Equotip
Portable Hardness Testing Selection Guide

The highest accuracy, durability, and functionality from the inventor of the Leeb method

Durability

The unmatched lifespan of probes and impact bodies, lasting longer than others on the market.

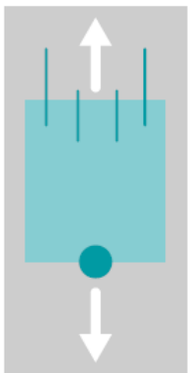
Accuracy

As ISO17025 certified calibration laboratory we pay attention to the detail to delivery instruments with highest accuracy and in accordance with the international standards

Versatility

World's broadest selection of methods, probes and conversion tables.
LEEB, UCI and Rockwell

Equotip 550
Method Guide



Leeb (Rebound)

For heavy samples, casts and forgings

In the Leeb method a spring propels an impact body through a guide tube toward the test piece. Measures the loss of velocity of the impact body before and after impact. The loss of velocity correlates with the hardness of the test piece.

Ultrasonic Contact Impedance (UCI)

Very universal. Widely used for heat-treated surfaces, weld inspection.

In the UCI method, a resonator excites a rod with an 136° ISO-6507-2 compliant Vickers diamond into longitudinal ultrasonic oscillation. As the diamond is forced into the material, the frequency of the rod oscillation changes in response to the contact surface between the diamond and the material under test.

Portable Rockwell

Can measure very thin and light samples

The Portable Rockwell method is the mobile adaptation of the bench-top method and measures the penetration depths of a 100° Rockwell diamond under a defined minor force before and after application of a larger force.

	LEEB							UCI		Portable Rockwell
Impact devices/probes	D	DC	DL	S	E	C	G	<10 N	10-100 N	50 N
Thin objects						○		●	○	●
Light objects						○		●	○	●
Objects with limited/difficult accessibility		●	●					○	●	
Polished objects [1]						●		●	●	●
Small round objects [2]	●	●	·	●	●	●	·	●	●	●
Mid-size objects	●	●	●	●	●	●	·	●	●	●
Very hard objects	·	·	·	●	●	·	·	●	●	●
Large objects	●	●	●	●	●	●	●	●	●	●
Large cast objects							●	○	○	○
Coatings						●		●	○	●

1) If only small indentation are allowed. 2) Leeb probes in combination with correct support ring. ○) Depending on test object.

Equotip 550
Method Guide – Test Objects

		Leeb For heavy samples, casts and forgings	UCI Very universal. Widely used for heat-treated surfaces, weld inspection	Portable Rockwell Can measure very thin and light samples
Oil & Gas 	Weld, base material & Heat Affected Zone (HAZ)	·	●	·
	Pressure vessels	●	●	●
	Pipes	●	●	●
	Flanges	●	●	●
	Wellhead equipment	·	●	●
	Rock Core	●	·	·
Automotive 	Engine blocks	●	·	·
	Shafts	●	●	●
	Gears	●	●	·
	Panels	·	·	●
	Brake Systems	·	·	●
Aerospace 	Turbine blades	●	●	●
	Casing / Housing	·	·	●
	Panels	·	·	●
	Cast objects	●	·	·
	Landing gears	●	·	·
Manufacturing & Machinery 	Rolls	●	·	·
	Coils	●	●	●
	Bars/pipes	●	●	●
	Heat treatment/Casting	●	●	·
	Wires	·	·	●
Power Generation 	Boilers	●	·	·
	Pipes	●	●	●
	High-alloy steel (incl. Superalloys) components	●	·	·
	Generator stator wedges	●	·	·
	Turbine bolts	·	●	·
	Turbine stator	·	●	·
	Wind turbine nose	●	·	·

