



CERTIFICATE OF ACCREDITATION

ANSI-ASQ National Accreditation Board

500 Montgomery Street, Suite 625, Alexandria, VA 22314, 877-344-3044

This is to certify that

VACS Ltd.

**15 Regan Road, Unit 6
Brampton ON L7A 1E3**

has been assessed by ANAB
and meets the requirements of international standard

ISO/IEC 17025:2005

and national standard

ANSI/NCSL Z540-1-1994 (R2002)

while demonstrating technical competence in the field of

CALIBRATION

Refer to the accompanying Scope of Accreditation for information regarding the types of calibrations to which this accreditation applies.

AC-1402

Certificate Number


ANAB Approval

Certificate Valid: 07/28/2017-07/29/2019
Version No. 003 Issued: 07/28/2017



This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. 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 April 2017).



**SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005
AND ANSI/NCSL Z540-1-1994 (R2002)**

VACS Ltd.

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CALIBRATION

Valid to: **July 29, 2019**

Certificate Number: **AC-1402**

Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
DC Voltage – Measure	(0 to 100) mV (0.1 to 1) V (1 to 10) V (10 to 100) V (100 to 1 000) V	5 μ V/V + 1.1 μ V 12 μ V/V + 1.6 μ V 12 μ V/V + 13 μ V 15 μ V/V + 0.13 mV 32 μ V/V + 1.6 mV	Agilent 3458A
DC Voltage – Generate	(0 to 20) mV (20 to 200) mV (0.2 to 2) V (2 to 20) V (20 to 200) V (200 to 1 000) V	6.1 μ V 14 μ V/V + 6.1 μ V 16 μ V/V + 8.9 μ V 20 μ V/V + 40 μ V 19 μ V/V + 0.43 mV 40 μ V/V + 4.5 mV	Fluke 5100B Agilent 3458A
DC Current – Measure	(0 to 100) μ A (0.1 to 1) mA (1 to 10) mA (10 to 100) mA (0.1 to 1) A	4.3 nA 35 μ A/A + 4.3 nA 35 μ A/A + 39 nA 59 μ A/A + 0.39 μ A 184 μ A/A + 6.3 μ A	Agilent 3458A
DC Current – Generate	(0 to 200) μ A (0.2 to 2) mA (2 to 20) mA (20 to 200) mA (0.2 to 1) A	25 nA 78 μ A/A + 25 nA 101 μ A/A + 0.18 μ A 250 μ A/A + 2.2 μ A 148 μ A/A + 52 μ A	Fluke 5100B Agilent 3458A



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Resistance – Measure	(1 to 10) Ω (10 to 100) Ω (0.1 to 1) kΩ (1 to 10) kΩ (10 to 100 kΩ (0.1 to 1) MΩ (1 to 10) MΩ	16 μΩ/Ω + 0.087 mΩ 19 μΩ/Ω + 0.25 mΩ 10 μΩ/Ω + 2.1 mΩ 11 μΩ/Ω + 12 mΩ 11 μΩ/Ω + 0.12 Ω 22 μΩ/Ω + 1.2 Ω 92 μΩ/Ω + 23 Ω	Agilent 3458A
Resistance – Generate	1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ	0.29 mΩ 1.2 mΩ 6.3 mΩ 60 mΩ 630 mΩ 6.1 Ω 120 Ω 5.9 kΩ	Fluke 5100B (6 months)
	1 Ω 10 Ω	0.64 mΩ 1.2 mΩ	GR I440
	100 Ω 1 kΩ 10 kΩ	6.5 mΩ 62 mΩ 0.62 Ω	Vishay S102K
Electrical Calibration of Thermocouple Indicating Devices Generate ¹	Type E (-20 to 1 000) °C Type J (-210 to 1 200) °C Type K (-200 to 1 372) °C Type N (-200 to 1 300) °C Type T (-200 to 1 300) °C Type R, S (0 to 1 767) °C	0.3 °C 0.3 °C 0.4 °C 0.6 °C 0.4 °C 1.1 °C	Fluke Process Calibrator
Electrical Calibration of RTD Indicating Devices-Generate ¹	100 Ω, Pt 385 (-200 to 0) °C (0 to 400) °C (400 to 800) °C	0.1 °C 0.2 °C 0.4 °C	Fluke Process Calibrator



