Accreditation Scope

Quality Technical Services, NAL 095
Calibration Laboratory, (ISO/IEC 17025:2017)

M72, MW4, Musaffah, Abu Dhabi, UAE

Issue Date: 29-08-2024 **Expiry Date: 28-12-2024**
Issue No: 09

Calibration Field/ Quantity/ Property	Measurand / Equipment	Measurement Range	Expanded Measurement Uncertainty (k=2)	Calibration Method (Standard/ Internal Procedure)	Permanent lab (P) / Client-site (S)
Balances	Weighing Balance (Non-automatic weighing instrument)	(0.001 to 62) g	0.08 mg	QTS/M-WP-02:2022 Euramet cg-18:2015	P/S
		(> 62 to 220) g	0.3 mg		
		(>220 to 600) g	1 mg		
		(> 0.6 to 1.2) kg	2 mg		
		(> 1.2 to 6.2) kg	0.01 g		
		(> 6.2 to 12) kg	0.1 g		
		(> 12 to 32) kg	0.2 g		
		(> 32 to 100) kg	10 g		
		(> 100 to 500) kg	0.02 kg		
		(> 500 to 1000) kg	0.1 kg		
		(> 1000 to 2000) kg	0.1 kg		
	Batching Plant (Concrete/asphalt plants, Hooper and Tank Scale)	(10 to 10 000) kg	0.2 %	QTS/M-WP-03:2021 ASTM C94/C94M	S
Mass	Conventional Mass	1 mg	0.06 mg	QTS/M-WP-02:2022 OIML R 111-1:2004 F1 from (1 to 50) g F2 from 1 g to 5 kg M1 from 1 mg to 20 kg	P
		2 mg	0.06 mg		
		5 mg	0.06 mg		
		10 mg	0.08 mg		
		20 mg	0.10 mg		
		50 mg	0.12 mg		
		100 mg	0.16 mg		
		200 mg	0.20 mg		
		500 mg	0.25 mg		
		1 g	0.03 mg	QTS/M-WP-02:2022 OIML R 111-1:2004 F1 from (1 to 50) g F2 from 1 g to 5 kg M1 from 1 mg to 20 kg	P
		2 g	0.04 mg		
		5 g	0.05 mg		
		10 g	0.06 mg		
		20 g	0.08 mg		

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Accreditation Scope

Quality Technical Services, NAL 095
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M72, MW4, Musaffah, Abu Dhabi, UAE

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Mass	Conventional Mass	50 g	0.10 mg	QTS/M-WP-02:2022 OIML R 111-1:2004 F1 from (1 to 50) g F2 from 1 g to 5 kg M1 from 1 mg to 20 kg	P
		100 g	0.50 mg		
		200 g	1.0 mg		
		500 g	3.0 mg		
		1 kg	5.0 mg		
		2 kg	10 mg		
		5 kg	30 mg		
		10 kg	0.2 g		
		20 kg	0.3 g		
	Unknown Masses or similar	1 mg to 30 kg	0.002 %	QTS/M-WP-02:2022	P/S
Force	Compression Machine (CBR Machine, Marshall testing machine, Flexural machine, UCS machine etc..)	(1 to 10) kN	0.08 %	QTS/F-WP-01:2022 ISO 7500-1:2018 ASTM E4-20	S
		(5 to 50) kN	0.10 %		
		(10 to 100) kN	0.12 %		
		(30 to 300) kN	0.13 %		
		(300 to 3000) kN	0.45 %		
	Tension Machine (Tensile Testing machine, Pull off Tester, etc…)	(0.2 to 10) kN	0.12 %	QTS/F-WP-01:2022 ISO 7500-1:2018 ASTM E4-20	S
		(5 to 50) kN	0.07 %		
		(30 to 300) kN	0.10 %		
		(120 to 1200) kN	0.10 %		
	Compression Machine Stability Test	(200 to 2000) kN	0.45%	QTS/F-WP-02:2021 BS EN 12390-4:2019	S
	Proving Ring	(1 to 10) kN	0.15 %	QTS/F-WP-06:2021	P
		(>10 to 50) kN	0.17 %		
		(>50 to 200) kN	0.14 %		

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Accreditation Scope

Quality Technical Services, NAL 095
Calibration Laboratory, (ISO/IEC 17025:2017)

M72, MW4, Musaffah, Abu Dhabi, UAE

Issue Date: 29-08-2024 **Expiry Date: 28-12-2024**
Issue No: 09

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Force	Hydraulic Jacks	(1 to 300) kN	0.5 %	QTS/F-WP-04:2021	P
		(300 to 1000) kN	0.8 %		
	Force Gauge	1 g to 50 kg	0.15 %	QTS/F-WP-07:2022	P/S
Uniaxial Speed	Force Machine Feed Speed	(0.1 to 50) mm/min	0.2 %	QTS/D-WP-36:2022	P
Torque	Torque Tools (preset, indicating ,torque screw, or similar)	(2.8 to 28) N.m	1.1 %	QTS/F-WP-05:2022 ISO 6789-1:2017 ISO 6789-2:2017	P
		(> 20.3 to 200) N.m	1.1 %		
		(200 to 2000) N.m	1.2 %		
Dimensional	Caliper (Vernier, dial and digital)	(0.01 to 300) mm	20 µm	QTS/M-WP-01:2022 BS EN ISO 13385-1:2011	P
		(>300 to 600) mm	30 µm		
		(>600 to 1000) mm	40 µm		
		(>1000 to 2000) mm	70 µm		
	External Micrometer (analog, digital and digimatic)	(0.001 to 25) mm	3 µm	QTS/M-WP-02:2022 BS EN ISO 3611:2010	P
		(>25 to 100) mm	5 µm		
		(>100 to 300) mm	11 µm		
		(>300 to 1000) mm	33 µm		
		(> 1000 to 2000) mm	65 µm		
	Inside Micrometer including Micrometer Stick (analog, digital and digimatic)	(0.001 to 25) mm	4 µm	QTS/D-WP-34:2022 BS 959:2008	P
		(>25 to 100) mm	5 µm		
		(>100 to 300) mm	11 µm		
		(>300 to 600) mm	21 µm		
	Micrometer Setting Rod	(25 to 150) mm	3 µm	QTS/D-WP-24:2021	P
		(>150 to 600) mm	12 µm		
	Height Gauge	(0.01 to 300) mm	20 µm	QTS/D-WP-05:2022	P
		(> 300 to 1000) mm	40 µm		
		(> 1 to 2) m	70 µm		
	Depth Gauge and Depth Caliper	(0.5 to 300) mm	20 µm	QTS/ D -WP-06:2022	P
		(> 300 to 1000) mm	50 µm		
		(> 1 to 2) m	80 µm		

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Accreditation Scope

Quality Technical Services, NAL 095
Calibration Laboratory, (ISO/IEC 17025:2017)

