

# Scope of Accreditation

## For

### OCS Technologies, Inc.

(dba: Ohio Counting Scale / Omni Calibration Services)

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In recognition of a successful assessment to ISO/IEC 17025:2005, accreditation is granted to **OCS Technologies, Inc.** to perform the following Calibrations:

Accreditation granted through: **November 27, 2010**

## Calibration

### Length - Dimensional Metrology – Artifacts and Standards 1D

Calibration Parameter/Equipment	Range	Best Measurement Capability(+/-) <sup>1</sup>	Remarks
Gage Blocks <sup>6</sup> Chrome Carbide	0.01 in to 4 in	(5 + 1.5L) μin	P&W LabMaster Universal and Grade 0.5 Gage Blocks
Steel, Ceramic, Tungsten Carbide	0.01 in to 4 in	(5.6 + 3.1L) μin	P&W LabMaster Universal and Grade 1 Gage Blocks
Steel	5 in to 12 in	(4 + 3.1L) μin	P&W LabMaster Universal and Grade 1 Gage Blocks
Plug /Pin Gages & Master Discs <sup>6</sup> Class XXX, XX, X, Y, Z, ZZ	0.01 in to 0.06 in 0.06 in to 1 in 1 in to 12 in	11 μin 8 μin (3.2 + 4D) μin	P&W LabMaster Universal and Grade 1 Gage Blocks
Pin Gages <sup>2</sup> Class ZZ	0.01 in to 2 in	78 μin	Comparisons with Laser Micrometer
Micrometer/Length/End Standards <sup>6</sup>	1 in to 12 in	(4 + 4.2L) μin	P&W LabMaster Universal and Grade 1 Gage Blocks
Ring Gages <sup>6</sup>	0.04 in to 1 in 1 in to 12 in	18 μin (8.4 + 3.9D) μin	P&W LabMaster Universal, Grade 1 Gage Blocks and Master Rings
Spheres/Precision Balls	0.1 in to 3 in	15 μin	P&W LabMaster Universal and Grade 1 Gage Blocks
Thread Wires <sup>8</sup>	2 TPI to 120 TPI	13 μin	P&W LabMaster Universal and Grade 1 Gage Blocks

**Length - Dimensional Metrology – Hand Tools and Precision Gages 1D**

<b>Calibration Parameter/Equipment</b>	<b>Range</b>	<b>Best Measurement Capability (+/-) <sup>1</sup></b>	<b>Remarks</b>
Micrometers <sup>2,6</sup>	0 in to 4 in 4 in to 80in	(98 + 4L) μin (58 + 10L) μin	Comparisons performed with Gage Blocks
Calipers <sup>2,6</sup>	0 in to 4 in 4 in to 80 in	(100 + 4L) μin (298+ 4L) μin	Comparisons performed with Gage Blocks
Height Gages <sup>2,6</sup>	0 in to 4 in 4 in to 60in	(161 + 2L) μin (271 + 8L) μin	Comparisons performed with Gage Blocks
Dial/Test Indicators <sup>2</sup>	0 in to 1 in	81 μin	Comparisons performed with Universal Measurement Machine
Dial/Test Indicators	0 in to 1 in 1 in to 4 in	34 μin 293 μin	P&W LabMaster Universal and Grade 1 Gage Blocks
Indicating Snap Gages <sup>2,6</sup>	0 in to 4 in 4 in to 40 in	(100 + 4L) μin (551 + 6L) μin	Comparisons performed with Gage Blocks
Bore Gages – 2 Point <sup>2,6</sup>	0.125 in to 4 in 4 in to 40 in	(100 + 4L) μin (257 + 8L) μin	Comparisons performed with Gage Blocks and End Caps
Bore Gages – 3 Point <sup>2,6</sup>	0.125 in to 7 in	(101 + 9L) μin	Comparisons performed with customer ring gages calibrated by OCS
Rulers	0 in to 72 in	0.023 in	Comparisons performed with Gage Blocks