Electrical – DC/Low Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Electrical Calibration of RTD Indicating Devices-Generate ¹	1 000 Ω, Pt 385		Fluke Process Calibrator
	(-200 to 0) °C	0.1 °C	
	(0 to 400) °C	0.2 °C	
	(400 to 800) °C	0.4 °C	
	100 Ω, Pt 3926		
	(-200 to 0) °C	0.1 °C	
(0 to 630) °C	0.2 °C		
100 Ω, Pt 3916			
(-200 to 0) °C	0.1 °C		
(0 to 630) °C	0.2 °C		

Length – Dimensional Metrology

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Calipers ¹	Up to 24 in	(289 + 7.3L) μin	Gauge Blocks & Micrometer Setting Standards
Micrometer (Outside) ¹	Up to 6 in	(32.4 + 13.7L) μin	Grade 2 gauge Blocks
Gauge Blocks ¹	Up to 4 in (200mm)	40 μin (1μm)	Grade 2 gauge Blocks CT60 Heidenhain
Indicators ¹	(0 to 1) in		Gage Blocks and Comparator Stand
	50 μin resolution	35 μin	
	100 μin resolution	60 μin	
	(0 to 2) in		
50 μin resolution	50 μin		
100 μin resolution	70 μin		
Indicators ¹ (Mounted in stands or custom fixtures)	(0 to 1) in		Gage blocks
	500 μin resolution	335 μin	
	1 000 μin in resolution	600 μin	
Measuring microscope ¹	(0 to 5) mm	1.3 μm	Stage Micrometer
Displacement Transducer ¹	(0 to 5) in	600 μin	Height Gauge
	(5 to 40) in	0.001 in/in	
Optical Comparator ¹	(0 to 50) mm	0.005 mm	Glass Scale Angle Blocks
	(0 to 90) °	0.5 minute angle	



Length – Dimensional Metrology

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Extensometer, Type 1 -Strain	Gauge length of 0.5 in: (0.06 to 1) in/in (0.002 to 0.06) in/in	(64 + 715L) μin/in 88 μin/in	Extensometer Calibrator
	Gauge length of 1 in : (0.025 to 1) in/in (0.001 to 0.025) in/in	(27 + 300L) μin/in 40 μin/in	
	Gauge length of 2 in : (0.000 5 to 0.5) in/in	(17 + 126L) μin/in	
-Gauge Length	(0.5 to 2) in	0.0004 in	
Material Testing Machine: ¹ Displacement	(0.01 to 0.4) in (0.4 to 40) in	0.000 6 in (0.000 6 + 0.000 2L) in	Height Gauge MT25B Heidenhain
Speed	(0.01 to 20) in/min	0.5 % of reading	Timer
Torque Drive Arms (2 Point Dimensional Measurement)	(4 to 60) in	0.1% of arm length	Height Gauge 60” Steel Rule Length Standards

Thermodynamic

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Temperature – Generate	0 °C	0.01 °C	Ice Bath
Temperature – Generate	(-78 to 150) °C	0.1 °C	Baths, Secondary Standard PRT, Instrulab 4312A thermometer
Temperature – Generate ¹	(150 to 660) °C	1.2 °C	Dry Block, Standard PRT, Instrulab 4312A thermometer
Temperature – Measure ¹	(-78 to 660) °C	0.05 °C	Secondary Standard PRT, Instrulab 4312A thermometer



Thermodynamic

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Temperature – Measure ¹	(660 to 1 200) °C	5.5 °C	Type N T/C, Fluke 744 meter
Dry Block (Well) Calibration ¹	(-78 to 660) °C	0.5 °C	Secondary Standard PRT, Instrulab 4312A thermometer
Resistance Thermometers	(10 to 400) Ω	0.006 Ω	Resistance Standards
PRT/RTD	(-78 to 660) °C	0.1 °C	Ice Bath, Liquid baths, Dry Block Calibrator Secondary Standard PRT, Instrulab 4312A thermometer
Thermocouples ¹	(-78 to 660) °C	0.5 °C	
Liquid in Glass Thermometers	(-78 to 150) °C	0.1 °C	
IR Gun ¹	(0 to 300) °C	2 °C	IR Calibrator
Humidity- Generate	11, 33, 57, 75, & 90 %RH	0.75 %RH	Custom Humidity Chamber, Salts, Vaisala Humidity Transmitter

