

Scotia Instrumentation Calibration Capabilities

ABERDEEN

PRESSURE MEASUREMENT

Range	Uncertainty	Cal. device	Notes
0 to 10 mbara 0 to 1000 mbara	0.35% rdg 0.1% rdg	Heated Baratron Capacitance Diaphragm Gauges with PDR Controller	Chell vac kit with turbo pump. Calibrations using oxygen free nitrogen.
0.2 to 160 mbarg	0.015% rdg	Pressurements V1600/1 DWT	Calibrations on Industrial Nitrogen.
1 to 70 barg 15 to 1000 psig	0.03% rdg	Budenberg 450 DWT	Calibrations on Industrial Nitrogen.
1 to 120 barg	0.025% rdg	Budenberg 450 DWT	Calibrations on Industrial Nitrogen.
1 to 600 barg 10 to 8000 psig	0.03% rdg	Budenberg 380/480D	Calibrations on Tellus oil. Water and other fluids on request using Fig 28 seal.
1 to 1200 barg 10 to 16000 psig	0.05% rdg	Budenberg 380/480H DWT	Calibrations on Tellus oil.
1 to 1400 barg 10 to 20000 psig	0.05% rdg	Budenberg 480 VHx DWT	Calibrations on Tellus oil.
1 to 2600 barg 10 to 40000 psig	0.04% rdg	Budenberg 580 EHx	Calibrations on Tellus oil.
100 to 4000 barg 1000 to 60000 psig	0.06% rdg	Budenberg 283 DWT	Calibrations on Tellus oil.
Barometric range	0.1% rdg	Druck DPI145	Comparison Barometer.
Barometric range	0.1% rdg	Druck DPI145	Barometers and Chamber barographs
0 to 70 barg	N/A	Vac Chamber	Depth Gauges Cal on Ind Nitrogen
0 to 200 mbarg	$\pm (0.01\% \text{ rdg} + 0.01\% \text{ fs})$	Pace 6000	Gauge mode Calibrations on industrial nitrogen
-1 to 2 barg -1 to 20 barg -1 to 135 barg	$\pm (0.005\% \text{ rdg} + 0.005\% \text{ fs})$	Pace 6000	Gauge mode Calibrations on industrial nitrogen
0 to 3 bara 0 to 21 bara 0 to 136 bara	$\pm (0.005\% \text{ rdg} + 0.005\% \text{ fs})$	Pace 6000	Absolute mode Calibrations on industrial nitrogen
Pressure absolute mode	0.025mbar	Gauge precision	
0 to 20barg	$\pm(0.005\% \text{ rig} + 0.005\% \text{ fs})$	PACE 6000	To calibrate tyre pressure gauges

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TEMPERATURE MEASUREMENT

<u>Range</u>	<u>Uncertainty</u>	<u>Cal. device</u>	<u>Notes</u>
-30°C to 250°C	±0.08°C	ASL F25/F250/CTR2000	Glycol/water bath/Silicon oil bath
35°C to 500°C	±0.5 to 0.8°C	Fluke 4181 IR Calibrator	
-30°C to 250°C	±0.05 to 0.1°C	6mm OD Pt100 RTD	ASL CTR2000
0°C to 650°C	±0.05 to 0.1°C	6mm OD Pt100 RTD	Via Newport Ind.
K type (-200°C to 1370°C) Thermocouple	0.1°C to 1.5°C	Unomat TRX Calibrator	Simulate/measure
J type (-210°C to +1200°C) Thermocouple	0.1°C to 1.5°C	Unomat TRX Calibrator	Simulate/measure
T type (-250°C to +400°C) Thermocouple	0.1°C to 1°C	Unomat TRX Calibrator	Simulate/measure
Thermocouple types K, J, T, B, C, E, N, R, S (-250°C to 2320°C)	0.15°C	Wavetek 9100 Calibrator	Generate only
Pt100 (-200°C to 850°C)	0.05°C	Wavetek 9100 Calibrator	Generate only

