



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005
& ANSI/NCSL Z540-1-1994

SUN-TEC CORPORATION
46590 Ryan Court
Novi, MI 48377
George Smolboski Phone: 248 669 3100

CALIBRATION

Valid To: March 31, 2019

Certificate Number: 1934.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations¹:

I. Dimensional

Parameter/Equipment	Range	CMC ² (±)	Comments
Extensometers/ Deflectometers –	Up to 2 in (2 to 10) in	140 µin 250 µin	ASTM E83, calibrator, gage blocks
Gauge Length	Up to 8 in	0.0014 in	Caliper
Calibration of Stage Micrometers	(0 to 10) mm	3.5 µm	Non-contact 2 axis CMM (vision system)

II. Mechanical

Parameter/Equipment	Range	CMC ³ (±)	Comments
<p>Calibration of Standardized Rockwell Hardness and Rockwell Superficial Hardness Test Blocks^{3,4,7} –</p> <p>Mean Hardness Value</p>	<p>HRA (Carbide): Low Medium High</p> <p>HRA Low Medium High</p> <p>HRBW Low Medium High</p> <p>HRC: Low Medium High</p> <p>HRD: Low Medium High</p> <p>HREW: Low Medium High</p> <p>HRFW: Low Medium High</p> <p>HRGW: Low Medium High</p>	<p>0.14 HRA 0.12 HRA 0.11 HRA</p> <p>0.23 HRA 0.21 HRA 0.19 HRA</p> <p>0.66 HRBW 0.54 HRBW 0.43 HRBW</p> <p>0.35 HRC 0.33 HRC 0.31 HRC</p> <p>0.51 HRD 0.42 HRD 0.40 HRD</p> <p>0.46 HREW 0.41 HREW 0.41 HREW</p> <p>0.49 HRFW 0.43 HRFW 0.39 HRFW</p> <p>0.46 HRGW 0.41 HRGW 0.38 HRGW</p>	<p>ASTM B294</p> <p>ASTM E18</p>



Parameter/Equipment	Range	CMC ² (±)	Comments
Calibration of Standardized Rockwell Hardness and Rockwell Superficial Hardness Test Blocks ^{3, 4, 7} – (cont)			
Mean Hardness Value	HRHW: Low High	0.44 HRHW 0.37 HRHW	ASTM E18
	HRKW: Low Medium High	0.48 HRKW 0.45 HRKW 0.42 HRKW	
	HRLW: Low High	0.44 HRLW 0.38 HRLW	
	HRMW: Low High	0.47 HRMW 0.42 HRMW	
	HRPW: Low High	0.50 HRPW 0.36 HRPW	
	HRRW: Low High	0.46 HRRW 0.43 HRRW	
	HRSW: Low High	0.41 HRSW 0.30 HRSW	
	HRVW: Low High	0.55 HRVW 0.38 HRVW	
	HR15N: Low Medium High	0.36 HR15N 0.28 HR15N 0.22 HR15N	
	HR15TW: Low Medium High	0.58 HR15TW 0.42 HR15TW 0.33 HR15TW	



Parameter/Equipment	Range	CMC ² (±)	Comments
Calibration of Standardized Rockwell Hardness and Rockwell Superficial Hardness Test Blocks ^{3, 4, 7} – (cont)			
Mean Hardness Value	HR15WW: Low High	0.42 HR15WW 0.38 HR15WW	ASTM E18
	HR15XW: Low High	0.47 HR15XW 0.33 HR15XW	
	HR15YW: Low High	0.46 HR15YW 0.38 HR15YW	
	HR30N: Low Medium High	0.41 HR30N 0.36 HR30N 0.31 HR30N	
	HR30TW: Low Medium High	0.50 HR30TW 0.42 HR30TW 0.34 HR30TW	
	HR30WW: Low High	0.63 HR30WW 0.55 HR30WW	
	HR30XW: Low High	0.49 HR30XW 0.44 HR30XW	
	HR30YW: Low High	0.50 HR30YW 0.40 HR30YW	
	HR45N: Low Medium High	0.48 HR45N 0.42 HR45N 0.42 HR45N	