Time and Frequency

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Timers	1 min to 24 h	0.25 s	NRC Time Signal
Frequency - Measure	(1 to 40) Hz 40 Hz to 10 MHz	805 uHz/Hz + 0.00083 Hz 160 uHz/Hz + 0.0065 Hz	Agilent 3458A
Frequency - Source	1 Hz to 10 MHz	120 uHz/Hz + 0.00062 Hz	RIGOL DG 1022

Mass

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Calibration of force ¹ testing machines and force measuring systems: Tension Compression	1 gf to 471 kgf (1 to 500 000) lbf 1 gf to 471 kgf (1 to 1 000 000) lbf	0.25 % reading 0.25 % reading	Loading weights and Working Standard ASTM E4



Mass

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Calibration of load cells	1 gf to 471 kgf	0.005 % reading	Loading weights
Calibration of force ¹ Tension and Compression Crane Scales Dynamometers Load Cells	(10 lbf to 1 040) lbf (1 000 to 500 000) lbf	0.01 % reading 0.05 % reading	Dead Weight Machine and Secondary Standard ASTM E74
Aircraft Wheel Scales	(1 to 100 000) lbf	0.05 % of reading	Dead Weight Machine, Loading Weights and Secondary Standards
Liquid Flow	(4 to 40) Litre/hour	0.75% of reading	Digital Balance/Stop Watch/Thermometer/ Distilled Water
Analytical Balances ¹	Up to 10 g (10 to 200) g	0.06 mg 0.12 mg	ASTM Class 1 Weights
	200 g to 35 kg 200 g to 220 kg	2.5 mg/kg 20 mg/ kg	ASTM Class 4 Weights
Mass (metric) : Conventional Mass (non integral weights)	(1 to 20) kg	30 mg/kg	ASTM Class 0 and Class 1 Weights
Mass (pound, avoirdupois): Conventional Mass	(0.01 to 0.05) lb (0.05 to 5) lb (5 to 50) lb	23 mg/lb 4.5 mg, /lb 14 mg/lb	ASTM Class 1 Weights
Mass (metric) : Conventional Mass	1 mg 2 mg 3 mg 5 mg 10 mg 20 mg 30 mg 50 mg 100 mg 200 mg 300 mg 500 mg 1 g 2 g 3 g 5 g	0.008 8 mg 0.008 8 mg 0.008 8 mg 0.008 8 mg 0.008 8 mg 0.008 8 mg 0.008 8 mg 0.008 8 mg 0.008 8 mg 0.008 8 mg 0.008 8 mg 0.008 8 mg 0.01 mg 0.011 mg 0.023 mg 0.023 mg	ASTM Class 0 and Class 1 Weights

Mass

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Mass (metric) : Conventional Mass	10 g 20 g 30 g 50 g 100 g 200 g 300 g 500 g 1 kg 2 kg 3 kg 5 kg 10 kg 20 kg	0.044 mg 0.039 mg 0.05 mg 0.05 mg 0.068 mg 0.28 mg 1.3 mg 1.3 mg 1.5 mg 12 mg 12 mg 120 mg 120 mg 350 mg	ASTM Class 0 and Class 1 Weights
Deadweight Testers			
Effective area	(0.01 to 0.5) in ²	0.000 33 in ² / in ²	Ametek DWT (PK-854, HK-1000, R-50)
Dead Weights	(0.01 to 10) lb	0.000 05 lb/lb	ASTM Class 1 Weights
Pressure calibrators	(4 to 854) in H ₂ O (30 to 1 000) psi (1 000 to 10 000) psi	0.000 33 psi/psi 0.000 14 psi/psi 0.000 33 psi/psi	Ametek DWT (PK-854, HK-1000, R-50)
Pressure Indicators and Gauges ¹	Up to 1 in H ₂ O Up to 5 psi Up to 30 psi Up to 500 psi (100 to 1 000) psi (1 000 to 10 000) psi	0.005 in H ₂ O 0.002 5 psi 0.015 psi 0.05 psi 0.25 % of reading 0.25 % of reading	Pressure modules and transducers
Vacuum ¹	Up to 28 in Hg	0.042 in Hg	MKS 270B with MKS 390HA/270
Torque Testers ¹ , analyzers, transducers	(8 to 36) lbf·in (40 to 300) lbf·in (22 to 651) lbf·ft	0.19 % reading 0.19 % reading 0.19 % reading	Torque Arms and loading weights
Torque wrenches ¹	(8 to 36) lbf·in (40 to 300) lbf·in (22 to 651) lbf·ft	0.75 % reading 0.75 % reading 0.75 % reading	Torque testers
Absolute Pressure	0 torr (1 to 10) torr (100 to 1 000) torr	1E-6 torr 0.08 % reading 0.08 % reading	MKS PVS-6/Ion Gauge MKS 390HA/270 MKS 390HA/270