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General Probe Parameters

Probe type	D, DC, DL	C	E	S	G	UCI	Motorized UCI	Portable Rockwell
Probe and indenter parameters								
Impact energy / test force	11 Nmm	3 Nmm	11 Nmm	11 Nmm	90 Nmm	HV1, HV5, HV10 in one probe (~10 N, ~50 N, ~100 N)	HV0.3 (2.9N), HV0.8 (7.8N)	50 N (10 N+40 N)
Indenter type	Tungsten Carbide		Poly-crystalline diamond	Silicon Nitride	Tungsten Carbide	ISO 6507-2 compliant Vickers diamond (a < 0.5 µm)		ASTM E3246 and DIN50157 compliant, 100° diamond
Standards and accreditation								
Accredited calibration ISO/IEC 17025	Yes, DIN EN ISO 16859					Yes, DIN 50159		Yes, DIN 50157
Traceability	Traceable to national standards (SI)							
Standard & guideline compliance – Method	ASTM A370 ASTM A956 DIN EN ISO 16859 GB/T 17394 JB/T 9378					ASTM A1038 DIN 50159 GB/T 34205		
Standard & guideline compliance – Conversion	ASTM E140 ASTM A370 ISO 16265 DL/T 1845 (Leeb D only)					ASTM E140 ISO 16265 ASTM A370		
Standard & guideline compliance – Guidelines	ASME CRTD-91 DGZfP Gudeline MC 1 VDI / VDE Gudeline 2616 Paper 1 Nordtest Technical Reports 99.12, 99.13, 99.36					ASME CRTD-91 DGZfP Gudeline MC 1 VDI / VDE Gudeline 2616 Paper 1		
Measurement and reliability parameters								
Measurement resolution	1 HLx/HV/HB, 0.1 HRC/HRB/HS 1 N/mm^2 (Rm)					1 HV(UCI), 0.1 HRC	1 HV(UCI), 0.1 HRC	0.1 µm, 0.1 HRC; 1 HV
Probes' accuracy	± 4 HLx (0.5% @850 HLx)					± 2%	± 3%	± 0.8 µm, ~ ± 1.0 HRC
Measurement deviation (E) Coefficient of variation	Lower than specified in DIN EN ISO 16859					Lower than specified in DIN 50159 & GB/T 34205		Lower than specified in DIN 50157 & ASTM E3246

