



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

ADVANCED TECHNOLOGY SERVICES – CATERPILLAR TECHNICAL CENTER  
14009 Old Galena Rd  
Mossville, IL 61552  
John Goodrich Phone: 309 494 5123

CALIBRATION

Valid To: August 31, 2019

Certificate Number: 1592.05

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory at the location above as well as the one satellite laboratory location listed below to perform the following calibrations<sup>1</sup>:

I. Chemical

Parameter/Equipment	Range	CMC <sup>2,3</sup> (±)	Comments
Gas Detection Equipment – Calibration of Horiba Gas Analyzers	(0 to 4000) mL/min	1.6 %	Horiba GDC-703B/w calibration gas
Particulate Exhaust	(2 to 20) SLPM (20 to 200) SLPM	0.59 % + 0.074 SCCM 0.89 % + 0.36 SCCM	CME model 60B LFE

II. Dimensional Testing/Calibration

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Angle <sup>5</sup>	(0 to 90) °	0.25 °	Spi-tronic Pro 360 w/Agilent 34401A
Rotational Angle (Tilt Table) <sup>5</sup>	(0 to 360) °	0.58 °	Rotation plate w/Agilent 34401A

Parameter/Equipment	Range	CMC <sup>2,3</sup> (±)	Comments
Surface Analysis <sup>5</sup>	Ra up to 260 mm	11 µm	Mahr LD-260
	Ra up to 200 mm	0.84 µm	Mitutoyo SVC-638
	Ra up to 100 mm	0.31 µm	Zeiss Surfcom 2000
Differential Transducers <sup>5</sup> (LVDT)	(0 to 50.8) mm	0.017 %	Mitutoyo 197-201 w/ Agilent 34410A
	(50.9 to 177.8) mm	0.30 %	Starrett 656-7041
	(177.9 to 304.8) mm	0.15 %	Starrett 656-12041
Inside Diameter <sup>5</sup>	(54 to 79.5) mm	4.2 µm	Dial bore #4 gage
	(78.5 to 156) mm	5.7 µm	Dial bore #5 gage
	(152.5 to 308) mm	7.0 µm	Dial bore #6 gage
Length <sup>5</sup> – 1D	Up to 25.4 mm	4.0 µm	Mitutoyo 543-452B
	Up to 127 mm	0.17 mm	Chatillon test stand
	Up to 1000 mm	8.8 µm	Mahr 817 CLM
Length <sup>5</sup> – 3D	X axis: 200 mm Y axis: 250 mm Z axis: 75 mm	7.8 µm	Dynascope microscope
	X axis: 200 mm Y axis: 250 mm Z axis: 75 mm	7.9 µm	Dynascope multi lens
External Diameter <sup>5</sup>	Up to 25.4 mm	2.9 µm	Mitutoyo micrometer
	(25.4 to 50.8) mm	3.1 µm	Starrett 733 micrometer
	(50.8 to 76.2) mm	3.5 µm	
	(76.2 to 101.6) mm	4.3 µm	
	(101.6 to 127) mm	5.8 µm	
	(127 to 152.4) mm	5.8 µm	
(0.1 to 101.6) mm	3.1 µm	Laser micrometer	



III. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
DC Voltage – Generate	(0 to 220) mV (0.22 to 2.2) V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1100) V	8.9 μV/V + 0.40 μV 5.2 μV/V + 0.7 μV 3.8 μV/V + 2.5 μV 7.4 μV/V + 4.0 μV 5.2 μV/V + 40 μV 6.8 μV/V + 0.40 mV	Fluke 5730A
	(1000 to 4000) V	0.16 % + 3.0 V	SRS-PS350
DC Voltage – Measure	(0 to 200) mV (0.2 to 2) V (2 to 20) V (20 to 200) V (200 to 1000) V	6.1 μV/V + 0.10 μV 3.7 μV/V + 0.40 μV 3.7 μV/V + 4.0 μV 5.7 μV/V + 40 μV 5.7 μV/V + 0.53 mV	Fluke 8508A
DC Current – Generate	(0 to 220) μA (0.22 to 2.2) mA (2.2 to 22) mA (22 to 220) mA (0.22 to 2.2) A	45 μA/A + 6.0 nA 38 μA/A + 7.0 nA 38 μA/A + 40 nA 47 μA/A + 0.70 μA 95 μA/A + 12 μA	Fluke 5730A
	(2.2 to 11) A	3.6 mA/A + 0.48 mA	Fluke 5725A
	(11 to 20.5) A	0.15 % + 0.75 mA	Fluke 5522A
	(0 to 2) A (2 to 20) A (20 to 120) A (120 to 2500) A	0.0098 % + 0.080 mA 0.011 % + 0.80 mA 93 μA/A + 4.8 mA 0.71 % + 0.84 A	Fluke 52120A / coil
	(100 to 1000) A (1000 to 2000) A	0.42 A 0.83 A	Current amplifier w/ transducers
	DC Current – Measure	(10 to 200) μA (0.2 to 2) mA (2 to 20) mA (20 to 200) mA (0.2 to 2) A (2 to 20) A	13 μA/A + 0.40 nA 15 μA/A + 4.0 nA 17 μA/A + 40 nA 57 μA/A + 0.80 μA 0.021 % + 16 μA 0.048 % + 0.40 mA



Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Capacitance – Generate	(0.4 to 1.0999) nF (1.1 to 3.2999) nF (3.3 to 10.9999) nF (11 to 32.9999) nF (33 to 109.999) nF (110 to 329.999) nF (0.33 to 1.09 999) µF (1.1 to 3.2999) µF (3.3 to 10.9999) µF (11 to 32.9999) µF (33 to 109.999) µF (110 to 329.999) µF (0.33 to 1.0999) mF (1.1 to 3.2999) mF (3.3 to 10.999) mF (11 to 32.999) mF (33 to 109.999) mF	0.55 % + 10 pF 2.2 % + 10 pF 0.28 % + 10 pF 1.4 % + 0.10 nF 0.29 % + 0.10 nF 1.4 % + 0.30 nF 0.27 % + 1.0 nF 1.4 % + 3.0 nF 0.31 % + 10 nF 1.8 % + 30 nF 0.48 % + 0.10 µF 1.8 % + 0.30 µF 0.48 % + 1.0 µF 1.8 % + 3.0 µF 0.47 % + 10 µF 2.5 % + 30 µF 1.1 % + 0.10 mF	Fluke 5522A
AC Voltage – Generate			
(0 to 2.2) mV	(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	0.16 % + 4.0 µV 0.15 % + 4.0 µV 0.18 % + 4.0 µV 0.25 % + 4.0 µV 0.26 % + 5.0 µV 0.38 % + 10 µV	Fluke 5730A
(2.2 to 22) mV	(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	0.030 % + 4.0 µV 0.020 % + 4.0 µV 0.022 % + 4.0 µV 0.035 % + 4.0 µV 0.065 % + 5.0 µV 0.13 % + 10 µV 0.17 % + 20 µV 0.38 % + 20 µV	
(22 to 220) mV	(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	0.027 % + 12 µV 0.014 % + 7.0 µV 92 µV/V + 7.0 µV 0.017 % + 7.0 µV 0.036 % + 17 µV 0.072 % + 20 µV 0.14 % + 25 µV 0.29 % + 45 µV	



Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
AC Voltage – Generate (cont.)			
(0.22 to 2.2) 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	0.026 % + 40 μV 0.011 % + 15 μV 75 μV/V + 8.0 μV 90 μV/V + 10 μV 0.011 % + 30 μV 0.039 % + 0.08 mV 0.10 % + 0.20 mV 0.20 % + 0.30 mV	Fluke 5730A
(2.2 to 22) 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	0.052 % + 0.40 mV 0.012 % + 0.15 mV 74 μV/V + 50 μV 90 μV/V + 0.10 mV 0.011 % + 0.20 mV 0.033 % + 0.60 mV 0.10 % + 2.0 mV 0.39 % + 3.2 mV	
(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	0.030 % + 4.0 mV 90 μV/V + 1.5 mV 80 μV/V + 0.60 mV 0.011 % + 1.0 mV 0.018 % + 2.5 mV 0.091 % + 16 mV 0.44 % + 40 mV 0.80 % + 80 mV	
(220 to 1100) V	(15 to 50) kHz (50 to 1) kHz	0.30 % + 16 mV 75 μV/V + 3.5 mV	
(220 to 750) V	(30 to 50) kHz (50 to 100) kHz	0.42 % + 11 mV 1.6 % + 45 mV	Fluke 5730A w/ 5725A
AC Voltage – Measure			
(0 to 200) mV	(10 to 40) Hz (40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz	0.016 % + 4.0 μV 0.012 % + 4.0 μV 0.012 % + 2.0 μV 0.014 % + 4.0 μV 0.035 % + 8.0 μV 0.078 % + 20 μV	Fluke 8508A



Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
AC Voltage – Measure (cont.)			
(0.2 to 2) V	(10 to 40) Hz (40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.012 % + 20 µV 0.010 % + 20 µV 0.0079 % + 20 µV 0.011 % + 20 µV 0.023 % + 40 µV 0.059 % + 0.20 mV 0.30 % + 2.0 mV 1.0 % + 20 mV	Fluke 8508A
(2 to 20) V	(10 to 40) Hz (40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz (100 to 300) kHz 300 kHz to 1 MHz	0.013 % + 0.20 mV 0.0098 % + 0.20 mV 0.0083 % + 0.20 mV 0.012 % + 0.20 mV 0.022 % + 0.40 mV 0.058 % + 2.0 mV 0.30 % + 20 mV 1.0 % + 0.20 V	
(20 to 200) V	(10 to 40) Hz (40 to 100) Hz 100 Hz to 2 kHz (2 to 10) kHz (10 to 30) kHz (30 to 100) kHz	0.013 % + 2.0 mV 0.0098 % + 2.0 mV 0.0084 % + 2.0 mV 0.012 % + 2.0 mV 0.022 % + 4.0 mV 0.058 % + 20 mV	
(200 to 1000) V	40 Hz to 10 kHz (10 to 30) kHz	0.016 % + 21 mV 0.038 % + 42 mV	
AC Current – Generate			
(9 to 220) µA	(10 to 20) Hz (20 to 40) Hz (40 to 1000) Hz (1 to 5) kHz (5 to 10) kHz	0.030 % + 16 nA 0.020 % + 10 nA 0.015 % + 8.0 nA 0.044 % + 12 nA 0.12 % + 65 nA	Fluke 5730A
(0.22 to 2.2) mA	(10 to 20) Hz (20 to 40) Hz (40 to 1000) Hz (1 to 5) kHz (5 to 10) kHz	0.030 % + 40 nA 0.019 % + 35 nA 0.014 % + 35 nA 0.025 % + 0.11 µA 0.11 % + 0.65 µA	



Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
AC Current – Generate (cont.)			
(2.2 to 22) mA	(10 to 20) Hz (20 to 40) Hz (40 to 1000) Hz (1 to 5) kHz (5 to 10) kHz	0.036 % + 0.40 µA 0.021 % + 0.35 µA 0.018 % + 0.35 µA 0.025 % + 0.55 µA 0.11 % + 5.0 µA	Fluke 5730A
(22 to 220) mA	(10 to 20) Hz (20 to 40) Hz (40 to 1000) Hz (1 to 5) kHz (5 to 10) kHz	0.036 % + 4.0 µA 0.018 % + 3.5 µA 0.016 % + 2.5 µA 0.026 % + 3.5 µA 0.12 % + 10 µA	
(0.22 to 2.2) A	(20 to 1000) Hz (1 to 5) kHz (5 to 10) kHz	0.028 % + 35 µA 0.051 % + 80 µA 0.73 % + 0.16 mA	
(0 to 2) A	(10 to 65) Hz (65 to 300) Hz 300 Hz to 1 kHz (1 to 3) kHz (3 to 6) kHz (6 to 10) kHz	0.025 % + 1.1 mA 0.032 % + 1.1 mA 0.081 % + 1.1 mA 0.23 % + 9.3 mA 0.78 % + 25 mA 1.6 % + 62 mA	Fluke 52120A / coil
(2 to 20) A	(10 to 65) Hz (65 to 300) Hz 300 Hz to 1 kHz (1 to 3) kHz (3 to 6) kHz (6 to 10) kHz	0.025 % + 9.4 mA 0.032 % + 9.4 mA 0.081 % + 9.4 mA 0.23 % + 31 mA 0.78 % + 62 mA 2.3 % + 94 mA	
(20 to 120) A	10 to 65) Hz (65 to 300) Hz 300 Hz to 1 kHz (1 to 3) kHz (3 to 6) kHz (6 to 10) kHz	0.028 % + 19 mA 0.033 % + 28 mA 0.082 % + 94 mA 0.23 % + 0.23 A 0.78 % + 0.42 A 3.1 % + 0.70 A	



Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
AC Current – Generate (cont.)			
120 A to 3 kA	(10 to 65) Hz (65 to 300) Hz	1.4 % + 0.84 A 1.4 % + 0.84 A	Fluke 52120A w/ 25/50 turn coil
120 A to 1 kA (120 to 300) A (0 to 100) A (0 to 50) A	300 Hz to 1 kHz (1 to 3) kHz (3 to 6) kHz (6 to 10) kHz	0.71 % + 0.84 A 1.6 % + 1.2 A 1.7 % + 1.2 A 2.6 % + 1.2 A	Fluke 52120A w/ 25 turn coil
AC Current – Measure			
(0 to 200) µA	10 Hz to 10 kHz	0.054 % + 20 nA	Fluke 8508A
(0.1 to 2.0) mA	10 Hz to 10 kHz	0.032 % + 0.20 µA	
(2.0 to 20) mA	10 Hz to 10 kHz	0.033 % + 2.0 µA	
(20 to 200) mA	10 Hz to 5 kHz	0.031 % + 20 µA	
(0.2 to 2.0) A	10 Hz to 2 kHz (2 to 10) kHz	0.063 % + 0.20 mA 0.090 % + 0.20 mA	
(2.0 to 20) A	10 Hz to 2 kHz (2 to 10) kHz	0.84 % + 2.0 mA 2.6 % + 2.0 mA	
Oscilloscopes –			
DC Signal 50 Ω Load 1 MΩ Load	(-6.6 to 6.6) V (-130 to 130) V	0.33 % + 40 µV 0.12 % + 40 µV	Fluke 5522A
Amplitude Square Wave 50 Ω, 10 Hz to 10 kHz	± 1 mV to 6.6 Vp-p	0.25 % + 40 µV	
1 MΩ 10 Hz to 1 kHz (1 to 10) kHz	± 1 mV to 130 Vp-p ± 1 mV to 130 Vp-p	0.12 % + 40 µV 0.26 % + 40 µV	
Leveled Sine Wave (Into 50 Ω Load)	50 kHz Reference	2.0 % + 0.30 mV	





Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Electrical Calibration of Thermocouple Indicators & Indicating Systems			
Type E	(-250 to -100) °C (-100 to -25) °C (-25 to 350) °C (350 to 650) °C (650 to 1000) °C	0.50 °C 0.16 °C 0.14 °C 0.16 °C 0.21 °C	Fluke 5522A
Type J	(-210 to -100) °C (-100 to -30) °C (-30 to 150) °C (150 to 760) °C (760 to 1200) °C	0.27 °C 0.16 °C 0.14 °C 0.17 °C 0.23 °C	
Type K	(-200 to -100) °C (-100 to -25) °C (-25 to 120) °C (120 to 1000) °C (1000 to 1372) °C	0.33 °C 0.18 °C 0.16 °C 0.26 °C 0.40 °C	
Type T	(-250 to -150) °C (-150 to 0) °C (0 to 120) °C (120 to 400) °C	0.63 °C 0.24 °C 0.16 °C 0.14 °C	

