Shown w/optional digital indicator-3814E

Rockwell Hardness Tester

Model No. 3814

Operation Manual

Operating Instructions & Parts Manual

Please read and save these instructions. Read carefully before attempting to assemble, install, operate or maintain the products described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain Instructions for future reference.

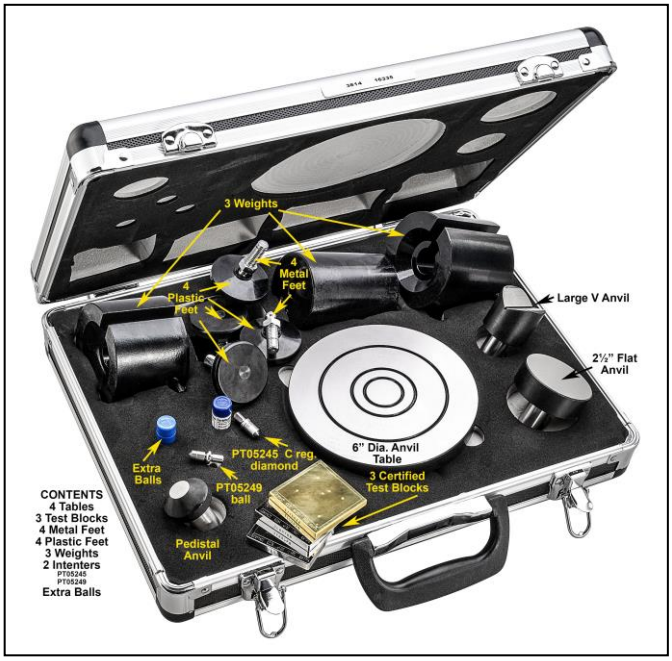
Description

The Starrett 3814 accurately measures hardness of materials in Rockwell hardness A, B, and C scales. Heat-treated steels are tested using a 120° diamond indenter in the C-scale (HRC 20-70). Soft materials are tested using a 1/16" carbide ball indenter in the B-scale (HRB 25-100). Very hard materials are tested using a 120° diamond indenter in the A-scale (HRA 20-88). Tester features a weight adjustment handle for quick and easy adjustments between different scales. Release and reset levers are provided for quick and accurate testing. The 3814 includes standard, large and V-shaped anvils for holding small, large and round or curved materials. Storage box, 3-test blocks, 120° diamond indenter, 1/16" ball indenter are provided.

Unpacking

Loose Parts Storage Box:

A. Large Anvil
B. Small Diameter Anvil
C. V-shaped Anvil
D. Four Test Blocks
E. 120° Diamond Indenter
F. 1/16" Steel Ball indenter



Remove 4-nuts from side panels of crate.
Carefully lift crate up from base. Leave the tester bolted to crate bottom.
Remove storage box from crate.

IMPORTANT!

Do Not Discard Shipping Crate as This May be Needed for Future Transportation.

Basic Set Up Information:

1) Loosen the 4 nuts on the bottom of the crate. Lift the crate off the platform being careful not to scratch the side of the hardness tester
2) Remove the tool kit from the platform
3) Remove the plastic dust cover
4) Remove the string holding the handles and top cover of the machine
5) Remove the two front screws and lift the top cover straight up and off the machine. (See pic below)
6) Remove the rubber band holding the indicator lever and discard it.
7) Remove the back cover of the machine by removing the 2 phillips head screws from the top and bottom of this cover
8) Carefully remove the string that is holding the weight bar to the loading bar
9) Remove the weight bar from the loading arm by lifting the hook of the bar from the loop on the arm.
10) Remove the 2-nuts from the bottom of the bar.
11) Open the test kit and remove the 3 weights. Clan and oil/grease from these weights.
12) Take the round weight marked "A" or "1" and slide it up the bottom of the weight bar and proceed to place both nuts back on the threaded part of the weight bar effectively holding the round weight in place.
13) Carefully place the weight bar back in the loop of the loading arm with the hook facing the front of the machine.
14) Place weight "B" or "2" and place on the middle section of the weight bar keeping the flat side of the weight facing the rear of the machine. Place weight "C" or "3"on top of the weight bar keeping the flat part towards the rear of the machine.
15) Install the rear cover with the 2-screws.
16) Install the top cover by placing it straight down while lining up the pins on each side.
17) Lower the rotary handle and remove the black plastic shaft protector. Keep this for future safety use.
18) Choose the applicable work table (anvil) and install on the machine.
19) Remove the Diamond penetrator from the tool kit and install in the penetrator shaft making sure the flat lines up with the set screw on this shaft. Be sure that the diamond sits flush inside this shaft. See "Seating Diamond" section in this manual prior to testing. Do not overtighten this set screw!
20) Remove all C-scale test blocks from the tool kit and clean off all grease or oil from both sides.
21) Set the weight selector know to 1471 (150kg).
22) Place one of these test blocks on the anvil and rotate until the block just makes contact with the diamond. Begin to turn the rotary handle making sure the large needle on the dial goes around 3 times. On the 3rd time you must be sure that you stop when the large needle lands on the "0" at top dead center.
23) Push the black handle towards the rear of the machine. At this time the tester is putting the load on the test block and you will see that the large needle will slowly move counter-clockwise. Once the needle stops moving you need to pull the black handle back towards the front of the machine. At this time you take the reading off the black numbers off the dial. Repeat this a minimum of 5 times to achieve an accurate reading.

