



**National Voluntary
Laboratory Accreditation Program**



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

Instron Calibration Laboratory
825 University Avenue
Norwood, MA 020162-2643
Mr. Jeffrey Manney
Phone: 781-575-5526 Fax: 781-575-5767
E-mail: jeffrey_manney@instron.com
URL: http://www.instron.com

CALIBRATION LABORATORIES

NVLAP LAB CODE 200301-0
Scope Revised: 2009-08-24

NVLAP Code: 20/A01 ANSI/NCSL Z540-1-1994; Part 1 Compliant

DIMENSIONAL

NVLAP Code: 20/D05
Length

<i>Range</i>	<i>Best Uncertainty</i> (\pm) ^{note 1}	<i>Remarks</i>
Field Service Calibration of Strain – ASTM E83 and ISO 9513		
0.3 to 4.0 in	0.0008 + 0.0002L in	Gage Length
0 to 1 in	0.000015 + 0.000165L in	Displacement
0 to 2 in	0.00003 + 0.000165L in	Displacement
0 to 10 in	0.0003 + 0.00015L in	Displacement
10 to 40 in	0.0003 + 0.00020L in	Displacement

Material Testing System Crosshead Displacement or Actuator Stroke – ASTM E2309 or Internal Method

<i>Range</i>	<i>Best Uncertainty</i> \pm ^{note 1}	<i>Remarks</i>
0 to 10 in	0.0003 + 0.00015L in	Digital Linear Encoders
10 to 40 in	0.0003 + 0.00020L in	Digital Linear Encoders

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Material Testing System Crosshead/Actuator Speed

Up to 50 in/min 0.0003 + 0.00015L in

Displacement Component using
Linear Encoders

Up to 50 in/min 10 milliseconds

Time Component by Comparison to
Time Base Oscillator

MECHANICAL

NVLAP Code: 20/M06

Force

In-house Application of Force – ASTM E74 and ISO 376

Range in lbf	Best Uncertainty (\pm) in % <small>note 1, 2, 3</small>	Remarks
0.1 to 130 000	0.005	Primary Standard
130 000 to 240 000	0.010	Secondary Standard

Field Service Calibration of Force – ASTM E4 and ISO 7500-1

Range	Best Uncertainty (\pm) <small>note 1</small>	Remarks
1 gram to 500 ton (0.01 N to 5 MN)	0.125 % of applied force	Compression
1 gram to 500 ton (0.01 N to 5 MN)	0.125 % of applied force	Tension

NVLAP Code: 20/M13

Hardness

Wilson - In-house calibration of Rockwell Test Blocks

Field Service Indirect verification of Rockwell Hardness testing Machines

Hardness Scale and Range	Best Uncertainty (\pm) in Rockwell Points <small>notes 1, 4, 5, 6, 7, 8, 9, 10</small>	Remarks
HRA Carbide		ASTM B294 Section A.1 & ISO 3738-2
93	0.07	
91	0.11	
85	0.17	

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HRA Steel Scale		ASTM E18 Annex A4 & ISO 6508-3
83	0.10	
73	0.27	
63	0.15	
HRB Scale		ASTM E18 Annex A4 & ISO 6508-3
95	0.17	
70	0.31	
40	0.48	
HRC Scale		ASTM E18 Annex A4 & ISO 6508-3
63	0.16	
45	0.18	
25	0.18	
HRD Scale		ASTM E18 Annex A4 & ISO 6508-3
73	0.05	
59	0.13	
43	0.14	
HRE Scale		ASTM E18 Annex A4 & ISO 6508-3
92	0.11	
87	0.24	
81	0.14	
HRF Scale		ASTM E18 Annex A4 & ISO 6508-3
98	0.11	
91	0.16	
80	0.13	
HRG Scale		ASTM E18 Annex A4 & ISO 6508-3
77	0.18	
56	0.28	
23	0.45	

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HRH Scale		ASTM E18 Annex A4 & ISO 6508-3
100	0.16	
97	0.22	
91	0.16	
HRK Scale		ASTM E18 Annex A4 & ISO 6508-3
91	0.20	
75	0.21	
57	0.39	
HRL Scale		ASTM E18 Annex A4 & ISO 6508-3
124	0.05	
116	0.10	
106	0.15	
HRM Scale		ASTM E18 Annex A4 & ISO 6508-3
120	0.07	
105	0.13	
90	0.30	
HR15N Scale		ASTM E18 Annex A4 & ISO 6508-3
91	0.08	
83	0.09	
71	0.09	
HR30N Scale		ASTM E18 Annex A4 & ISO 6508-3
80	0.15	
64	0.23	
46	0.16	
HR45N Scale		ASTM E18 Annex A4 & ISO 6508-3
70	0.13	
49	0.12	
24	0.19	