**Length – Dimensional Metrology – Hand Tools and Precision Gages 2D**

<b>Calibration Parameter/Equipment</b>	<b>Range</b>	<b>Best Measurement Capability(+/-) <sup>1</sup></b>	<b>Remarks</b>
Optical Comparators <sup>2,5</sup> X axis and Y axis	0 in to 12 in	180 μin	Comparisons to Optical Comparator Scale and Gage Blocks
Magnification	10x, 20x, 31.5x, 50x, 62.5x, 100x	180 μin	
Angle	5°, 10°, 15°, 20°, 25°, 30°	0.12°	Comparison performed with Angle Blocks
Protractors	0°, 5°, 10°, 15°, 20°, 25° 30°	0.11°	Comparisons performed with Angle Blocks and Surface Plate

Calibration Parameter/Equipment	Range	Best Measurement Capability(+/-) <sup>1</sup>	Remarks
Angle	0° to 90°	0.27°	Digital Protractor
Level	0°	0.27°	Digital Protractor

**Length - Dimensional Metrology – Other**

Calibration Parameter/Equipment	Range	Best Measurement Capability(+/-) <sup>1</sup>	Remarks
Thread Plug Gages - Straight Major Diameter	0.06 to 6 in	53 μin	P&W LabMaster Universal and Grade 1 Gage Blocks with Thread Wires
Pitch Diameter	(4 thru 80) TPI	78 μin	
Thread Plug Gages - Straight <sup>2</sup> Major Diameter	0.06 to 1 in	66 μin	Comparisons to Universal Measurement Machine with Thread Wires
Pitch Diameter	(4 thru 80) TPI	89 μin	
Thread Plug Gages – ¾ TPF	0.3 to 6 in	69 μin	P&W LabMaster Universal and Grade 1 Gage Blocks with Thread Wires
Pitch Diameter	(8 thru 27) TPI	90 μin	
Thread Ring Gages Functional Pitch Diameter	0.06 in to 12 in (4 thru 80) TPI	84 μin	In Accordance with ASME B1.2, paragraph 5.1.1; the Ring is Sized to a Plug with the Plug's Uncertainty Given. Class X or W Set Plugs to be Used as Available
Tapered Plug Gages <sup>6</sup> Major Diameter	0.1 in to 7 in	(59 + 3.2D) μin	P&W LabMaster Universal and Grade 1 Gage Blocks with 2 Pin Method
Taper	All	(105 + 8.4D) μin	
Bench/Super Micrometers <sup>2</sup> Outside Diameter	0.1 in to 2 in	24 μin	Comparisons performed with Grade 2 Gage Blocks and Force Gages
Force	2 ozf to 32 ozf 32 ozf to 40 ozf	0.8 ozf 2.2 ozf	
Laser Micrometers <sup>2,5</sup>	0.06 in to 1 in	61 μin	Master Plug Gages

**Mass – Mass Standards**

Calibration Parameter/Equipment	Range	Best Measurement Capability(+/-) <sup>1</sup>	Remarks
Weights <sup>2</sup>	1 mg to 160 g 160 g to 400 g 0.8 lb to 10 lb 10 lb to 27.5 lb 27.5 lb to 70 lb	0.62 mg 4.1 mg 0.000086 lb 0.0008 lb 0.004 lb	Comparison Using High Resolution Scales That Have Been Calibrated with ASTM Class 1 Test Weights

**Mass – Scale and Balances**

<b>Calibration Parameter/Equipment</b>	<b>Range</b>	<b>Best Measurement Capability(+/-) <sup>1</sup></b>	<b>Remarks</b>
Weighing Systems <sup>2,3</sup>			
0.001 mg resolution	0 g to 5 g	0.24mg	Comparisons to ASTM Class 1 Weights and NIST Handbook 44
0.01mg resolution	0 g to 20 g	0.97 mg	
0.1mg resolution	0 g to 50 g	0.2 mg	
0.1mg resolution	50 g to 150 g	0.47 mg	
0.001g resolution	0 g to 100 g	1.4 mg	
0.001 g resolution	100 g to 600 g	2.3 mg	
0.01 g resolution	0 g to 500 g	14 mg	
0.01 g resolution	500 g to 6 000 g	23 mg	
0.1 g resolution	0 g to 6 000 g	135 mg	
0.1 g resolution	6 000 g to 12 000 g	138 mg	
0.1 g resolution	12 000 g to 60 000 g	225 mg	
1 g resolution	0 g to 60 000 g	1.4 g	
0.00002 lb resolution	0 lb to 2 lb	0.00025 lb	
0.00002 lb resolution	2 lb to 10 lb	0.00123 lb	
0.0002 lb resolution	0 lb to 25 lb	0.0031 lb	
0.001 lb resolution	0 lb to 50 lb	0.0063 lb	
0.002 lb resolution	0 lb to 100 lb	0.013 lb	
0.005 lb resolution	0 lb to 50 lb	0.009 lb	
0.01 lb resolution	0 lb to 500 lb	0.063 lb	
0.02 lb resolution	0 lb to 200 lb	0.036 lb	
0.05 lb resolution	0 lb to 500 lb	0.091 lb	
0.1 lb resolution	0 lb to 500 lb	0.15 lb	
0.2 lb resolution	0 lb to 1 000 lb	0.17 lb	
0.5 lb resolution	0 lb to 1 000 lb	0.32 lb	
1 lb resolution	0 lb to 5 000 lb	0.84 lb	
2 lb resolution	0 lb to 10 000 lb	1.7 lb	
5 lb resolution	0 lb to 20 000 lb	3.8 lb	
20 lb resolution	0 lb to 120 000 lb	19 lb	