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ELECTRICAL MEASUREMENT

Section 1: Voltage DC

Generate

<u>Range</u>	<u>Accuracy</u>	<u>Cal. device</u>	<u>Notes</u>
100µV	10ppm +1µV	Wavetek 4805	
1mV	0.006%	Wavetek 4805/ 9100/5080A/ 5560A	
10mV	0.006%	Wavetek 4805/ 9100/5080A/ 5560A	
100mV	0.006%	Wavetek 4805/ 9100/5080A/ 5560A	
1V	0.006%	Wavetek 4805/ 9100/5080A/ 5560A	
10V	0.0065%	Wavetek 4805/ 9100/5080A/ 5560A	
100V	0.0065%	Wavetek 4805/ 9100/5080A/ 5560A	
1000V	0.006%	Wavetek 4805/ 9100/5080A/ 5560A	
40kV	±2%	HV probe	Using T&R PT30-10.

Measure

<u>Range</u>	<u>Accuracy</u>	<u>Cal. device</u>	<u>Notes</u>
100mV	10ppm	Wavetek 1271/Fluke 8508A/ Transmille 8104	
1V	8ppm	Wavetek 1271/Fluke 8508A/ Transmille 8104	
10V	7ppm	Wavetek 1271/Fluke 8508A/ Transmille 8104	
100V	8ppm	Wavetek 1271/Fluke 8508A/ Transmille 8104	
1000V	11ppm	Wavetek 1271/Fluke 8508A/ Transmille 8104	
up to 40kV	±2%	HV probe	
up to 100kV	±3%	Avo OTS VCM100D	

Scotia Instrumentation Calibration Capabilities

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ELECTRICAL MEASUREMENT

Section 2: Voltage AC

Generate

<u>Range</u>	<u>Accuracy</u>	<u>Cal. device</u>	<u>Notes</u>
1mV	120ppm +6 μ V	Wavetek 4805/9100/5080A/ Fluke 5560A	
10mV	120ppm +6 μ V	Wavetek 4805/9100/5080A/ Fluke 5560A	
100mV	110ppm +6 μ V	Wavetek 4805/9100/5080A/ Fluke 5560A	
1V	110ppm +8 μ V	Wavetek 4805/9100/5080A/ Fluke 5560A	
10V	110ppm +50 μ V	Wavetek 4805/9100/5080A/ Fluke 5560A	
100V	110ppm +3.5mV	Wavetek 4805/9100/5080A/ Fluke 5560A	
1000V	110ppm +80mV	Wavetek 4805/9100/5080A/ Fluke 5560A	
40kV	5%	HV Probe	T&R PT 30-40

Measure

<u>Range</u>	<u>Accuracy</u>	<u>Cal. device</u>	<u>Notes</u>
100mV	10ppm	Wavetek 1271/Fluke 8508A/ Transmille 8104	
1V	8ppm	Wavetek 1271/Fluke 8508A/ Transmille 8104	
10V	7ppm	Wavetek 1271/Fluke 8508A/ Transmille 8104	
100V	8ppm	Wavetek 1271/Fluke 8508A/ Transmille 8104	
1000V	11ppm	Wavetek 1271/Fluke 8508A/ Transmille 8104	
up to 40kV	$\pm$ 5%	HV probe	
up to 100kV	$\pm$ 3%	Avo OTS VCM 100D	

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ELECTRICAL MEASUREMENT

Section 3: Current DC

Generate

<u>Range</u>	<u>Accuracy</u>	<u>Cal. device</u>	<u>Notes</u>
1µA	97ppm +6nA	Wavetek 9100/Fluke 5080A/ Fluke 5560A	
10µA	97ppm +6nA	Wavetek 9100/Fluke 5080A/ Fluke 5560A	
100µA	97ppm +6nA	Wavetek 4805/9100/Fluke 5080A/Fluke 5560A	
1mA	78ppm +15nA	Wavetek 4805/9100/Fluke 5080A/Fluke 5560A	
10mA	78ppm + 80nA	Wavetek 4805/9100/Fluke 5080A/Fluke 5560A	
100mA	78ppm +800nA	Wavetek 4805/9100/Fluke 5080A/Fluke 5560A	
2A	120ppm +10µA	Wavetek 4805/9100/Fluke 5080A/Fluke 5560A	
30A	780ppm +500µA	Wavetek 9100/Fluke 5080A/ Fluke 5560A	
1500A	0.65%	Wavetek 9100/Fluke 5080A/ Fluke 5560A	Via current coil