M72, MW4, Musaffah, Abu Dhabi, UAE

Issue Date: 29-08-2024 **Expiry Date: 28-12-2024**
Issue No: 09

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Dimensional	Depth Micrometer	(0.5 to 300) mm	20 µm	QTS/ D -WP-33:2022	P
		(> 300 to 1000) mm	50 µm		
		(> 1 to 2) m	80 µm		
	2-pt. Bore Gauge	(6 to 300) mm	10 µm	QTS/D-WP-07:2021	P
		(> 300 to 600) mm	30 µm		
	3-pt. Internal Micrometer	(0.001 to 100) mm	4 µm	QTS/D-WP-10:2022	P
		200 mm	11 µm		
		300 mm	11 µm		
	Feeler Gauge	(0.05 to 1) mm	3 µm	QTS/D-WP-11:2021 BS 957:2008	P
	Radius gauge, radius measurement (sheave gauge, etc…)	(1 to 300) mm	20 µm	QTS/D-WP-12:2022	P
	Protractors, angle gauges, angle measurement	0.1° to 360°	0.1 °	QTS/D-WP-13:2022	P
	Thickness Gauge (dial and digital)	(0.001 to 100) mm	0.02 mm	QTS/D-WP-08:2022	P
	Graduated Steel Rule	(0.001 to 1) m	0.4 mm	QTS/D-WP-15:2022 OIML R 35 2:2011	P
	Graduated Steel Tape	(0.001 to 100) m	0.04 %	QTS/D-WP-15:2022 OIML R 35 2:2011	P
	Circumference Tape	(10 to 300) mm diameter	0.7 mm	QTS/D-WP-30:2021	P
	Dial Gauge - Plunger Type	(0.0001 to 25) mm	0.8 µm	QTS/D-WP-03:2022 BS EN ISO 463:2006	P
		(>25 to 100) mm	5 µm		
	Displacement Transducer with indicator (LVDT)	(0.001 to 25) mm	4 µm	QTS/D-WP-14:2021	P / S
		(>25 to 100) mm	5 µm		
		(>100 to 600) mm	19 µm		
	Dial Test Indicator - Lever Type	(0.01 to 1.6) mm	1.4 µm	QTS/D-WP-04:2021	P
	Dial Gauge Calibrator	(0.001 to 50) mm	3 µm	QTS/D-WP-17:2021	P
	Contact Extensometer	(0.5 to 50) mm	3 µm	QTS/D-WP-26:2021	P/S

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Accreditation Scope

Quality Technical Services, NAL 095
Calibration Laboratory, (ISO/IEC 17025:2017)

M72, MW4, Musaffah, Abu Dhabi, UAE

Issue Date: 29-08-2024 **Expiry Date: 28-12-2024**
Issue No: 09

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	Test Sieves (Wire Mesh)	20 µm to 125 mm	9 µm	QTS/D-WP-18:2022 ASTM E11:2017 ISO 3310-1:2016	P
	Test Sieves (Perforated Plate)	32 µm to 125 mm	9 µm	QTS/D-WP-18:2022 ASTM E 323:2017 ISO 3310-2:2016	P
Dimensional	Surface Plate Flatness	(0.3 × 0.3) to (2 × 2) m	7 µm	QTS/D-WP-29:2021	P / S
	Surface Roughness	(0.4 to 250) µm	0.6 µm	QTS/Ph-WP-07:2021	P/S
	2-dimensional Profile Projector (Linear axis x & y, angle, circle)	x = (0.1 to 400) mm	(6 + 10 L) µm; L in meter	QTS/D-WP-09:2022	P / S
		y = (0.1 to 400) mm			
		Angle : 0.1° to 360°	0.04°		
	Pin Gauges	(0.17 to 25) mm	6 µm	QTS/D-WP-19:2022	P
	Welding Gauges (length and angle)	(0.1 to 300) mm	20 µm	QTS/D-WP-28:2021	P
		(0.01° to 90°)	0.1°		
	Dial Gauge for Penetrometer, or similar	(0.001 to 300) mm	30 µm	QTS/D-WP-27:2021	P
	Paint Coating Thickness Gauge (dry film and wet film)	(0.023 to 1) mm	0.9 µm	QTS/D-WP-32:2021	P
		(>1 to 4) mm	4 µm		
		(>4 to 10) mm	9 µm		
	Plain Plug Gauge (diameter, roundness, straightness and parallelism)	(2 to 100) mm	3.4 µm	QTS/D-WP-22:2022 EURAMET cg-06:2011	P
	Taper Plug Gauge (effective diameter)	(2 to 100) mm	3.4 µm	QTS/D-WP-39:2022	P
	Thread Plug Gauge (major, effective diameter)	(2 to 100) mm	3.4 µm	QTS/D-WP-20:2022	P
	Taper Thread Plug Gauge (effective diameter)	(2 to 100) mm	3.4 µm	QTS/D-WP-40:2022	P

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Accreditation Scope

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Calibration Laboratory, (ISO/IEC 17025:2017)

M72, MW4, Musaffah, Abu Dhabi, UAE

Issue Date: 29-08-2024 **Expiry Date: 28-12-2024**
Issue No: 09

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Dimensional	Plain Ring Gauge (diameter, roundness, straightness and parallelism)	(6 to 300) mm	3.4 µm	QTS/D-WP-25:2022 EURAMET cg-06:2011	P
	Taper Ring Gauge (effective diameter)	(6 to 100) mm	3.4 µm	QTS/D-WP-41:2022	P
	Thread Ring Gauge (minor, effective diameter)	(6 to 100) mm	3.4 µm	QTS/D-WP-21:2021	P
	Taper Thread Ring Gauge (effective diameter)	(6 to 100) mm	3.4 µm	QTS/D-WP-42:2022	P
	Thickness Foil Standard or similar	(0.01 to 10) mm	0.4 µm	QTS/D-WP-38:2022	P
		(> 10 to 30) mm	1.0 µm		
	Length/ thickness/ width/ depth measurement (mold, flakiness gauge, tamping apparatus, liquid limit device, hegman gauge, etc…)	(0.1 to 10) mm	3 µm	QTS/D-WP-23:2022	P / S
		(>10 to 100) mm	5 µm		
		(>100 to 500) mm	9 µm		
		(>500 to 1000) mm	13 µm		
Length	Laser Distance Meter	(0.001 to 3) m	0.9 mm	QTS/D-WP-37:2022	P
Level	Precision/ Machinist Level	(0.01 to 0.1) mm/m	0.007 mm/m	QTS/D-WP-43:2022	P
Electrical – Calibration of Meters	DC Voltage - Fluke 5522A	(0.0001 to < 330) mV	27 µV/V	QTS/E-WP-01:2021 Euramet cg-15: 2015	P/S
		(0.33 to < 3.3) V	18 µV/V		
		(3.3 to < 33) V	19 µV/V		
		(33 to < 330) V	21 µV/V		
		(330 to 1020) V	26 µV/V		
Electrical – Calibration of Meters	DC Current - Direct - Fluke 5522A	(0.001 to < 330) µA	0.019 %	QTS/E-WP-01:2021 Euramet cg-15: 2015	P/S
		(0.33 to < 3.3) mA	0.011 %		
		(3.3 to < 33) mA	0.011 %		
		(33 to < 330) mA	0.01 %		
		(0.33 to < 1.1) A	0.029 %		
		(1.1 to < 3) A	0.011 %		
		(3 to < 11) A	0.055 %		

