



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

BUEHLER, A DIVISION OF ILLINOIS TOOL WORKS, INC.
41 Waukegan Road
Lake Bluff, IL 60044
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CALIBRATION

Valid To: October 31, 2023

Certificate Number: 2237.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory at the location listed above as well as the satellite laboratory locations listed, to perform the following calibrations^{1,5}:

I. Mechanical

Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Rockwell Hardness and Rockwell Superficial Hardness Testers ³ –	HRA:		ASTM E18, ISO 6508-2
	Low	0.15 HRA	
	Medium	0.20 HRA	
	High	0.08 HRA	
	HRBW:		
	Low	0.46 HRBW	
	Medium	0.24 HRBW	
	High	0.17 HRBW	
	HRC:		
	Low	0.19 HRC	
	Medium	0.20 HRC	
	High	0.17 HRC	
	HRD:		
	Low	0.15 HRD	
	Medium	0.14 HRD	
	High	0.05 HRD	

Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Rockwell Hardness and Rockwell Superficial Hardness Testers ³ (cont) –	HREW: Low Medium High HRFW: Low Medium High HRGW: Low Medium High HRHW: Low High HRKW: Low Medium High HRLW: Low High HRRW: Low High HRSW: Low High HR15N: Low Medium High	0.24 HREW 0.24 HREW 0.24 HREW 0.14 HRFW 0.18 HRFW 0.18 HRFW 0.47 HRGW 0.30 HRGW 0.19 HRGW 0.18 HRHW 0.20 HRHW 0.43 HRKW 0.21 HRKW 0.22 HRKW 0.17 HRLW 0.05 HRLW 0.13 HRRW 0.13 HRRW 0.18 HRSW 0.16 HRSW 0.10 HR15N 0.10 HR15N 0.10 HR15N	ASTM E18, ISO 6508-2

Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Rockwell Hardness and Rockwell Superficial Hardness Testers ³ (cont) –	HR15TW: Low Medium High	0.18 HR15TW 0.25 HR15TW 0.05 HR15TW	ASTM E18, ISO 6508-2
	HR15WW: Low High	0.13 HR15WW 0.11 HR15WW	
	HR15YW: Low High	0.11 HR15YW 0.15 HR15YW	
	HR30N: Low Medium High	0.16 HR30N 0.23 HR30N 0.15 HR30N	
	HR30TW: Low Medium High	0.29 HR30TW 0.29 HR30TW 0.20 HR30TW	
	HR30WW: Low High	0.27 HR30WW 0.13 HR30WW	
	HR45TW: Low Medium High	0.23 HR45TW 0.36 HR45TW 0.11 HR45TW	
	HR45N: Low Medium High	0.21 HR45N 0.16 HR45N 0.14 HR45N	

Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Vickers and Knoop Hardness Machines ³ –	(100 to 240) HV (240 to 600) HV > 600 HV	2.8 HV 6.9 HV 9.5 HV	ASTM E92/ASTM E384-11e1
	< 250 HV (400 to 600) HV > 700 HV	2.8.HV 6.9 HV 9.5 HV	ISO 6507-2
	(100 to 250) HK (250 to 650) HK > 650 HK	4.5 HK 6.3 HK 8.5 HK	ASTM E92/ASTM E384-11e1, ISO 4545-2
Indirect Verification of Brinell Hardness Testers at Test Conditions ³ –			
10/3000/15	(96 to 225) HBW (226 to 650) HBW	1.6 HBW 3.3 HBW	Indirect verification method per ASTM E10, ISO 6506-2
10/1000	(32 to 218) HBW	0.26 HBW	
10/500/15	(16 to 109) HBW	0.1 HBW	
5/750	(96 to 653) HBW	1.2 HBW	
5/250	(32 to 218) HBW	0.34 HBW	
2.5/187.5	(96 to 653) HBW	1.1 HBW	
2.5/62.5	(32 to 218) HBW	0.54 HBW	
1/30	(96 to 653) HBW	2.4 HBW	
1/10	(32 to 218) HBW	1.3 HBW	
1/5	(16 to 109) HBW	0.51 HBW	