#### IV. Fluid Quantities

Parameter/Equipment	Range	CMC <sup>2,3</sup> (±)	Comments
Fuel Flow – Measure	(10 to 15 000) g/min	0.41 % + 0.59 g/min	Gravimetric calibrator g = grams
Air Flow – Measure	(20 to 23 000) kg/hr (1.3 to 5500) kg/hr	0.55 % 0.33 %	Subsonic nozzles, critical flow nozzles
Liquid Flow – Measuring Equipment	(0 to 1514) L/min	2.4 %	FTI omni track Gravimetric (OT-400)



Parameter/Equipment	Range	CMC <sup>2,3</sup> (±)	Comments
Water Flow – Measuring Equipment	(25 to 800) kg/min	0.10 % + 0.15 kg/min	CMF200 micro motion w/ Agilent 34970A

#### V. Mechanical

Parameter/Equipment	Range	CMC <sup>2,3</sup> (±)	Comments
Scales & Balances	1 mg to 1 g 1.1 g to 1 kg (1.1 to 40) kg (41 to 121) kg	54 µg/g + 0.014 µg 5.1 mg/g + 1.0 mg 0.26 g/kg + 0.12 g 4.0 g/kg + 1.3 g	Verification w/ standard weights
Force –  Tension	(89 to 445) N	0.7 N	C-K Engineering (tangential tension)
Compression & Tension	(0 to 4.5) N (4.5 to 900) N (900 to 4450) N	0.15 N 1.4 N 16 N	Chatillon TCD-1100 w/load cell
	(0 to 2224) N	0.052 N	Morehouse model-L
	(0 to 1112) N (0 to 2224) N (0 to 4450) N (0 to 11 120) N (0 to 22 241) N (0 to 44 482) N (0 to 111 205) N	0.64 N 1.3 N 3.8 N 9.6 N 19 N 39 N 96 N	Comparison w/ standard load cell
Compression	(0 to 667 233) N (0 to 2 224 110) N	2.2 kN 7.3 kN	Comparison w/ standard load cell
Pressure –  Hydraulic	500 kPa to 5 MPa (5 to 500) MPa	0.069 % + 15 Pa 0.096 % + 65 Pa	Fluke PG7302 AMH



Parameter/Equipment	Range	CMC <sup>2,3</sup> (±)	Comments
Pressure – (cont.)  Pneumatic	(0 to 62.2) kPa (>62.2 to 206.9) kPa (104 to 2064.7) kPa (>2064.7 to 6890.3) kPa	0.29 Pa/kPa + 1.4 Pa 0.30 Pa/kPa + 8.0 Pa 0.30 Pa/kPa + 30 Pa 0.29 Pa/kPa + 3.6 Pa	Fluke PPC4
Rotational Speed, Non-contact	(50 to 5000) RPM	0.30 RPM	Phototach & fluke PM6680B
Torque – Measuring Equipment	(1 to 8605.9) Nm  (0 to 2370) N·m (0 to 5924) N·m (0 to 11 848) N·m (0 to 23 696) N·m (0 to 59 241) N·m	0.017 % + 0.023 N·m  3.4 N·m 8.6 N·m 17 N·m 34 N·m 87 N·m	Lever arm w/ class F weights  Standard load cells w/ dynamometer
Torque Wrenches	(4.5 to 23) N·m (27 to 136) N·m (163 to 814) N·m	0.072 N·m 0.47 N·m 2.4 N·m	Precision torque transducers
Torque – Shaft	(0 to 169) N·m (0 to 338) N·m (0 to 847) N·m (0 to 1694) N·m (0 to 3390) N·m (0 to 8474) N·m (0 to 16 948) N·m (0 to 33 895) N·m (0 to 84 739) N·m	0.22 N·m 0.42 N·m 1.1 N·m 2.2 N·m 4.6 N·m 14 N·m 23 N·m 47 N·m 0.10 kN·m	Torque shaft cal bench w/ arm