**Mass – Hardness**

<b>Calibration Parameter/Equipment</b>	<b>Range</b>	<b>Best Measurement Capability(+/-) <sup>1</sup></b>	<b>Remarks</b>	
Indirect Verification of Rockwell Hardness Testers <sup>2</sup>	HRC			
	Low	0.44 HRC		
	Middle	0.37 HRC		
	High	0.37 HRC		
	HRBW			
	Low	0.71 HRBW		
	Middle	0.72 HRBW		
	High	0.73 HRBW		
	HRA			
	Low	0.48 HRA		
	Middle	0.39 HRA		
	High	0.53 HRA		
	HR15N			
	Low	0.50 HR15N	Indirect Verification per ASTM E18	
Middle	0.48 HR15N			
High	0.43 HR15N			
HR30N				
Low	0.73 HR30N			
Middle	0.73 HR30N			
High	0.53 HR30N			
HR15TW				
Low	0.73 HR15TW			
Middle	0.64 HR15TW			
High	0.44 HR15TW			
HR30TW				
Low	0.58 HR30TW			
Middle	0.55 HR30TW			
High	0.46 HR30TW			
Indirect Verification of Brinell Hardness Testers at Test Conditions: <sup>2</sup>	125 < HBW ≤ 225	4.5 HBW	Indirect Verification per ASTM E10	
	HBW > 225	6.2 HBW		
10/3000/15				

**Mass – Pressure**

Calibration Parameter/Equipment	Range	Best Measurement Capability(+/-) <sup>1</sup>	Remarks
Pressure Transducers, Dial and Digital Pressure Gages, Absolute Pressure Instruments <sup>2</sup>	0.001 inH <sub>2</sub> O to 1 inH <sub>2</sub> O	0.006 inH <sub>2</sub> O	Comparisons to a Manometer
	1 inH <sub>2</sub> O to 20 inH <sub>2</sub> O	0.05 inH <sub>2</sub> O	
	0.3 psia to 50 psia	0.07 psia	Comparisons to Pressure Transducer and Indicator
	0.01 psi to 60 psi	0.08 psi	
	60 psi to 120 psi	0.15 psi	
	120 psi to 180 psi	0.22 psi	
	180 psi to 240 psi	0.28 psi	
	240 psi to 300 psi	0.35 psi	
	300 psi to 1 000 psi	0.44 psi	Comparisons to Digital Pressure Gages
	1 000 psi to 2 000 psi	2.5 psi	
	2 000 psi to 4 000 psi	4.8 psi	
	4 000psi to 6 000 psi	7.0 psi	
6 000 psi to 8 000 psi	9.3 psi		
8 000 psi to 10 000 psi	11.6 psi		

**Mass – Vacuum**

Calibration Parameter/Equipment	Range	Best Measurement Capability(+/-) <sup>1</sup>	Remarks
Vacuum Gages and Transducers <sup>2</sup>	-0.01 to -14.5 psi	0.05 psi	Digital Pressure Gage