Measure

<u>Range</u>	<u>Accuracy</u>	<u>Cal. device</u>	<u>Notes</u>
100µA up to 10mA	13ppm +4ppm/rng	Wavetek 1271/Fluke 8508A/ Transmille 8104	
100mA	36ppm + 6ppm/rng	Wavetek 1271/Fluke 8508A/ Transmille 8104	
2A	150ppm	Wavetek 1271/Fluke 8508A/ Transmille 8104	
2000A	±1.3% of rdg	Heme LH 2015 clampmeter/ Transmille 8104	
2000A	+0.01%	High current transformer/ Transmille 8104	
30A	569ppm + 145ppm/rng	Transmille 8104/Fluke 8508A	

Scotia Instrumentation Calibration Capabilities

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ELECTRICAL MEASUREMENT

Section 4: Current AC

Generate

<u>Range</u>	<u>Accuracy</u>	<u>Cal. device</u>	<u>Notes</u>
1 μ A	190ppm +10nA	Wavetek 9100/Fluke 5080A/ Fluke 5560A	
10 μ A	190ppm +10nA	Wavetek 9100/Fluke 5080A/ Fluke 5560A	
100 μ A	190ppm +10nA	Wavetek 4805/9100/Fluke 5080A/Fluke 5560A	
1mA	190ppm +100nA	Wavetek 4805/9100/Fluke 5080A/Fluke 5560A	
10mA	190ppm +1 μ A	Wavetek 4805/9100/Fluke 5080A/Fluke 5560A	
100mA	190ppm +8 μ A	Wavetek 4805/9100/Fluke 5080A/Fluke 5560A	
2A	190ppm +50 μ A	Wavetek 4805/9100/Fluke 5080A/Fluke 5560A	
30A	540ppm +8mA	Wavetek 9100/Fluke 5080A/ Fluke 5560A	
1500A	0.65%	Heme LH2015/Wavetek 9100/ High current transformer/Fluke 5080A/Fluke 5560A via coil	Via high current inj set.

Measure

<u>Range</u>	<u>Accuracy</u>	<u>Cal. device</u>	<u>Notes</u>
100 μ A up to 100mA	200ppm	Wavetek 1271/Fluke 8508A/ Transmille 8104	
2A	500ppm	Wavetek 1271/Fluke 8508A/ Transmille 8104	
2000A	$\pm 1.3\%$ of rdg	Heme LH2015	
2000A	$\pm 0.01\%$	High current transformer	

Scotia Instrumentation Calibration Capabilities

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ELECTRICAL MEASUREMENT

Section 5: Resistance

Generate

<u>Range</u>	<u>Accuracy</u>	<u>Cal. device</u>	<u>Notes</u>
50 $\mu\Omega$ to 2 Ω	$\pm 0.8\%$	Time 5070	
1 Ω	0.025% +10m Ω	Wavetek 9100/Fluke 5080A	Used as transfer standard against Time 5070
10 Ω	0.025% +10m Ω	Wavetek 4805/9100/Fluke 5080A/Fluke 5560A	The 1271 is a meter and can only measure the stated values.
100 Ω	0.02% +20m Ω	Wavetek 4805/9100/Fluke 5080A/Fluke 5560A	
1k Ω	0.015% +80m Ω	Wavetek 4805/9100/Fluke 5080A/Fluke 5560A	
10k Ω	0.020% +800m Ω	Wavetek 4805/9100/Fluke 5080A/Fluke 5560A	
100k Ω	0.02% +8 Ω	Wavetek 4805/9100/Fluke 5080A/Fluke 5560A	
1M Ω	0.05% +100 Ω	Wavetek 4805/9100/Fluke 5080A/Fluke 5560A	
10M Ω	0.15% +2k Ω	Wavetek 4805/9100/Fluke 5080A/Fluke 5560A	
100M Ω	0.26% +40k Ω	Wavetek 4805/9100/Fluke 5080A/Fluke 5560A	
100G Ω	$\pm 1\%$	Hi Ohms Box/Fluke 5320A	

