



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

Fox Valley Metrology, Ltd.

303 Polk Parkway St. Croix Falls WI 54024
Chris Kuczynski Phone: 715-483-5334

CALIBRATION & TESTING

Valid to: June 27, 2011

Certificate Number: ACT-1277

I. Electromagnetic – DC / Low Frequency

PARAMETER / EQUIPMENT	RANGE	BEST MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(+)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
DC Voltage – Source ⁸	Up to 220 mV 220 mV to 2.2 V (2.2 to 11) V (11 to 22) V (22 to 220) V 220 V to 1.1 kV	12 μV/V + 400 nV 5.8 μV/V + 700 nV 4.2 μV/V + 2.5 μV 4.1 μV/V + 4 μV 5.8 μV/V + 40 μV 7.6 μV/V + 400 μV	Fluke 5720A	OEM and GIDEP Sourced Procedures
DC Voltage – Measure ⁸	Up to 100 mV 100 mV to 1 V (1 to 10) V (10 to 100) V 100 V to 1 kV (1 to 10) kV (10 to 100) kV	7.8 μV/V + 800 nV 5.7 μV/V + 800 nV 5.6 μV/V + 1 μV 7.9 μV/V + 80 μV 7.9 μV/V + 150 μV 60 V 600 V	Agilent 3458A Opt 002 Hipotronics KVM-100	
DC Current – Source ⁸	Up to 220 μA 220 μA to 2.2 mA (2.2 to 22) mA (22 to 220) mA 220 mA to 2.2 A (2.2 to 11) A (11 to 20.5) A (20.5 to 1 000) A	118 μA/A + 6 nA 42 μA/A + 7 nA 41 μA/A + 40 nA 52 μA/A + 700 nA 93 μA/A + 12 μA 582 μA/A + 500 μA 1.21 mA/A + 750 μA 86 mA/A + 500 mA	Fluke 5720A Fluke 5520A Fluke 5520A w/ 50-turn coil	

PARAMETER / EQUIPMENT	RANGE	BEST MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(+)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
AC Voltage – Source (cont.) ⁸	Up to 2.2 mV			
	(10 to 20) Hz	2.35 mV/V + 4 μV		
	(20 to 40) Hz	2.34 mV/V + 4 μV		
	40 Hz to 20 kHz	2.17 mV/V + 4 μV		
	(20 to 50) kHz	2.18 mV/V + 4 μV		
	(50 to 100) kHz	2.25 mV/V + 5 μV		
	(100 to 300) kHz	2.49 mV/V + 10 μV		
	(300 to 500) kHz	2.71 mV/V + 20 μV		
	500 kHz to 1 MHz	3.8 mV/V + 20 μV		
	(2.2 to 22) mV			
	(10 to 20) Hz	612 μV/V + 4 μV		
	(20 to 40) Hz	555 μV/V + 4 μV		
	40 Hz to 20 kHz	361 μV/V + 4 μV		
	(20 to 50) kHz	418 μV/V + 4 μV		
	(50 to 100) kHz	694 μV/V + 5 μV		
	(100 to 300) kHz	1.29 mV/V + 10 μV		
	(300 to 500) kHz	1.68 mV/V + 20 μV		
	500 kHz to 1 MHz	3.35 mV/V + 20 μV		
	(22 to 220) mV			
	(10 to 20) Hz	289 μV/V + 12 μV		
	(20 to 40) Hz	132 μV/V + 7 μV		
	40 Hz to 20 kHz	109 μV/V + 7 μV		
	(20 to 50) kHz	238 μV/V + 7 μV		
	(50 to 100) kHz	537 μV/V + 17 μV		
(100 to 300) kHz	1.05 mV/V + 20 μV			
(300 to 500) kHz	1.62 mV/V + 25 μV			
500 kHz to 1 MHz	3.28 mV/V + 45 μV			
(0.22 to 2.2) V				
(10 to 20) Hz	279 μV/V + 40 μV			
(20 to 40) Hz	108 μV/V + 15 μV			
40 Hz to 20 kHz	55 μV/V + 8 μV			
(20 to 50) kHz	119 μV/V + 10 μV			
(50 to 100) kHz	130 μV/V + 30 μV			
(100 to 300) kHz	487 μV/V + 80 μV			
(300 to 500) kHz	1.16 mV/V + 200 μV			
500 kHz to 1 MHz	1.97 mV/V + 300 μV			
(2.2 to 22) V				
(10 to 20) Hz	279 μV/V + 400 μV			
(20 to 40) Hz	108 μV/V + 150 μV			
40 Hz to 20 kHz	56 μV/V + 50 μV			
(20 to 50) kHz	119 μV/V + 100 μV			
(50 to 100) kHz	119 μV/V + 200 μV			
(100 to 300) kHz	321 μV/V + 600 μV			
(300 to 500) kHz	1.16 mV/V + 2 mV			
500 kHz to 1 MHz	1.74 mV/V + 3.2 mV			