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Accreditation Scope

Quality Technical Services, NAL 095
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		(11 to 20.5) A	0.088 %		
	DC Current - Clamp-on - Fluke 5522A & Fluke 5500A coil	(0.01 to < 16.5) A	0.83 %	QTS/E-WP-02:2022	P/S
		(16.5 to < 150) A	0.57 %		
		(150 to 1025) A	0.54 %		
	Resistance - Fluke 5522A	(0.0001 to < 11) Ω	0.017 %	QTS/E-WP-01:2021 Euramet cg-15: 2015	P/S
		(11 to < 33) Ω	0.011 %		
		(33 to < 110) Ω	49 µΩ/Ω		
		(110 to < 330) Ω	42 µΩ/Ω		
		(0.33 to < 1.1) kΩ	31 µΩ/Ω		
		(1.1 to < 3.3) kΩ	33 µΩ/Ω		
		(3.3 to < 11) kΩ	30 µΩ/Ω		
		(11 to < 33) kΩ	31 µΩ/Ω		
		(33 to < 110) kΩ	33 µΩ/Ω		
		(110 to < 330) kΩ	34 µΩ/Ω		
		(0.33 to < 1.1) MΩ	34 µΩ/Ω		
		(1.1 to < 3.3) MΩ	65 µΩ/Ω		
		(3.3 to < 11) MΩ	0.014 %		
		(11 to < 33) MΩ	0.043 %		
		(33 to < 110) MΩ	0.073 %		
		(110 to < 330) MΩ	0.31 %		
		(0.33 to 1.1) GΩ	1.5 %		
Electrical – Calibration of Meters	Earth Resistance (4w) - Fluke 5322A	10 mΩ	5.4 %	QTS/E-WP-06:2021	P/S
		(100 to > 200) mΩ	4 %		
		(0.2 to < 0.5) Ω	1.8 %		
		(0.5 to < 2) Ω	0.66 %		
		(2 to < 5) Ω	0.39 %		
		(5 to < 30) Ω	0.24 %		
		(30 to < 200) Ω	0.15 %		
		(200 to < 500) Ω	0.15 %		
		(0.5 to < 2) kΩ	0.15 %		
		(2 to < 5) kΩ	0.15 %		
		(5 to 10) kΩ	0.15 %		
	Insulation Resistance -Fluke 5322A	(10 to < 40) kΩ	0.16%	QTS/E-WP-09:2021	P/S
		(40 to < 100) kΩ	0.15%		
		(100 to < 200) kΩ	0.15%		

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Accreditation Scope

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Calibration Laboratory, (ISO/IEC 17025:2017)

M72, MW4, Musaffah, Abu Dhabi, UAE

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		(0.2 to < 1) MΩ	0.15%		
		(1 to < 10) MΩ	0.24%		
		(10 to < 1000) MΩ	0.89%		
		(1 to > 10) GΩ	1.2%		
		(10 to 98) GΩ	2.3%		
	AC Voltage -Fluke 5522A	**(1 to < 33) mV**		QTS/E-WP-01:2021 Euramet cg-15: 2015	P/S
		(10 to 45) Hz	0.086%		
		> 45 Hz to 10 kHz	0.034%		
		(> 10 to 20) kHz	0.036%		
		(> 20 to 50) kHz	0.11%		
		(> 50 to 100) kHz	0.34%		
		(> 100 to 500) kHz	0.92%		
	AC Voltage -Fluke 5522A	**(33 to < 330) mV**		QTS/E-WP-01:2021 Euramet cg-15: 2015	P/S
		(10 to 45) Hz	0.03%		
		> 45 Hz to 10 kHz	0.018%		
		(> 10 to 20) kHz	0.019%		
Electrical – Calibration of Meters	AC Voltage -Fluke 5522A	(> 20 to 50) kHz	0.034%	QTS/E-WP-01:2021 Euramet cg-15: 2015	P/S
		(> 50 to 100) kHz	0.079%		
		(> 100 to 500) kHz	0.22%		
		(0.33 to < 3.3) V			
		(10 to 45) Hz	0.03%		
		> 45 Hz to 10 kHz	0.017%		
		(> 10 to 20) kHz	0.02%		
		(> 20 to 50) kHz	0.031%		
		(> 50 to 100) kHz	0.077%		
		(> 100 to 500) kHz	0.26%		
		(3.3 to < 33) V			
		(10 to 45) Hz	0.016%		
		> 45 Hz to 10 kHz	0.018%		
		(> 10 to 20) kHz	0.025%		
		(> 20 to 50) kHz	0.034%		
		(> 50 to 100) kHz	0.085%		
		(33 to < 330) V			
		45 Hz to 1 kHz	0.017%		
		(> 1 to 10) kHz	0.02%		
		(> 10 to 20) kHz	0.024%		
		(> 20 to 50) kHz	0.031%		

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Accreditation Scope

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Calibration Laboratory, (ISO/IEC 17025:2017)

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		(> 50 to 100) kHz	0.2%		
		(330 to 1020) V			
		45 Hz to 1 kHz	0.03%		
		(> 1 to 5) kHz	0.024%		
		(> 5 to 10) kHz	0.03%		
	AC Current - Direct -Fluke 5522A	**(33 to < 330) µA**		QTS/E-WP-01:2021 Euramet cg-15: 2015	P/S
		(10 to 20) Hz	0.2%		
		(> 20 to 45) Hz	0.16%		
		> 45 Hz to 1 kHz	0.14%		
Electrical – Calibration of Meters	AC Current - Direct -Fluke 5522A	(> 1 to 5) kHz	0.31%	QTS/E-WP-01:2021 Euramet cg-15: 2015	P/S
		(> 5 to 10) kHz	0.76%		
		(> 10 to 30) kHz	1.6%		
		(0.33 to < 3.3) mA			
		(10 to 20) Hz	0.18%		
		(> 20 to 45) Hz	0.12%		
		> 45 Hz to 1 kHz	0.1%		
		(> 1 to 5) kHz	0.18%		
		(> 5 to 10) kHz	0.44%		
		(> 10 to 30) kHz	0.92%		
		(3.3 to < 33) mA			
		(10 to 20) Hz	0.16%		
		(> 20 to 45) Hz	0.09%		
		> 45 Hz to 1 kHz	0.05%		
		(> 1 to 5) kHz	0.08%		
		(> 5 to 10) kHz	0.19%		
		(> 10 to 30) kHz	0.39%		
		(33 to < 330) mA			
		(10 to 20) Hz	0.17%		
		(> 20 to 45) Hz	0.09%		
		> 45 Hz to 1 kHz	0.05%		
		(> 1 to 5) kHz	0.11%		
		(> 5 to 10) kHz	0.21%		
		(> 10 to 30) kHz	0.43%		
		(0.33 to < 1.1) A			
		(10 to 45) Hz	0.17%		
		> 45 Hz to 1 kHz	0.07%		