Parameter/Equipment	Range	CMC ² (±)	Comments
Direct Verification of Brinell Hardness Testers ³ –			Direct verification per ASTM E10, ISO 6506-2
Verification of Test Force	Up to 250 kgf (> 250 to 3000) kgf	0.035 kgf 0.52 kgf	Verification of the test force is by elastic device
Verification of the Device for Measuring Indentation Diameters	Up to 6 mm	0.013 mm	By mechanical comparison
Verification of Testing Cycle (Time)	Up to 30 s	0.39 s	Stopwatch
Direct Verification of Rockwell Hardness Testing Machines ³ –			Direct verification method per ASTM E18, ISO 6506-2
Verification of the Test Force	(3 to 15) kgf (30 to 150) kgf	0.085 kgf 0.094 kgf	Verification of test force by an elastic device
Verification of the Depth-Measuring Device	(0 to 0.2) mm (0 to 0.26) mm	0.34 µm 0.44 µm	Gage blocks Kal-Rock measuring device
Verification of Testing Cycle (Time)	Up to 30 s	0.30 s	Stopwatch
Direct Verification of Vickers and Knoop Hardness Testing Machines ³ –			Direct verification method per ASTM E92, ISO 6507-2
Verification of the Test Force	(10 to 100) gf (> 100 to 1000) gf 2000 gf to 50 kgf (> 50 to 120) kgf	0.04 gf 19 gf 0.041 kgf 0.21 kgf	Verification of forces by an elastic device
Verification of the Device for Measuring Indentation Diagonals	Up to 1000 µm	0.0040 mm	Stage micrometer
Verification of Testing Cycle (Time)	Up to 30 s	0.39 s	Stopwatch

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I. Mechanical

Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Rockwell Hardness and Rockwell Superficial Hardness Testers ³ –	HRA:		ASTM E18, ISO 6508-2
	Low	0.15 HRA	
	Medium	0.20 HRA	
	High	0.08 HRA	
	HRBW:		
	Low	0.46 HRBW	
	Medium	0.24 HRBW	
	High	0.17 HRBW	
	HRC:		
	Low	0.19 HRC	
	Medium	0.20 HRC	
	High	0.17 HRC	
	HRD:		
Low	0.15 HRD		
Medium	0.14 HRD		
High	0.05 HRD		

Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Rockwell Hardness and Rockwell Superficial Hardness Testers ³ (cont) –	HREW: Low Medium High HRFW: Low Medium High HRGW: Low Medium High HRHW: Low High HRKW: Low Medium High HRLW: Low High HRRW: Low High HRSW: Low High HR15N: Low Medium High	0.24 HREW 0.24 HREW 0.24 HREW 0.14 HRFW 0.18 HRFW 0.18 HRFW 0.47 HRGW 0.30 HRGW 0.19 HRGW 0.18 HRHW 0.20 HRHW 0.43 HRKW 0.21 HRKW 0.22 HRKW 0.17 HRLW 0.05 HRLW 0.13 HRRW 0.13 HRRW 0.18 HRSW 0.16 HRSW 0.10 HR15N 0.10 HR15N 0.10 HR15N	ASTM E18, ISO 6508-2

Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Rockwell Hardness and Rockwell Superficial Hardness Testers ³ (cont) –	HR15TW: Low Medium High	0.18 HR15TW 0.25 HR15TW 0.05 HR15TW	ASTM E18, ISO 6508-2
	HR15WW: Low High	0.13 HR15WW 0.11 HR15WW	
	HR15YW: Low High	0.11 HR15YW 0.15 HR15YW	
	HR30N: Low Medium High	0.16 HR30N 0.23 HR30N 0.15 HR30N	
	HR30TW: Low Medium High	0.29 HR30TW 0.29 HR30TW 0.20 HR30TW	
	HR30WW: Low High	0.27 HR30WW 0.13 HR30WW	
	HR45TW: Low Medium High	0.23 HR45TW 0.36 HR45TW 0.11 HR45TW	
	HR45N: Low Medium High	0.21 HR45N 0.16 HR45N 0.14 HR45N	

Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Vickers and Knoop Hardness Machines ³ –	(100 to 240) HV (240 to 600) HV > 600 HV	2.8 HV 6.9 HV 9.5 HV	ASTM E92/ASTM E384-11e1
	< 250 HV (400 to 600) HV > 700 HV	2.8 HV 6.9 HV 9.5 HV	ISO 6507-2
	(100 to 250) HK (250 to 650) HK > 650 HK	4.5 HK 6.3 HK 8.5 HK	ASTM E92/ASTM E384-11e1, ISO 4545-2
Indirect Verification of Brinell Hardness Testers at Test Conditions ³ –			
10/3000/15	(96 to 225) HBW (226 to 650) HBW	1.6 HBW 3.3 HBW	Indirect verification method per ASTM E10, ISO 6506-2
10/1000	(32 to 218) HBW	0.26 HBW	
10/500/15	(16 to 109) HBW	0.1 HBW	
5/750	(96 to 653) HBW	1.2 HBW	
5/250	(32 to 218) HBW	0.34 HBW	
2.5/187.5	(96 to 653) HBW	1.1 HBW	
2.5/62.5	(32 to 218) HBW	0.54 HBW	
1/30	(96 to 653) HBW	2.4 HBW	
1/10	(32 to 218) HBW	1.3 HBW	
1/5	(16 to 109) HBW	0.51 HBW	