Example of Weight installation

Adding Oil to the Handle Buffer

When moving the Load/Unload handle and you feel it make fast hard contact or hear a suction noise then its time to check the oil buffer.
On the left side of the machine (when standing in front of it) there is a small metal access plate held on by 2 small screws. Remove the screws and plate to expose the valve and reservoir.
Push the Load/Unload handle towards the back of the machine. Gently lift up the felt pad and carefully add high grade hydraulic oil into the hole.
Begin pulling/pushing the Load/Unload handle back and forth until any suction noise has disappeared.
Replace access plate.

Scale	Indentor	Total force (Kg-F)	Hardness Range
A	120 Diamond	98.07N (60kgf)	HRA 20-88
B	1/16" Ball	980.7N (100kgf)	HRB 25-100
C	120 Diamond	1471 (150kgf)	HRC 20-70

See Page 13 for full Weight Load/Scale/Indenter Chart

General Safety Instructions

1. Never use clamps, straps, any other tooling or equipment to mount specimen to the tester anvil.
2. Always use the proper anvil supplied.
3. Be sure to use proper indenter and weight for material and hardness to be tested. (See Figure 3).

Hardness Tester Should Be Maintained

1. Consult operation instructions for specific maintaining and adjusting procedures.
2. Keep the tool clean for best results.
3. Remove adjusting tools and wrenches. Form habit of checking that adjusting tools are removed before using machine.
4. Keep all parts in working order. Check to determine that the parts will operate properly and perform their intended function.
5. Check for damaged parts. Check for alignment, binding, breakage, mounting and any other condition that may affect tool's operation.
6. Part that is damaged should be properly repaired or replaced. Do not perform makeshift repairs. (Use the parts list provided to order replacement parts.)

Installation

Hardness Tester must be installed in a dust and vibration free environment. Mount tester to a support bench or table for a load of at least 500 lbs.

1. Position tester on support surface as desired, mark location of the 4 mounting holes in the corners of the frame base and for the elevation screw on the support surface.
2. Drill 10mm (7/16") diameter holes at the 4 mounting hole locations. Drill a 2" diameter hole for the elevation screw.

Caution: The hardness tester will not open to its full capacity unless the elevation screw is allowed to pass through a hole on the support surface.

3. Bolt tester to support surface securely using the 4 each hex head bolts or use longer 10-1.5mm bolts if required.

Be sure tester is level both front/back and left/right to 0.002 in/in.

Basic Set-Up Information:

1) Remove Top crate cover from base. Carefully lift straight up to avoid scratching the side of the machine
2) Remove the tool kit and manual from the base of the crate
3) Remove plastic machine cover
4) With assistance, remove the two bolts under the base of the crate to remove the machine from the base.
5) Place machine on a sturdy vibration free table or bench. Bench should be rated for up to 500lbs.
6) It is recommended that the machine gets bolted to the table. To do this you should reference Figure 1 shown below

Seating Your Diamond:

Caution: To ensure accuracy, mount the indenter by sliding it in the holder as far as possible and then securing the indenter by tightening the set screw finger-tight only.
Place HRC test block on the small round anvil and begin by turning the handwheel clockwise until the block just touches the diamond. At this point, continue rotating the handwheel until the large needle goes around approx. 3 revolutions. Let the machine sit idle for a few seconds and then loosen the set screw. Wait a few more seconds and then tighten the set screw back up. This will allow the diamond to be "seated" in the shank. Take the load off by turning the handwheel counter-clockwise and you can begin following instructions below.