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Accreditation Scope

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Calibration Laboratory, (ISO/IEC 17025:2017)

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		(> 1 to 5) kHz	0.65%		
		(> 5 to 10) kHz	2.8%		
Electrical – Calibration of Meters	AC Current - Direct -Fluke 5522A	**(1.1 to < 3) A**		QTS/E-WP-01:2021 Euramet cg-15: 2015	P/S
		(10 to 45) Hz	0.15%		
		> 45 Hz to 1 kHz	0.06%		
		(> 1 to 5) kHz	0.5%		
		(> 5 to 10) kHz	2.2%		
		(3 to < 11) A			
		(10 to 100) Hz	0.09%		
		(> 0.1 to 1) kHz	0.13%		
		(> 1 to 5) kHz	3.1%		
		(11 to 20.5) A			
		(45 to 100) Hz	0.14%		
		(> 0.1 to 1) kHz	0.18%		
		(> 1 to 5) kHz	3%		
	AC Current – Clamp-on -Fluke 5522A & Fluke 5500A coil	**(0.1 to < 16.5) A**		QTS/E-WP-01:2021 Euramet cg-15: 2015	P/S
		(45 to 65) Hz	0.7%		
		(> 65 to 440) Hz	1.1%		
		(16.5 to < 150) A			
		(45 to 65) Hz	0.7%		
		(> 65 to 440) Hz	1.1%		
		(150 to 1025) A			
		(45 to 65) Hz	0.6%		
		(> 65 to 440) Hz	1.0%		
	Capacitance -Fluke 5522A	(0.22 to < .04) nF	4.8%	QTS/E-WP-01:2021 Euramet cg-15: 2015	P/S
		(0.4 to < 1.1) nF	1.6%		
		(1.1 to < 3.3) nF	0.88%		
		(3.3 to < 11) nF	0.4%		
		(11 to < 33) nF	0.56%		
		(33 to < 110) nF	0.35%		
		(110 to < 330) nF	0.34%		
		(0.33 to < 1.1) µF	0.36%		
Electrical – Calibration of Meters	Capacitance -Fluke 5522A	(1.1 to < 3.3) µF	0.34%	QTS/E-WP-01:2021 Euramet cg-15: 2015	P/S
		(3.3 to < 11) µF	0.32%		
		(11 to < 33) µF	0.56%		
		(33 to < 110) µF	0.49%		
		(110 to < 330) µF	0.51%		

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Accreditation Scope

Quality Technical Services, NAL 095
Calibration Laboratory, (ISO/IEC 17025:2017)

M72, MW4, Musaffah, Abu Dhabi, UAE

Issue Date: 29-08-2024 **Expiry Date: 28-12-2024**
Issue No: 09

Calibration Field/ Quantity/ Property	Measurand / Equipment	Measurement Range	Expanded Measurement Uncertainty (k=2)	Calibration Method (Standard/ Internal Procedure)	Permanent lab (P) / Client-site (S)
		(0.33 to < 1.1) mF	0.53%		
		(1.1 to < 3.3) mF	0.53%		
		(3.3 to < 11) mF	0.53%		
		(11 to < 33) mF	0.79%		
		(33 to 110) mF	1.1%		
	Frequency -Fluke 5522A	(0.01 to < 120) Hz	3 µHz/Hz	QTS/E-WP-01:2021 Euramet cg-15: 2015	P/S
		(0.12 to < 120) kHz	3 µHz/Hz		
		(0.12 to 2) MHz	3 µHz/Hz		
	DC Power (Single Phase) -Fluke 5522A	**(3 to 1020) V (0.1 to 20) A**		QTS/E-WP-01:2021	P/S
		0.3 W to 3.06 kW	0.13 %		
		(> 3.06 to 20.4) kW	0.13 %		
	AC Power (Single Phase) -Fluke 5522A	**(3 to 1020) V (0.1 to 20) A 45 Hz to 50 kHz**		QTS/E-WP-01:2021	P/S
		0.3 W to 3.06 kW	0.17 %		
		(> 3.06 to 20.4) kW	0.18 %		
	Phase Angle -Fluke 5522A	**10 Hz to 30 kHz**		QTS/E-WP-01:2021	P/S
		(0.01 to 90)°	0.4 %		
	Ground Bond Resistance (4-wire) -Fluke 5322A	1.05 mΩ @30 A max	14%	QTS/E-WP-07:2021	P/S
		16.43 mΩ @30 A max	4.3%		
		42.28 mΩ @28 A max	3.9%		
		85.4 mΩ @ 25A max	2.1%		
		340.6 mΩ @14 A max	1.1%		
		479.3 mΩ @12 A max	0.78%		
		867.4 mΩ @ 8 A max	0.93%		
Electrical – Calibration of Meters	Ground Bond Resistance (4-wire) -Fluke 5322A	1.693 Ω @ 6 A max	0.57%	QTS/E-WP-07:2021	P/S
		4.647 Ω @ 3.2 A max	0.42%		
		8.703 Ω @ 2 A max	0.39%		
		16.93 Ω @ 1.5 A max	0.23%		
		46.89 Ω @ 0.8 A max	0.49%		
		90.93 Ω @ 0.5 A max	0.44%		
		172.85 Ω @ 0.25Amax	0.4%		
		471.5 Ω @ 0.1 A max	0.37%		
		881.3 Ω @ 50 mA max	0.41%		
		1.7 kΩ @ 30 mA max	0.41%		

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Accreditation Scope

Quality Technical Services, NAL 095
Calibration Laboratory, (ISO/IEC 17025:2017)

