SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

AND

ANSI/NCSL Z540-1-1994 (R2002)

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CALIBRATION, DIMENSIONAL MEASUREMENT, AND TESTING

Valid to: **June 6, 2024** Certificate Number: **ACT-1116**

CALIBRATION

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Voltage – Source [1,2]	Up to 330 mV (0.33 to 3.3) V (3.3 to 33) V (33 to 330) V (330 to 1 020) V	7.1 µV 40 µV 0.4 mV 5.9 mV 20 mV	Multiproduct Calibrator
DC Voltage – Measure [1,2]	Up to 200 mV (0.2 to 2) V (2 to 20) V (20 to 200) V (200 to 1 020) V	7.6 µV 37 µV 0.32 mV 7 mV 55 mV	Keithley 2002 8.5 Digit Multimeter
DC Current – Source [1,2]	Up to 330 µA (0.33 to 3.3) mA (3.3 to 33) mA (33 to 330) mA (0.33 to 1.1) A (1.1 to 11) A (11 to 20.5) A	72 nA 0.38 µA 3.5 µA 35 µA 0.61 mA 5.1 mA 24 mA	Multiproduct Calibrator
DC Current – Source [1,2] Clamp-On Ammeters	(20.5 to 205) A	208 mA	Multiproduct Calibrator w/ 10-turn Coil
	(205 to 1 025) A	1 A	Multiproduct Calibrator w/ 10-turn Coil

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
DC Current – Measure [1,2]	Up to 200 µA (0.2 to 2) mA (2 to 20) mA (20 to 200) mA (0.2 to 2) A	0.1 µA 0.99 µA 10 µA 0.13 mA 2.2 mA	Keithley 2002 8.5 Digit Multimeter
DC Current – Measure [1,2]	(2 to 10) A	16 mA	Fluke 8846A 6.5 Digit Multimeter
	(10 to 400) A	8.2 A	Fluke 8846A 6.5 Digit Multimeter w/ Current Shunt
	(400 to 2 000) A	19 A	Fluke 353 Clamp Meter
AC Voltage – Source [1,2]	Up to 33 mV 10 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz (33 to 330) mV (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz (0.33 to 3.3) V (10 to 45 Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 500) kHz (3.3 to 33) V (10 to 45) Hz 45 Hz to 10 kHz (10 to 20) kHz (20 to 50) kHz (50 to 100) kHz	 16 µV 15 µV 40 µV 0.13 mV 0.3 mV 0.13 mV 0.13 mV 73 µV 0.13 mV 0.28 mV 0.74 mV 1.3 mV 1.3 mV 0.72 mV 1.1 mV 2.3 mV 8.9 mV 9.1 mV 14 mV 9.6 mV 13 mV 32 mV	Multiproduct Calibrator