Rotate the weight adjustment knob until the required weight scale is aligned with the alignment mark on the frame of the machine.

1. Prepare the test specimen properly. Be sure that the top and bottom surfaces of the specimen are clean and free of any grease, oil dirt, etc and free of any burrs or debris.
2. For small specimens (under 3" maximum length or diameter) use the small round anvil. Use the large anvil for larger specimens. Use the V-shaped anvil for round or curved specimens.

Warning!

Do not test any specimen that cannot be safely and properly positioned on and supported by the tester anvil.

Operation:

Determine the proper indenter, scale and weight for the material hardness to be tested (see last page in manual). Mount the required indenter in the indenter holder using the set screw on the side of the holder.

Test Procedure

Test procedure consists of a preload of the specimen using the force of the elevation screw and a test load using the weights and lever arm assembly. Be sure that the weight reset handle is in rest("unload") position.

1. Mount specimen on required anvil. Rotate the elevation screw threaded collar clockwise slowly until the specimen contacts the indenter. Be sure to position specimen so the indenter contacts clean, untested material.
2. Preload the specimen by rotating the leadscrew collar slowly until the large needle on the dial indicator rotates three (3) revolutions. Stop rotation of handwheel when the large needle is within 3 hash marks of vertical(TDC)

Caution: As the large needle is properly rotated 3 revolutions, the small needle rotates counterclockwise 90° to vertical at the red dot. If the large needle overshoots vertical by more than 5 hash marks, the test is invalid and must be repeated from step 1.

3. Rotate the bezel so that the hash mark at the "0" mark at the top of the dial is aligned with the large needle.
4. Pull the weight release handle to apply the major load. Wait until the large needle stops rotating, approx. 5-8 seconds. This 5-8 second "dwell" time can be adjusted by turning valve on dashpot.
5. Slowly push the weight reset handle back until it resets and locks in the reset position.
6. Read the material hardness from the required scale on the dial.
7. Rotate the handwheel counterclockwise to lower and release the specimen.

Figure 4 - Dial Indicator

Maintenance

1. Be sure elevation screw and threaded collar are clean and lubricated. Lubricate with general purpose light duty oil.
2. Keep top of leadscrew, collar and anvils clean and free of grease, oil, dirt, burrs, etc.
3. Use the test blocks periodically to check tester accuracy. Use an oil sharpening stone to remove the burrs from the test blocks.

Fine adjustment for 3814

IMPORTANT!

Please follow these instructions before making any adjustments:

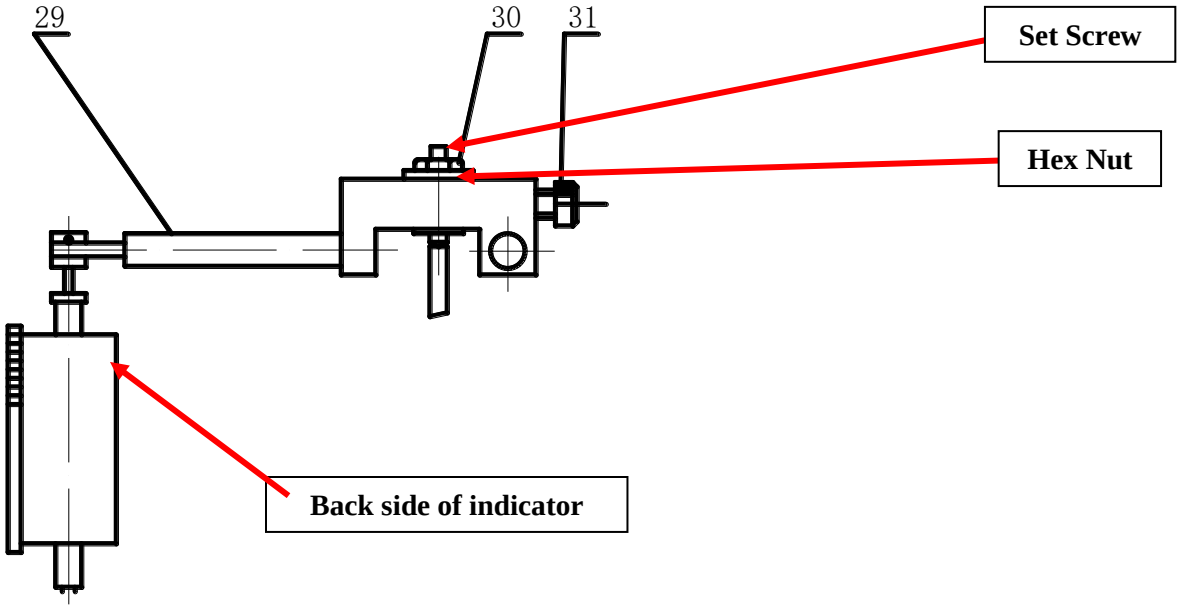
1) Be sure that ALL packaging material is removed from inside and outside of the machine.
2) Be sure that all three weights are in the correct position on the weight bar.
3) Make sure the machine is placed on a very sturdy bench as any movement will likely change calibration over time. Level the machine by releasing the weights and making sure they move only straight up and down. Adjust feet to counteract any front to back or side to side motion.
4) Install the Diamond Penetrator (chrome) in to the machine
5) Set weight dial on 150kg (1471n)
6) Clean off and install the small round anvil
7) Clean off all HRC (Rockwell C) test blocks and place one on the anvil for testing.
8) Make sure the Load/Unload handle is in the UNLOAD position. (towards front of machine)
9) Take note of the dial. The large needle on the dial should be slightly to the left of the HRC "0". Digital Indicators should be set to zero.
10) Turn the handwheel to bring the test block up until it just touches the Diamond.
11) Continue turning up the handwheel until the large needle on the dial goes around 3 full revolutions. On the 3rd rev make sure to stop when the large needle is TDC on the HRC "0". Digital Indicators you should stop between 285 and 290 as side bar raises to the dot.
12) Release the Load/unload handle back to load position. This puts the main load on the machine. The large needle on the dial will begin to turn counter clockwise.
13) Once needle stops moving (approx. 5-8 seconds) move the load/unload handle forward to unload position and then take your reading. The black numbers are HRC scale. Digital indicators wait till numbers stop and count dwell time.

Please be sure to make very slight adjustments when calibrating the 3814 as this machine is extremely sensitive to any movement.

Always test first in Rockwell C scale. Install diamond indenter and set weight selector to 150kg(1471). Remove the top cover from the 3814.

Adjusting the Indicator needle starting point:
While holding this screw steady, carefully loosen the set screw hex nut. By a slight turn of the set screw, you will see the large needle on the dial begin to move.
Move to rest position which is 3 lines left of center.

Compensation adjustment for calibration:
Loosen the set screw hex nut. Facing the back of the machine, turn the knurled knob #31 clockwise to increase the number and counterclockwise to decrease the number. Take a minimum of 3 tests on your test block to make sure the machine is reading correctly. If readings are low or high you will need to raise or lower as just described. Make sure you start with indicator at rest position which is 3 lines left of center on analog or set to zero on digital as the indicator setting may move during knurled knob adjustment.



Troubleshooting Chart

Symptom	Possible cause(s)	Corrective Action
Incorrect hardness measurement	1. Contaminants effecting measurement 2. Elevation screw cover is interfering with specimen, anvil or elevation screw. 3. Indentor is damaged. 4. Dash pot is low on oil.	1. Be sure the anvil, top of elevation screw, threaded collar, indentor and specimen are all clean and free of oil, grease, dirt, shavings, debris, etc. 2. Be sure elevation screw cover and top is clean and free of any dirt, oil, grease, etc. Position cover properly on the elevation screw well below the anvil. 3. Inspect indentor for damage, replace diamond indentor if chipped or broken, replace 1/16" steel ball if deformed or damaged. 4. Refill dash pot, see Maintenance, above.
When using the test block, a different hardness is measured at different locations on the block.	1. Burrs on bottom of test block. 2. Air trapped under test block.	1. Use oil sharpening stone to remove burrs. 2. When testing different locations on a test block, slide test block on anvil, maintaining contact between anvil and block.
Dial indicator needle rotates too fast at start of test	1. Dash pot is low on oil.	1. Refill dash pot See Maintenance, above.