Parameter/Equipment	Range	CMC ² (±)	Comments
Direct Verification of Brinell Hardness Testers ³ –			Direct verification per ASTM E10, ISO 6506-2
Verification of Test Force	Up to 250 kgf (> 250 to 3000) kgf	0.070 kgf 0.53 kgf	Verification of the test force is by elastic device
Verification of the Device for Measuring Indentation Diameters	Up to 6 mm	0.013 mm	By mechanical comparison
Verification of Testing Cycle (Time)	Up to 30 s	0.45 s	Stopwatch
Direct Verification of Rockwell Hardness Testing Machines ³ –			Direct verification method per ASTM E18, ISO 6506-2
Verification of the Test Force	(3 to 15) kgf (30 to 150) kgf	0.090 kgf 0.15 kgf	Verification of test force by an elastic device
Verification of the Depth-Measuring Device	(0 to 0.2) mm (0 to 0.26) mm	0.34 µm 0.44 µm	Gage blocks Kal-Rock measuring device
Verification of Testing Cycle (Time)	Up to 30 s	0.38 s	Stopwatch
Direct Verification of Vickers and Knoop Hardness Testing Machines ³ –			Direct verification method per ASTM E92, ISO 6507-2
Verification of the Test Force	(10 to 100) gf (> 100 to 1000) gf 2000 gf to 50 kgf (> 50 to 120) kgf	0.04 gf 20 gf 0.080 kgf 0.22 kgf	Verification of forces by an elastic device
Verification of the Device for Measuring Indentation Diagonals	Up to 1000 µm	0.0040 mm	Stage micrometer
Verification of Testing Cycle (Time)	Up to 30 s	0.45 s	Stopwatch

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I. Mechanical

Parameter/Equipment	Range	CMC ² (±)	Comments
Calibration of Standardized Rockwell Hardness and Rockwell Superficial Hardness Test Blocks –	HRA Carbide: Low Medium High	0.15 HRA 0.10 HRA 0.07 HRA	ASTM B294 and ISO 3738-2
	HRA: Low Medium High	0.14 HRA 0.27 HRA 0.10 HRA	ASTM E18, ISO 6508-3, and JIS B 7730
	HRBW: Low Medium High	0.40 HRBW 0.31 HRBW 0.17 HRBW	
	HRC: Low Medium High	0.17 HRC 0.17 HRC 0.16 HRC	

Parameter/Equipment	Range	CMC ² (±)	Comments
Calibration of Standardized Rockwell Hardness and Rockwell Superficial Hardness Test Blocks (cont) –	HRD: Low Medium High	0.14 HRD 0.13 HRD 0.05 HRD	ASTM E18, ISO 6508-3, and JIS B 7730
	HREW: Low Medium High	0.14 HREW 0.21 HREW 0.11 HREW	
	HRFW: Low Medium High	0.13 HRFW 0.16 HRFW 0.11 HRFW	
	HRGW: Low Medium High	0.45 HRGW 0.28 HRGW 0.18 HRGW	
	HRHW: Low High	0.16 HRHW 0.16 HRHW	
	HRKW: Low Medium High	0.35 HRKW 0.21 HRKW 0.20 HRKW	
	HRLW: Low High	0.15 HRLW 0.10 HRLW	
	HRMW: Low High	0.30 HRMW 0.13 HRMW	
	HRPW: Low High	0.26 HRPW 0.23 HRPW	
	HRRW: Low High	0.12 HRRW 0.12 HRRW	

Parameter/Equipment	Range	CMC ² (±)	Comments
Calibration of Standardized Rockwell Hardness and Rockwell Superficial Hardness Test Blocks (cont) –	HRSW: Low High	0.16 HRSW 0.12 HRSW	ASTM E18, ISO 6508-3, and JIS B 7730
	HRVW: Low High	0.22 HRVW 0.17 HRVW	
	HR15N: Low Medium High	0.09 HR15N 0.09 HR15N 0.08 HR15N	
	HR15TW: Low Medium High	0.17 HR15TW 0.23 HR15TW 0.05 HR15TW	
	HR15WW: Low High	0.11 HR15WW 0.08 HR15WW	
	HR15XW: Low High	0.10 HR15XW 0.08 HR15XW	
	HR15YW: Low High	0.10 HR15YW 0.13 HR15YW	
	HR30N: Low Medium High	0.15 HR30N 0.23 HR30N 0.16 HR30N	
	HR30TW: Low Medium High	0.24 HR30TW 0.20 HR30TW 0.20 HR30TW	
	HR30WW: Low High	0.24 HR30WW 0.13 HR30WW	
	HR30XW: Low High	0.12 HR30XW 0.16 HR30XW	