Measure

<u>Range</u>	<u>Accuracy</u>	<u>Cal. device</u>	<u>Notes</u>
50 $\mu\Omega$ to 2000 Ω	$\pm 0.01\%$	Time 5070	
10 Ω	18ppm	Wavetek 1271/Fluke 8508A/Transmille 8104	
100 Ω to 100K Ω	10ppm	Wavetek 1271/Fluke 8508A/Transmille 8104	
1M Ω	15ppm	Wavetek 1271/Fluke 8508A/Transmille 8104	
10M Ω	30ppm	Wavetek 1271/Fluke 8508A/Transmille 8104	
100M Ω	400ppm	Wavetek 1271/Fluke 8508A/Transmille 8104	
1G Ω	$\pm 0.3\%$	Wavetek 1271/Fluke 8508A/Transmille 8104	

Scotia Instrumentation Calibration Capabilities

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ELECTRICAL MEASUREMENT

Section 6: Frequency

Generate

<u>Range</u>	<u>Accuracy</u>	<u>Cal. device</u>	<u>Notes</u>
0.1Hz to 10MHz	0.01ppm	Global 4401/Wavetek 395	
0.5Hz to 10MHz	25ppm of rdg	Wavetek 9100/Fluke 5560A	

Measure

<u>Range</u>	<u>Accuracy</u>	<u>Cal. device</u>	<u>Notes</u>
10Hz to 200MHz	±1 count +time base	Racal Dana 9904	Standard used: GPS Frequency Reference.

Section 7: Conductivity and Capacitance

Generate

<u>Range</u>	<u>Accuracy</u>	<u>Cal. device</u>	<u>Notes</u>
2.5nS to 2.5mS	±0.04% (Best)	Wavetek 9100	
500pF to 120mF	±0.3 +15pF (Best)	Wavetek 9100/Fluke 5560A	
10pF to 100µF	±1%	Time 1071 Decade box	
1mH to 11.11H	±5%	Hameg HM8118	Via Time 1053 Inductance Box.

Measure

<u>Range</u>	<u>Accuracy</u>	<u>Cal. device</u>	<u>Notes</u>
2.5µS to 2.5mS	±0.04%	Wavetek 9100	
500pF to 40mF	±0.2%	Wavetek 9100	

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Section 8: RCD Testers

Measure

<u>Range</u>	<u>Accuracy</u>	<u>Cal. device</u>	<u>Notes</u>
3mA to 3000mA	0.1mA on 3000mA rng	Fluke 5320A	
10ms to 5000ms	±0.25ms	Fluke 5320A	

Section 9: Tachometers

Generate

<u>Range</u>	<u>Accuracy</u>	<u>Cal. device</u>	<u>Notes</u>
90000rpm	±0.01%	Global 4401/Wavetek 395	Via test box.
10000rpm	±1%	Global 4401/Wavetek 395	Via motor and calibrated tachometer.

Section 10: Sound Level Calibration

Generate

<u>Range</u>	<u>Accuracy</u>	<u>Cal. device</u>	<u>Notes</u>
94 & 104dB	±0.3dB	Cirrus Calibrator	Generate. Dual Frequency

Measure

<u>Range</u>	<u>Accuracy</u>	<u>Cal. device</u>	<u>Notes</u>
35dB to 135dB			Via calibrated sound level meter.