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Source [1,2]	(33 to 330) V		Multiproduct Calibrator
	(10 to 45) Hz	0.11 V	
	45 Hz to 10 kHz	73 mV	
	(10 to 20) kHz	97 mV	
	(20 to 50) kHz	0.11 V	
	(50 to 100) kHz	0.74 V	
	(330 V to 1 020) V		
	45 Hz to 5 kHz	0.26 V	
	(5 to 10) kHz	0.32 V	
AC Voltage – Measure [1,2]	Up to 200 mV		Keithley 2002 8.5 Digit Multimeter
	(20 to 50) Hz	1.6 mV	
	(50 to 100) Hz	0.21 mV	
	100 Hz to 10 kHz	99 µV	
	(10 to 30) kHz	0.11 mV	
	(30 to 50) kHz	0.76 mV	
	(50 to 100) kHz	1.9 µV	
	(100 to 200) kHz	5.1 mV	
	200 kHz to 2 MHz	13 mV	
	(0.22 to 2) V		
	(20 to 100) Hz	2.1 mV	
	100 Hz to 10 kHz	1 mV	
	(10 to 30) kHz	1.1 mV	
	(30 to 50) kHz	7.6 mV	
	(50 to 100) kHz	19 mV	
	(100 to 200) kHz	51 mV	
	200 kHz to 2 MHz	0.13 V	
	(2 to 20) V		
	(20 to 50) Hz	37 mV	
	50 Hz to 1 kHz	11 mV	
	(1 to 5) kHz	13 mV	
	(5 to 25) kHz	16 mV	
	(25 to 50) kHz	76 mV	
	(50 to 100) kHz	0.19 V	
	(20 to 200) V		
	(20 to 50) Hz	0.38 V	
	50 Hz to 1 kHz	0.12 V	
	(2 to 10) kHz	0.14 V	
	(10 to 30) kHz	0.17 V	
	(30 to 50) kHz	0.77 V	
	(50 to 100) kHz	1.9 V	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Voltage – Measure [1,2]	(200 to 750) V		Keithley 2002 8.5 Digit Multimeter
	(20 to 50) Hz	1.5 V	
	50 Hz to 1 kHz	1.1 V	
	(2 to 10) kHz	1.2 V	
	(10 to 25) kHz	1.4 V	
AC Current – Source [1,2]	(29 to 330) µA		Multiproduct Calibrator
	(20 to 45) Hz	0.52 µA	
	45 Hz to 1 kHz	0.52 µA	
	(1 to 5) kHz	0.87 µA	
	(5 to 10) kHz	2.6 µA	
	(10 to 30) kHz	3.9 µA	
	(0.33 to 3.3) mA		
	(20 to 45) Hz	3.2 µA	
	45 Hz to 1 kHz	3.2 µA	
	(1 to 5) kHz	5.2 µA	
	(5 to 10) kHz	16 µA	
	(10 to 30) kHz	18 µA	
	(3.3 to 33) mA		
	(20 to 45) Hz	16 µA	
	45 Hz to 1 kHz	16 µA	
	(1 to 5) kHz	28 µA	
	(5 to 10) kHz	68 µA	
	(10 to 30) kHz		
	(33 to 330) mA	0.13 mA	
	(10 to 20) Hz	0.63 mA	
	(20 to 45) Hz	0.16 mA	
	45 Hz to 1 kHz	0.16 mA	
	(1 to 5) kHz	0.4 mA	
	(5 to 10) kHz	0.75 mA	
	(10 to 30) kHz	1.5 mA	
	(0.33 to 1.1) A		
	(10 to 45) Hz	0.69 mA	
	45 Hz to 1 kHz	0.69 mA	
	(1 to 5) kHz	7.8 mA	
	(5 to 10) kHz	33 mA	
	(1.1 to 3) A		
	(10 to 45) Hz	1.9 mA	
	45 Hz to 1 kHz	1.9 mA	
	(1 to 5) kHz	19 mA	
	(5 to 10) kHz	78 mA	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
AC Current – Source [1,2]	(3 to 11) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz (11 to 20.5) A (45 to 100) Hz 100 Hz to 1 kHz (1 to 5) kHz	 8.7 mA 12 mA 0.3 A 31 mA 26 mA 0.62 A	Multiproduct Calibrator
AC Current – Source [1,2] Clamp-On Ammeters	(20.5 to 205) A (45 to 440) Hz	 0.37 A	Multiproduct Calibrator, 10-turn Coil
	(205 to 1 025) A (45 to 440) Hz	 1.5 A	Multiproduct Calibrator, 50-turn Coil
Resistance – Source [1,2]	Up to 11 Ω (11 to 33) Ω (33 to 110) Ω (110 to 330) Ω 330 Ω to 1.1 kΩ (1.1 to 3.3) kΩ (3.3 to 11) kΩ (11 to 33) kΩ (33 to 110) kΩ (110 to 330) kΩ 330 kΩ to 1.1 MΩ (1.1 to 3.3) MΩ (3.3 to 11) MΩ (11 to 33) MΩ (33 to 110) MΩ (110 to 330) MΩ 330 MΩ to 1.1 GΩ	1.7 mΩ 2.5 mΩ 4.8 mΩ 11 mΩ 33 mΩ 0.11 Ω 0.32 Ω 1.1 Ω 3.2 Ω 12 Ω 37 Ω 0.51 kΩ 0.5 kΩ 0.97 kΩ 62 kΩ 21 kΩ 6.4 MΩ	Multiproduct Calibrator
Resistance – Measure [1,2]	Up to 20 Ω (20 to 200) Ω (0.2 to 2) kΩ (2 to 20) kΩ (20 to 200) kΩ (0.2 to 2) MΩ (2 to 20) MΩ (20 to 200) MΩ (0.2 to 1) GΩ	1.8 mΩ 8.2 mΩ 41 mΩ 0.44 Ω 6.5 Ω 0.11 kΩ 4.3 kΩ 1.9 MΩ 18 MΩ	Keithley 2002 8.5 Digit Multimeter