PARAMETER / EQUIPMENT	RANGE	BEST MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(+)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
AC Voltage – Source (cont.) ⁸	(22 to 220) V (10 to 20) Hz (20 to 40) Hz 40 Hz to 20 kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (300 to 500) kHz 500 kHz to 1 MHz 220 V to 1.1 V (15 to 50) Hz 50 Hz to 1 kHz	279 $\mu\text{V}/\text{V}$ + 4 mV 109 $\mu\text{V}/\text{V}$ + 1.5 mV 65 $\mu\text{V}/\text{V}$ + 600 μV 123 $\mu\text{V}/\text{V}$ + 1 mV 176 $\mu\text{V}/\text{V}$ + 2.5 mV 1.04 mV/V + 16 mV 5.08 mV/V + 40 mV 9.24 mV/V + 80 mV 348 $\mu\text{V}/\text{V}$ + 16 mV 88 $\mu\text{V}/\text{V}$ + 3.5 mV	Fluke 5720A	
AC Voltage – Measure ⁸ Bandwidth < 2 MHz	Up to 10 mV (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz (10 to 100) mV (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 2) MHz 100 mV to 1 V (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 2) MHz (1 to 10) V (1 to 40) Hz 40 Hz to 1 kHz (1 to 20) kHz (20 to 50) kHz (50 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz (1 to 2) MHz	463 $\mu\text{V}/\text{V}$ + 13 μV 348 $\mu\text{V}/\text{V}$ + 11.1 μV 463 $\mu\text{V}/\text{V}$ + 11.1 μV 1.27 mV/V + 11.1 μV 5.89 mV/V + 11.1 μV 46 mV/V + 12 μV 140 $\mu\text{V}/\text{V}$ + 4.5 μV 143 $\mu\text{V}/\text{V}$ + 2.5 μV 222 $\mu\text{V}/\text{V}$ + 2.5 μV 407 $\mu\text{V}/\text{V}$ + 2.5 μV 984 $\mu\text{V}/\text{V}$ + 2.5 μV 3.53 mV/V + 10.5 μV 11.6 mV/V + 10.5 μV 17.4 mV/V + 10.5 μV 139 $\mu\text{V}/\text{V}$ + 45 μV 139 $\mu\text{V}/\text{V}$ + 25 μV 220 $\mu\text{V}/\text{V}$ + 25 μV 406 $\mu\text{V}/\text{V}$ + 25 μV 982 $\mu\text{V}/\text{V}$ + 25 μV 3.5 mV/V + 105 μV 11.6 mV/V + 105 μV 17.4 mV/V + 105 μV 139 $\mu\text{V}/\text{V}$ + 450 μV 139 $\mu\text{V}/\text{V}$ + 250 μV 220 $\mu\text{V}/\text{V}$ + 250 μV 405 $\mu\text{V}/\text{V}$ + 250 μV 982 $\mu\text{V}/\text{V}$ + 250 μV 3.5 mV/V + 1.05 mV 11.6 mV/V + 1.05 mV 17.4 mV/V + 1.05 mV	Agilent 3458A Opt 002	OEM and GIDEP Sourced Procedures