## VI. Thermodynamics

Parameter/Equipment	Range	CMC <sup>2,3</sup> (±)	Comments
Temperature, RTD – Measuring Equipment	( 0 to 99) °C (100 to 150) °C	0.069 °C 0.046 °C	SPRT & temperature bath

Parameter/Equipment	Range	CMC <sup>2,3</sup> (±)	Comments
Dew Point – Measuring Equipment	(0 to 25) °C	0.20 °C	Thunder Scientific 1200
Relative Humidity – Measuring Equipment	(20 to 80) % RH	0.83 % RH	Thunder Scientific 1200

## VII. Time & Frequency

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Frequency – Measuring Equipment	10 Hz to 80 MHz	2.3 part in 10 <sup>6</sup>	Agilent 33250A
Frequency – Measure	10 Hz to 225 MHz	5.8 part in 10 <sup>6</sup>	Fluke PM6680B

<sup>1</sup> This laboratory is not available for commercial service.

<sup>2</sup> 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.

<sup>3</sup> In the statement of CMC, a percent refers to a percent of reading unless otherwise noted.

<sup>4</sup> The measurands stated are generated using the indicated instrument (see Comments). This capability is suitable for the calibration of the devices intended to measure the measurand in the ranges indicated. CMC's are expressed as either a specific value that covers the full range or as a fraction/percentage of the reading plus a fixed floor specification.

<sup>5</sup> This laboratory meets *R205 – Specific Requirements: Calibration Laboratory Accreditation Program* for the types of dimensional tests listed above and is considered equivalent to that of a calibration.

<sup>6</sup> In the statement of CMC,  $D$  is the numerical value of the diameter. In the statement of CMC,  $L$  is the numerical value of the nominal length.

<sup>7</sup> This accreditation covers testing/calibration performed at the main laboratory listed above, and the following satellite laboratories listed below.

ADVANCED TECHNOLOGY SERVICES – CATERPILLAR TECHNICAL CENTER  
 AC 6132 Dock 29 Rensch Rd Route 29  
 Mossville, IL 61552  
 John Goodrich Phone: 309 494 5123

CALIBRATION

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory at the location below to perform the following calibrations<sup>1</sup>:

I. Electrical – DC/Low Frequency

Parameter	Range	CMC <sup>2</sup> (±)	Comments
Voltage – Measure	(0.25 to 8.25) V	0.39 V	FAST UNIT model 3525
Frequency – Measure	(0 to 9009) Hz	1.2 % rdg	FAST UNIT model 3525

II. Thermodynamics

Parameter	Range	CMC <sup>2</sup> (±)	Comments
Temperature – Measure	(-80 to 300) °C	0.27 °C	Class B RTD w/ Fluke 1586A
Humidity – Measuring Equipment	(20 to 80) % RH	3.6 % RH	Omega IBTHX-SD

<sup>1</sup> This laboratory is not available for commercial service.

<sup>2</sup> 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.



ADVANCED TECHNOLOGY SERVICES - CATERPILLAR PROVING GROUNDS  
 Peoria Proving Ground, 27194 Caterpillar Lane  
 Washington, IL 61571  
 John Goodrich Phone: 309 494 5123

CALIBRATION

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations<sup>1</sup>:

I. Dimensional

Parameter/Equipment	Range	CMC <sup>2,3</sup> (±)	Comments
Linear Displacement - Travel	(0 to 2032) mm (2033 to 7620) mm	(5 + 0.16L) μm (15 + 0.23L) μm	Heidenhain linear encoder LS106
Angle	(0 to 60) °	0.16 °	Gage blocks w/ sine bar