**Mass – Torque**

Calibration Parameter/Equipment	Range	Best Measurement Capability(+/-) <sup>1</sup>	Remarks
Torque Wrenches, Drivers, Screwdrivers including Click Type <sup>2</sup>	(10 to 100) in · ozf (100 to 500) in · ozf (10 to 100) in · lbf (5 to 50) ft · lbf (50 to 500) ft · lbf	1.9 % of reading	Torque Tester and Torque Cells
Torque Transducers, Torque Analyzers, Dial Torque Wrenches <sup>2,4</sup>	(3 to 640) in · ozf (7.5 to 1200) in · lbf (100 to 1 000) ft · lbf	0.08 % of reading + 0.11 in · ozf 0.09 % of reading + 0.05 in · lbf 0.04 % of reading + 0.05 ft · lbf	Torque Arms and ASTM Class 6 Weights

**Mass – Force**

Calibration Parameter/Equipment	Range	Best Measurement Capability(+/-) <sup>1</sup>	Remarks
Force Gage <sup>2,7</sup>	0.1 lbf to 2 lbf 2 lbf to 10 lbf 10 lbf to 50 lbf 50 lbf to 100 lbf 100 lbf to 200 lbf 200 lbf to 500 lbf	0.002 lbf 0.005 lbf 0.030 lbf 0.050 lbf 0.100 lbf 0.240 lbf	ASTM Class 6 Weights

Calibration Parameter/Equipment	Range	Best Measurement Capability(+/-) <sup>1</sup>	Remarks	
Force Gage <sup>2,7</sup>	500 lbf to 1 000 lbf	0.470 lbf	Force Indicator and Load Cells	
	1 lbf to 100 lbf	0.30 lbf		
	100 lbf to 500 lbf	1.47 lbf		
	500 lbf to 1 000 lbf	3.05 lbf		
	1 000 lbf to 5 000 lbf	14.7 lbf		
Testing Machines <sup>2,7</sup>	Force -Tension	0.1 lbf to 2 lbf	0.002 lbf	ASTM Class 6 Weights/ Force Indicator and Load Cells
		2 lbf to 10 lbf	0.005 lbf	
		10 lbf to 50 lbf	0.030 lbf	
		50 lbf to 100 lbf	0.050 lbf	
		100 lbf to 1 000 lbf	3.05 lbf	
		1 000 lbf to 5 000 lbf	14.7 lbf	
		5 000 lbf to 20 000 lbf	59 lbf	
	Force - Compression	0.1 lbf to 2 lbf	0.002 lbf	ASTM Class 6 Weights/ Force Indicator and Load Cells
		2 lbf to 10 lbf	0.005 lbf	
		10 lbf to 50 lbf	0.030 lbf	
		50 lbf to 100 lbf	0.050 lbf	
		100 lbf to 500 lbf	1.47 lbf	
		500 lbf to 1 000 lbf	3.05 lbf	
		1 000 lbf to 5 000 lbf	14.7 lbf	
5 000 lbf to 20 000 lbf	59 lbf			
Crosshead Travel	0.1 in to 6 in	0.002 in	Digital Caliper	
Crosshead Speed	0.5 in/min to 12 in/min	0.04 in/min	Digital Stopwatch/Caliper	
Durometers – Spring Force	Type A, B, C, D, DO, O, OO	0.6 Duros	Balance / ASTM Class 6 Test Weights	

**Electricity and Magnetism – Resistance**

Calibration Parameter/Equipment	Range	Best Measurement Capability(+/-) <sup>1</sup>	Remarks
Resistance – Source <sup>2,4</sup>	0 Ω to 33 Ω	35 μΩ/Ω + 240 μΩ	Comparisons performed with a Multifunction Calibrator
	33 Ω to 330 Ω	33 μΩ/Ω + 2.4 mΩ	
	330 Ω to 33 kΩ	33 μΩ/Ω + 24 mΩ	
	33 kΩ to 330 kΩ	37 μΩ/Ω + 240 mΩ	
	330 kΩ to 3.3 MΩ	70 μΩ/Ω + 2.4 Ω	
	3.3 MΩ to 33 MΩ	300 μΩ/Ω + 24 Ω	
	33 MΩ to 110 MΩ	600 μΩ/Ω + 240 Ω	
	110 MΩ to 330 MΩ	4 mΩ/Ω + 240 Ω	
	330 MΩ to 1.1 GΩ	18 mΩ/Ω + 2400 Ω	