PARAMETER / EQUIPMENT	RANGE	BEST MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(+)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
AC Current – Source ⁸ (cont.)	Up to 220 μA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz 220 μA to 2.2 mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (2.2 to 22) mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (22 to 220) mA (10 to 20) Hz (20 to 40) Hz 40 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz 220 mA to 2.2 A 20 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz	299 μ A/A + 16 nA 200 μ A/A + 10 nA 156 μ A/A + 8 nA 331 μ A/A + 12 nA 1.29 mA/A + 65 nA 313 μ A/A + 40 nA 220 μ A/A + 35 nA 153 μ A/A + 35 nA 240 μ A/A + 110 nA 1.27 mA/A + 650 nA 319 μ A/A + 400 nA 229 μ A/A + 350 nA 151 μ A/A + 350 nA 239 μ A/A + 550 nA 1.27 mA/A + 5 μ A 299 μ A/A + 4 μ A 200 μ A/A + 3.5 μ A 153 μ A/A + 2.5 μ A 240 μ A/A + 3.5 μ A 1.27 mA/A + 10 μ A 309 μ A/A + 35 μ A 525 μ A/A + 80 μ A 8.09 mA/A + 160 μ A	Fluke 5720A	OEM and GIDEP Sourced Procedures
	(2 to 3) A (10 to 45) Hz 45 Hz to 1 kHz (1 to 5) kHz (5 to 10) kHz (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 (20.5 to 1 000) A (45 to 65) Hz (20.5 to 150) A (65 to 440) Hz	2.10 μ m/A + 100 μ A 746 μ A/A + 100 μ A 6.9 mA/A + 1 mA 28.9 mA/A + 5 mA 738 μ A/A + 2 mA 1.18 mA/A + 2 mA 34.6 mA/A + 2 mA 1.41 m/A + 5 mA 1.74 mA/A + 5 mA 34.6 mA/A + 5 mA 90 mA/A + 500 mA 544 μ A/A + 500 mA	Fluke 5520A	

PARAMETER / EQUIPMENT	RANGE	BEST MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(+)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
AC Current – Measure ⁸	<p>Up to 100 μA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz</p> <p>100 μA to 1 mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz</p> <p>(1 to 10 mA) (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz</p> <p>(10 to 100) mA (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz (50 to 100) kHz</p> <p>100 mA to 1 A (10 to 20) Hz (20 to 45) Hz (45 to 100) Hz 100 Hz to 5 kHz (5 to 20) kHz (20 to 50) kHz</p> <p>(1 to 10) A 45 Hz to 2 kHz</p>	<p>4.75 mA/A + 30 nA 1.89 mA/A + 30 nA 827 μA/A + 30 nA 827 μA/A + 30 nA</p> <p>4.84 mA/A + 200 nA 1.89 mA/A + 200 nA 827 μA/A + 200 nA 473 μA/A + 200 nA 827 μA/A + 200 nA 4.85 mA/A + 400 nA 6.62 mA/A + 1.5 μA</p> <p>4.85 mA/A + 2 μA 1.89 mA/A + 2 μA 827 μA/A + 2 μA 473 μA/A + 2 μA 827 μA/A + 2 μA 4.85 mA/A + 4 μA 6.62 mA/A + 15 μA</p> <p>4.8 mA/A + 20 μA 1.89 mA/A + 20 μA 827 μA/A + 20 μA 473 μA/A + 20 μA 473 μA/A + 20 μA 4.85 mA/A + 40 μA 6.62 mA/A + 150 μA</p> <p>4.8 mA/A + 200 μA 2 mA/A + 200 μA 1.1 mA/A + 200 μA 1.3 mA/A + 200 μA 3.7 mA/A + 200 μA 11.8 mA/A + 400 μA</p> <p>116 mA/A + 20 mA</p>	<p>Agilent 3458A OPT002</p> <p>Fluke 189</p>	<p>OEM and GIDEP Sourced Procedures</p>