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HRP Scale		ASTM E18 Annex A4 & ISO 6508-3
108	0.15	
99	0.23	
88	0.26	
 HRR Scale		 ASTM E18 Annex A4 & ISO 6508-3
121	0.12	
119	0.12	
116	0.12	
 HRS Scale		 ASTM E18 Annex A4 & ISO 6508-3
114	0.12	
109	0.15	
106	0.16	
 HR15T Scale		 ASTM E18 Annex A4 & ISO 6508-3
90	0.05	
83	0.27	
76	0.17	
 HR30T Scale		 ASTM E18 Annex A4 & ISO 6508-3
70	0.20	
56	0.20	
43	0.29	
 HR45T Scale		 ASTM E18 Annex A4 & ISO 6508-3
67	0.10	
41	0.33	
23	0.21	
 HRV Scale		 ASTM E18 Annex A4 & ISO 6508-3
106	0.17	
98	0.21	
95	0.22	
 HR15W Scale		 ASTM E18 Annex A4 & ISO 6508-3
94	0.08	

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88	0.07	
84	0.11	
HR30W Scale		ASTM E18 Annex A4 & ISO 6508-3
88	0.09	
75	0.13	
69	0.24	
HR45W Scale		ASTM E18 Annex A4 & ISO 6508-3
82	0.08	
69	0.23	
50	0.11	
HR15X Scale		ASTM E18 Annex A4 & ISO 6508-3
97	0.08	
95	0.08	
90	0.10	
HR30X Scale		ASTM E18 Annex A4 & ISO 6508-3
93	0.11	
88	0.16	
80	0.12	
HR45X Scale		ASTM E18 Annex A4 & ISO 6508-3
90	0.08	
82	0.11	
71	0.18	
HR15Y Scale		ASTM E18 Annex A4 & ISO 6508-3
97	0.12	
95	0.15	
92	0.10	

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HR30Y Scale

ASTM E18 Annex A4 & ISO 6508-3

94	0.09
91	0.19
83	0.41

HR45Y Scale

ASTM E18 Annex A4 & ISO 6508-3

91	0.10
86	0.18
75	0.11

Wilson - In-house calibration of Rockwell Diamond Testing Indenters

Rockwell Regular and Superficial diamond indenters for testing machines

<i>Measured Quantity</i>	<i>Best Uncertainty (±) ^{note 1,14}</i>	<i>Remarks</i>
Cone Angle	2.1 minutes	ASTM E18
Tip Radius	2.9 microns	ASTM E18
Concentricity of Axis	2.1 minutes	ASTM E18
Polished Flank	5 microns	ASTM E18
Local Deviation From A True Radius	.5 Micron	ASTM E18
Straightness of the Generatrix Line of the Diamond Cone	.5 Micron	ASTM E18
Indenter Performance	0.1 Rockwell Units	ASTM E18

Wilson - In-house calibration of Rockwell Ball Indenters

Calibration of Steel and Carbide indenters for standardizing and testing machines

<i>Measured Quantity</i>	<i>Best Uncertainty (±) in μin ^{note 1, 15, 16, 17}</i>	<i>Remarks</i>
Hardness	2.12 HV	ASTM E18
Indenter Performance	0.1 Rockwell Units	ASTM E18

Wilson - In-house calibration of Vickers and Knoop Indenters

Calibration of Knoop & Vickers indenters for standardizing and testing machines Angular Measurement

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<i>Measured Quantity</i>	<i>Best Uncertainty (±) ^{notes 1, 18, 19}</i>	<i>Remarks</i>
Knoop 130° Angle	31 seconds	ASTM E92 & ASTM E384
Knoop 172° 30' Angle	32 seconds	ASTM E92 & ASTM E384
Vickers 148° 6' 42" Angle	20 seconds	ASTM E92 & ASTM E384
Indenter Offset determined on indent		
0.001 mm Vickers ASTM E92,	0.17 microns	ASTM E92 & ASTM E384 (Measured by Standardizing Optics)
0.0005 mm Vickers ASTM E384,		
0.001 Knoop ASTM E384		