Approximate Hardness Conversion Numbers for Non-Austenitic Steels (Rockwell C Hardness Range)[A]

		Brinell Hardness Number[C]			Rockwell		Superficial Rockwell Number			
Rockwell C 150kgf (HRC)	Vickers (HV)	10-mm Standard ball 3000kgf (HBS)	10-mm Carbide ball 3000kgf (HBW)	Knoop 500-gf and Over (HK)	A Scale 60 kgf (HRA)	D Scale 100kgf (HRD)	15-N Scale 15-kgf (HR15N)	30-N Scale 30-kgf (HR30N)	45-N Scale 45-kgf (HR45N)	Scleroscope Hardness[B]
68	940	...	...	920	85.6	76.9	93.2	84.4	75.4	97.3
67	900	...	...	895	85.0	76.1	92.9	83.6	74.2	95.0
66	865	...	...	870	84.5	75.4	92.5	82.8	73.3	92.7
65	832	...	(739)	846	83.9	74.5	92.2	81.9	72.0	90.6
64	800	...	(722)	822	83.4	73.8	91.8	81.1	71.0	88.5
63	772	...	(705)	799	82.8	73.0	91.4	80.1	69.9	86.5
62	746	...	(688)	776	82.3	72.2	91.1	79.3	68.8	84.5
61	720	...	(670)	754	81.8	71.5	90.7	78.4	67.7	82.6
60	697	...	(654)	732	81.2	70.7	90.2	77.5	66.6	80.8
59	674	...	634	710	80.7	69.9	89.8	76.6	65.5	79.0
58	653	...	615	690	80.1	69.2	89.3	75.7	64.3	77.3
57	633	...	595	670	79.6	68.5	88.9	74.8	63.2	75.6
56	613	...	577	650	79.0	67.7	88.3	73.9	62.0	74.0
55	595	...	560	630	78.5	66.9	87.9	73.0	60.9	72.4
54	577	...	543	612	78.0	66.1	87.4	72.0	59.8	70.9
53	560	...	525	594	77.4	65.4	86.9	71.2	58.6	69.4
52	544	(500)	512	576	76.8	64.6	86.4	70.2	57.4	67.9
51	528	(487)	496	558	76.3	63.8	85.9	69.4	56.1	66.5
50	513	(475)	481	542	75.9	63.1	85.5	68.5	55.0	65.1
49	498	(464)	469	526	75.2	62.1	85.0	67.6	53.8	63.7
48	484	451	455	510	74.7	61.4	84.5	66.7	52.5	62.4
47	471	442	443	495	74.1	60.8	83.9	65.8	51.4	61.1
46	458	432	432	480	73.6	60.0	83.5	64.8	50.3	59.8
45	446	421	421	466	73.1	59.2	83.0	64.0	49.0	58.5
44	434	409	409	452	72.5	58.5	82.5	63.1	47.8	57.3
43	423	400	400	438	72.0	57.7	82.0	62.2	46.7	56.1
42	412	390	390	426	71.5	56.9	81.5	61.3	45.5	54.9
41	402	381	381	414	70.9	56.2	80.9	60.4	44.3	53.7
40	392	371	371	402	70.4	55.4	80.4	59.5	43.1	52.6
39	382	362	362	391	69.9	54.6	79.9	58.6	41.9	51.5
38	372	353	353	380	69.4	53.8	79.4	57.7	40.8	50.4
37	363	344	344	370	68.9	53.1	78.8	56.8	39.6	49.3
36	354	336	336	360	68.4	52.3	78.3	55.9	38.4	48.2
35	345	327	327	351	67.9	51.5	77.7	55.0	37.2	47.1
34	336	319	319	342	67.4	50.8	77.2	54.2	36.1	46.1
33	327	311	311	334	66.8	50.0	76.6	53.3	34.9	45.1
32	318	301	301	326	66.3	49.2	76.1	52.1	33.7	44.1
31	310	294	294	318	65.8	48.4	75.6	51.3	32.5	43.1
30	302	286	286	311	65.3	47.7	75.0	50.4	31.3	42.2
29	294	279	279	304	64.8	47.0	74.5	49.5	30.1	41.3
28	286	271	271	297	64.3	46.1	73.9	48.6	28.9	40.4
27	279	264	264	290	63.8	45.2	73.3	47.7	27.8	39.5
26	272	258	258	284	63.3	44.6	72.8	46.8	26.7	38.7
25	266	253	253	278	62.8	43.8	72.2	45.9	25.5	37.8
24	260	247	247	272	62.4	43.1	71.6	45.0	24.3	37.0
23	254	243	243	266	62.0	42.1	71.0	44.0	23.1	36.3
22	248	237	237	261	61.5	41.6	70.5	43.2	22.0	35.5
21	243	231	231	256	61.0	40.9	69.9	42.3	20.7	34.8
20	238	226	226	251	60.5	40.1	69.4	41.5	19.6	34.2