**Electricity and Magnetism – Voltage**

Calibration Parameter/Equipment	Range	Best Measurement Capability(+/-) <sup>1</sup>	Remarks
DC Volts – Source <sup>2,4</sup>	0 mV to 330 mV 330 mV to 3.3 V 3.3V to 33 V 33 V to 330 V 330 V to 1 000 V	24 $\mu$ V/V + 3 $\mu$ V 13 $\mu$ V/V + 14 $\mu$ V 14 $\mu$ V/V + 131 $\mu$ V 21 $\mu$ V/V + 1.3 mV 21 $\mu$ V/V + 13 mV	Comparisons performed with a Multifunction Calibrator
DC Volts – Measure <sup>2</sup>	1 mV to 100 mV 100mV to 10 V 10 V to 1 000 V	12 $\mu$ V 0.5 mV 72 mV	Measured with a 6 ½ Digit Multimeter
AC Volts – Source <sup>2,4</sup>  1 mV to 33 mV	10 Hz to 45 Hz 45 Hz to 10 kHz 10 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 500 kHz	930 $\mu$ V/V + 8 $\mu$ V 180 $\mu$ V/V + 8 $\mu$ V 240 $\mu$ V/V + 8 $\mu$ V 1.2 mV/V + 8 $\mu$ V 4.1 mV/V + 15 $\mu$ V 9.3 mV/V + 58 $\mu$ V	Comparisons performed with a Multifunction Calibrator
33 mV to 330 mV	10 Hz to 45 Hz 45 Hz to 10 kHz 10 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 500 kHz	580 $\mu$ V/V + 10 $\mu$ V 170 $\mu$ V/V + 11 $\mu$ V 190 $\mu$ V/V + 10 $\mu$ V 410 $\mu$ V/V + 13 $\mu$ V 930 $\mu$ V/V + 39 $\mu$ V 2.4 mV/V + 87 $\mu$ V	Comparisons performed with a Multifunction Calibrator
330 mV to 3.3 V	10 Hz to 45 Hz 45 Hz to 10 kHz 10 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 500 kHz	347 $\mu$ V/V + 100 $\mu$ V 174 $\mu$ V/V + 145 $\mu$ V 220 $\mu$ V/V + 116 $\mu$ V 347 $\mu$ V/V + 68 $\mu$ V 810 $\mu$ V/V + 178 $\mu$ V 2.8 mV/V + 840 $\mu$ V	Comparisons performed with a Multifunction Calibrator
3.3 V to 33 V	10 Hz to 45 Hz 45 Hz to 10 kHz 10 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz	347 $\mu$ V/V + 884 $\mu$ V 174 $\mu$ V/V + 904 $\mu$ V 278 $\mu$ V/V + 904 $\mu$ V 405 $\mu$ V/V + 835 $\mu$ V 1.1 mV/V + 2.1 mV	Comparisons performed with a Multifunction Calibrator
33 V to 330 V	45 Hz to 1 kHz 1 kHz to 10 kHz 10 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz	220 $\mu$ V/V + 5.2 mV 231 $\mu$ V/V + 7.8 mV 289 $\mu$ V/V + 7.4 mV 347 $\mu$ V/V + 7.4 mV 2.4 mV/V + 58 mV	Comparisons performed with a Multifunction Calibrator
330 V to 1000 V	45 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	347 $\mu$ V/V + 24.5 mV 289 $\mu$ V/V + 20.7 mV 347 $\mu$ V/V + 30 mV	Comparisons performed with a Multifunction Calibrator
DC High Voltage – Measure <sup>2,4</sup>	0.5 kV to 2 kV 2 kV to 40 kV	0.09 V/kV + 7 V 0.39 V/kV + 14 V	Comparisons performed with a precision HV Meter
AC High Voltage – Measure 50 Hz to 60 Hz <sup>2,4</sup>	0.5 kV to 2 kV 2 kV to 25 kV	0.23 V/kV + 7 V 4.7 V/kV + 70 V	