Wilson - In-house calibration of Vickers and Knoop Test Blocks

Calibration of Brinell, Knoop & Vickers Standardized Test Blocks

<i>Measured Quantity</i>	<i>Best Uncertainty (±) ^{notes 1, 20,21,22}</i>	<i>Remarks</i>
Brinell Hardness		ASTM E10
Applied Forces of 10 kgf to 3000 kgf	HB	
Ball Diameter of 1 mm to 10 mm		
Low Hardness:		
94 HBW 10/500	0.97	
100 HBW 2.5/62.5	0.91	
111 HBW 10/3000	1.29	
139 HBW 2.5/62.5	1.63	
140 HBW 10/1000	1.79	
Mid Hardness:		
183 HBW 10/3000	2.36	
199 HBW 2.5/187.5	2.72	
200 HBW 2.5/187.5	1.45	
200 HBW 10/1500	1.35	
High Hardness:		
315 HBW 10/3000	2.14	

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326 HBW 5/750 3.37
462 HBW 10/3000 4.28

Vickers Hardness
Applied Forces 10 gf to 120 kgf HV ASTM E384 or E92

Low Hardness:

129 HV/0.1 1.35
212 HV/10 1.41
217 HV/0.5 2.12
255 HV/15 1.72
261 HV/100 1.61

Mid Hardness:

321 HV/5 3.79
388 HV/0.5 4.06
395 HV/0.1 5.73
441 HV/100 2.76

High Hardness:

598 HV/30 5.78
611 HV/5 3.27
694 HV/0.5 4.84
697 HV/100 5.06
705 HV/0.2 7.72
719 HV/30 3.46

Knoop Indentation Hardness
Applied Forces of 10 gf to 1 kgf HK ASTM E384

Low Hardness:

112 HK/0.01 3.86
142 HK/0.1 2.11
238 HK/0.5 3.34

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Mid Hardness:

319 HK/0.2	3.45
516 HK/1	4.64
524 HK/0.1	5.47

High Hardness:

637 HK/0.1	9.09
700 HK/0.025	11.92
741 HK/0.1	5.95

Field Service Calibration of Brinell, Knoop and Vickers hardness testing machines

Brinell Microscope

Measured Quantity	Best Uncertainty (\pm) <small>note 1,11,12,13</small>	Remarks
10X to 100 X Magnification	1.6 micron	ASTM E10

Vickers and Knoop Microscope

30X to 1000 X Magnification	0.9 microns	ASTM E92 and E384
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Indirect Verification of Brinell, Knoop & Vickers Testing Machines

Measured Quantity	Best Uncertainty (\pm) <small>notes 1, 20,21,22</small>	Remarks
Brinell Hardness		
Applied Forces of 10 kgf to 3000 kgf	HBW	ASTM E10
Ball Diameter of 1 mm to 10 mm		

Low Hardness:

94 HBW 10/500	1.12
100 HBW 2.5/62.5	0.98
111 HBW 10/3000	1.41
139 HBW 2.5/62.5	1.74
140 HBW 10/1000	1.92

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Mid Hardness:

183 HBW 10/3000	2.42
199 HBW 2.5/187.5	2.82
200 HBW 2.5/187.5	1.62
200 HBW 10/1500	1.69

High Hardness:

315 HBW 10/3000	2.59
326 HBW 5/750	3.97
462 HBW 10/3000	4.95

Vickers Hardness

Applied Forces 10 gf to 120 kgf HV ASTM E384 or E92

Low Hardness:

129 HV/0.1	1.61
212 HV/10	1.44
217 HV/0.5	2.41
255 HV/15	1.77
261 HV/100	1.75

Mid Hardness:

321 HV/5	3.87
388 HV/0.5	4.21
395 HV/0.1	6.36
441 HV/100	2.81

High Hardness:

598 HV/30	5.79
611 HV/5	3.49
694 HV/0.5	5.53
697 HV/100	5.50
705 HV/0.2	9.06
719 HV/30	3.64

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Measurement Hysteresis .01 HR

ASTM E18 Annex A1

99 to 101 Rockwell Points for all Rockwell Hardness Scales Except Rockwell Ball Scales Noted Below

129 to 131 Rockwell Points for Rockwell Ball Scales: HRB, HRE, HRF, HRG, HRH & HRK Only

