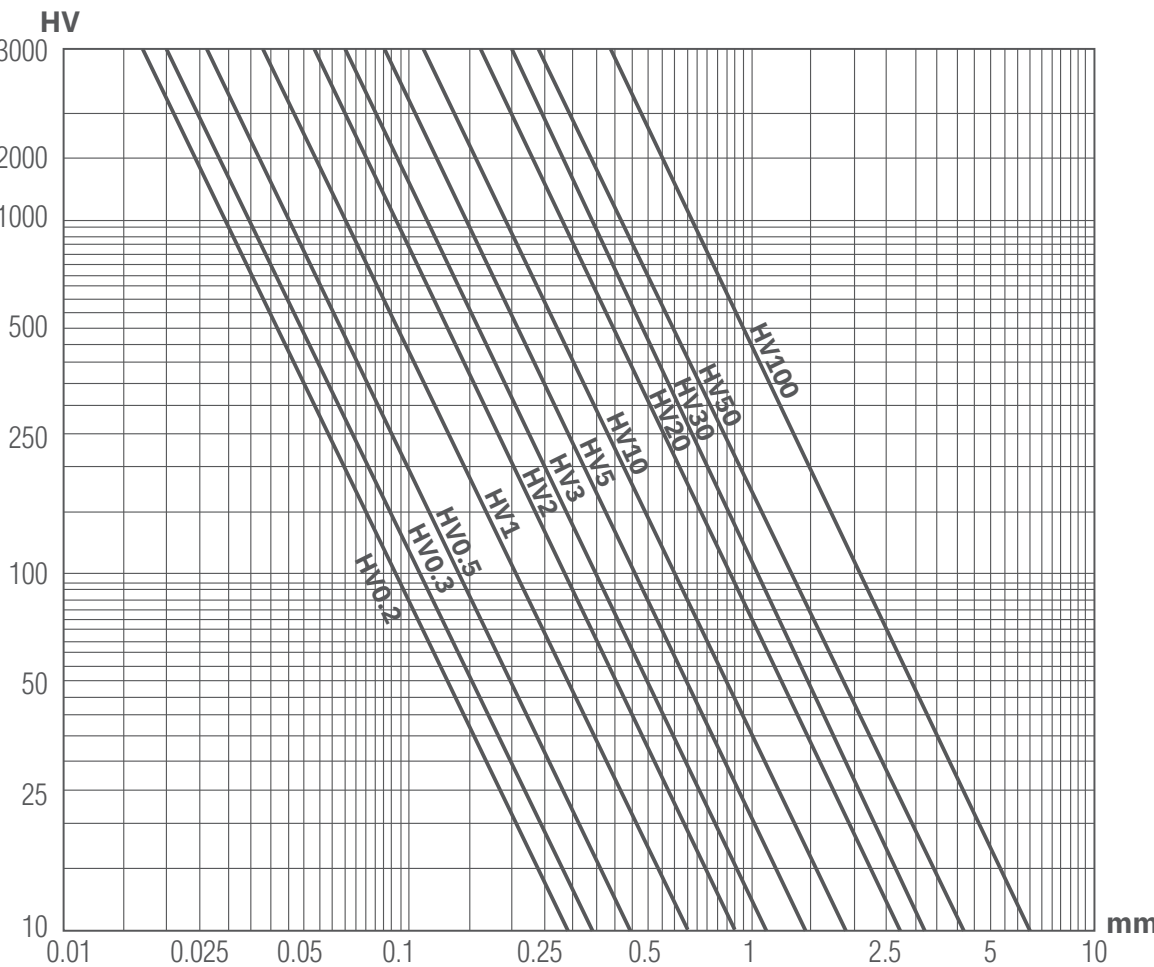
Impression- and edge distance

In order that the results will not be affected, the following distances have to be kept:



	Hardness- abbreviation	Penetrator	Load	Application	
Micro hardness range	HV 0.01 HV 0.02 HV 0.05 HV 0.1 HV 0.2	Diamond pyramid 136°	0.01 kp 0.02 kp 0.05 kp 0.1 kp 0.2 kp	Structure component very thin coats	Range 10 HV - 3000 HV
Low load hardness range	HV 0.2 HV 0.3 HV 0.5 HV 1 HV 2 HV 3 HV 5	Diamond pyramid 136°	0.2 kp 0.3 kp 0.5 kp 1 kp 2 kp 3 kp 5 kp	Thin coats Eht-/Rht-/Nht-range thin sheets small components	
Conventional hardness range	HV 5 HV 10 HV 20 HV 30 HV 50 HV 100	Diamond pyramid 136°	5 kp 10 kp 20 kp 30 kp 50 kp 100 kp	Common components	