M72, MW4, Musaffah, Abu Dhabi, UAE

Issue Date: 29-08-2024 **Expiry Date: 28-12-2024**
Issue No: 09

Calibration Field/ Quantity/ Property	Measurand / Equipment	Measurement Range	Expanded Measurement Uncertainty (k=2)	Calibration Method (Standard/ Internal Procedure)	Permanent lab (P) / Client-site (S)
	Loop / Line Impedance (2-wire; 50 Hz) -Fluke 5322A	30.32 mΩ	20%	QTS/E-WP-08:2021	P/S
		55.59 mΩ	12%		
		94.5 mΩ	9.9%		
		355.9 mΩ	2.2%		
		495.7 mΩ	1.6%		
		884.7 mΩ	1.1%		
		1.710 Ω	0.65%		
		4.665 Ω	0.5%		
		8.716 Ω	0.49%		
		16.944 Ω	0.44%		
		46.90 Ω	0.48%		
		90.94 Ω	0.43%		
		172.79 Ω	0.46%		
		471.5 Ω	0.41%		
		881.5 Ω	0.43%		
		1.7 kΩ	0.47%		
	Leakage Current -Fluke 5322A	(100 to 300) µA	0.98 %	QTS/E-WP-07:2021	P/S
		(> 0.3 to 3) mA	0.47 %		
		(> 3 to 30) mA	0.4 %		
Electrical – Calibration of Meters	Trip Current - Residual Current Device (RCD) -Fluke 5322A	(10 to 30) mA	0.87 %	QTS/E-WP-07:2021	P/S
		(> 30 to 300) mA	0.78 %		
		(>0.3 to 3) A	0.82 %		
	Trip Time - Residual Current Device (RCD) -Fluke 5322A	10 ms to 4.1 s	0.63 %	QTS/E-WP-07:2021	P/S
Oscilloscope	Oscilloscope -Fluke 5522A/6-240 Oscilloscope Option	**Amplitude (Vertical Axis)**		QTS/E-WP-04:2021 EURAMET cg-07: 2011	P/S
		1 mV to 130 V	0.6 %		
		Period (Horizontal Axis)			
		2 ns to 5 s	68 µs/s		
		Bandwidth			
		(1 to 600) MHz	2.1 %		
Electrical – Calibration of Sources	DC Voltage -Fluke 8588A	(0.001 to 200) mV	20 µV/V	QTS/E-WP-03:2021	P/S
		(> 0.2 to 2) V	8 µV/V		
		(> 2 to 20) V	7 µV/V		
		(> 20 to 200) V	10 µV/V		
		(> 200 to 1000) V	12 µV/V		

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Accreditation Scope

Quality Technical Services, NAL 095
Calibration Laboratory, (ISO/IEC 17025:2017)

M72, MW4, Musaffah, Abu Dhabi, UAE

Issue Date: 29-08-2024 **Expiry Date: 28-12-2024**
Issue No: 09

Calibration Field/ Quantity/ Property	Measurand / Equipment	Measurement Range	Expanded Measurement Uncertainty (k=2)	Calibration Method (Standard/ Internal Procedure)	Permanent lab (P) / Client-site (S)
	DC High Voltage -Fluke 5322A	(> 1 to 5) kV	0.46 %	QTS/E-WP-03:2021	P/S
		(> 5 to 10) kV	0.3 %		
	DC Current -Fluke 8588A	(0.1 to 20) µA	97 µA/A	QTS/E-WP-03:2021	P/S
		(> 20 to 200) µA	21 µA/A		
		(> 0.2 to 2) mA	20 µA/A		
		(> 2 to 20) mA	26 µA/A		
		(> 20 to 200) mA	0.01 %		
		(> 0.2 to 2) A	0.032 %		
		(> 2 to 10) A	0.042 %		
		(> 10 to 30) A	0.11 %		
	DC Current, Welding machine and similar	(10 to 900) A	2.1%	QTS/E-WP-10:2022	P/S
Electrical – Calibration of Sources	Resistance - Normal -Fluke 8588A	(0.0001 to 2) Ω	80 µΩ/Ω	QTS/E-WP-03:2021	P/S
		(> 2 to 20) Ω	21 µΩ/Ω		
		(> 20 to 200) Ω	16 µΩ/Ω		
		(> 0.2 to 2) kΩ	16 µΩ/Ω		
		(> 2 to 20) kΩ	17 µΩ/Ω		
		(> 20 to 200) kΩ	16 µΩ/Ω		
		(> 0.2 to 2) MΩ	19 µΩ/Ω		
		(> 2 to 20) MΩ	40 µΩ/Ω		
		(> 20 to 100) MΩ	0.03%		
		(0.1 to 1) GΩ	0.32%		
	Resistance - HV -Fluke 8588A	(0.1 to 1) GΩ-HV	0.08%	QTS/E-WP-03:2021	P/S
		(> 1 to 10) GΩ-HV	0.32%		
	AC Voltage -Fluke 8588A	**(0.0001 to 10) mV**		QTS/E-WP-03:2021	P/S
		10 Hz to 2 kHz	0.05 %		
		(> 2 to 10) kHz	0.063 %		
		(> 10 to 30) kHz	0.07 %		
		(> 30 to 100) kHz	0.45 %		
		(> 100 to 300) kHz	1.7 %		
		(> 0.3 to 1) MHz	3.1 %		
		(> 10 to 100) mV			
		10 Hz to 2 kHz	0.015 %		
		(> 2 to 10) kHz	0.023 %		
		(> 10 to 30) kHz	0.044 %		

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Accreditation Scope

Quality Technical Services, NAL 095
Calibration Laboratory, (ISO/IEC 17025:2017)

M72, MW4, Musaffah, Abu Dhabi, UAE

Issue Date: 29-08-2024 **Expiry Date: 28-12-2024**
Issue No: 09

Calibration Field/ Quantity/ Property	Measurand / Equipment	Measurement Range	Expanded Measurement Uncertainty (k=2)	Calibration Method (Standard/ Internal Procedure)	Permanent lab (P) / Client-site (S)
		(> 30 to 100) kHz	0.11 %		
		(> 100 to 300) kHz	0.45 %		
		(> 0.3 to 1) MHz	1.6 %		
		(> 0.1 to 1) V			
		10 Hz to 2 kHz	0.014 %		
		(> 2 to 10) kHz	0.022 %		
		(> 10 to 30) kHz	0.046 %		
Electrical – Calibration of Sources	AC Voltage -Fluke 8588A	(> 30 to 100) kHz	0.12 %	QTS/E-WP-03:2021	P/S
		(> 100 to 300) kHz	0.47 %		
		(> 0.3 to 1) MHz	1.7 %		
		(> 1 to 10) V			
		10 Hz to 2 kHz	0.014 %		
		(> 2 to 10) kHz	0.022 %		
		(> 10 to 30) kHz	0.04 %		
		(> 30 to 100) kHz	0.11 %		
		(> 100 to 300) kHz	0.42 %		
		(> 0.3 to 1) MHz	1.6 %		
		(> 10 to 100) V			
		10 Hz to 2 kHz	0.016 %		
		(> 2 to 10) kHz	0.021 %		
		(> 10 to 30) kHz	0.046 %		
		(> 30 to 100) kHz	0.11 %		
		(> 100 to 300) kHz	0.7 %		
		(> 0.3 to 1) MHz	2 %		
		(> 100 to 1000) V			
		10 Hz to 2 kHz	0.02 %		
		(> 2 to 10) kHz	0.021 %		
		(> 10 to 30) kHz	0.046 %		
		(> 30 to 100) kHz	0.12 %		
	AC High Voltage -Fluke 5322A	**(> 1 to 5) kV**		QTS/E-WP-03:2021	P/S
		(50 to 60) Hz	0.64 %		
		(>5 to 7) kV			
		(50 to 60) Hz	0.75 %		
	AC Current -Fluke 8588A	(10 to 100) µA		QTS/E-WP-03:2021	P/S
		10 Hz to 2 kHz	0.05 %		
		(> 2 to 10) kHz	0.09 %		
		(> 10 to 30) kHz	0.14 %		