Shore - In-house calibration of Durometers

Durometers

Parameter	Range in D.P. <small>note 23</small>	Best Uncertainty (\pm) in D.P. <small>notes 1, 23, 25, 27</small>	Remarks
SI Durometers			
Type A	0 to 100	0.27	ASTM D2240 and DIN 53505
Type B	0 to 100	0.27	ASTM D2240
Type C	0 to 100	0.36	ASTM D2240
Type D	0 to 100	0.36	ASTM D2240 and DIN 53505
Type DO	0 to 100	0.36	ASTM D2240
Type M	0 to 100	0.50	ASTM D2240
Type O	0 to 100	0.27	ASTM D2240
Type OO	0 to 100	0.27	ASTM D2240
Round Style Durometers			
Type A	0 to 100	1.16	ASTM D2240
Type B	0 to 100	1.16	ASTM D2240
Type C	0 to 100	1.16	ASTM D2240
Type D	0 to 100	1.16	ASTM D2240
Type DO	0 to 100	1.16	ASTM D2240
Type M	0 to 100	1.24	ASTM D2240
Type O	0 to 100	1.16	ASTM D2240
Type OO	0 to 100	1.20	ASTM D2240
Type OOO	0 to 100	1.20	ASTM D2240
Type OOOS	0 to 100	1.16	ASTM D2240

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Type T	0 to 100	1.16	Shore Calibration Laboratory Specifications
Quad Style Durometers			
Type A	0 to 100	5.78	ASTM D2240
Type B	0 to 100	5.78	ASTM D2240
Type C	0 to 100	5.78	ASTM D2240
Type D	0 to 100	5.78	ASTM D2240
Type DO	0 to 100	5.78	ASTM D2240
Type O	0 to 100	5.78	ASTM D2240
Type OO	0 to 100	5.78	ASTM D2240
Type T	0 to 100	5.78	Shore Calibration Laboratory Specifications
Durotronic Style Durometers			
Type A	0 to 100	0.42	ASTM D2240
Type B	0 to 100	0.42	ASTM D2240
Type C	0 to 100	0.40	ASTM D2240
Type D	0 to 100	0.40	ASTM D2240
Type DO	0 to 100	0.40	ASTM D2240
Type O	0 to 100	0.50	ASTM D2240
Type M	0 to 100	0.60	ASTM D2240
Pencil Style Durometers			
Type A	0 to 100	5.78	ASTM D2240
Shore - In-house calibration of IRHD			

Range	Best Uncertainty (\pm) <small>notes 1, 28</small>	Remarks
10 to 100 IRHD	See Below	ASTM D1415 Type S2 & ISO 48 Method N
0.295 N	0.002 N	Minor Force on Ball
5.4 N	0.006 N	Major Force on Ball
5.7 N	0.006 N	Total Force on Ball
8.3 N	0.016 N	Force on Foot
6.0 mm	0.02 mm	Inside Diameter of Foot

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THERMODYNAMIC

NVLAP Code: 20/T08
Field Calibration of Temperature

In situ Temperature Measurement Type T Thermocouple

Range	Best Uncertainty (\pm) ^{note 1}	Remarks
-200 °C to -150 °C	1.3 °C	Type T Thermocouple with Fluke 714
-150 °C to -100 °C	1.2 °C	Type T Thermocouple with Fluke 714
-100 °C to -50 °C	1.1 °C	Type T Thermocouple with Fluke 714
-50 °C to 0 °C	1.1 °C	Type T Thermocouple with Fluke 714

In situ Temperature Measurement Type K Thermocouple

0 °C to 100 °C	0.7 °C	Type K Thermocouple with Fluke 714
100 °C to 200 °C	0.7 °C	Type K Thermocouple with Fluke 714
200 °C to 300 °C	1.2 °C	Type K Thermocouple with Fluke 714
300 °C to 400 °C	2.1 °C	Type K Thermocouple with Fluke 714
400 °C to 500 °C	2.6 °C	Type K Thermocouple with Fluke 714
500 °C to 600 °C	3.2 °C	Type K Thermocouple with Fluke 714
600 °C to 700 °C	3.7 °C	Type K Thermocouple with Fluke 714
700 °C to 800 °C	4.2 °C	Type K Thermocouple with Fluke 714
800 °C to 900 °C	4.8 °C	Type K Thermocouple with Fluke 714