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Capacitance – Source [1,2]	(0.19 to 3.3) nF	14 pF	Multiproduct Calibrator
	(3.3 to 11) nF	40 pF	
	(11 to 33) nF	0.13 nF	
	(110 to 330) nF	1.1 nF	
	(0.33 to 1.1) µF	4 nF	
	(1.1 to 3.3) µF	13 nF	
	(3.3 to 11) µF	40 nF	
	(11 to 33) µF	0.16 µF	
	(33 to 110) µF	0.64 µF	
	(110 to 330) µF	2.5 µF	
	(0.33 to 1.1) mF	8.1 µF	
	(1.1 to 3.3) mF	25 µF	
	(3.3 to 11) mF	57 µF	
	(11 to 33) mF	0.51 mF	
	(33 to 110) mF	1.4 mF	
Electrical Simulation of Thermocouple Indicating Devices [1]	Type E		Multiproduct Calibrator
	(-250 to -100) °C	0.88 °C	
	(-100 to -25) °C	0.74 °C	
	(-25 to 350) °C	0.73 °C	
	(350 to 650) °C	0.74 °C	
	(650 to 1 000) °C	0.75 °C	
	Type J		
	(-210 to -100) °C	0.66 °C	
	(-100 to -30) °C	0.62 °C	
	(-30 to 150) °C	0.62 °C	
	(150 to 760) °C	0.62 °C	
	(760 to 1 200) °C	0.64 °C	
	Type K		
	(-200 to -100) °C	0.68 °C	
	(-100 to -25) °C	0.63 °C	
	(-25 to 120) °C	0.62 °C	
	(120 to 1 000) °C	0.65 °C	
	(1 000 to 1 372) °C	0.72 °C	
	Type R		
	(0 to 250) °C	3.64 °C	
	(250 to 400) °C	3.62 °C	
	(400 to 1 000) °C	3.62 °C	
	(1 000 to 1 767) °C	3.62 °C	

Electrical – DC/Low Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electrical Simulation of Thermocouple Indicating Devices [1]	Type S (0 to 250) °C (250 to 1 000) °C (1 000 to 1 400) °C (1 400 to 1 767) °C Type T (-250 to -150) °C (150 to 0) °C (0 to 120) °C (120 to 400) °C	 3.63 °C 3.62 °C 3.62 °C 3.63 °C 0.87 °C 0.65 °C 0.62 °C 0.62 °C	Multiproduct Calibrator