Minimum thickness (hardness coat) of the sample in relation to the test load and to the Vickers hardness



ROCKWELL EN ISO 6508

Rockwell Hardness HR

HR = E - e

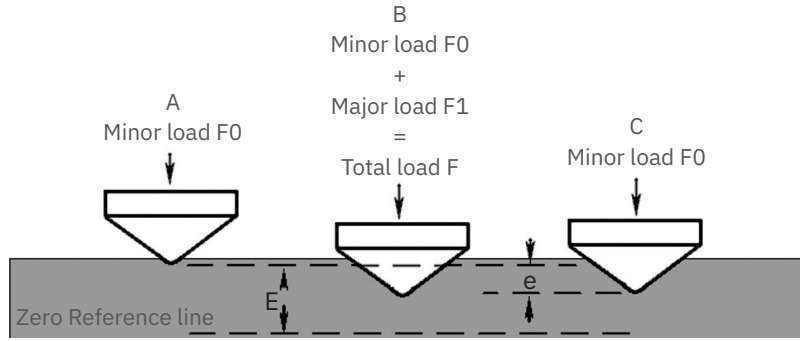
E = a constant of 100 (diamond) or 130 (ball) units
e = the penetration depth in units of 0.002 mm

Example 1:

60 HRC: e = 100 - 60 = 40; 40 x 0.002 mm = 0.08 mm

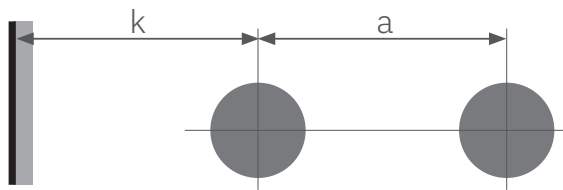
Example 2:

e = 0.05 mm => HR = 100 - (0.05 / 0.002) = 75 HRC



Impression- and edge distance

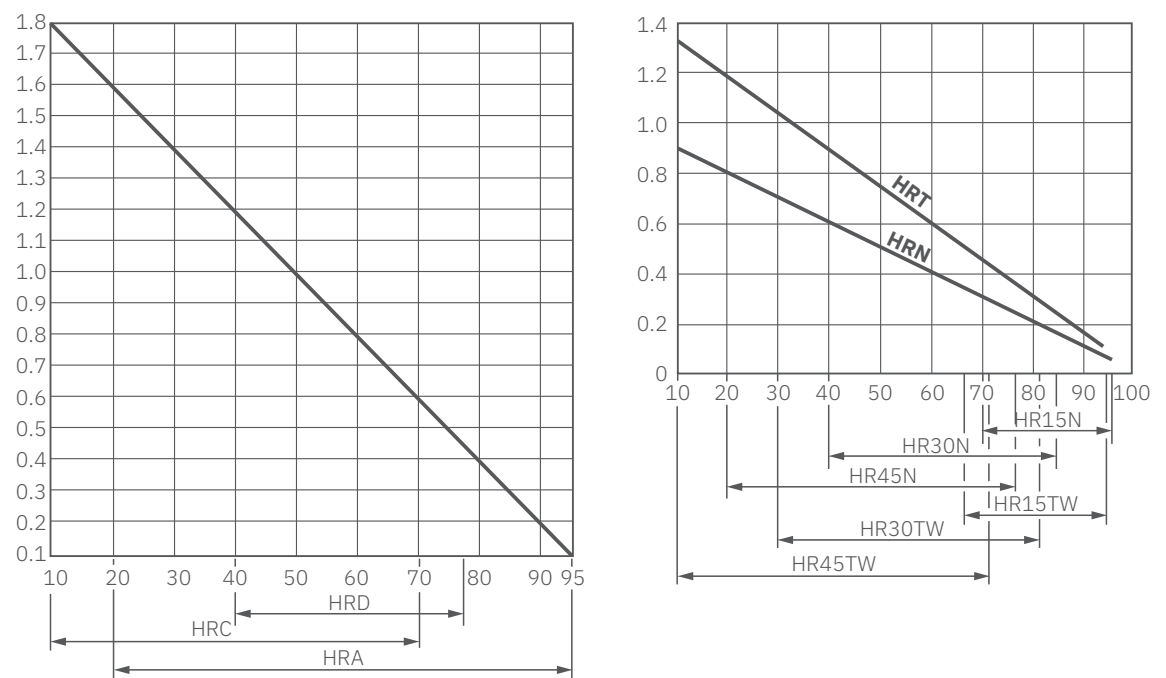
In order that the results will not be affected, the following distances have to be kept:



Process HR	Edge distance (k in mm)	Impression distance (a in mm)
A, C, B, F	3	3
N	1	1
T	2	2