Approximate Hardness Conversion Numbers for Non-Austenitic Steels (Rockwell B Hardness Range)[A]

				Rockwell		Superficial Rockwell Number		
Rockwell B 100kgf (HRB)	Vickers (HV)	10-mm Standard ball 3000kgf (HBS)	Knoop 500-gf and Over (HK)	A Scale 60 kgf (HRA)	F Scale 60kgf (HRF)	15-T Scale 15-kgf (HR15T)	30-T Scale 30-kgf (HR30T)	45-T Scale 45-kgf (HR45T)
100	240	240	251	61.5	...	93.1	83.1	72.9
99	234	234	246	60.9	...	92.8	82.5	71.9
98	228	228	241	60.2	...	92.5	81.8	70.9
97	222	222	236	59.5	...	92.1	81.1	69.9
96	216	216	231	58.9	...	91.8	80.4	68.9
95	210	210	226	58.3	...	91.5	79.8	67.9
94	205	205	221	57.6	...	91.2	79.1	66.9
93	200	200	216	57.0	...	90.8	78.4	65.9
92	195	195	211	56.4	...	90.5	77.8	64.8
91	190	190	206	55.8	...	90.2	77.1	63.8
90	185	185	201	55.2	...	89.9	76.4	62.8
89	180	180	196	54.6	...	89.5	75.8	61.8
88	176	176	192	54.0	...	89.2	75.1	60.8
87	172	172	188	53.4	...	88.9	74.4	59.8
86	169	169	184	52.8	...	88.6	73.8	58.8
85	165	165	180	52.3	...	88.2	73.1	57.8
84	162	162	176	51.7	...	87.9	72.4	56.8
83	159	159	173	51.1	...	87.6	71.8	55.8
82	156	156	170	50.6	...	87.3	71.1	54.8
81	153	153	167	50.0	...	86.9	70.4	53.8
80	150	150	164	49.5	...	86.6	69.7	52.8
79	147	147	161	48.9	...	86.3	69.1	51.8
78	144	144	158	48.4	...	86.0	68.4	50.8
77	141	141	155	47.9	...	85.6	67.7	49.8
76	139	139	152	47.3	...	85.3	67.1	48.8
75	137	137	150	46.8	99.6	85.0	66.4	47.8
74	135	135	147	46.3	99.1	84.7	65.7	46.8
73	132	132	145	45.8	98.5	84.3	65.1	45.8
72	130	130	143	45.3	98.0	84.0	64.4	44.8
71	127	127	141	44.8	97.4	83.7	63.7	43.8
70	125	125	139	44.3	96.8	83.4	63.1	42.8
69	123	123	137	43.8	96.2	83.0	62.4	41.8
68	121	121	135	43.3	95.6	82.7	61.7	40.8
67	119	119	131	42.8	95.1	82.4	61.0	39.8
66	117	117	129	42.3	94.5	82.1	60.4	38.7
65	116	116	127	41.8	93.9	81.8	59.7	37.7
64	114	114	125	40.9	93.4	81.4	59.0	36.7
63	112	112	124	40.4	92.8	81.1	58.4	35.7
62	110	110	122	40.0	92.2	80.8	57.7	34.7
61	108	108	120	39.5	91.7	80.5	57.0	33.7
60	107	107	118	39.0	91.1	80.1	56.4	32.7
59	106	106	117	38.6	90.5	79.8	55.7	31.7
58	104	104	115	38.1	90.0	79.5	55.0	30.7
57	103	103	114	37.7	89.4	79.2	54.4	29.7
56	101	101	112	37.2	88.8	78.8	53.7	28.7
55	100	100	111	36.8	88.2	78.5	53.0	27.7
...	...	...	110	36.3	87.7	78.2	52.4	26.7
...	...	...	109	35.9	87.1	77.9	51.7	25.7
...	...	...	108	35.5	86.5	77.5	51.0	24.7
...	...	...	107	35.0	86.0	77.2	50.3	23.7
...	...	...	106	34.6	85.4	76.98	49.7	22.7
...	...	...	105	34.1	84.8	76.6	49.0	21.7
...	...	...	104	33.7	84.3	76.2	48.3	20.7
...	...	...	103	33.3	83.7	75.9	47.7	19.7
...	...	...	102	32.9	83.1	75.6	47.0	18.7
...	...	...	101	32.4	82.6	75.3	46.3	17.7
...	...	...	100	32.0	82.0	74.9	45.7	16.7
...	...	...	99	31.6	81.4	74.6	45.0	15.7
...	...	...	98	31.2	80.8	74.3	44.3	14.7
...	...	...	97	30.7	80.3	74.0	43.7	13.6
...	...	...	96	30.3	79.7	73.6	43.0	12.6
...	...	...	95	29.9	79.1	73.3	42.3	11.6
...	...	...	94	29.5	78.6	73.0	41.6	10.6
...	...	...	93	29.1	78.0	72.7	41.0	9.6
...	...	...	92	28.7	77.4	72.3	40.3	8.6
...	...	...	91	28.2	76.9	72.0	39.6	7.6
...	...	...	90	27.8	76.3	71.7	39.0	6.6
...	...	...	89	27.4	75.7	71.4	38.3	5.6
...	...	...	88	27.0	75.2	71.0	37.6	4.6
...	...	...	87	26.6	74.6	70.7	37.0	3.6
...	...	...			74.0	70.4	36.3	2.6