Mass

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Direct Verification of Brinell Hardness ¹ Testing Machines:			ASTM E10
Verification of Test Force	(1 to 3 000) kgf	± 0.25% reading	Working force standards
Verification of the Indentation Measuring System	(1 to 5) mm (5 to 10) mm	± 0.001 mm ± 0.005 mm	Stage micrometer Glass Scale
Rockwell Hardness ¹ Testers Indirect verification	HRA Low	0.28 HRA	Hardness test blocks ASTM E18
	HRA Med	0.17 HRA	
	HRA High	0.16 HRA	
	HRBW Low	1.4 HRBW	
	HRBW Med	0.87 HRBW	
	HRBW High	0.42 HRBW	
	HRC Low	0.40 HRC	
	HRC Med	0.36 HRC	
	HRC High	0.32 HRC	
	HRD Low	0.27 HRD	
	HRD Med	0.26 HRD	
	HRD High	0.18 HRD	
	HRE Low	0.54 HRE	
	HRE Med	0.54 HRE	
HRE High	0.54 HRE		
HRF Low	0.54 HRF		
HRF Med	0.40 HRF		
HRF High	0.40 HRF		
HRG Low	0.76 HRG		
HRG Med	0.36 HRG		
HRG High	0.36 HRG		
HRH Low	0.54 HRH		
HRH Med	0.41 HRH		
HRH High	0.41 HRH		



Mass

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Rockwell Hardness ¹ Testers Indirect verification	HRK Low	0.64 HRK	Hardness test blocks ASTM E18
	HRK Med	0.4 HRK	
	HRK High	0.4 HRK	
	(90 to 114) HRL (115 to 130) HRL	0.36 HRL 0.36 HRL	
Rockwell Superficial Hardness ¹ Testers Indirect verification	(70 to 99) HRM (100 to 130) HRM	0.56 HRM 0.56 HRM	Hardness test blocks ASTM E18
	(40 to 84) HRP (85 to 130) HRP	0.91 HRP 0.65 HRP	
	(100 to 119) HRR (120 to 130) HRR	0.41 HRR 0.24 HRR	
	(110 to 111) HRS (112 to 130) HRS	0.95 HRS 0.2 HRS	
	(80 to 103) HRV (104 to 130) HRV	0.95 HRV 0.2 HRV	
	HR15N Low HR15N Med HR15N High	0.39 HR15N 0.19 HR15N 0.19 HR15N	
	HR30N Low HR30N Med HR30N High	0.55 HR30N 0.28 HR30N 0.28 HR30N	
	HR45N Low HR45N Med HR45N High	0.43 HR45N 0.22 HR45N 0.19 HR45N	
	HR15TW Low HR15TW Med HR15TW High	0.37 HR15TW 0.21 HR15TW 0.21 HR15TW	
	HR30TW Low HR30TW Med HR30TW High	0.9 HR30TW 0.66 HR30TW 0.39 HR30TW	



Mass

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Rockwell Superficial Hardness ¹ Testers Indirect verification	HR45TW Low	0.73 HR45TW	Hardness test blocks ASTM E18
	HR45TW Med	0.41 HR45TW	
	HR45TW High	0.41 HR45TW	
	(80 to 88) HR15W	0.67 HR15W	
	(89 to 100) HR15W	0.67 HR15W	
	(40 to 64) HR30W	0.9HR30W	
	(65 to 100) HR30W	0.76 HR30W	
	(10 to 47) HR45W	0.30 HR45W	
	(48 to 100) HR45W	0.13 HR45W	
	(80 to 87) HR15X	0.62 HR15X	
	(88 to 100) HR15X	0.33 HR15X	
	(60 to 78) HR30X	0.99 HR30X	
	(79 to 100) HR30X	0.15 HR30X	
(40 to 68) HR45X	0.81 HR45X		
(69 to 100) HR45X	0.35 HR45X		
(85 to 93) HR15Y	1.3 HR15Y		
(94 to 100) HR15Y	0.63 HR15Y		
(60 to 87) HR30Y	0.82 HR30Y		
(88 to 100) HR30Y	0.37 HR30Y		
(60 to 81) HR45Y	0.94 HR45Y		
(82 to 100) HR45Y	0.3 HR45Y		
Brinell Hardness Testers ¹			Brinell Test Blocks & Brinell Scope ASTM E10
1/62.5	(200 to 400) HBW (400 to 600) HBW	9.5 HBW 25 HBW	
2.5/187.5	(200 to 400) HBW (400 to 600) HBW	6.2 HBW 15 HBW	
10/500	(20 to 100) HBW (100 to 150) HBW	1 HBW 1.5 HBW	