II. Electrical – DC/Low Frequency

Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
DC Voltage – Generate	(0 to 220) mV (0.22 to 2.2) V (2.2 to 11) V (11 to 22) V (22 to 220) V (220 to 1100) V	8.9 μV/V + 0.40 μV 5.3 μV/V + 0.70 μV 3.8 μV/V + 2.5 μV 4.4 μV/V + 4.0 μV 5.3 μV/V + 40 μV 6.8 μV/V + 0.40 mV	Fluke 5730A
DC Voltage – Measure	(0 to 100) mV 100 mV to 1 V (1 to 10) V (10 to 100) V (100 to 1000) V  5 V 10 V (+20 to -20) mV (+10 to -10) V (+2.5 to -2.5) V (+2 to -2) V (+5 to -5) V	90 μV/V + 4.2 μV 47 μV/V + 8.4 μV 36 μV/V + 60 μV 49 μV/V + 0.72 mV 56 μV/V + 10 mV  0.75 mV 0.87 mV 0.046 mV 5.9 mV 1.8 mV 1.5 mV 2.7 mV	Agilent 34410A  Somat cal stand/Keithley 2750/MSBRG



Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
DC Voltage – Measure (cont)	(-0.5 to 2) V	0.90 mV	Somat cal stand/Keithley 2750/ MSBRG
	(-2 to 0.5) V	0.94 mV	
	(+1 to -1) V	0.72 mV	
	(+200 to -200) mV	0.15 mV	
	(+250 to -250) mV	0.19 mV	
	(+500 to -500) mV	0.38 mV	
	(0 to 400) mV	0.15 mV	
	(375 to 500) mV	0.086 mV	
	3 V	24 mV	Somat cal stand/Keithley 2750/ MSHLS
	5 V	20 mV	
	10 V	19 mV	
	15 V	20 mV	
	20 V	20 mV	
	24 V	23 mV	
	28 V	33 mV	
	(-120 to +120) mV	0.13 mV	
	(-10 to +10) V	4.4 mV	
	(+60 to -60) mV	0.10 mV	
	(+80 to -80) V	45 mV	
	(+10 to -10) V	3.3 mV	
	(+2.5 to -2.5) V	0.97 mV	
	(+2 to -2) V	0.76 mV	
	(+5 to -5) V	2.0 mV	
	(0 to +10) V	3.0 mV	
	(-10 to 0) V	2.8 mV	
	(+1 to -1) V	0.51 mV	
	(+120 to -120) mV	0.12 mV	
	(0 to +120) mV	0.10 mV	
	(-120 to 0) mV	0.11 mV	
	(0 to 240) mV	0.12 mV	
	(-240 to 0) mV	0.13 mV	
	(+500 to -500) mV	0.26 mV	
	4 V	24 mV	Somat cal stand/Keithley 2750/ELHLS
	5 V	22 mV	
	9 V	25 mV	
	10 V	24 mV	
	12 V	23 mV	
	14 V	24 mV	
	15 V	24 mV	
	(+62.5 to -62.5) mV	0.045 mV	
(+16 to -16) V	4.4 mV		
(+10 to -10) V	2.2 mV		
(+2.5 to -2.5) V	0.52 mV		
(+2 to -2) V	0.45 mV		





Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
DC Voltage – Measure (cont.)	(+5 to -5) V	1.1 mV	Somat cal stand/Keithley 2750/ELHLS
	(+1 to -1) V	0.24 mV	
	(+200 to -200) mV	33 μV	
	(-125 to +125) mV	27 μV	
	(-250 to +250) mV	53 μV	
	(-400 to +400) mV	83 μV	
	(+500 to -500) mV	91 μV	
	(-10 to +10) V	6.3 mV	Somat cal stand/Keithley 2750/MSHLB
	(-20 to +20) V	9.0 mV	
	(-100 to +100) mV	0.047 mV	Somat cal stand/Keithley 2750/MSTCB
(-100 to +100) mV	0.045 mV	Somat cal stand/Keithley 2750/ELTCB	
5 V	0.19 mV	Somat cal stand/Keithley 2750/SMSTRB-120	
10 V	0.37 mV		
10 Gain	48 μV		
100 Gain	54 μV		
5 V	0.16 mV	Somat cal stand/Keithley 2750/SMSTRB-350	
10 V	0.30 mV		
10 Gain	0.046 mV		
100 Gain	0.34 mV		
Resistance – Measure	(0 to 100) Ω	0.15 mΩ/Ω + 4.8 mΩ	Agilent 34410A
	100 Ω to 1 kΩ	0.12 mΩ/Ω + 12 mΩ	
	(1 to 10) kΩ	0.12 mΩ/Ω + 12 mΩ	
	(10 to 100) kΩ	0.12 mΩ/Ω + 1.2 Ω	
	100 kΩ to 1 MΩ	0.14 mΩ/Ω + 12 Ω	
	(1 to 10) MΩ	0.49 mΩ/Ω + 0.12 kΩ	
	50 kΩ	12 Ω	Somat cal stand/Keithley 2750/MSBRG
	100 kΩ	19 Ω	
	200 kΩ	240 Ω	
	500 kΩ	610 Ω	