Parameter/Equipment	Range	CMC ² (±)	Comments
Calibration of Standardized Rockwell Hardness and Rockwell Superficial Hardness Test Blocks (cont) –	HR30YW: Low High HR45N: Low Medium High HR45TW: Low Medium High HR45WW: Low High HR45XW: Low High HR45YW: Low High	0.41 HR30YW 0.19 HR30YW 0.19 HR45N 0.12 HR45N 0.13 HR45N 0.21 HR45TW 0.33 HR45TW 0.10 HR45TW 0.11 HR45WW 0.23 HR45WW 0.18 HR45XW 0.18 HR45XW 0.11 HR45YW 0.18 HR45YW	ASTM E18, ISO 6508-3, and JIS B 7730
Calibration of Standardized Vickers Test Blocks –	(60 to 100) HV (> 100 to 240) HV (> 240 to 600) HV (> 600 to 1200) HV	1.3 HV 1.5 HV 4.8 HV 7.3 HV	ASTM E92, ASTM E384, ISO 6507-3, and JIS B 7735
Calibration of Standardized Knoop Test Blocks –	(60 to 100) HK (> 100 to 250) HK (> 250 to 650) HK > 650 HK	1.7 HK 1.7 HK 3.6 HK 7.6 HK	ASTM E92, ASTM E384, ISO 4545-3, and JIS B 7734
Calibration of Standardized Brinell Test Blocks –	(94 to 225) HBW (226 to 350) HBW (351 to 550) HBW	1.8 HBW 2.7 HBW 4.3 HBW	ASTM E10, ISO 6506-3, and JIS B 7736

Parameter/Equipment	Range	CMC ² (±)	Comments
Rockwell Hardness Indenters, Indirect Verification of Ball Holder Assembly –			
Ball Protrusion	Indenter sizes: 1/16 in, 1/8 in, 1/4 in, 1/2 in	0.43 Rockwell Points	ASTM E18 (A3.4.4.2, A3.4.5), ISO 6508-2 (6.3.2), and JIS B 7730
Ball Performance	1/16 in	0.43 HRBW	
	1/8 in	0.14 HREW	
	1/4 in	0.10 HRLW	
	1/2 in	0.12 HRRW	
Hardness of Ball Holder	(238 to 392) HV (20 HRC to 40 HRC) ⁴	9 HV	Vickers Hardness per ASTM E92, ISO 6507-1, and JIS 2244
Hardness of Ball	(700 to 1300) HV (1301 to 1700) HV	10 HV 28 HV	
Indirect Verification of Rockwell Hardness and Rockwell Superficial Hardness Standardizing Machines –	HRA Carbide: Low Medium High HRA: Low Medium High HRBW: Low Medium High HRC: Low Medium High	0.17 HRA 0.11 HRA 0.07 HRA 0.15 HRA 0.27 HRA 0.10 HRA 0.45 HRBW 0.33 HRBW 0.17 HRBW 0.18 HRC 0.17 HRC 0.16 HRC	Indirect verification per ASTM B294 and ISO 3738 ASTM E18, ISO 6508-3, and JIS B 7730

Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Rockwell Hardness and Rockwell Superficial Hardness Standardizing Machines (cont) –	HR15N: Low Medium High HR30N: Low Medium High HR30TW: Low Medium High	0.09 HR15N 0.09 HR15N 0.08 HR15N 0.16 HR30N 0.22 HR30N 0.16 HR30N 0.27 HR30TW 0.20 HR30TW 0.19 HR30TW	ASTM E18, ISO 6508-3, and JIS B 7730
Direct Verification of Rockwell Hardness Standardizing Machines – Verification of the Test Force Verification of the Depth-Measuring Device Verification of Testing Cycle (Time)	 (3 to 15) kgf (30 to 150) kgf (0 to 2.2) mm Up to 30 s	 0.0041 kgf 0.0085 kgf 0.049 µm 0.36 s	Direct verification method per ASTM E18, ISO 6508-3, and JIS B 7730 Verification of the test force is by load cell Gage blocks Stopwatch
Indirect Verification of Vickers and Knoop Hardness Standardizing Machines – ≤ 1 kgf ≥ 1 kgf	(60 to 100) HV (100 to 240) HV (240 to 600) HV > 600 HV (60 to 100) HK (100 to 250) HK (250 to 650) HK > 650 HK (100 to 240) HV (240 to 650) HV > 650 HV	1.3 HV 2.1 HV 3.0 HV 6.9 HV 1.7 HK 1.7 HK 2.5 HK 5.7 HK 2.4 HV 4.5 HV 7.3 HV	ASTM E92/ISO 6507-3/ISO 4545-3/ JIS B 7735/ JIS B 7734