**Electricity and Magnetism – Current**

Calibration Parameter/Equipment	Range	Best Measurement Capability(+/-) <sup>1</sup>	Remarks
DC Current – Source <sup>2,4</sup>	0 µA to 30 µA 0 mA to 3.3 mA 3.3 mA to 33 mA 33 mA to 330 mA 330 mA to 1.1 A 1.1 A to 3 A 3 A to 11 A 11 A to 20.5 A 20 A to 1 000 A	174 µA/A to 30 nA 116 µA/A + 60 nA 116 µA/A + 300 nA 116 µA/A + 14 µA 230 µA/A + 48 µA 439 µA/A + 48 µA 578 µA/A + 592 µA 1.2 mA/A + 876 µA 9 mA/A + 0.6 mA	Comparisons performed with a Multifunction Calibrator
DC Current – Measure <sup>2</sup>	0.1 mA to 10 mA 10 mA to 100 mA 100 mA to 1 A	9 µA 69 µA 1.4 mA	Comparisons performed with a 6 ½ Digit DMM
AC Current – Source <sup>2,4</sup>  29 µA to 330 µA	10 Hz to 20 Hz 20 Hz to 45 Hz 45 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz 10 kHz to 30 kHz	2.4 mA/A + 120 nA 1.8 mA/A + 120 nA 1.5 mA/A + 120 nA 3.5 mA/A + 170 nA 9.3 mA/A + 230 nA 19 mA/A + 460 nA	Comparisons performed with a Multifunction Calibrator
330 µA to 3.3 mA	10 Hz to 20 Hz 20 Hz to 45 Hz 45 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz 10 kHz to 30 kHz	2.4 mA/A + 170 nA 1.5 mA/A + 170 nA 1.2 mA/A + 170 nA 230 nA/A + 230 nA 5.8 mA/A + 350 nA 12 mA/A + 690 nA	Comparisons performed with a Multifunction Calibrator
3.3 mA to 33 mA	10 Hz to 20 Hz 20 Hz to 45 Hz 45 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz 10 kHz to 30 kHz	2.1 mA/A + 2.3 µA 1.1 mA/A + 2.3 µA 462 µA/A + 2.3 µA 924 µA/A + 2.3 µA 2.4 mA/A + 3.5 µA 4.7 mA/A + 4.6 µA	Comparisons performed with a Multifunction Calibrator
33 mA to 330 mA	10 Hz to 20 Hz 20 Hz to 45 Hz 45 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz 10 kHz to 30 kHz	2.1 mA/A + 27 µA 1.1 mA/A + 27 µA 462 µA/A + 27 µA 1.2 mA/A + 60 µA 2.4 mA/A + 117 µA 4.7 mA/A + 232 µA	Comparisons performed with a Multifunction Calibrator
330 mA to 3 A	10 Hz to 45 Hz 45 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	2.1 mA/A + 117 µA 693 µA/A + 117 µA 7 mA/A + 1.2 mA 29 mA/A + 5.8 mA	Comparisons performed with a Multifunction Calibrator

Calibration Parameter/Equipment	Range	Best Measurement Capability(+/-) <sup>1</sup>	Remarks
AC Current – Source <sup>2,4</sup> Continued 3 A to 11 A	45 Hz to 100 Hz 100 Hz to 1 kHz 1 kHz to 5 kHz	693 $\mu$ A/A + 2.4 mA 1.2 mA/A + 2.4 mA 35 mA/A + 2.4 mA	Comparisons performed with a Multifunction Calibrator
11 A to 20.5 A	45 Hz to 100 Hz 100 Hz to 1 kHz 1 kHz to 5 kHz	1.4 mA/A + 5.8 mA 1.7 mA/A + 5.8 mA 35 mA/A + 5.8 mA	Comparisons performed with a Multifunction Calibrator
20 A to 1000 A	45 Hz to 65 Hz 65 Hz to 440 Hz	7.2 mA/A + 584 mA 7.8 mA/A + 584 mA	Comparisons performed with a Multifunction Calibrator

**Electricity and Magnetism – Capacitance**

Calibration Parameter/Equipment	Range	Best Measurement Capability(+/-) <sup>1</sup>	Remarks
Capacitance – Source <sup>2,4</sup>	0.19 nF to 3.3 nF 3.3 nF to 110 nF 110 nF 330 nF 0.33 $\mu$ F to 1.1 $\mu$ F 1.1 $\mu$ F to 3.3 $\mu$ F 3.3 $\mu$ F to 33 $\mu$ F 33 $\mu$ F to 330 $\mu$ F 330 $\mu$ F to 3.3 mF 3.3 mF to 11 mF 11 mF to 33 mF 33 mF to 110 mF	6 mF/F + 12 pF 3 mF/F + 115 pF 3 mF/F + 346 pF 3 mF/F + 2 nF 3 mF/F + 4 nF 5 mF/F + 35 nF 6 mF/F + 346 nF 6 mF/F + 4 $\mu$ F 6 mF/F + 12 $\mu$ F 9 mF/F + 35 $\mu$ F 13 mF/F + 120 $\mu$ F	Comparisons performed with a Multifunction Calibrator