Scotia Instrumentation Calibration Capabilities**ABERDEEN****PUMP TESTING**

<u>Range</u>	<u>Uncertainty</u>	<u>Cal. device</u>	<u>Notes</u>
Testing to 60,000psi	0.5%	Test Cabinet	Testing of adaptors, valves, hose assemblies etc.

GAS BOOSTER TESTING

<u>Range</u>	<u>Uncertainty</u>	<u>Cal. device</u>	<u>Notes</u>
Testing to 25,000psi	0.2%	Remote test panel/Test bay (SDAS).	Testing with industrial Nitrogen.

Scotia Instrumentation Calibration Capabilities

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DIMENSIONAL METROLOGY

<u>Device type</u>	<u>Range</u>	<u>Cal. device</u>	<u>Uncertainty & Notes</u>
External Micrometers	0 to 48" 0 to 1200mm	Slip gauges Optical flat	BS870:2008 To 24"/600mm >24" Manufacturer's spec.
Internal Micrometers	0 to 40" 0 to 1000mm	Trimos Linear Meas. Device	BS959:2008 To 36"/900mm >36" Manufacturer's spec.
Depth Micrometers	0 to 12" 0 to 300mm	Trimos Linear Meas. Device Slip Gauges	BS6468:2008
Vernier Calipers	0 to 48" 0 to 1200mm	Slip gauges Trimos Linear Meas. Device Inside Microchecker	BS887:2008
Plug gauges	0 to 6" 0 to 150mm	ULM	BS969:2008
Engineers Steel Rules	2m	Rabone Chesterman	BS4732:1968
Depth Verniers	0 to 40"	Traceable Slip gauges/ Trimos Linear Meas. Device	BS6365:2008 To 24"/600mm >24" Manufacturer's spec.
Height Gauges	0 to 40"	Traceable Slip/Rod Gauges	BS1643:2008
Dial Indicator Plunger/Lever	0.0001/001"	Traceable Slip Gauges/ Trimos Linear Meas. Device	BS907:2008/ BS2795:1981
Feeler Gauges	Length 75 to 300mm 3 to 12"	ULM	BS957:2008
Tape Measure	20m	Rabone Chesterman	Manufacturer's spec.
Crankhaft Deflection	0.0001"/Gauges	Trimos Linear Meas. Device 001"	Manufacturer's spec.
Protractors	Digital & Mechanical	Sine Bar/Slip gauges	Digital - Manufacturer's spec. BS1685:2008
Engineers Square	18" max.	Angle Plate/Slips Cylindrical Square	BS939:2007
Angle Plate	18" max.	Angle Plate/Slips	BS5535:1978
Coatings Thickness Foil	1000microns	ULM	±0.005mm/ Manufacturer's spec.
Paint Thickness meters	1000microns	Calibrated foils	Manufacturer's spec.
Ultrasonic Thickness meters	120mm max.	Panametric Test Block	Manufacturer's spec.

Scotia Instrumentation Calibration Capabilities

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DIMENSIONAL METROLOGY contd

<u>Device type</u>	<u>Range</u>	<u>Cal. device</u>	<u>Uncertainty & Notes</u>
3 Point Bore Micrometers	0.25 to 6"	Calibrated rings/ULM	Manufacturer's spec.
Engineers Level	0 to 14" Level	10" Sine bar/Slip Blocks	BS958:1968
Straight Edges	0 to 72" length	Slip blocks Granite Table	BS5204-Pt 2:1977
Screw Thread Gauges Plug Go/No Go	1/4" up to 6" dia. UN/Metric, BSP, Whitworth	ULM	BS1580:2007, BS3643:2007, BS919:200
Screw Thread Gauges Ring Go and No Go	>1/2" up to 4" UN, Metric	ULM	BS1580:2007, BS3643:2007, BS919:2007
Plain Rings	0.2" up to 6" dia.	ULM	BS4064 & BS4065:1966
Plate & Form Gauges		Baty Profile Projector	Drawing spec.
Taper Ring & Plug Gauges	0 to 12" dia.	Slip Blocks Calibrated Rollers	Drawing spec.
Lead Gauge Setting Standard	Various	Baty Profile Projector	API Spec 7-2
Dip Tapes	Up to 30m	Traceable Master Tapes	±2mm