Parameter/Equipment	Range	CMC ² (±)	Comments
<p>Direct Verification of Vickers and Knoop Hardness Standardizing Machines –</p> <p>Verification of the Test Force</p> <p>Verification of the Device for Measuring Indentation Diagonals</p> <p>Verification of Testing Cycle (Time)</p>	<p>(10 to 100) gf 200 gf to 5 kgf (> 10 to 120) kgf</p> <p>(0 to 1000) µm</p> <p>Up to 30 s</p>	<p>0.01 gf 0.0040 kgf 0.013 kgf</p> <p>0.48 µm</p> <p>0.36 s</p>	<p>Direct verification method per ASTM E92/ ISO 6507-3/ ISO 4545-3/JIS B 7735/JIS B 7734</p> <p>Verification of the test force is by loadcell</p> <p>Stage micrometer</p> <p>Stopwatch</p>
<p>Brinell Hardness Indenters, Verification of Ball –</p> <p>Vickers Hardness</p>	<p>≥ 1500 HV</p>	<p>21 HV</p>	<p>ASTM E10 (A3.4 to A3.5), ISO 6506-2 (5.3), and JIS B 7724</p> <p>Vickers Hardness per ASTM E92, ISO 6507-1 and JIS Z 2244</p>
<p>Indirect Verification of Brinell Hardness Standardizing Machines –</p>	<p>(94 to 225) HBW (>225 to 350) HBW (>350 to 600) HBW</p>	<p>1.3 HBW 2.5 HBW 4.2 HBW</p>	<p>ASTM E10, ISO 6506-3, and JIS B 7736</p>
<p>Direct Verification of Brinell Hardness Standardizing Machines –</p> <p>Verification of the Test Force</p>	<p>5 kgf (10 to 125) kgf (>125 to <500) kgf (500 to 3000) kgf</p>	<p>0.0040 kgf 0.0086 kgf 0.17 kgf 0.41 kgf</p>	<p>Direct verification methods per ASTM E10, ISO 6506-3, and JIS B 7736</p> <p>Verification of the test force is by elastic device</p>

Parameter/Equipment	Range	CMC ² (±)	Comments
Direct Verification of Brinell Hardness Standardizing Machines (cont) –			
Verification of the Device for Measuring Indentation Diameters	Up to 8 mm	0.00085 mm	Stage micrometer
Verification of Testing Cycle (Time)	Up to 30 s	0.44 s	Stopwatch

¹ This laboratory offers commercial calibration service and field calibration service.

² Calibration and Measurement Capability Uncertainty (CMC) is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards or nearly ideal measuring equipment. CMCs represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of $k = 2$. The actual measurement uncertainty of a specific calibration performed by the laboratory may be greater than the CMC due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.

³ Field calibration service is available for this calibration. Please note the actual measurement uncertainties achievable on a customer's site can normally be expected to be larger than the CMC found on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the actual uncertainty introduced by the item being calibrated, (e.g., resolution) must also be considered and this, on its own, could result in the actual measurement uncertainty achievable on a customer's site being larger than the CMC.

⁴ The hardness of the ball holder is measured using the Vickers hardness scale and the results can be converted to Rockwell hardness values.

⁵ This scope meets A2LA's *P112 Flexible Scope Policy*.



Accredited Laboratory

A2LA has accredited

BUEHLER, A DIVISION OF ILLINOIS TOOL WORKS, INC.

Lake Bluff, IL

for technical competence in the field of

Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets R205 – Specific Requirements: Calibration Laboratory Accreditation Program. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).



Presented this 3rd day of January 2022.

A blue ink signature of the Vice President of Accreditation Services.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2237.01
Valid to October 31, 2023

For the calibrations to which this accreditation applies, please refer to the laboratory's Calibration Scope of Accreditation.