PARAMETER / EQUIPMENT	RANGE	BEST MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(+)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
Capacitance – Source ⁸	130 pF to 3.3 nF (3.3 to 11) nF (11 to 110) nF (110 to 330) nF 330 nF to 1.1 μF (1.1 to 3.3) μF (3.3 to 11) μF (11 to 33) μF (33 to 110) μF (110 to 330) μF 330 μF to 1.1 mF (1.1 to 3.3) mF (3.3 to 11) mF (11 to 33) mF (33 to 110) mF	5.8 mF/F + 10 pF 2.9 mF/F + 10 pF 2.9 mF/F + 100 pF 2.9 mF/F + 300 pF 2.9 mF/F + 1 nF 2.9 mF/F + 3 nF 2.9 mF/F + 10 nF 4.7 mF/F + 30 nF 5.3 mF/F + 100 nF 1 mF/F + 300 nF 6 mF/F + 1 μF 5.3 mF/F + 3 μF 5.3 mF/F + 10 μF 8.9 mF/F + 30 μF 13.0 mF/F + 100 μF	Fluke 5520A	
Oscilloscopes ⁸			Fluke 5520A SC1100	OEM and GIDEP Sourced Procedures
DC Voltage (50Ω)	1 mV to 6.6 V	2.9 mV/V + 40 μV		
DC Voltage (1MΩ)	1 mV to 130 V	544 μV/V + 40 μV		
AC Voltage (50Ω)	1 mV to 6.6 V	2.9 mV/V + 40 μV		
AC Voltage (1MΩ)	1 mV to 130 V	1.1 mV/V + 40 μV		
Leveled Sine Wave 50 kHz to 1.1 GHz	5 mV to 5.5 V	50.7 mV/V + 100 μV		
Time Markers	1 ns to 5 s	6.4 μs/s	Fluke 5520A SC1100	
Wave Generator (50 Ω)	(0.0018 to 2.5) V p-p	34.6 mV/V + 100 μV		
Wave Generator (1 MΩ)	(0.0018 to 55) V p-p	34.6 mV/V + 100 μV		
Pulse Generator - Width	(4 to 45) ns (45 to 500) ns	57.8 ms/s + 500 ps 57.8 ms/s + 4ns		
Pulse Generator - Period	200 ns to 20 ms	57.8 ms/s + 200 ns		
Input Impedance Measure	(50 to 60) Ω 500 kΩ to 1 MΩ	1.2 mΩ/Ω 1.2 mΩ/Ω		

PARAMETER / EQUIPMENT	RANGE	BEST MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(+)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
Electrical Simulation of Thermocouple Indicators ⁸				OEM and GIDEP Sourced Procedures
Type K	(-200 to -100) °C (-100 to 120) °C (120 to 1 000) °C (1 000 to 1 372) °C	0.98 °C 0.93 °C 0.95 °C 1.02 °C	Fluke 5520A	
Type J	(-210 to -100) °C (-100 to 760) °C (760 to 1 200) °C	0.5 °C 0.44 °C 0.47 °C		
Type E	(-250 to -100) °C (-100 to 650) °C (650 to 1 000) °C	0.67 °C 0.38 °C 0.41 °C		
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 400) °C	0.83 °C 0.48 °C 0.43 °C		
Type S	(0 to 250) °C (250 to 1 400) °C (1 400 to 1 767) °C	1.82 °C 1.79 °C 1.81 °C		
pH Meters ⁸	(4.01, 7.00, 10.00) pH	0.02 pH	pH Buffer Solutions	
Conductivity Meters ⁸	12.85 mS/cm 1 408 µS/cm	0.18 mS/cm 13.5 µS/cm	Conductivity Solutions	
Refractometers ⁸	(0.0, 18.0, 29.7) BRIX	0.24 BRIX	Refractive Index Solutions	
Sound Level – Source ⁸				
100 Hz, 250 Hz, 500 Hz, 1 000 Hz, 2 000 Hz	114 dB	0.6 dB	Gen Rad 1562-A	