Parameter/Equipment	Range	CMC ² (±)	Comments
Calibration of Standardized Rockwell Hardness and Rockwell Superficial Hardness Test Blocks ^{3,4,7} – (cont) Mean Hardness Value	HR45TW: Low Medium High HR45WW: Low High HR45XW: Low High HR45YW: Low High	0.49 HR45TW 0.46 HR45TW 0.44 HR45TW 0.52 HR45WW 0.32 HR45WW 0.53 HR45XW 0.48 HR45XW 0.53 HR45YW 0.45 HR45YW	ASTM E18
Calibration of Standardized Brinell Hardness Test Blocks ⁶ – Mean Hardness Value –			
1/5/10	Low Medium High	0.19 HBW 0.42 HBW 0.8 HBW	ASTM E10
1/10/10	Low Medium High	0.34 HBW 0.69 HBW 1.5 HBW	
1/30/10	Low Medium High	0.79 HBW 1.3 HBW 5.3 HBW	
2.5/62.5/10	Low Medium High	0.24 HBW 0.44 HBW 1.5 HBW	
5/125/10	Low Medium High	0.14 HBW 0.32 HBW 0.85 HBW	



Parameter/Equipment	Range	CMC ² (±)	Comments
Calibration of Standardized Brinell Hardness Test Blocks ⁶ – (cont)			
Mean Hardness Value –			
2.5/187.5/10	Low Medium High	0.58 HBW 1.7 HBW 3.8 HBW	ASTM E10
5/250/10	Low Medium High	0.19 HBW 0.41 HBW 1.2 HBW	
10/500/10	Low Medium High	0.12 HBW 0.38 HBW 1.1 HBW	
5/750/10	Low Medium High	0.75 HBW 1.6 HBW 3.8 HBW	
10/1000/10	Low Medium High	0.21 HBW 0.40 HBW 0.85 HBW	
10/1500/10	Low Medium High	0.34 HBW 0.56 HBW 1.4 HBW	
10/2000/10	Low Medium High	0.95 HBW 0.87 HBW 3.1 HBW	
10/2500/10	Low Medium High	0.46 HBW 0.89 HBW 3.0 HBW	
10/3000/10	Low Medium High	0.80 HBW 1.6 HBW 3.7 HBW	



Parameter/Equipment	Range	CMC ² (±)	Comments
Calibration of Standardized Knoop & Vickers Hardness Test Blocks ⁵ – Mean Hardness Value ≥ 1 kgf Mean Hardness Value ≤ 1 kgf	(80 to 250) HK (>250 to 650) HK >650 HK (80 to 240) HV (> 240 to 600) HV > 600 HV (80 to 240) HV (> 240 to 600) HV > 600 HV (80 to 250) HK (> 250 to 650) HK > 650 HK	1.5 % of range 1.6 % of range 1.5 % of range 1.1 % of range 0.78 % of range 0.60 % of range 0.71 % of range 0.44 % of range 0.30 % of range 0.68 % of range 0.42 % of range 0.20 % of range	ASTM E92
Calibration of Standardized Leeb Hardness Test Blocks	HLD: Low Medium High	6.6 HLD 7.8 HLD 9.2 HLD	ASTM A956
Direct Verification of Rockwell Hardness Testers ³ – Verification of the Test Force Depth Measuring Gage	(3 to 150) kgf	0.050 % of range 0.11 μm	Direct verification per ASTM E18, verification of the test force by load cell per ASTM E4, gage blocks