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Accreditation Scope

Quality Technical Services, NAL 095
Calibration Laboratory, (ISO/IEC 17025:2017)

M72, MW4, Musaffah, Abu Dhabi, UAE

Issue Date: 29-08-2024 **Expiry Date: 28-12-2024**
Issue No: 09

Calibration Field/ Quantity/ Property	Measurand / Equipment	Measurement Range	Expanded Measurement Uncertainty (k=2)	Calibration Method (Standard/ Internal Procedure)	Permanent lab (P) / Client-site (S)
Electrical – Calibration of Sources	AC Current -Fluke 8588A	**(> 0.1 to 1) mA**		QTS/E-WP-03:2021	P/S
		10 Hz to 2 kHz	0.05 %		
		(> 2 to 10) kHz	0.09 %		
		(> 10 to 30) kHz	0.13 %		
		(> 1 to 10) mA			
		10 Hz to 2 kHz	0.05 %		
		(> 2 to 10) kHz	0.09 %		
		(> 10 to 30) kHz	0.12 %		
		(> 10 to 100) mA			
		10 Hz to 2 kHz	0.05 %		
		(> 2 to 10) kHz	0.09 %		
		(> 10 to 30) kHz	0.12 %		
		(> 0.1 to 1) A			
		10 Hz to 2 kHz	0.06 %		
		(> 2 to 10) kHz	0.13 %		
		(> 10 to 30) kHz	0.12 %		
		(> 1 to 10) A			
		10 Hz to 2 kHz	0.18 %		
		(> 2 to 10) kHz	0.18 %		
		(> 10 to 30) A			
		10 Hz to 2 kHz	0.19 %		
		(> 2 to 10) kHz	0.21 %		
	AC Current, Welding machine and similar	**(10 to 900) A**		QTS/E-WP-10:2022	P/S
		40 to 400 Hz	2.1 %		
	Capacitance -Fluke 8588A	(0.001 to 2) nF	0.42 %	QTS/E-WP-03:2021	P/S
		(> 2 to 20) nF	0.34 %		
		(> 20 to 200) nF	0.09 %		
		(> 0.2 to 2) µF	0.09 %		
		(> 2 to 20) µF	0.08 %		
Electrical – Calibration of Sources	Capacitance -Fluke 8588A	(> 20 to 200) µF	0.11 %	QTS/E-WP-03:2021	P/S
		(> 0.2 to 2) mF	0.11 %		
		(> 2 to 20) mF	0.13 %		
		(> 20 to 100) mF	0.14 %		
	Frequency -Fluke 8588A	10 Hz to 100 MHz	1 µHz/Hz	QTS/E-WP-03:2021	P/S
	Thermocouple Type B	(600 to 800) ˚C	0.68 °C	QTS/E-WP-05:2021	P/S

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Accreditation Scope

Quality Technical Services, NAL 095
Calibration Laboratory, (ISO/IEC 17025:2017)

M72, MW4, Musaffah, Abu Dhabi, UAE

Issue Date: 29-08-2024 **Expiry Date: 28-12-2024**
Issue No: 09

Calibration Field/ Quantity/ Property	Measurand / Equipment	Measurement Range	Expanded Measurement Uncertainty (k=2)	Calibration Method (Standard/ Internal Procedure)	Permanent lab (P) / Client-site (S)
Temperature Simulation – Source and Measure		(> 800 to 1000) ˚C	0.56 °C		
		(> 1000 to 1550) ˚C	0.45 °C		
		(> 1550 to 1820) ˚C	0.47 °C		
	Thermocouple Type E	(-250 to -100) ˚C	0.41°C	QTS/E-WP-05:2021	P/S
		(> -100 to -25) ˚C	0.16 °C		
		(> -25 to 350) ˚C	0.14 °C		
		(> 350 to 650) ˚C	0.15 °C		
		(> 650 to 1000) ˚C	0.19 °C		
	Thermocouple Type J	(-210 to -100) ˚C	0.25 °C	QTS/E-WP-05:2021	P/S
		(> -100 to -30) ˚C	0.17 °C		
		(> -30 to 150) ˚C	0.15 °C		
		(> 150 to 760) ˚C	0.17 °C		
		(> 150 to 760) ˚C	0.21 °C		
	Thermocouple Type K	(-200 to -100) ˚C	0.31 °C	QTS/E-WP-05:2021	P/S
		(> -100 to -25) ˚C	0.20 °C		
		(> -25 to 120) ˚C	0.19 °C		
		(> 120 to 1000) ˚C	0.25 °C		
		(> 1000 to 1372) ˚C	0.36 °C		
	Thermocouple Type N	(-200 to -100) ˚C	0.38 °C	QTS/E-WP-05:2021	P/S
		(> -100 to -25) ˚C	0.25 °C		
		(> -25 ˚C to 120) ˚C	0.22 °C		
		(> 120 to 410) ˚C	0.20 °C		
		(> 410 to 1300) ˚C	0.25 °C		
Temperature Simulation – Source and Measure	Thermocouple Type R	(0 to 250) ˚C	0.65 °C	QTS/E-WP-05:2021	P/S
		(> 250 to 400) ˚C	0.50 °C		
		(> 400 to 1000) ˚C	0.42 °C		
		(> 1000 to 1767) ˚C	0.47 °C		
	Thermocouple Type S	(0 to 250) ˚C	0.61 °C	QTS/E-WP-05:2021	P/S
		(> 250 to 1000) ˚C	0.53 °C		
		(> 1000 to 1400) ˚C	0.47 °C		
		(> 1400 to 1767) ˚C	0.55 °C		
	Thermocouple Type T	(-250 to -150) ˚C	0.83 °C	QTS/E-WP-05:2021	P/S
		(> -150 to 0) ˚C	0.23 °C		
		(> 0 to 120) ˚C	0.17 °C		
		(> 120 to 400) ˚C	0.15 °C		
	RTD - Pt 385, 100 Ω	(-200 to -80) ˚C	0.06 °C	QTS/E-WP-05:2021	P/S
		(> -80 to 0) ˚C	0.06 °C		

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Accreditation Scope

Quality Technical Services, NAL 095
Calibration Laboratory, (ISO/IEC 17025:2017)