PARAMETER / EQUIPMENT	RANGE	BEST MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(+)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
Tuned RF Level – Measure ^{3,8} Relative Level (-90 to +30) dBm (-106 to -90) dBm (-129 to -106) dBm (-90 to +30) dBm (-113 to -90) dBm (-81 to +30) dBm (-104 to -81) dBm (-70 to +30) dBm (-93 to -70) dBm (-62 to +30) dBm (-85 to -62) dBm	500 kHz to 3.05 GHz (3.05 to 6.6) GHz (6.6 to 13.2) GHz (13.2 to 19.2) GHz (19.2 to 26.5) GHz	0.03 dB + 0.005 dB/10 dB 0.07 dB + 0.12 dB/10 dB 0.08 dB + 0.12 dB/10 dB 0.03 dB + 0.005 dB/10 dB 0.07 dB + 0.12 dB/10 dB 0.03 dB + 0.005 dB/10 dB 0.06 dB + 0.12 dB/10 dB 0.03 dB + 0.005 dB/10 dB 0.06 dB + 0.12 dB/10 dB 0.03 dB + 0.005 dB/10 dB 0.05 dB + 0.12 dB/10 dB	Agilent N5531S Measuring Receiver with N5532A Sensor Modules	OEM and GIDEP Sourced Procedures
RF Power Sensors- Calibration Factor ^{3,8} (-20 to +14) dBm	100 kHz to 10 MHz 10 MHz to 10 GHz (10 to 18) GHz	1.5 % 1.5 % 1.7 %	Tegam 1827, Agilent 3458A, Agilent E8257D, Agilent E4419B, Agilent 3325B	
Frequency Modulation – Measure ⁸ Rate: 20 Hz to 10 kHz Dev.: ≤ 40 kHz peak Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz peak Rate: 20 Hz to 200 kHz Dev.: ≤ 400 kHz peak	250 kHz to 10 MHz 10 MHz to 3 GHz (3 to 26.5) GHz	3.1 % of reading 3.1 % of reading 7.7 % of reading	Agilent N5531S Measuring Receiver with N5532A Sensor Modules	
Frequency Modulation – Source ⁸ 1 dB Rate: DC to 100 kHz 3 dB Rate: DC to 10 MHz Dev: ≤ (N X 800 kHz)	250 kHz to 40 MHz	4.2 % setting + 20 Hz	Agilent E8257D	

PARAMETER / EQUIPMENT	RANGE	BEST MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(+)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
Amplitude Modulation – Measure ⁸ Rate: 50 Hz to 10 kHz Depths: 5% to 99% Rate: 50 Hz to 100 kHz Depths: 20% to 99% Rate: 50 Hz to 100 kHz Depths: 5% to 20% Rate: 50 Hz to 100 kHz Depths: 20% to 99% Rate: 50 Hz to 100 kHz Depths: 5% to 20%	100 kHz to 10 MHz 10 MHz to 3 GHz 10 MHz to 3 GHz (3 to 26.5) GHz (3 to 26.5) GHz	2.2 % of reading 1.2 % of reading 4.2 % of reading 3.5 % of reading 6.0 % of reading	Agilent N5531S Measuring Receiver with N5532A Sensor Modules	
Amplitude Modulation – Source ⁸ Rate: DC to 100 kHz Depths: 0% to 100%	250 kHz to 40 GHz	7.1 % setting + 1%	Agilent E8257D	
Phase Modulation – Measure ⁸ Rate: 200 Hz 20 kHz Dev.: > 0.7 rad Rate: 200 Hz 20 kHz Dev.: > 0.3 rad Rate: 200 Hz 20 kHz Dev.: > 2.0 rad Rate: 200 Hz 20 kHz Dev.: > 0.6 rad Rate: 200 Hz 20 kHz Dev.: > 2.0 rad Rate: 200 Hz 20 kHz Dev.: > 0.6 rad	100 kHz to 6.6 GHz 100 kHz to 6.6 GHz (6.6 to 13.2) GHz (6.6 to 13.2) GHz (13.2 to 26.5) GHz (13.2 to 26.5) GHz	1.2 % of reading 3.6 % of reading 1.2 % of reading 3.6 % of reading 1.2 % of reading 3.6 % of reading	Agilent N5531S Measuring Receiver with N5532A Sensor Modules	OEM and GIDEP Sourced Procedures
Phase Modulation – Source ⁸ Rate: DC to 100 kHz	250 kHz to 40 GHz	5.9 % setting + 0.1 rad	Agilent E8257D	