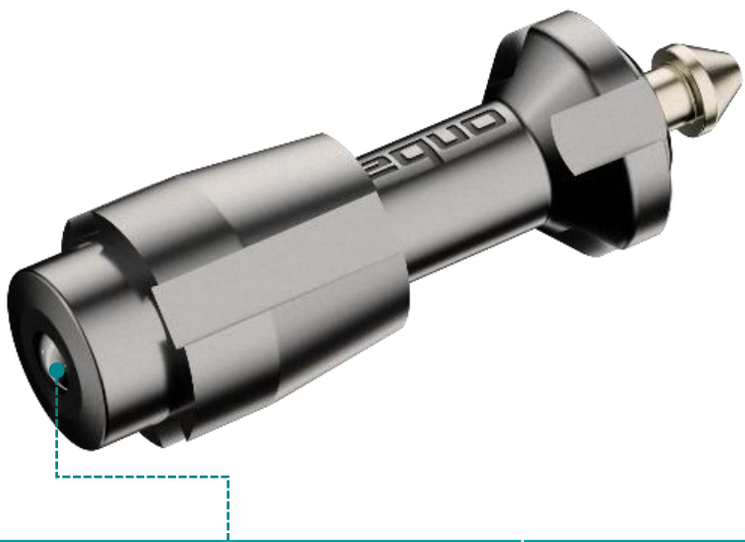
Equotip 550
Test Object Parameters

Probe type	D, DC, DL, E, S	C	G	HV0.3	HV0.8	HV1	UCI HV5	UCI HV10	Rockwell 50N
Min. weight of samples									
of compact shape	5 kg 11 lbs	1.5 kg 3.3 lbs	15 kg 33 lbs			0.3 kg 0.66 lbs			no specific requirements
on solid support	2 kg 4.5 lbs	0.5 kg 1.1 lbs	5 kg 11 lbs						
coupled on plate	0.05 kg 0.2 lbs	0.02 kg 0.045 lbs	0.5 kg 1.1 lbs						
Min. thickness of samples									
uncoupled	25 mm 0.98 inch	15 mm 0.59 inch	70 mm 2.73 inch			2 mm* 0.2 inch			
coupled	3 mm 0.12 inch	1 mm 0.04 inch	10 mm 0.4 inch						10x indentation depth
surface layer thickness	0.8 mm 0.03 inch	0.2 mm 0.006 inch							
Surface roughness requirements of samples									
Min roughness class ISO	N7	N5	N9	N6	N7	N8	N10		N7
Average roughness depth Ra	2 µm 80 µinch	0.4 µm 16 µinch	7 µm 275 µinch	< 0.8 µm < 31 µinch	1.6 µm 63 µinch	5 µm 125 µinch	12.5µm 500 µinch		2µm 80 µinch
Min. grit size	P120	P180	P80	P200	P120	P80	P60		P120
Indentation diameter at given hardness on steel									
~570HLD,~300HV,~46HRC	540 µm	380 µm	1030 µm	43 µm	70 µm	79.1 µm	177.1 µm	248.1 µm	53.6 µm
~760HLD,~600HV,~55HRC	450 µm	320 µm	900 µm	30.4 µm	49.7 µm	56 µm	125.3 µm	175.4 µm	26.2 µm
~840HLD,~800HV,~63HRC	350 µm	300 µm	-	26.3 µm	43 µm	48.3 µm	108.5 µm	151.9 µm	16.7 µm
Indentation depth at given hardness on steel									
~570HLD,~300HV,~46HRC	24.5 µm	12.1 µm	53.6 µm	6.1 µm	10 µm	11.3 µm	25.3 µm	35.4 µm	22.5 µm
~760HLD,~600HV,~55HRC	17 µm	8.6 µm	40.8 µm	4.3 µm	7.1 µm	8 µm	17.9 µm	25.1 µm	11 µm
~840HLD,~800HV,~63HRC	10.2 µm	7.5 µm		3.8 µm	6.1 µm	6.9 µm	15.5 µm	21.7 µm	7 µm

*According to DIN 50159-1, ASTM A1038 requires 2-3 mm 15 mm/0.078-0.118 inch.

Minimum requirements for mass and thickness of samples according to DIN EN ISO 16859/DIN 50159-1, ASTM A956 and GB/T 17394

Equotip 550
Probe Selection - Impact Body Lifetime



Probe / Impact body type	Impact body tip material	Hardness application range
C, D, DC, G, DL	Tungsten carbide	Standard hardness range
S	Silicon nitride	Recommended at higher hardness
E	Polycrystalline diamond	Unmatched durability at higher hardness

Various Leeb probes come with a specific impact body, which selection shall be also considered with respect to the anticipated hardness of the test object to maximize the impact body lifetime, as harder surfaces cause more impact body wear. Please note that results can vary depending on the surrounding environment (e.g. dirt, debris, handling). A rough environment will always have a negative effect on both the impact device and body.

For harder surfaces it is recommended to consider S-type or E-type Leeb probes to maximize the impact body lifetime, minimize the wear-related drift over time (extend accuracy and quality of measurements) and minimize the down-time due to service.