M72, MW4, Musaffah, Abu Dhabi, UAE

Issue Date: 29-08-2024 **Expiry Date: 28-12-2024**
Issue No: 09

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		(> 0 to 100) ˚C	0.07 °C		
		(> 100 to 300) ˚C	0.09 °C		
		(> 300 to 400) ˚C	0.10 °C		
		(> 400 to 630) ˚C	0.12 °C		
		(> 630 to 800) ˚C	0.22 °C		
	RTD - Pt 3926, 100 Ω	(-200 to -80) ˚C	0.06 °C	QTS/E-WP-05:2021	P/S
		(> -80 to 0) ˚C	0.06 °C		
		(> 0 to 100) ˚C	0.07 °C		
		(> 100 to 300) ˚C	0.09 °C		
		(> 300 to 400) ˚C	0.10 °C		
		(> 400 to 630) ˚C	0.12 °C		
	RTD - Pt 3916, 100 Ω	(-200 to -190) ˚C	0.20 °C	QTS/E-WP-05:2021	P/S
		(> -190 to -80) ˚C	0.05 °C		
		(> -80 to 0) ˚C	0.06 °C		
		(> 0 to 100) ˚C	0.06 °C		
		(> 100 to 260) ˚C	0.07 °C		
Temperature Simulation – Source and Measure		(> 260 to 300) ˚C	0.08 °C		
		(> 300 to 400) ˚C	0.09 °C		
		(> 400 to 600) ˚C	0.10 °C		
		(> 600 to 630) ˚C	0.20 °C		
	RTD - Pt 385, 200 Ω	(-200 to -80) ˚C	0.04 °C	QTS/E-WP-05:2021	P/S
		(> -80 to 0) ˚C	0.04 °C		
		(> 0 to 100) ˚C	0.04 °C		
		(> 100 to 260) ˚C	0.05 °C		
		(> 260 to 300) ˚C	0.10 °C		
		(> 300 to 400) ˚C	0.11 °C		
		(> 400 to 600) ˚C	0.12 °C		
		(> 600 to 630) ˚C	0.13 °C		
	RTD - Pt 385, 500 Ω	(-200 to -80) ˚C	0.04 °C	QTS/E-WP-05:2021	P/S
		(> -80 to 0) ˚C	0.05 °C		
		(> 0 to 100) ˚C	0.05 °C		
		(> 100 to 260) ˚C	0.05 °C		
		(> 260 to 300) ˚C	0.07 °C		
		(> 300 to 400) ˚C	0.07 °C		
		(> 400 to 600) ˚C	0.08 °C		
		(> 600 to 630) ˚C	0.09 °C		

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Accreditation Scope

Quality Technical Services, NAL 095
Calibration Laboratory, (ISO/IEC 17025:2017)

M72, MW4, Musaffah, Abu Dhabi, UAE

Issue Date: 29-08-2024 **Expiry Date: 28-12-2024**
Issue No: 09

Calibration Field/ Quantity/ Property	Measurand / Equipment	Measurement Range	Expanded Measurement Uncertainty (k=2)	Calibration Method (Standard/ Internal Procedure)	Permanent lab (P) / Client-site (S)
	RTD - Pt 385, 1 kΩ	(-200 to -80) ˚C	0.03 °C	QTS/E-WP-05:2021	P/S
		(> -80 to 0) ˚C	0.03 °C		
		(> 0 to 100) ˚C	0.04 °C		
		(> 100 to 260) ˚C	0.05 °C		
		(> 260 to 300) ˚C	0.05 °C		
		(> 300 to 400) ˚C	0.06 °C		
		(> 400 to 600) ˚C	0.06 °C		
		(> 600 to 630) ˚C	0.18 °C		
Temperature	Direct Indicating Thermometer with Thermocouple Sensors	(-40 to 0) °C	0.18 °C	QTS/T-WP-01:2021 Euramet cg-08:2019	P/S
		(> 0 to 120) °C	0.27 °C		
		(> 120 to 300) °C	0.60 °C		
		(> 300 to 650) °C	1.2 °C		
		(> 650 to 900) °C	2.9 °C		
		(> 900 to 1200) °C	3.2 °C		
	Direct Indicating Thermometer with RTD Sensors	(-40 to 120) °C	0.17 °C	QTS/T-WP-01:2021 ASTM E2877-12e1	P/S
		(> 120 to 300) °C	0.30 °C		
		(> 300 to 650) °C	0.36 °C		
	Liquid-in-glass Thermometer	(-40 to 50) °C	0.25 °C	QTS/T-WP-03:2021 OIML R 133:2002	P
		(> 50 to 250) °C	0.30 °C		
	Infrared Thermometer - Body Mode	(20 to 50) °C	0.3 °C	QTS/T-WP-02:2021 ASTM E2847:2014	P
	Infrared Thermometer - Surface Mode	(-30 to 10) °C	2.7 °C	QTS/T-WP-02:2021 ASTM E2847:2014	P
		(> 10 to 150) °C	1.7 °C		
		(> 150 to 500) °C	2.4 °C		
	Dry Block Calibrator	(-40 to 600) °C	0.24 °C	QTS/T-WP-05:2022 Euramet cg-13:2017	P/S
		(> 600 to 1200) °C	2.9 °C		
	Climatic Chamber (Calibration of chillers, freezers, incubators, ovens, etc. 1 pt./9 pt.)	(-30 to 120) °C	0.52 °C	QTS/T-WP-04:2022 DKD-R 5-7:2009 Methods (A, B & C)	P/S
		(> 120 to 300) °C	1.4 °C		

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Quality Technical Services, NAL 095
Calibration Laboratory, (ISO/IEC 17025:2017)