Weight - Load - Indenter Chart

Scale Symbol	Indentor Type	Preliminary Force N (kgf)	Total Force N (kgf)	Typical Applications
A	Spheroconical Diamond	98.07 (10)	588.4 (60)	Cemented carbides, thin steel, and shallow case hardened steel
B	1/16" Carbide Ball	98.07 (10)	980.7 (100)	Copper alloys, soft steels, aluminum alloys, malleable iron, etc.
C	Spheroconical Diamond	98.07 (10)	1471 (150)	Steel, hard cast irons, pearlitic malleable iron, titanium, deep case hardened steel, other harder than HRB 100
D	Spheroconical Diamond	98.07 (10)	980.7 (100)	Thin steel and medium case hardened steel, and pearlitic malleable iron
E	1/8" Carbide Ball	98.07 (10)	980.7 (100)	Cast Iron, Aluminum and magnesium alloys, and bearing metals
F	1/16" Carbide Ball	98.07 (10)	588.4 (60)	Annealed copper alloys and thin soft sheet metals
G	1/16" Carbide Ball	98.07 (10)	1471 (150)	Malleable irons, copper-nickel-zinc and cupro-nickel alloys
H	1/8" Carbide Ball	98.07 (10)	588.4 (60)	Aluminum, zinc and lead
K	1/8" Carbide Ball	98.07 (10)	1471 (150)	Bearing Metals and other very soft or thin materials. Use smallest ball and heaviest load that doesn't give anvil effect.
L	¼" Carbide Ball	98.07 (10)	588.4 (60)	
M	¼" Carbide Ball	98.07 (10)	980.7 (100)	
P	¼" Carbide Ball	98.07 (10)	1471 (150)	
R	½" Carbide Ball	98.07 (10)	588.4 (60)	
S	½" Carbide ball	98.07 (10)	980.7 (100)	
V	½" Carbide ball	98.07 (10)	1471 (150)	
15N	Spheroconical Diamond	29.42 (3)	147.1 (15)	Similar to A, C and D scales but for thinner gage material.
30N	Spheroconical Diamond	29.42 (3)	294.2 (30)	
45N	Spheroconical Diamond	29.42 (3)	441.3 (45)	
15T	1/16" Carbide Ball	29.42 (3)	147.1 (15)	Similar to B, F and G scales but for thinner gage material.
30T	1/16" Carbide Ball	29.42 (3)	294.2 (30)	
45T	1/16" Carbide Ball	29.42 (3)	441.3 (45)	
15W	1/8" Carbide Ball	29.42 (3)	147.1 (15)	Very Soft Material
30W	1/8" Carbide Ball	29.42 (3)	294.2 (30)	
45W	1/8" Carbide Ball	29.42 (3)	441.3 (45)	
15X	¼" Carbide Ball	29.42 (3)	147.1 (15)	
30X	¼" Carbide Ball	29.42 (3)	294.2 (30)	
45X	¼" Carbide Ball	29.42 (3)	441.3 (45)	
15Y	½" Carbide Ball	29.42 (3)	147.1 (15)	
30Y	½" Carbide Ball	29.42 (3)	294.2 (30)	
45Y	½" Carbide Ball	29.42 (3)	441.3 (45)	

Round Correction Factors

Corrections to be added to test results in the following scales for various diameter parts.