PARAMETER / EQUIPMENT	RANGE	BEST MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(+)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
Pulse Generation – Measure ⁸ DC to 225 MHz Pulse Width Rise/Fall Time	5 ns to 10 ⁵ s 5 ns to 10 ⁵ s	1.1 ns 1.1 ns	Agilent 53132A	OEM and GIDEP Sourced Procedures
Pulse Generation – Source ⁸ Repetition Frequency: 0.024 Hz to 14.28 MHz Period: 70 ns to 42 s	10 ns to 42 s	17.3 ns	Agilent E8257D	
Pulse Modulation – Source ⁸ Level Rise/Fall Time	(0 to 9) dBm 10 MHz to 40 GHz	0.59 dBm 11.5 ns	Agilent E8257D	

III. Optical Radiation

PARAMETER / EQUIPMENT	RANGE	BEST MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(+)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
Optical Power – Measure ⁸ (800 to 1650) nm	(+20 to -70) dBm	0.03 dB/dBm	Agilent 8153A, 81533B, and 81525A	OEM and GIDEP Sourced Procedures
Optical Power – Source ⁸ 1 310 nm, 1 550 nm	(0 to -60) dB	0.05 dB/dB	Agilent 81554SM, 8153A, 81533B, 81525A, and 8158B	
Optical Attenuation – Generate ⁸ (1 200 to 1 650) nm	(0 to 60) dB	0.04 dB/dB	Agilent 8158B	

IV. Time and Frequency

PARAMETER / EQUIPMENT	RANGE	BEST MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(+)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
Time Interval ⁸	(1 to 86 400) s	0.00045 s	Agilent 53132A & SRS FS725	OEM and GIDEP Sourced Procedures
Frequency – Measure ⁸	DC to 225 MHz	6.7 parts in 10 ¹¹	Agilent 53132A, SRS FS725	
	DC to 26.5 GHz	6.7 parts in 10 ¹¹	Agilent N5531S, SRS FS725	
Frequency – Source ⁸	10 MHz	6.7 parts in 10 ¹¹	SRS FS725	
	DC to 40 GHz	6.7 parts in 10 ¹¹	Agilent 3325B, Agilent E8257D, & SRS FS725	

V. Thermodynamic

PARAMETER / EQUIPMENT	RANGE	BEST MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(+)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
Temperature – Source ⁸	(-30 to 600) °C	0.03 °C	Hart Scientific 9011 with PRT	OEM and GIDEP Sourced Procedures
Temperature – Measure ⁸	(-30 to 600) °C	0.03 °C	Hart Scientific 1502 with PRT	

VI. Dimensional

PARAMETER / EQUIPMENT	RANGE	BEST MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(+)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
Gage Blocks	Up to 8 in (8 to 20) in	(4.6 + 1.6L) μin (7.7 + 1L) μin	P&W Labmaster OKM OPAL 600	ASME B89.1.9
Length Standards	Up to 9 in (9 to 24) in	(39 + 0.4L) μin (16 + 0.9L) μin	P&W Supermicrometer Zeiss ULM 600	OEM and GIDEP Sourced Procedures