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Gage Blocks	(0.05 to 1) in (1 to 4) in (4 to 20) in	3.3 µin 5.4 µin 9.9 µin	Grade 0 & 00 Gage Blocks, Gage Block Comparator
Bench Micrometer	Up to 1 in (lead screw)	6.3 µin	Grade 0 Gage Blocks, Precision Ball, Oz Testers
Outside Micrometer [1]	Up to 24 in	602 µin	Grade 0 Gage Blocks
Height Gage [1]	Up to 38 in	79 µin	Grade 0 Gage Blocks
Height Master [1]	Up to 12 in	35 µin	Grade 0 Gage Blocks, Digital Indicator
Plain Plug Gage [1]	Up to 8 in	16 µin	Grade 0 Gage Blocks, P&W Supermicrometer
Plain Ring Gage [1]	(0.04 to 12) in	25 µin	Grade 0 Gage Blocks, Ring Gage Comparator
Thread Plug [1]	(0.06 to 10) in	28 µin	Grade 0 Gage Blocks, P&W Supermicrometer, Thread Wires
Thread Ring [1]	Up to 10 in	28 µin	Set Plugs, Bore Gage
Tapered Pipe Thread Plug [1]	Up to 4 in	38 µin	Thread Wires, Sine Block, Supermicrometer, Height Master, Indicator

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Tapered Sine Block [1]	(0.062 5 to 3) in	15 µin	3/8 Ball, P&W Supermicrometer, Gage Block
Thread Measuring Wire [1]	(4 to 100) TPI	6.1 µin	Class X Cylindrical Roll, P&W Supermicrometer
Micrometer Standard [1]	(1 to 20) in	49 µin	Grade 0 Gage Blocks, P&W Supermicrometer
Caliper [1]	Up to 60 in	0.001 in	Grade 0 Gage Blocks
Test Indicator [1]	Up to 0.06 in	60 µin	Grade 0 Gage Blocks
Plunger Indicator [1]	Up to 2 in	31 µin	Grade 0 Gage Blocks
Optical Comparator [1] Squareness Linearity Magnification	 Up to 18 in Up to 18 in 10X, 20X, 31.25X, 50X, 100X	 91 µin 107 µin 487 µin	 Master Square Optical Magnification Checker, Gage Blocks Glass Scale
Surface Plates [1,3] Grades AA, A and B Overall Flatness Local Area Flatness (repeat reading)	 Up to 180 in x 240 in Up to 0.001 6 in	 (25 + 0.7*DL*) µin 15.7 µin	 Precision Level System Repeat-O-Meter
Squares, Steps, Angle Plates [1]	Up to 18 in	62 µin	Squareness Checker
Angles & Angle Blocks [1]	Up to 90 °	81 µin	Electronic Gage Head, Mu Checker, Sine Bar
Spheres [1]	Up to 1 in	11 µin	Grade 0 Gage Blocks, P&W Supermicrometer
Measuring Tapes	Up to 30 ft	0.06 in	Lixer Master, Lecia Laser
Rulers	Up to 12 in (12 to 72) in	73 µin 0.06 in	Optical Comparator Leica Laser

Length – Dimensional Metrology

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Radius Gages (Leaf Style)	(0.0625 to 2) in	85 µin	OGP Smart Scope
Thickness / Feeler Gages	(0.001 to .2) in	9.2 µin	Grade 0 Gage Blocks, P&W Supermicrometer

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Pressure – Measure [1]	Up to 1 000 psig	3 psi	Heise Gauge
Pressure – Source [1]	Up to 200 psig Up to 1 500 psig Up to 15 000 psig	0.025 psi 3.1 psi 31 psi	Ametek Calibrator Mansfield & Green Deadweight Tester
Vacuum – Source [1]	(-30 to 0) inHg	0.017 inHg	Manometer
Weights	Up to 20 g Up to 32 000 g	0.17 mg 4.2 g	ASTM E617 Class 1 Weights, Mass Comparator
Scales and Balances [1]	Up to 20 g	30 µg	ASTM E617 Class 1 Weights and internal calibration procedure utilized in the calibration of the weighing system.
Scales [1]	Up to 1 000 lb	1.3 lb	NIST Class F Weights and internal calibration procedure utilized in the calibration of the weighing system.
Durometers (Force Only) Type A & D	(0 to 90) Duro	0.6 Duro	Durocalibrator