Parameter/Equipment	Range	CMC <sup>2</sup> (±)	Comments
Thermocouple Simulation – Generate			
Type J	(-210 to 760) °C	0.31 °C	Xitron 2000M
Type K	(-140 to 800) °C (800 to 1372) °C	0.27 °C 0.29 °C	
Type T	(-200 to -100) °C (-100 to 400) °C	0.29 °C 0.26 °C	
Type E	(-270 to -260) °C (-260 to -250) °C (-250 to -240) °C (-240 to -230) °C (-230 to 1000) °C	0.82 °C 0.47 °C 0.39 °C 0.33 °C 0.29 °C	
Thermocouple Simulation – Measure	Type E Type J Type K Type T	1.0 °C 0.54 °C 0.74 °C 0.78 °C	

### III. Mechanical

Parameter/Equipment	Range	CMC <sup>2,3</sup> (±)	Comments
Force	Up to 966 N  (0 to 2224.1) N (0 to 8896.4) N (0 to 22241.1) N  (0 to 1200) kN	0.19 N  0.035 % + 5.9 N 0.082 % + 22 N 0.070 % + 52 N  0.72 % + 0.1 kN	Class F weights  ATS press & load cells  Instron press & load cells
Torque	(0 to 10 000) N·m	22 N·m + 0.0021 N·m	Drive shaft calibrator
Micro-Strain Indicators	0 to 20 000 µE	1.9 µE + 280 µE/E	Vishay 1550A



Parameter/Equipment	Range	CMC <sup>2,4</sup> (±)	Comments
Pressure –  Hydraulic	0 kPa to 12 MPa (12 to 40) MPa 100 kPa to 42 MPa (42 to 140) MPa	6.2 kPa + 0.0047 kPa 2.6 kPa + 0.16 kPa 6.3 kPa + 0.030 kPa 8.2 kPa + 0.17 kPa	Fluke PPCH
Pneumatic	(0 to 206.84) kPa (206.84 to 689.8) kPa (100 to 2068.4) kPa (2068.4 to 6894.8) kPa	7.0 kPa + 0.065 kPa 5.1 kPa + 0.077 kPa 6.9 % + 0.061 kPa 0.010 % + 0.42 kPa	DH Instruments PPC3
Vibration (Accelerometer)	(10 to 99) Hz 100 Hz (101 to 920) Hz (921 to 5000) Hz 5001 Hz to 10 kHz (10 to 15) kHz (15 to 20) kHz	2.2 % 1.9 % 2.0 % 2.4 % 2.8 % 4.5 % 5.4 %	Modal Shop 9155C

<sup>1</sup> This laboratory is not available for commercial service.

<sup>2</sup> 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.

<sup>3</sup> In the statement of CMC,  $L$  is the numerical value of the nominal length of the device measured in millimeters.

<sup>4</sup> In the statement of CMC, % is the percent of reading unless otherwise indicated.

<sup>5</sup> This laboratory meets R205 – Specific Requirements: Calibration Laboratory Accreditation Program for the types of dimensional tests listed above and is considered equivalent to that of a calibration.



## *Accredited Laboratory*

A2LA has accredited

# ADVANCED TECHNOLOGY SERVICES - CATERPILLAR TECHNICAL CENTER

*Mossville, IL*

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 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 6<sup>th</sup> day of November 2017.

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

President and CEO  
For the Accreditation Council  
Certificate Number 1592.05  
Valid to August 31, 2019

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