Parameter/Equipment	Range	CMC ² (±)	Comments
Direct Verification of Indenters – Rockwell Diamond Indenter – Included Cone Angle Mean Tip Radius Tip Radius Section Axis Normal to Seating Surface	$120^\circ \pm 0.35^\circ$ (0.200 ± 0.010) mm (0.200 ± 0.015) mm $\leq 0.5^\circ$	640" 5.6 μ m 2.9 μ m 13'	Rockwell A, C, D, & N Evaluated by non-contact two axis CMM (vision system)
Direct Verification of Indenters – (cont) Rockwell Diamond Indenter (cont) – Cone Flank Straightness Ball Protrusion Carbide Ball Indenter – Vickers Hardness Steel Ball Indenter – Vickers Hardness Knoop & Vickers Diamond Indenter – Knoop Edge Angle A Corresponding Angle B Vickers Edge Angle Inclination to Axis Junction Offset	> 0.3 mm ≥ 1500 HV ≥ 746 HV	3.0 μ m 2.5 μ m 19 HV 7.8 HV	Rockwell A, C, D, & N Vickers hardness determination per ASTM E92 Evaluated by non-contact two axis CMM (vision system) Per ASTM E92



Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Rockwell Hardness and Rockwell Superficial Hardness Testers ^{3, 4, 7}	HRA (Carbide): Low Medium High	0.16 HRA 0.14 HRA 0.13 HRA	Indirect verification per ASTM E18 and ASTM B294
	HRA Low Medium High	0.50 HRA 0.44 HRA 0.31 HRA	Indirect verification per ASTM E18 and ASTM E110
	HRBW Low Medium High	0.75 HRBW 0.61 HRBW 0.52 HRBW	
	HRC: Low Medium High	0.41 HRC 0.39 HRC 0.36 HRC	



Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Rockwell Hardness and Rockwell Superficial Hardness Testers ^{3, 4, 7} –	HRD: Low Medium High	0.61 HRD 0.54 HRD 0.51 HRD	Indirect verification per ASTM E18 and ASTM B294
	HREW: Low Medium High	0.56 HREW 0.53 HREW 0.50 HREW	Indirect verification per ASTM E18 and ASTM E110
	HRFW: Low Medium High	0.61 HRFW 0.57 HRFW 0.49 HRFW	
	HRGW: Low Medium High	0.49 HRGW 0.49 HRGW 0.43 HRGW	
	HRHW: Low High	0.55 HRHW 0.45 HRHW	
	HRKW: Low Medium High	0.53 HRKW 0.49 HRKW 0.46 HRKW	
	HRLW: Low High	0.51 HRLW 0.43 HRLW	
	HRMW: Low High	0.59 HRMW 0.50 HRMW	
	HRPW: Low High	0.53 HRPW 0.44 HRPW	



Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Rockwell Hardness and Rockwell Superficial Hardness Testers ^{3, 4, 7} – (cont)	HRRW: Low High HRSW: Low High HRVW: Low High HR15N: Low Medium High HR15TW: Low Medium High HR15WW: Low High	0.51 HRRW 0.46 HRRW 0.46 HRSW 0.39 HRSW 0.61 HRVW 0.47 HRVW 0.47 HR15N 0.36 HR15N 0.31 HR15N 0.69 HR15TW 0.55 HR15TW 0.51 HR15TW 0.54 HR15WW 0.42 HR15WW	Indirect verification per ASTM E18 and ASTM E110



Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Rockwell Hardness and Rockwell Superficial Hardness Testers ^{3, 4, 7} – (cont)	HR15XW: Low High HR15YW: Low High HR30N: Low Medium High HR30TW: Low Medium High HR30WW: Low High HR30XW: Low High HR30YW: Low High HR45N: Low Medium High HR45TW: Low Medium High	0.62 HR15XW 0.39 HR15XW 0.59 HR15YW 0.49 HR15YW 0.51 HR30N 0.44 HR30N 0.39 HR30N 0.57 HR30TW 0.51 HR30TW 0.47 HR30TW 0.71 HR30WW 0.63 HR30WW 0.58 HR30XW 0.51 HR30XW 0.56 HR30YW 0.49 HR30YW 0.58 HR45N 0.56 HR45N 0.53 HR45N 0.65 HR45TW 0.54 HR45TW 0.50 HR45TW	Indirect verification per ASTM E18 and ASTM E110



Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Rockwell Hardness and Rockwell Superficial Hardness Testers ^{3, 4, 7} – (cont)	HR45WW: Low High HR45XW: Low High HR45YW: Low High	0.58 HR45WW 0.47 HR45WW 0.60 HR45XW 0.56 HR45XW 0.63 HR45YW 0.54 HR45YW	Indirect verification per ASTM E18 and ASTM E110
Direct Verification of Brinell Hardness Testers ³ –			
Verification of the Test Force	≤ 3000 kgf	0.050 % of range	Direct verification per ASTM E10 and ASTM E110
Verification of the Device for Measuring Indentation Diameters	Up to 1 mm Up to 2 mm Up to 3 mm Up to 4 mm Up to 5 mm Up to 6 mm Up to 7 mm Up to 8 mm	0.009 mm 0.017 mm 0.025 mm 0.034 mm 0.042 mm 0.051 mm 0.059 mm 0.067 mm	Verification of the test force is by load cell ASTM E4, stage micrometer
Verification of Test Cycle	(1 to 15) s	0.14 s	Digital stopwatch

Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect Verification of Brinell Hardness Testers ^{3,6} –			
1/5/10	Low High	0.46 HBW 0.87 HBW	Indirect verification per ASTM E10 and ASTM E110
1/10/10	Low High	0.38 HBW 1.7 HBW	
1/30/10	Low High	1.5 HBW 5.8 HBW	
2.5/62.5/10	Low High	0.25 HBW 1.6 HBW	
5/125/10	Low High	0.54 HBW 0.88 HBW	
2.5/187.5/10	Low High	0.60 HBW 3.9 HBW	
5/250/10	Low High	0.42 HBW 1.3 HBW	
10/500/10	Low High	0.14 HBW 1.3 HBW	
5/750/10	Low High	0.86 HBW 3.9 HBW	
10/1000/10	Low High	0.47 HBW 1.0 HBW	
10/1500/10	Low High	0.41 HBW 1.7 HBW	
10/2000/10	Low High	1.1 HBW 3.7 HBW	
10/2500/10	Low High	1.1 HBW 3.7 HBW	
10/3000/10	Low High	0.96 HBW 4.3 HBW	



Parameter/Equipment	Range	CMC ² (±)	Comments
<p>Direct Verification of Knoop & Vickers Hardness Testers³ –</p> <p>Verification of the Test Force</p> <p>Verification of the Device for Measuring Indentation Diagonals</p>	<p>≥ 1 kgf</p> <p>Up to 30 μm Up to 60 μm Up to 90 μm Up to 120 μm Up to 150 μm Up to 200 μm Up to 300 μm Up to 400 μm Up to 500 μm Up to 600 μm Up to 700 μm Up to 800 μm Up to 900 μm Up to 1000 μm</p>	<p>0.050 % of range</p> <p>0.18 μm 0.33 μm 0.48 μm 0.67 μm 0.83 μm 1.1 μm 1.7 μm 2.2 μm 2.7 μm 3.3 μm 3.7 μm 4.3 μm 4.9 μm 5.4 μm</p>	<p>Direct verification per ASTM E92</p> <p>Verification of the test force is by load cell per ASTM E4, stage micrometer</p>
<p>Indirect Verification of Knoop and Vickers Hardness Testers^{3,5} –</p> <p>≤ 1 kgf</p> <p>≥ 1 kgf</p>	<p>(100 to 240) HV (> 240 to 600) HV > 600 HV</p> <p>(100 to 250) HK (> 250 to 650) HK > 650 HK</p> <p>(100 to 240) HV (>240 to 600) HV >600 HV</p>	<p>0.72 % of range 0.45 % of range 0.31 % of range</p> <p>0.69 % of range 0.43 % of range 0.21 % of range</p> <p>1.6 % of range 0.80 % of range 0.62 % of range</p>	<p>Indirect verification per ASTM E92</p>