Mass

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Brinell Hardness Testers ¹			
5/1 000	(200 to 400) HBW (400 to 600) HBW	4 HBW 8 HBW	Brinell Test Blocks & Brinell Scope ASTM E10
10/1 000	(200 to 400) HBW (400 to 600) HBW	3.3 HBW 7 HBW	
10/1 500	(200 to 400) HBW (400 to 600) HBW	2.7 HBW 6.5 HBW	
10/2 000	(200 to 400) HBW (400 to 600) HBW	2.2 HBW 5.2 HBW	
10/2 500	(200 to 400) HBW (400 to 600) HBW	2 HBW 4.4 HBW	
10/3 000	(200 to 400) HBW (400 to 600) HBW	1.9 HBW 4.9 HBW	
Vickers ¹ , ≥1 kgf			
HV 1	200 HV 400 HV 700 HV	4.1 HV 8 HV 18 HV	Hardness test blocks ASTM E384
HV 2	200 HV 400 HV 700 HV	3 HV 8 HV 14 HV	
HV 5	200 HV 400 HV 700 HV	3 HV 6 HV 11 HV	
HV 10	200 HV 400 HV 700 HV	3 HV 6 HV 11 HV	
HV 20	200 HV 400 HV 700 HV	3 HV 6 HV 11 HV	



Mass

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Vickers ¹ , ≥1 kgf HV 30	200 HV 400 HV 700 HV	3 HV 4 HV 7 HV	Hardness test blocks ASTM E384
HV 50	200 HV 400 HV 700 HV	3 HV 4 HV 7 HV	
Vickers ¹ , <1 kgf HV 0.01	200 HV 400 HV 700 HV	10 HV 20 HV 35 HV	Hardness test blocks ASTM E384
HV 0.025	200 HV 400 HV 700 HV	10 HV 20 HV 35 HV	
HV 0.05	200 HV 400 HV 700 HV	10 HV 20 HV 35 HV	
HV 0.1	200 HV 400 HV 700 HV	8 HV 20 HV 35 HV	
HV 0.2	200 HV 400 HV 700 HV	8 HV 18 HV 35 HV	
HV 0.3	200 HV 400 HV 700 HV	5 HV 14 HV 24 HV	
Vickers ¹ , <1 kgf HV 0.5	200 HV 400 HV 700 HV	5 HV 12 HV 24 HV	
HV 1	200 HV 400 HV 700 HV	4 HV 8 HV 17 HV	Hardness test blocks ASTM E384

Mass

Parameter / Equipment	Range	Expanded Uncertainty of Measurement (+/-)	Reference Standard, Method and/or Equipment
Knoop ¹ Micro-Indentation Hardness Testers HK 0.01	200 HK	7 HK	Hardness test blocks ASTM E384
	400 HK	16 HK	
	700 HK	33 HK	
HK 0.025	200 HK	7 HK	
	400 HK	14 HK	
	700 HK	22 HK	
HK 0.05	200 HK	7 HK	
	400 HK	14 HK	
	700 HK	20 HK	
HK 0.1	200 HK	7 HK	
	400 HK	12 HK	
	700 HK	19 HK	
HK 0.2 and 0.3	200 HK	5 HK	
	400 HK	8 HK	
	700 HK	17 HK	
HK 0.5 and 1	200 HK	5 HK	
	400 HK	7 HK	
	700 HK	15 HK	

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. L = length in inches
3. This scope is formatted as part of a single document including Certificate of Accreditation No. AC-1402.



Vice President