Equotip 550
Accuracy

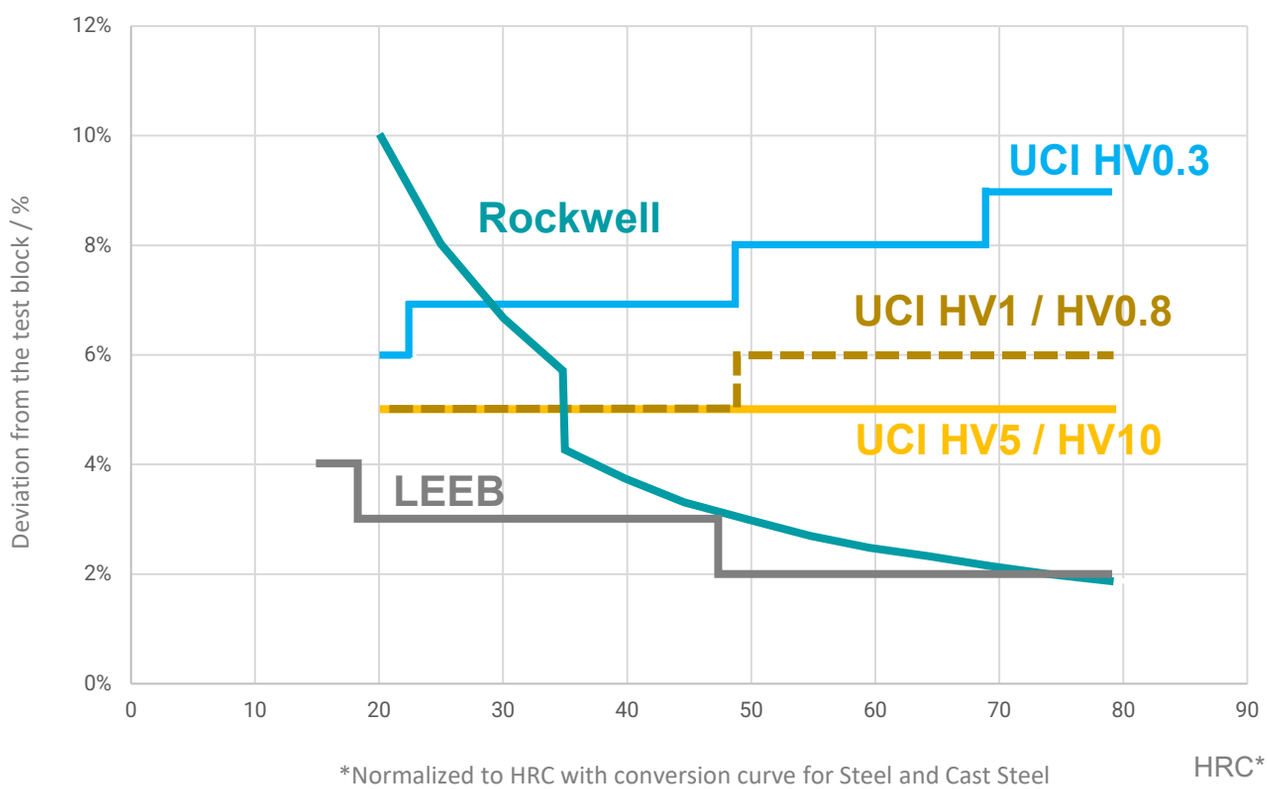
Instrument Daily Verification Acceptance Criteria

LEEB D
DIN EN ISO 16859-1
(ISO/IEC 17025 accreditation)

UCI
DIN 50159-1
(ISO/IEC 17025 accreditation)

Rockwell
DIN 50159-1
(ISO/IEC 17025 accreditation)

The following diagram shows the permissible maximum measurement deviation of the device from the certified value of a test block. Within this tolerance a device can be used.