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Issue Date: 29-08-2024 **Expiry Date: 28-12-2024**
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Calibration Field/ Quantity/ Property	Measurand / Equipment	Measurement Range	Expanded Measurement Uncertainty (k=2)	Calibration Method (Standard/ Internal Procedure)	Permanent lab (P) / Client-site (S)
	Climatic Chamber (Calibration of Furnace, Asphalt Content, etc… 1 pt.)	Ambient temperature up to 300 °C	0.7 °C	QTS/T-WP-04:2022 DKD-R 5-7:2009 Methods (C)	P/S
		(> 300 to 1200) °C	2.1 °C		
Temperature	Liquid Bath (5 pt. calibration)	(-30 to 120) °C	0.52°C	QTS/T-WP-04:2022 DKD-R 5-7:2009 Methods (C)	P/S
		(> 120 to 300) °C	1.4 °C		
Humidity	Humidity Chamber 1 pt.	(15 to 95) % RH	2.7 %RH	QTS/T-WP-04:2022 DKD-R 5-7:2009	P/S
Temperature & Humidity	Thermo-hygrometer	(5 to 50) °C	0.3 °C	QTS/T-WP-06:2021	P
		(15 to 95) % RH	2.7 %RH		
Temperature & Pressure	Autoclave, and similar	(- 40 to 140) °C	0.3 °C	QTS/T-WP-07:2021	P/S
		(0.05 to 4) bar	0.04 bar		
Vacuum & Pressure	Vacuum	(-0.9 to -0.4) bar	3.2 mbar	QTS/P-WP-01:2022 ISO 3567:2011	P/S
		(> -0.4 to 0) bar	0.2 mbar		
	Pressure – (Pneumatic)	(> 0 to 0.4) bar	0.2 mbar	QTS/P-WP-01:2022 DKD-R 6-1:2014	P/S
		(> 0.4 to 20) bar	4.7 mbar		
		(> 20 to 160) bar	46 mbar		
	Pressure – (Hydraulic)	(0 to 700) bar	0.09 bar	QTS/P-WP-01:2022 DKD-R 6-1:2014	P/S
		(> 700 to 2800) bar	2.0 bar		
Barometric Pressure	Barometer	(500 to 1100) hPa	1.2 hPa	QTS/P-WP-02:2022	P
Rotation Speed	Tachometer, contact rotation measuring instrument	(6 to 100) rpm	0.8 rpm	QTS/Ph-WP-01:2022	P/S
		(> 100 to 1000) rpm	0.9 rpm		
		(> 1 to 10) krpm	2.1 rpm		
	Tachometer, non-contact rotation measuring instrument (optical)	(6 to 60) rpm	0.3 rpm	QTS/Ph-WP-01:2022	P/S
		(> 60 to 600) rpm	0.4 rpm		
		600 rpm to 6 krpm	0.4 rpm		
		(> 6 to 60) krpm	0.9 rpm		
		(> 60 to 90) krpm	1.2 rpm		
Rotation Speed	Centrifuge, Extractor machines, motors, or similar	(6 to 100) rpm	0.8 rpm	QTS/Ph-WP-01:2022	P/S
		(> 100 to 5000) rpm	0.9 rpm		
		(> 1 to 30) krpm	2.0 rpm		

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		(> 30 to 50) krpm	3.5 rpm		
		(> 50 to 99) krpm	3.9 rpm		
Wind Velocity	Air meter, Anemometer, Air Flow measurement	(0.1 to 30) m/s	8 %	QTS/En-WP-03:2021	P
pH	pH Meter	(4, 7, 10) pH @ 25°C	0.03 pH	QTS/En-WP-04:2021	P/S
Electrical Conductivity	Electrical Conductivity (EC) Meter	(100, 1413, 10000) µS/cm @ 25°C	1.7 %	QTS/En-WP-04:2021	P/S
Total Dissolved Solids	Total Dissolved Solids (TDS) Meter	(66, 941, 6656) ppm @ 25°C	1.7 %	QTS/En-WP-04:2021	P/S
Viscosity	Kinematic Viscosity (viscometer, BS/ ISO/Ford cup, or similar)	(400 to 35000) cSt @ 25°C	3.3 %	QTS/En-WP-04:2021	P/S
	Dynamic Viscosity (viscometer, BS/ ISO/Ford cup, or similar)	(500 to 31500) mPa.s @ 25°C	3.2 %	QTS/En-WP-04:2021	P/S
Density	Density Hydrometer	(0.90 to 1.10) g/ml	0.0012 g/ml	QTS/Ph-WI-11:2022	P
Acoustic	Sound Level Meter	74 dB	0.2 dB	QTS/En-WP-01: 2021	P
		84 dB	0.2 dB		
		94 dB	0.2 dB		
		104 dB	0.2 dB		
		114 dB	0.2 dB		
	Acoustic Calibrator	74 dB	0.8 dB	QTS/En-WP-01: 2021	P
		84 dB	0.8 dB		
		94 dB	0.8 dB		

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		104 dB	0.8 dB		
		114 dB	0.8 dB		
Time Interval	Stopwatch and Timer	10 s to 1 hr	0.2 s	QTS/Ph-WP-02:2022	P/S
Illuminance	Light Meter, Illuminance Measurement	(0.1 to 20) klux	4.4 %	QTS/En-WP-02: 2021	P/S
Material Gloss	Gloss Meter	(10 to 100) Gloss unit (Gu)	5 Gu	QTS/Ph-WP-05: 2021	P/S
Material Hardness	Hardness Testing Machines and Metal Hardness – Indirect Verification (Rockwell, Brinell, Vikers)	Rockwell 35 HRB	0.8 HRB	QTS/Ph-WP-03: 2021	P/S
		Rockwell 55 HRB	0.6 HRB		
		Rockwell 77 HRB	0.7 HRB		
		Rockwell 28 HRC	0.9 HRC		
		Rockwell 45 HRC	0.7 HRC		
		Rockwell 64 HRC	0.6 HRC		
	Durometer – Shore A, Rubber hardness	(0 to 100) HA	0.6 HA		
	Durometer – Shore D, Rubber hardness	(0 to 100) HD	0.6 HD		
Vibration	Vibration Meter and Vibration Measurement	**Acceleration (a); 16Hz to 1.3 kHz**		QTS/Ph-WP-06: 2021	P/S
		(1 to 20) m/s^2	1.2 %		
		Velocity (v)			
		(0 to 20) m/s	1.2 %		
		Displacement (d)			
		(0.01 to 1) mm	1.2 %		
Volumetric	Micropipette Pipette (piston operated and digital)	(>100 to 200) µl	1.2 µl	QTS/Ph-WP-04:2022	P
		(200 to 500) µl	1.2 µl		
		(0.5 to 1) ml	2.9 µl		
		(1 to 10) ml	11.8 µl		
	Burette	10 ml	0.06 ml	QTS/Ph-WP-04:2021	P
		25 ml	0.06 ml		
		50 ml	0.08 ml		

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		100 ml	0.13 ml		
	Beaker and Graduated Cylinder	10 ml	0.06 ml	QTS/Ph-WP-04:2021	P
		20 ml	0.16 ml		
		50 ml	0.3 ml		
		100 ml	0.6 ml		
		200 ml	0.6 ml		
		500 ml	0.8 ml		
		1 L	1.5 ml		
		2 L	3.0 ml		
Volumetric	Single-Mark Flask	10 ml	0.06 ml	QTS/Ph-WP-04:2021	P
		20 ml	0.06 ml		
		50 ml	0.07 ml		
		100 ml	0.11 ml		
		200 ml	0.19 ml		
		500 ml	0.46 ml		
		1 L	0.9 ml		
		10 L	9 ml		
		30 L	27 ml		
Energy	Dynamic Penetrometer (SPT Hammer Energy Verification)	473 J	4.5 %	QTS/Ph-WP-15:2022	S
Physical	Concrete Test Hammer - Schmidt Original - Silver Schmidt	Original Schmidt N = 81 R / L = 75 R Silver Schmidt UN=76.5 Q/UL=78.0 Q	1.5 %	QTS/Ph-WP-14:2022	P/S
END					

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