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TORQUE MEASUREMENT

<u>Range</u>	<u>Accuracy</u>	<u>Cal. device</u>	<u>Notes</u>
10 to 1000 lbf.in	±0.25% of reading	Torque analysers	Torque wrenches are also serviced and adjusted. BS EN ISO 6789 2003
10 to 750 lbf.ft	±0.25% of reading	Torque analysers	BS EN ISO 6789 2003
100 to 2800 Nm / 2100 lbf.ft	±0.25% of reading	Torque analysers	BS EN ISO 6789 2003
Multipliers	±0.25% of reading	Torque analysers	Max output 2000 lbf.ft Documented in-house method
0 to 1000 ft/lbs	±0.25% of reading	Torque transducer	Analogue static torque meters Documented in-house method
1 to 1500 Nm	±0.5% of reading (Transducers) ±0.05% of reading (T-Box 2)	T-Box 2 With various ranges of transducers	New standard for torque wrenches and drivers BSENISO6789-1:2017 BSENISO6789-2:2017

Scotia Instrumentation Calibration Capabilities**ABERDEEN****GAS MEASUREMENT**

<u>Type</u>	<u>Cal. device</u>	<u>Notes</u>
Methane Oxygen Hydrogen Sulphide Carbon Dioxide Carbon Monoxide Nitrogen Sulphur Dioxide Butane in Nitrogen	GMI Gas Distributor Box	Calibration of most gas meters.

ABERDEEN**HUMIDITY**

<u>Range</u>	<u>Accuracy</u>	<u>Cal. device</u>	<u>Notes</u>
10 to 98% RH/-10 to 100°C	1%RH	Vaisala HM141	

DEWPOINT

<u>Range</u>	<u>Accuracy</u>	<u>Cal. device</u>	<u>Notes</u>
-80°C to 20°C	±0.1°C dp	Michell series 8000RS Precision Dewpoint Hygrometer	

FLOWMETERS (LIQUID)

<u>Range</u>	<u>Accuracy</u>	<u>Cal. device</u>	<u>Notes</u>
N/A	N/A	Standard Pipework Flowloop	Test only.

AIRFLOW

<u>Range</u>	<u>Accuracy</u>	<u>Cal. device</u>	<u>Notes</u>
0 to 60Knots	±1kt	Munro IM159	Rotating cup type.
0.4 to 40m/s	±3% of reading or ±0.1m/s	Kestrel 1000	25mm Rotating vane type.
0.25 to 30m/s/ 5 to 45°C	±1% of reading or ±0.02m/s/ ±1°C	TSI Airflow LCA501	100mm Rotating vane type.
0 to 20m/s/-18 to 93°C	±5% of rdg or 0.025m/s/ ±0.3°C	TSI TA410	Hot Wire Type

Scotia Instrumentation Calibration Capabilities

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Load Testing, Weights & Scales

<u>Range</u>	<u>Accuracy</u>	<u>Cal. device</u>	<u>Notes</u>
0 to 50tonne (compression)	0.2%	Druck DPI620 c/w PDCR910 transducer	Roebuck 50T press
0 to 50000lbs (tension)	1%	M/D Totco 6" gauge	M/D Totco tension test rig
0 to 11kg	±0.1% of fs	UWE digital scales	M3 - M1 class Certify Mass Weights
0.1 to 31kg	±0.010g	AND Analytical Balance	F2-F1 class Certify Mass Weights
0 to 300Kg	Various - increment dependant	M1 Class Weights	Calibration of Scales
0 to 400g	±0.2% of fs	Kern Digital Scales	M3 - M1 class Certify Mass Weights

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