PARAMETER / EQUIPMENT	RANGE	BEST MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(+)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
Cylindrical Rings	(0.025 to 12) in	$(33.9 + 1.7D) \mu\text{in}$	Zeiss ULM 600	ASME B89.1.6
Cylindrical Plugs ⁴	(0.010 to 8) in	$(21.7 + 0.3D) \mu\text{in}$	Zeiss ULM 600	OEM and GIDEP
Thread Rings Pitch Diameter Minor Diameter	(0.01 to 8) in (0.030 to 3) in	$(236 + 0.3 D) \mu\text{in}$ 422 μin	Setting Plug Gages ID Bore Gages	ASME B1.2
NPT Rings Standoff and Basic Length	(0.0625 to 6) in	244 μin	NPT Plugs and P&W Labmaster	ASME B1.20.5
NPT Plugs Standoff and Basic Length	(0.0625 to 6) in	488 μin	NPT Rings and P&W Labmaster	ASME B1.20.5
Threaded Plugs ⁴ Pitch Diameter Major Diameter	(0.01 to 10) in (0.01 to 10) in	$(73 + 0.9D) \mu\text{in}$ $(40 + 1.2D) \mu\text{in}$	P&W Supermicrometer and Thread Measuring Wires	ASME B1.2
Calipers ⁸	Up to 40 in	$(382 + 15L) \mu\text{in}$	Gage Blocks	OEM and GIDEP Sourced Procedures
Dial Indicators ⁸	Up to 4 in	$(36 + 10L) \mu\text{in}$	Indicator Checker	
Test Indicator ⁸	Up to 0.06 in	232 μin		
OD Micrometer ⁸	Up to 24 in	$(62 + 20L) \mu\text{in}$	Gage Blocks	
ID Micrometer ⁸	(1.5 to 24) in	$(64 + 6L) \mu\text{in}$	Gage Blocks	
Height Gages ⁸	Up to 40 in	$(375 + 11L) \mu\text{in}$	Gage Blocks	
Crimpers ⁸ Die Check Crimp Height	(0.011 to 0.5) in (0.01 to 0.5) in	233 μin 0.0012 in	Pin Gages Micrometer	

PARAMETER / EQUIPMENT	RANGE	BEST MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(+)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
Profilometer ⁸ Ra	(2 to 300) μ in	2.2 μ in	Roughness Specimen	OEM and GIDEP Sourced Procedures
Surface Plates ⁸ Repeatability	(4 to 34) in (Diagonal)	(30 + 0.2D) μ in	Repeat – O – Meter	
Flatness	(34 to 175) in (Diagonal)	(66 + 0.2D) μ in	Electronic Levels	
CMM Calibration ⁸ Volumetric	(5 to 40) in	(12 + 14L) μ in	Ball Bars	
Linearity	(1 to 60) in	(7 + 14L) μ in	Step Gage	
Linearity	Above 60 in	(20 + 0.4L) μ in	Renishaw Laser System	
Bore Gages ⁸	(0.25 to 12) in	351 μ in	Cylindrical Rings	
Optical Comparator ⁸ Linearity	Up to 12 in	(97 + 12L) μ in	Glass Scale / Precision Balls	
Magnification	10x, 20x, 31.25x, 50x, 62.5x, 100x, 200x	0.0005 in	Calibration Sphere	
Roundness Testers ⁸ Axial Error	All	0.15 μ m	Test Sphere	
Radial Error		0.15 μ m		
ULM ⁸ Length	(1 to 100) mm	0.19 μ m	Gage Blocks	
Film Thickness Gage ⁸	(0.01 to 0.06) in	382 μ in	Film Thickness Standards	
Brinell Scope ⁸	(1 to 6) mm	11 μ m	Stage Micrometer	

VII. Dimensional Inspection / Measurement

PARAMETER/ EQUIPMENT	RANGE	BEST MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(+)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
Dimensional Inspection				
Volumetric	Up to (24 x 28 x 24) in	323 μin	CMM	Customer Drawings
Linear	Up to 6 in	(358 + 5L) μin	Video Measuring Machine	

VIII. Mechanical Calibration

PARAMETER/ EQUIPMENT	RANGE	BEST MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(+)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
Bench and Floor Scales ⁸	Up to 5 000 lb	1 lb	NIST 105 Class F Weights	NIST Handbook 44 Methods
Analytical Balances ⁸	Up to 13 kg	0.28 mg	ASTM E617 Class 1 Weights	
Pressure ⁸	(-13 to 300) psi (300 to 1 000) psi (1 000 to 10 000) psi	0.1 psi 1.3 psi 3.9 psi	Pressure Calibrator Pressure Transducers	OEM and GIDEP Sourced Procedures
Force – On Site ⁸	Up to 500 lb (500 to 1 000) lb (1 000 to 10 000) lb	0.05 % reading 0.6 % reading 0.5 % reading	Dead Weight Load Cell	
Force – In Lab	1 g to 500 lb (500 to 1 000) lb (1 000 to 10 000) lb (10 000 to 100 000) lb	0.05 % reading 0.03 % reading 0.03 % reading 0.04 % reading	Dead Weight Proving Ring	
Torque – Generate ⁸	Up to 250 lbf-ft (250 to 2 000) lbf-ft	0.05 % range 0.06 % range	Torque Arms & Dead Weight	
Torque - Measure ⁸	4 lbf-in to 2 500 lbf-ft	0.3 % reading	AKO Torque System	
Hardness Testers ⁸ Rockwell	HRA Low HRA Med HRA High HRB Low HRB Med HRB High HRC Low	1.22 HRA 1.24 HRA 0.75 HRA 1.39 HRB 1.39 HRB 1.33 HRB 1.22 HRC	Rockwell Test Blocks	