Parameter/Equipment	Range	CMC ² (±)	Comments
Indirect verification of Leeb Testers ^{3, 8}	HLD: Low Medium High	7.0 HLD 8.0 HLD 9.5 HLD	Indirect verification per ASTM A956
Indirect Verification of Ultrasonic Contact Impedance Testers ^{3, 4}	UCI (HRC) Low Medium High	0.41 UCI (HRC) 0.34 UCI (HRC) 0.36 UCI (HRC)	ASTM A1038
Direct Verification of the Ball Punch Deformation Machines ³ – Height Indicator	(1 to 25) lbf (25 to 100) lbf (100 to 500) lbf (500 to 2000) lbf (2000 to 10 000) lbf (10 000 to 50 000) lbf (0 to 1) in	0.050 % of range 0.050 % of range 0.050 % of range 0.050 % of range 0.050 % of range 0.13 % of range 0.00058 in	Direct verification per Sun-Tec procedure WI-S004 (Reference ASTM E643 & ASTM E4) Compared to gage blocks
Force ³ – Tension and Compression	(1 to 25) lbf (25 to 100) lbf (100 to 500) lbf (500 to 2000) lbf (2000 to 10 000) lbf (10 000 to 60 000) lbf (60 000 to 300 000) lbf	0.050 % of range 0.050 % of range 0.050 % of range 0.050 % of range 0.050 % of range 0.13 % of range 0.13 % of range	ASTM E4
Crosshead Displacement	(0.2 to 2.0) in	0.00064 in	ASTM E2309, digital indicator
Crosshead Speed	(0.01 to 2.0) in/min	0.18 % of rdg	ASTM E2658, digital indicator, 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 and this laboratory meets A2LA R104 – *General Requirements: Accreditation of Field Testing and Field Calibration Laboratories* for these calibrations. 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 standardized test blocks used for verification are calibrated at the Sun-Tec Standardizing Laboratory in accordance with ASTM E18 using NIST Rockwell HRC standard reference material (SRM) 2810, 2811, 2812, 2816, 2817, 2818, 2819, 2820, and 2821 unless otherwise noted. All other Rockwell scales are traceable to the MPA or Sun-Tec hardness levels through laboratory standardizing machines. The standardizing machines are directly verified according to ASTM E18 using devices that are traceable to NIST.
- ⁵ The standardized test blocks used for verification are calibrated at the Sun-Tec Standardizing Laboratory in accordance with ASTM E92 using NIST Vickers or Knoop standard reference material (SRM) 1906, 1893, 1894a, 1895, and 1896. All other micro-indentation scales are traceable to the MPA or Sun-Tec hardness levels through laboratory standardizing machines. The standardizing machines are directly verified according to ASTM E92 using devices that are traceable to NIST.
- ⁶ The standardized test blocks used for verification are calibrated at the Sun-Tec Standardizing Laboratory in accordance with ASTM E10 and are traceable through laboratory standardizing machines. The standardizing machines are directly verified according to ASTM E10 using devices that are traceable to NIST.
- ⁷ The standardized test blocks used for verification are calibrated at the Sun-Tec Standardizing Laboratory in accordance with ASTM E18 and ASTM B294 using a master secondary set from the CCPA.
- ⁸ The standardized test blocks used for verification are calibrated at the Sun-Tec standardizing laboratory in accordance with ASTM A956, and traceable to the MPA.



Accredited Laboratory

A2LA has accredited

SUN-TEC CORPORATION

Novi, MI

for technical competence in the field of

Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of ANSI/NCSLI Z540-1-1994 and 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 8 January 2009).



Presented this 28th day of July 2017.

A handwritten signature in black ink, written over a horizontal line.

President and CEO
For the Accreditation Council
Certificate Number 1934.01
Valid to March 31, 2019
Revised April 06, 2018

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