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Rockwell Hardness Testers [1,4]	(40 to 95) HR15N (20 to 79) HR15TW ≥ 80 HR15TW ≥ 80 HR15W ≥80 HR15X (85 to 93) HR15Y ≥94 HR15Y (40 to 59) HR30N (60 to 85) HR30N (20 to 49) HR30TW (50 to 56) HR30TW ≥57 HR30TW (40 to 64) HR30W ≥65 HR30W (60 to 78) HR30X ≥79 HR30X (60 to 87) HR30Y ≥88 HR30Y (10 to 49) HR45N (50 to 66) HR45N (67 to 75) HR45N (1 to 39) HR45TW ≥40 HR45TW (10 to 47) HR45W ≥48 HR45W (40 to 68) HR45X ≥69 HR45X	0.19 HR15N 0.37 HR15TW 0.21 HR15TW 0.67 HR15W 0.33 HR15X 1.3 HR15Y 0.63 HR15Y 0.55 HR30N 0.28 HR30N 0.9 HR30TW 0.66 HR30TW 0.39 HR30TW 0.9 HR30W 0.76 HR30W 0.99 HR30X 0.15 HR30X 0.82 HR30Y 0.37 HR30Y 0.43 HR45N 0.22 HR45N 0.19 HR45N 0.73 HR45TW 0.41 HR45TW 0.3 HR45W 0.13 HR45W 0.81 HR45X 0.35 HR45X	Indirect Verification per ASTM E18 using Hardness Test Blocks.

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Rockwell Hardness Testers [1,4]	(60 to 81) HR45Y ≥82 HR45Y (60 to 69) HRA (70 to 79) HRA (80 to 85) HRA Carbide ≥86 HRA (1 to 50) HRBW (51 to 79) HRBW ≥80 HRBW (20 to 39) HRC (40 to 59) HRC (60 to 70) HRC (40 to 49) HRD (50 to 69) HRD (70 to 80) HRD ≥65 HREW (40 to 69) HRFW ≥70 HRFW (1 to 39) HRGW ≥40 HRGW (60 to 79) HRHW ≥80 HRHW (10 to 29) HRKW ≥30 HRKW ≥90 HRLW ≥70 HRMW (40 to 84) HRP ≥85 HRRW	0.94 HR45Y 0.35 HR45Y 0.28 HRA 0.17 HRA 0.16 HRA 0.16 HRA 1.4 HRBW 0.87 HRBW 0.42 HRBW 0.4 HRC 0.36 HRC 0.32 HRC 0.27 HRD 0.26 HRD 0.18 HRD 0.54 HREW 0.54 HRFW 0.4 HRFW 0.76 HRGW 0.3 HRGW 0.54 HRHW 0.41 HRHW 0.64 HRKW 0.40 HRKW 0.36 HRLW 0.56 HRMW 0.91 HRP 0.65 HRRW	Indirect Verification per ASTM E18 using Hardness Test Blocks.

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Rockwell Hardness Testers [1,4]	(100 to 119) HRSW ≥120 HRSW (110 to 111) HRVW ≥112 HRVW ≥80 HRVW	0.41 HRSW 0.24 HRSW 0.95 HRVW 0.2 HRVW 0.21 HRVW	Indirect Verification per ASTM E18 using Hardness Test Blocks.
Vickers Hardness Testers [1]	HV1 200 HV 400 HV 700 HV HV2 200 HV 400 HV 700 HV HV5 200 HV 400 HV 700 HV HV10 200 HV 400 HV 700 HV HV20 200 HV 400 HV 700 HV HV30 200 HV 400 HV 700 HV HV50 200 HV 400 HV 700 HV HV 0.01 400 HV 700 HV HV 0.025 200 HV 400 HV 700 HV	 8.7 HV 21 HV 44 HV 6.9 HV 16 HV 31 HV 3.9 HV 11 HV 20 HV 3.1 HV 7.7 HV 15 HV 2.5 HV 6.2 HV 11 HV 2 HV 4.4 HV 9.3 HV 1.9 HV 3.5 HV 6.3 HV 30 HV 40 HV 9 HV 20 HV 30 HV	Indirect Verification per ASTM E384 using Hardness Test Blocks.