**Time and Frequency – Frequency / Period**

Calibration Parameter/Equipment	Range	Best Measurement Capability(+/-) <sup>1</sup>	Remarks
Timers / Stopwatches <sup>2</sup>	0.1 min to 1 440 min	0.9 s	Comparisons performed with Reference Stopwatch
Tachometer / Shaft Speed <sup>2</sup>	10 rpm to 1000 rpm 1000 rpm to 2000 rpm 2000 rpm to 5000 rpm 5000 rpm to 19999 rpm	0.7 rpm 2.6 rpm 4.2 rpm 12.8 rpm	Comparisons performed with a Photo/Contact Tachometer
Centrifuge Speed <sup>2</sup>	10 rpm to 1000 rpm 1000 rpm to 2000 rpm 2000 rpm to 5000 rpm 5000 rpm to 19999 rpm	0.7 rpm 2.6 rpm 4.2 rpm 12.8 rpm	Comparisons performed with a Photo/Contact Tachometer
Linear Surface Speed Indicators / Conveyor Belt Speed <sup>2</sup>	(3 to 30) ft/min (30 to 300) ft/min	0.8 ft/min 6.6 ft/min	Comparisons performed with a Contact Tachometer

**Electricity and Magnetism – Electrical Temperature Simulation**

<b>Calibration Parameter/Equipment</b>	<b>Range</b>	<b>Best Measurement Capability(+/-) <sup>1</sup></b>	<b>Remarks</b>
Thermocouple Electrical Simulation <sup>2</sup> Type J  K  T  E  R  S	-220 °C to 400 °C	0.51 °C	Comparisons performed with Multifunction Calibrator and Thermocouple Indicator
	401 °C to 800 °C	0.77 °C	
	801 °C to 1 180 °C	1.2 °C	
	-200 °C to 400 °C	0.5 °C	
	401 °C to 800 °C	0.76 °C	
	801 °C to 1370 °C	1.24 °C	
RTD Simulation <sup>2</sup> Type Pt 385, 100 Ω  Pt 385, 1000 Ω	-250 °C to 0 °C	0.35 °C	Comparisons performed with Multifunction Calibrator and Electronic Indicator
	1 °C to 380 °C	0.44 °C	
	-100 °C to 400 °C	0.44 °C	
	401 °C to 990 °C	1.1 °C	
	0 °C to 1767 °C	0.93 °C	
	0 °C to 1767 °C	0.85 °C	
RTD Simulation <sup>2</sup> Type Pt 385, 100 Ω  Pt 385, 1000 Ω	-200 °C to 300 °C	0.18 °C	Comparisons performed with Multifunction Calibrator and Electronic Indicator
	300 °C to 800 °C	0.46 °C	
	-200 °C to 300 °C	0.12 °C	
	100 °C to 600 °C	0.14 °C	

**Thermodynamic – Thermodynamic Devices (all)**

<b>Calibration Parameter/Equipment</b>	<b>Range</b>	<b>Best Measurement Capability(+/-) <sup>1</sup></b>	<b>Remarks</b>
Thermodynamics – Measure (Temperature Chambers, Liquid in Glass Thermometers, Thermocouples, Bi-Metal Thermometers) <sup>2</sup>	-125 °C to 125 °C	0.95 °C	Comparisons with a Digital Thermometer and thermocouple
	125 °C to 400 °C	2 °C	
	400 °C to 1200 °C	5.71 °C	
	-100 °C to 400 °C	0.13 °C	Comparisons to a Platinum Resistance Thermometer and Bath or Chamber
IR Thermometers <sup>2</sup>	-18°C to 149 °C	1.1 °C	Blackbody Calibrator (ε = 0.95)

**Thermodynamic – Humidity**

<b>Calibration Parameter/Equipment</b>	<b>Range</b>	<b>Best Measurement Capability(+/-) <sup>1</sup></b>	<b>Remarks</b>
Relative Humidity <sup>2</sup>	11.3 % RH	1.5 % RH	Comparisons to Salt Solutions
	75.5 % RH	1.8 % RH	
	95 % RH	2.3 %RH	
	11 % RH to 75 % RH	2.5 % RH	Comparisons to a Humidity Indicator and Probe
75 % RH to 95 % RH	3 % RH		