Thermocouple Simulation

Type K	1.3 °C	Sensor substitution method using Fluke 714
Type J	0.9 °C	Sensor substitution method using Fluke 714
Type B	2.6 °C	Sensor substitution method using Fluke 714
Type E	0.9 °C	Sensor substitution method using Fluke 714
Type T	0.9 °C	Sensor substitution method using Fluke 714
Type R	0.9 °C	Sensor substitution method using Fluke 714
Type S	2.4 °C	Sensor substitution method using Fluke 714
Type U	0.9 °C	Sensor substitution method using Fluke 714
Type L	0.8 °C	Sensor substitution method using Fluke 714

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1. Represents an expanded uncertainty using a coverage factor, $k = 2$, at an approximate level of confidence of 95 %.
2. Uncertainty of the voltage ratio is < 0.1 microvolt per volt.
3. Uncertainties of the measured value are determined by the statistics of the test and the artifact tested but are typically better than ± 0.05 % for class AA instruments, ± 0.25 % for class A instruments, and ± 0.1 % for class A1 instruments.
4. The standardized test blocks used for verification are calibrated at the Wilson Hardness Calibration Laboratory in accordance with ASTM E18 Annex A4 using NIST Rockwell HRC standard reference materials (SRM) 2810, 2811, and 2812. All Rockwell Ball hardness scales are traceable to Wilson hardness levels through laboratory standardizing machines. All other Rockwell diamond hardness scales are traceable to NIST through a NIST Reference Diamond. The standardizing machines are directly verified according to ASTM E18 using devices that are traceable to NIST either directly or through a NVLAP -approved laboratory.
5. The HRC Hardness scale is traceable to the NIST Rockwell HRC standard reference materials (SRM) 2810, 2811, 2812.
6. Standardized Rockwell test blocks calibrated by ball penetrators are traceable to traditional Wilson Hardness Levels.
7. Standardized Rockwell test blocks calibrated for the HRA carbide hardness scale are directly traceable to the Cemented Carbide Producers Association (CCPA) through standard reference materials.
8. Standardized Rockwell test blocks calibrated for the HRA steel, HRD and HRN hardness scales are traceable to N.I.S.T.
9. The standardizing machines are directly verified according to ASTM E18 using devices that are traceable to NIST—either directly or through a NVLAP-approved laboratory.
10. The stated measurement uncertainty is expanded with a coverage factor of $k = 2$, representing a level of confidence of approximately 95 %. The measurement uncertainty reported is the actual measurement uncertainty for the calibration standards used during customer machine indirect verification. All standardized test blocks are calibrated using Laboratory Standardizing Machines at the Wilson Hardness Calibration Laboratory.
11. The calibration shall be in accordance with ASTM E10 for Brinell measuring microscope verification.
12. The calibration shall be in accordance with ASTM E384 for micro-indentation measuring device verification.
13. Direct verification of hardness testing machines shall be in accordance with ASTM E18. Measurement uncertainty reported is the actual measurement uncertainty of the calibration standards used during direct verification.
14. The calibration shall be in accordance with ASTM E18.
15. The calibration shall be in accordance with ASTM E18 for Rockwell calibrations or ASTM E10 for Brinell calibrations.

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16. Ball Diameter, Roundness, Chemical Composition, Density & Surface Finish are subcontracted calibration from an accredited laboratory recognized by the ILAC agreement.
17. Ball hardness is measured internally by Instron or subcontracted calibration from an accredited laboratory recognized by the ILAC agreement.
18. The calibration shall be in accordance with ASTM E384 for Knoop and Vickers micro-indentation indenters.
19. The calibration shall be in accordance with ASTM E92 for Vickers heavy load testing indenters & standardizing indenters.
20. The calibration shall be in accordance with ASTM E10 for Brinell test block calibrations.
21. The calibration shall be in accordance with ASTM E92 for Vickers heavy load test block calibrations.
22. The calibration shall be in accordance with ASTM E384 for Knoop and Vickers micro-indentation test block calibrations.
23. D.P. = Durometer Points
24. Durocalibrator calibrates A, B, O & T type durometers.
25. Durocalibrator calibrates C, D, & DO type durometers.
26. Durocalibrator calibrates A, B, C, D, DO, O & T type durometers.
27. Shore T scale specified is certified to Shore Hardness Calibration Laboratory Procedures.
28. IRHD = International Rubber Hardness Degree
29. Best measurement uncertainty stated for rubber test blocks on scope assumes perfect test block uniformity. Actual test block non-uniformity will be calculated in overall measurement uncertainty calculation for each test block. The combined measurement uncertainty for each test block is reported on the calibration certificate.

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