PARAMETER / EQUIPMENT	RANGE	BEST MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(+)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
Hardness Testers ⁸ Rockwell (cont.)	HRC Med HRC High	1.22 HRC 0.7 HRC	Rockwell Test Blocks	Indirect Comparison per ASTM E18
	HRE Low HRE Med HRE High	1.28 HRE 1.42 HRE 1.34 HRE		
	HRF Low HRF Med HRF High	1.43 HRF 1.43 HRF 1.42 HRF		
	HRH Low HRH Med HRH High	1.35 HRH 1.35 HRH 1.35 HRH		
	HR15N Low HR15N Med HR15N High	1.51 HR15N 1.24 HR15N 0.9 HR15N		
	HR30N Low HR30N Med HR30N High	1.31 HR30N 1.25 HR30N 0.93 HR30N		
Brinell	HR45N Low HR45N Med HR45N High	1.34 HR45N 1.26 HR45N 0.95 HR45N	Brinell Test Blocks & Brinell Scope	Indirect comparison per ASTM E10
Knoop and Vickers	HR15T Low HR15T Med HR15T High	1.95 HR15T 1.40 HR15T 1.47 HR15T	Knoop & Vickers Test Blocks	Indirect comparison per ASTM E384
	HR30T Low HR30T Med HR30T High	1.99 HR30T 1.51 HR30T 1.33 HR30T		
	HR45T Low HR45T Med HR45T High	1.95 HR45T 1.33 HR45T 1.42 HR45T		
	(1 to 7) mm	0.03 mm		
	(1 to 200) μm (1 to 200) μm	0.25 μm 0.17 μm		

PARAMETER / EQUIPMENT	RANGE	BEST MEASUREMENT CAPABILITY [EXPRESSED AS UNCERTAINTY(+)]	REFERENCE STANDARD OR EQUIPMENT	METHOD(S)
Durometers ⁸				
Spring Force	(0.1 to 45) N	0.05 N	Triple Beam Balance	Per ASTM D2240
Indentor Angle	(20 to 40) °	0.07 °	Video Measuring Machine	
Indentor Length Indentor Radius	(0.049 to 0.198) in (0.05 to 0.1) in	333 μin 337 μin	Gage Blocks	
Tachometers ⁸				
Contact Non-Contact	(1 to 40 000) RPM (500 to 40 000) RPM	0.08 % of reading 0.08 % of reading	Quantum Dynamics N-11-E	OEM and GIDEP Sourced Procedures

Notes:

1. Best Measurement Uncertainties (Expanded Uncertainties) are based on approximately a 95% confidence interval, using a coverage of $k=2$.
2. This laboratory's capabilities include in-laboratory and field (on-site) calibrations. Since field conditions are typically more variable than those in the laboratory, larger measurement uncertainties are expected in the field than what is reported on the accredited scope.
3. RF/Microwave uncertainties do not include possible contributions from mismatch error.
4. Field calibration available for this parameter using plug gage comparator only (gages up to 4 inches).
5. For uncertainties expressed as $b + mL$, L = Length in inches.
6. For uncertainties expressed as $b + mD$, D = Diameter or Diagonal in inches.
7. Where ranges overlap, the uncertainty for the overlapping specifications will be the lower of the two uncertainties.
8. Field (on-site) capability offered for this parameter.
9. Uncertainties for Electromagnetic – DC/Low Frequency parameters do not include possible contributions from the unit under test.
10. This scope is part of and must be included with the Certificate of Accreditation No. ACT -1277



Vice President