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Vickers Hardness Testers [1]	HV 0.05 200 HV 400 HV 700 HV HV 0.1 200 HV 400 HV 700 HV HV 0.2 200 HV 400 HV 700 HV HV 0.3 200 HV 400 HV 700 HV HV 0.5 200 HV 400 HV 700 HV	 8.5 HV 19 HV 27 HV 8 HV 18 HV 25 HV 7 HV 17 HV 20 HV 6 HV 16 HV 19 HV 5 HV 15 HV 17 HV	Indirect Verification per ASTM E384 using Hardness Test Blocks.
Brinell Hardness Testers [1]	HBW 1 / 62.5 (200 to 400) HBW (400 to 600) HBW HBW 2.5 / 187.5 (200 to 400) HBW (400 to 600) HBW HBW 10 / 500 (200 to 400) HBW (400 to 600) HBW HBW 5 / 1 000 (200 to 400) HBW (400 to 600) HBW HBW 10 / 1 000 (200 to 400) HBW (400 to 600) HBW HBW 10 / 1500 (200 to 400) HBW (400 to 600) HBW HBW 10 / 2 000 (200 to 400) HBW (400 to 600) HBW	 2 HBW 4 HBW 2 HBW 4 HBW 2 HBW 4 HBW 2 HBW 4 HBW 2 HBW 4 HBW 2 HBW 4 HBW 2 HBW 4 HBW	Indirect Verification per ASTM E10 using Hardness Test Blocks.

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Brinell Hardness Testers [1]	HBW 10 / 2 500 (200 to 400) HBW (400 to 600) HBW HBW 10 / 3 000 (200 to 400) HBW (400 to 600) HBW	 2 HBW 4 HBW 2 HBW 4 HBW	Indirect Verification per ASTM E10 using Hardness Test Blocks.
Knoop Hardness Testers [1]	HK 0.01 400 HK 700 HK HK 0.025 200 HK 400 HK 700 HK HK 0.05 200 HK 400 HK 700 HK HK 0.1 200 HK 400 HK 700 HK HK 0.2 200 HK 400 HK 700 HK HK 0.3 200 HK 400 HK 700 HK HK 0.5 200 HK 400 HK 700 HK HK 1 200 HK 400 HK 700 HK	 30 HK 40 HK 9 HK 20 HK 30 HK 8.5 HK 19 HK 27 HK 8 HK 18 HK 25 HK 7 HK 17 HK 20 HK 6 HK 16 HK 19 HK 5 HK 15 HK 17 HK 5 HK 10 HK 15 HK	Indirect Verification per ASTM E384 using Hardness Test Blocks.
Torque Tools	(25 to 250) lbf·in (25 to 250) lbf·ft (100 to 1 000) lbf·ft	0.66 % of reading 0.61 % of reading 0.61 % of reading	Norbar Torque Calibrator

Mass and Mass Related

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Force – Compression and Tension [1]	(0 to 10) lbf (0 to 100) lbf	0.12 % of reading + 0.25 lbf 0.12 % of reading + 0.5 lbf	NIST Class F Weights
	(100 to 1 124) lbf (1 000 to 3 000) lbf (3 000 to 11 240) lbf (10 000 to 20 000) lbf (20 000 to 50 000) lbf	0.06 % of reading 0.05 % of reading 0.05 % of reading 0.002 % of reading 0.002 % of reading	Load Cells
Force – Compression	(50 000 to 300 000) lbf	0.1 % of reading	Load Cells