**Electricity and Magnetism / Time and Frequency – Oscilloscopes**

Calibration Parameter/Equipment	Range	Best Measurement Capability(+/-) <sup>1</sup>	Remarks
Oscilloscopes <sup>2,4</sup>			Comparisons performed with a Multifunction Calibrator and an Oscilloscope
DC Voltage (50Ω) DC Voltage (1MΩ)	1 mV to 6.6 V 1 mV to 130 V	2.9 mV/V + 47 μV 600 μV/V + 47 μV	
AC Voltage (50Ω) AC Voltage (1MΩ)	1 mV to 6.6 Vp-p 1 mV to 130 Vp-p	2.9 mV/V + 47 μV 1.2 mV/V + 47 μV	
Leveled Sinewave 50kHz to 600MHz	5 mV to 5.5 V	47 mV/V + 116 μV	
Time Markers	2 nS to 20 ms 50 ms to 5 s	3 μs/s 2 ms/s+ 29 μs	
Wave Gen. (50Ω) Wave Gen. (1MΩ)	1.8 mV to 2.5 Vp-p 1.8 mV to 55 Vp-p	35 mV/V + 116 μV 35 mV/V + 116 μV	
Edge Characteristics 1 kHz to 10 MHz into 50 Ω Amplitude Risetime	5 mV to 2.5 V 1 nS to 1 μS	23 mV/V + 231 μV less than 350 pS	Comparisons performed with a Multifunction Calibrator and an Oscilloscope

**Amount of Substance – Chemical**

Calibration Parameter/Equipment	Range	Best Measurement Capability(+/-) <sup>1</sup>	Remarks
pH Meters <sup>2</sup>	4 pH 7 pH 10 pH	0.017 pH 0.036 pH 0.07 pH	Comparisons to Buffer Solutions


**Length - Dimensional Inspection – Dimensional Measurement 1D**

Inspection Parameter	Range	Best Measurement Capability (+/-) <sup>1</sup>	Remarks
Dimensional Measurement 1D Outside Diameter Length <sup>5,6</sup>	0.1 in to 4 in 4 in to 12 in	27μin (15+2.5L) μin	P&W LabMaster Universal and Grade 1 Gage Blocks
Dimensional Measurement 1D Inside Diameter <sup>5,6</sup>	0.1 in to 4 in 4 in to 12 in	27μin (15+2.5L) μin	P&W LabMaster Universal and Grade 1 Gage Blocks
Dimensional Measurement 1D Outside Diameter Length <sup>2</sup>	0.000 5 in to 1.5 in	59 μin	Universal Measurement Machine
Dimensional Measurement 1D Outside Diameter Length <sup>2</sup>	0.001 in to 1 in	175 μin	Digital Micrometer

Inspection Parameter	Range	Best Measurement Capability (+/-) <sup>1</sup>	Remarks
Dimensional Measurement 1D Outside Diameter Inside Diameter Length Depth <sup>2</sup>	0.001 in to 6 in	0.0014 in	Digital Caliper

Notes:

- 1) Best uncertainties, expressed as a percentage of the applied test load, represent expanded uncertainties at approximately the 95% confidence level using a coverage factor of k=2.
- 2) Laboratory offers calibration services at the laboratory's own facilities and at the client or other agreed upon facilities. For calibration at other facilities, best measurement capabilities may be higher if a temperature controlled area is not available.
- 3) The uncertainty associated when calibrating a balance/scale is dependent on local conditions, such as the resolution of the unit being calibrated and the environment, which the balance/ scale is operating in. Therefore, a statement of the best measurement capability can be misleading. The Class of weight used by the laboratory for each range is identified in the BMC column to clarify the measurement being made by the laboratory.
- 4) Uncertainty stated as fractional part of reading plus floor.
- 5) Micrometer Masters, Caliper Masters, Feeler Gages & shims would be included in category.
- 6) L = Length in inches, D = Diameter in inches.
- 7) Force capabilities are limited to 20 000 lbf in compression and 12 000 lbf in tension at OCS. Customer setup or testing machine may allow for a higher capacity test.
- 8) Uncertainty shown is per wire for thread wire sets.

Approved by:  Date: June 26, 2009

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