Corrections to be added to Rockwell C, A and D values

Diameter of Convex Cylindrical Surfaces

Hardness Reading	¼" 6.4mm	3/8" 10mm	½" 13mm	5/8" 16mm	¾" 19mm	7/8" 22mm	1" 25mm	1-1/4" 32mm	1-1/2" 38mm
20	6.0	4.5	3.5	2.5	2.0	1.5	1.5	1.0	1.0
25	5.5	4.0	3.0	2.5	2.0	1.5	1.0	1.0	1.0
30	5.0	3.5	2.5	2.0	1.5	1.5	1.0	1.0	0.5
35	4.0	3.0	2.0	1.5	1.5	1.0	1.0	0.5	0.5
40	3.5	2.5	2.0	1.5	1.0	1.0	1.0	0.5	0.5
45	3.0	2.0	1.5	1.0	1.0	1.0	0.5	0.5	0.5
50	2.5	2.0	1.5	1.0	1.0	0.5	0.5	0.5	0.5
55	2.0	1.5	1.0	1.0	0.5	0.5	0.5	0.5	0
60	1.5	1.0	1.0	0.5	0.5	0.5	0.5	0	0
65	1.5	1.0	1.0	0.5	0.5	0.5	0.5	0	0
70	1.0	1.0	0.5	0.5	0.5	0.5	0.5	0	0
75	1.0	0.5	0.5	0.5	0.5	0.5	0	0	0
80	0.5	0.5	0.5	0.5	0.5	0	0	0	0
85	0.5	0.5	0.5	0	0	0	0	0	0
90	0.5	0	0	0	0	0	0	0	0

Corrections to be added to Rockwell B, F and G values

Diameter of Convex Cylindrical Surfaces

Hardness Reading	¼" 6.4mm	3/8" 10mm	½" 13mm	5/8" 16mm	¾" 19mm	7/8" 22mm	1" 25mm
0	12.5	8.5	6.5	5.5	4.5	3.5	3.0
10	12.0	8.0	6.0	5.0	4.0	3.5	3.0
20	11.0	7.5	5.5	4.5	4.0	3.5	3.0
30	10.0	6.5	5.0	4.5	3.5	3.0	2.5
40	9.0	6.0	4.5	4.0	3.0	2.5	2.5
50	8.0	5.5	4.0	3.5	3.0	2.5	2.0
60	7.0	5.0	3.5	3.0	2.5	2.0	2.0
70	6.0	4.0	3.0	2.5	2.0	2.0	1.5
80	5.0	3.5	2.5	2.0	1.5	1.5	1.5
90	4.0	3.0	2.0	1.5	1.5	1.5	1.0
100	3.5	2.5	1.5	1.5	1.0	1.0	0.5

Minimum Thickness Requirements

Minimum allowable thickness for a corresponding hardness in the respective scales

Minimum Thickness Inch	Minimum Thickness mm	Rockwell C	Rockwell A	Rockwell B	Superficial 15N	Superficial 30N	Superficial 45N	Superficial 15T	Superficial 30T	Superficial 45T
0.006	0.15	...	...	...	...	...	...	...	...	...
0.008	0.20	...	...	...	92	...	...	...	...	...
0.010	0.25	...	...	...	90	...	...	91	...	...
0.012	0.30	...	...	...	88	82	77	86	...	...
0.014	0.36	...	...	...	83	78.5	74	81	80	...
0.016	0.41	...	86	...	76	74	72	75	72	71
0.018	0.46	...	84	...	68	66	68	68	64	62
0.020	0.51	...	82	...	...	57	63	...	55	53
0.022	0.56	69	79	...	...	47	58	...	45	43
0.024	0.61	67	76	94	...	...	51	...	34	31
0.026	0.66	65	71	87	...	...	37	...	...	18
0.028	0.71	62	67	80	...	...	20	...	...	4
0.030	0.76	57	60	71	...	...	...	...	...	...
0.032	0.81	52	...	62	...	...	...	...	...	...
0.034	0.86	45	...	52	...	...	...	...	...	...
0.036	0.91	37	...	40	...	...	...	...	...	...
0.038	0.96	28	...	28	...	...	...	...	...	...
0.040	1.02	20	...	...	...	...	...	...	...	...

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