Thermodynamic

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Temperature – Measure [1]	(-35 to 200) °C	0.08 °C	Fluke 1524 Indicator, Fluke 5627A PRT
Humidity – Measure [1]	(0 to 90) %RH	1.1 %RH	MI70 / HMP77 Temperature/Humidity Indicator

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Frequency – Measure [1]	(1.1 to 10) Hz (10 to 100) Hz 100 Hz to 1.1 kHz (1.1 to 10) kHz (10 to 100) kHz 100 kHz to 1.1 MHz (1.1 to 10) MHz (10 to 15) MHz	9.5 mHz 0.58 Hz 0.37 Hz 58 mHz 36 Hz 0.37 kHz 0.58 kHz 6 kHz	Keithley 2002 8.5 Digit Multimeter
Tachometers (Non-Contact Type)	(30 to 500 000) rpm	2.5 rpm	Comparison to Nova-Strobe PBL Stroboscope
Stopwatches & Timers (Push Button)	Up to 24 hr	55 ms	Frequency Counter

Time and Frequency

Parameter/Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method, and/or Equipment
Electric Timers (Pulse)	1 ms to 24 hr	4.5 µs	Frequency Counter

DIMENSIONAL MEASUREMENT

3 Dimensional

Specific Tests and / or Properties Measured	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
3D Dimensional Parts	X = (0 to 25) in Y = (0 to 35) in Z = (0 to 17) in	272 µin 293 µin 264 µin	B&S Bridge Type CMM, Customer Drawing, PC DMIS S/W

TESTING

Mechanical

Specific Tests and/or Properties Measured	Specification, Standard, Method, or Test Technique	Items, Materials or Product Tested	Comments
Hardness – Rockwell and Superficial Scales	ASTM E18	Sintered and Wrought Products	Wilson Rockwell Hardness Tester, Rockwell Scales – A, B, C, E, F, G, & H Superficial Scales – T & N
Hardness – Brinell	ASTM E10	Sintered and Wrought Products	Newage Dyna Brinell HB500 to HB3 000
Hardness – Portable	ASTM E110	Sintered and Wrought Products	Mitutoyo Portable
Hardness – Leeb, Equotip	ASTM A956	Sintered and Wrought Products	Equotip, LD Scale
Microhardness – Vickers	ASTM E92	Sintered and Wrought Products	Mitutoyo MVK, Heavy Load Vickers 500 g to 5 kg

Mechanical

Specific Tests and/or Properties Measured	Specification, Standard, Method, or Test Technique	Items, Materials or Product Tested	Comments
Microhardness – Knoop and Vickers	ASTM E384 ASTM B933	Sintered and Wrought Products	Buehler Micro Hardness Tester, Knoop Scale – (10 to 1 000) g Range Vickers Scale – (10 to 1 000) g Range

Calibration and Measurement Capability (CMC) is expressed in terms of the measurement parameter, measurement range, expanded uncertainty of measurement and reference standard, method, and/or equipment. The expanded uncertainty of measurement is expressed as the standard uncertainty of the measurement multiplied by a coverage factor of 2 (k=2), corresponding to a confidence level of approximately 95%.

Notes:

1. On-site calibration service is available for this parameter, since on-site conditions are typically more variable than those in the laboratory, larger measurement uncertainties are expected on-site than what is reported on the accredited scope.
2. CMC for Electrical – DC/Low Frequency Calibrations do not include possible contributions to uncertainty from a "best available" unit under test.
3. The use of (DL) signifies the Diagonal Length of the surface plate in feet.
4. The following statement is from the NIST recommended practice guide (Special Publication 960-5, page 60, section 8.3.3, paragraph 2) "Currently, there are no generally agreed upon U.S. or international methods for calculating the measurement uncertainty of a Rockwell hardness machine or the uncertainty in the certified value of standardized test blocks."
5. This scope is formatted as part of a single document including Certificate of Accreditation No. ACT-1116.

R. Douglas Leonard Jr., VP, PILR SBU