Abbreviation for test methods	Penetrator	Pre-load F ₀	Additional load F ₁	Main-load F	Application range (Range of Rockwell hardness)
HRA	Diamond cone	98.07 N	490.3 N	588.6 N	20 - 88 HRA
HRB	Ball 1.587 5 mm	98.07 N	882.6 N	980.7 N	20 - 100 HRB
HRC	Diamond cone	98.07 N	1.373 kN	1.471 kN	20 - 70 HRC
HRD	Diamond cone	98.07 N	882.6 N	980.7 N	40 - 77 HRD
HRE	Ball 3.175 mm	98.07 N	882.6 N	980.7 N	70 - 100 HRE
HRF	Ball 1.587 5 mm	98.07 N	490.3 kN	588.4 N	60 - 100 HRF
HRG	Ball 1.587 5 mm	98.07 N	1.373 kN	1.471 kN	30 - 94 HRG
HRH	Ball 3.175 mm	98.07 N	490.3 kN	588.4 N	80 - 100 HRH
HRK	Ball 3.175 mm	98.07 N	1.373 kN	1.471 kN	40 - 100 HRK
HR15N	Diamond cone	29.42 N	117.7 N	147.1 N	70 - 94 KR15N
HR30N	Diamond cone	29.42 N	264.8 N	294.2 N	42 - 86 HR30N
HR45N	Diamond cone	29.42 N	411.9 N	441.3 N	20 - 77 HR45N
HR15T	Ball 1.587 5 mm	29.42 N	117.7 N	147.1 N	67 - 93 HR15T
HR30T	Ball 1.587 5 mm	29.42 N	264.8 N	294.2 N	29 - 82 HR30T
HR45T	Ball 1.587 5 mm	29.42 N	411.9 N	441.3 N	10 - 72 HR45T

Minimum thickness (hardness coat) of the sample in relation to Rockwell hardness



HRA, HRC, HRD

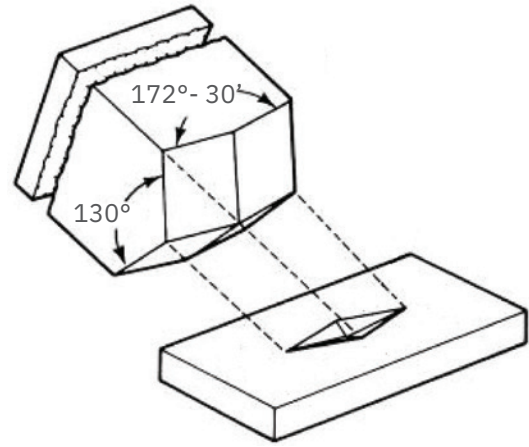
HR15N, HR30N, HR45N
HR15TW, HR30TW, HR45TW

KNOOP EN ISO 4545

Knoop Hardness HK

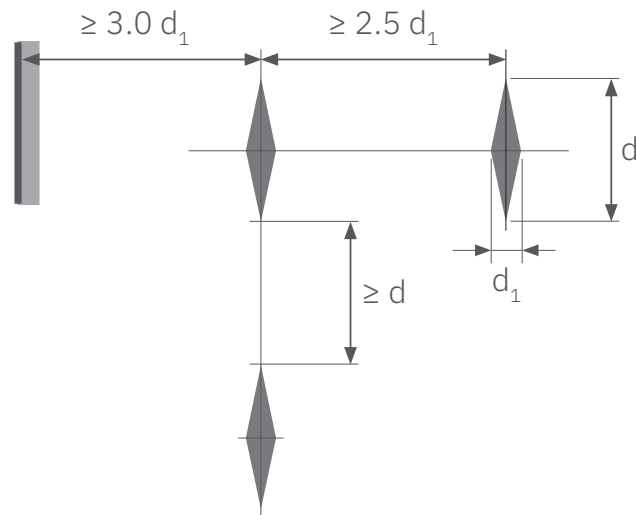
HK: Knoop hardness
F: Test load (gf)
L: Long diagonal length (µm)

$$HK = 14229 \frac{F}{L^2}$$



Impression- and edge distance

In order that the results will not be affected, the following distances have to be kept:



Hardness- abbreviation	Indenter	Load F	Application
HK 0.01	Diamond pyramid 172.5° / 130°	0.09807 N	Very thin coats
HK 0.025		0.2452 N	
HK 0.05		0.4903 N	
HK 0.1		0.9807 N	Very thin coats Mounted samples Serial measurements
HK 0.2		0.961 N	
HK 0.3		2.942 N	
HK 0.5		4.903 N	Very thin coats
HK 1		9.807 N	
HK 2		19.614 N	

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information about
Struers' hardness
testers