*Normalized to HRC with conversion curve for Steel and Cast Steel

Equotip 550 LEEB
Available Scale Conversions

Material Class	Method	Unit	Probe D/DC	DL	S	E	G	C
Steel and Cast Steel	Vickers	HV	81-955	80-950	101-964	84-1211	*	81-1012
	Brinell	HB	81-654	81-646	101-640	83-686	90-646	81-694
	Rockwell	HRB	38-100	37-100	*	*	48-100	*
		HRC	20-68	21-68	22-70	20-72	*	20-70
		HRA	*	*	61-88	61-88	*	*
	Shore	HS	30-99	31-97	28-104	29-103	*	30-102
	R_m σ1[a]	MPa	275-2194	275-2297	340-2194	283-2195	305-2194	275-2194
	R_m σ2[b]	MPa	616-1148	614-1485	615-1480	616-1479	618-1478	615-1479
	R_m σ3[c]	MPa	449-847	449-847	450-846	448-849	450-847	450-846
Work Tool Steel	Vickers	HV	80-900	80-905	104-924	82-1009	*	98-942
	Rockwell	HRC	21-67	21-67	22-68	23-70		20-67
Stainless Steel	Vickers	HV	85-802	*	119-934	88-668	*	*
	Brinell	HB	85-655	*	105-656	87-661	*	*
	Rockwell	HRB	46-102	*	70-104	49-102	*	*
		HRC	20-62	*	21-64	20-64	*	*
High Alloy Steels								
P/T91(10Cr9Mo1VNbN)	Brinell	HBW	130-300	*	*		*	*
P/T92 (10Cr9moW2VNbBN)			130-281	*	*		*	*
P/T92 welded			140-330	*	*		*	*
GH4145			280-390	*	*		*	*
C422 (22Cr12NiWMoV)			240-380	*	*		*	*
20Cr13			280-310	*	*		*	*
05Cr17Ni4Cu4Nb			265-333	*	*		*	*
14Cr12NiBmo2VN			280-403	*	*		*	*
22CR12NiWMoV			256-320	*	*		*	*
Grey Cast Iron (GG) Lamellar Graphite	Brinell	HB	90-664	*	*		*	*
	Vickers	HV	90-698	*	*		92-326	*
	Rockwell	HRC	21-59	*	*		*	*
Nodular Cast Iron (GGG)	G Brinell	HB	95-686	*	*		127-364	*
	Vickers	HV	96-724	*	*		*	*
	Rockwell	HRC	21-60	*	*		19-37	*
Cast Aluminum Alloys	Brinell	HB	19-164	20-187	20-184	23-176	19-168	21-167
	Vickers	HV	22-193	21-191	22-196	22-198	*	*
	Rockwell	HRB	24-85	*	*	*	24-86	23-85
Brass Copper/Zinc Alloys	Brinell	HB	40-173	*	*		*	*
	Rockwell	HRB	14-95	*	*		*	*
CuAl CuSn Alloys (Bronze)	Brinell	HB	60-290	*	*		*	*
Wrought Copper Alloys	Brinell	HB	45-315	*	*		*	*

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Available Scale Conversions

UCI

Material Class	Method	Unit	Conversion Range	E modulus GPa
Steel and cast Steel	Leeb	HLD	290-890	210
	Brinell	HB	66-737	
	Rockwell	HRC	37-85	
		HRA	59-99	
		HRB	20-70	
		HR15N	69-94	
		HR15T	78-96	
	R_m	MPa	220-2264	
Aluminium	Vickers	HV	24-225	75
	Brinell**	HB	24-199	
	Rockwell**	HRB	24-225	
1 point quick shift conversion curves				
Titanium Ti 6Al 4V HV	Vickers	HV	263-406*	115
Cast Iron			141-193*	160
Incoloy 825 / 2.4858			32-197*	195
304L/1.4307			170-244*	200
P91/T91			140-228*	218
Alloy 75/2.4630			140-225*	221

• Recommended conversion range base on 1-point quick shift conversions. Measurements outside of this range may be prone to higher measurement errors
** Conversion based on ISO 18265

Portable Rockwell

Material Class	Method	Unit	Conversion Range
Steel and cast Steel	Leeb	HLD	290-890
	Vickers	HV	30-1080
	Brinell	HB	76-618
	Rockwell	HRA	37-87
		HRB	55-100
		HRC	19-70
		HR15N	69-93
		HMMRC	19-70
	R_m	MPa	255-2180