



Annex (1)

To the Accreditation Certificate No. **JAS Cal. - 001** Dated **2021-03-26**

For **Jordan National Metrology Institute at Royal Scientific Society/ Amman**

In the field of Calibration of:

AC & DC Current, AC & DC Voltage, DC Resistance, Electrical-High Voltage, Electrical-Earth Resistance & Insulation Resistance, Electrical- Power and Power Factor, Mass, Temperature, Relative humidity, Force, Length, Pressure, Acoustics, Volume, Time, Frequency, Rotational Speed

Measurand	Measuring Range	Calibration and measurement Capability (CMC) <sup>a</sup>	Calibration Methods/ Standards/ Remarks
<b>DC Voltage (Calibration Location: JNMI/Permanent)</b>			
Sources, Fixed Values	100 mV	$6.4 * 10^{-6} * U$	JNMI SMP 48 [Issue No.:(2) Date: 15/7/2020] - Calibration of DC Voltage Source  U= measured voltage Calibration using 732 B DC Reference Standard
	1 V	$2.5 * 10^{-6} * U$	
	1.018 V	$2.5 * 10^{-6} * U$	
	10 V	$2.4 * 10^{-6} * U$	
	100 V	$2.4 * 10^{-6} * U$	
	1000 V	$2.6 * 10^{-6} * U$	
Measuring Instruments	1 mV to 2.2 mV	2 $\mu$ V	JNMI SMP 02 [Issue No.:(2) Date: 15/07/2020 ] Calibration of DC Voltage Meter  Euramet cg-15 (V 3.0)  Using Multi-function Calibrator
	> 2.2 mV to 10 mV	2 $\mu$ V	
	> 10 mV to 220 mV	$2.4 * 10^{-6} * U + 5.8 \mu$ V	
	> 220 mV to 2.2 V	$4.0 * 10^{-6} * U + 5.2 \mu$ V	
	> 2.2 V to 11 V	$4.2 * 10^{-6} * U + 3.8 \mu$ V	
	> 11 V to 22 V	$4.3 * 10^{-6} * U + 4.0 \mu$ V	
	> 22 V to 220 V	$5.6 * 10^{-6} * U + 38 \mu$ V	
	> 220 V to 1000 V	$7.0 * 10^{-6} * U + 0.38$ mV	
	1 mV to < 10 mV	2.5 $\mu$ V	JNMISMP( 49), Issue No. (2), Date: 15/7/2020] Using DMM Agilent 34420A
Sources	10 mV to < 0.2 V	9 $\mu$ V	JNMI SMP 01 [Issue No.:(2) Date: 15/07/2020] - Calibration of DC Voltage Source Using DMM
	0.2 V to < 2 V	$4.1 * 10^{-6} * U + 7.6 \mu$ V	
	2 V to < 20 V	$5.0 * 10^{-6} * U + 7.7 \mu$ V	
	20 V to < 200 V	$7.2 * 10^{-6} * U + 55 \mu$ V	
	200 V to 1000 V	$8.4 * 10^{-6} * U + 0.6$ mV	



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Measurand	Measuring Range	Calibration and measurement Capability (CMC) <sup>a</sup>	Calibration Methods/ Standards/ Remarks
DC Voltage Source	1 kV to 40 kV	0.2 % * U	JNMISMP82, Issue No.(2), Date: 15/7/2020 Where U is the Measured Voltage
DC Voltage Meter (Probe)	1 kV to 25 kV	0.4 % * U	JNMISMP82, Issue No.(2), Date: 15/7/2020 Where U is the Measured Voltage
<b>DC Current (Calibration Location: JNMI/Permanent)</b>			
Measuring Instruments	10 μA to < 0.22 mA 0.22 mA to 2.2 mA > 2.2 mA to 22 mA > 22 mA to 220 mA > 220 mA to 2.2 A > 2.2 A to 11 A	42 * 10 <sup>-6</sup> * I + 6 nA 38 * 10 <sup>-6</sup> * I + 7 nA 40 * 10 <sup>-6</sup> * I + 40 nA 55 * 10 <sup>-6</sup> * I + 0.7 μA 0.1 * 10 <sup>-3</sup> * I + 10 μA 0.39 * 10 <sup>-3</sup> * I + 0.46 mA	JNMI SMP 04 [Issue No.:(2) Date: 15/07/2020] - Calibration of DC Current Meter  Euramet cg-15 (V 3.0)
Fixed Values	50 μA 100 μA 200 μA 500 μA 1 mA 2 mA 5 mA 10 mA 20 mA 50 mA	8 * 10 <sup>-6</sup> * I 10 * 10 <sup>-6</sup> * I 9 * 10 <sup>-6</sup> * I 7 * 10 <sup>-6</sup> * I 6 * 10 <sup>-6</sup> * I 12 * 10 <sup>-6</sup> * I 10 * 10 <sup>-6</sup> * I 10 * 10 <sup>-6</sup> * I 15 * 10 <sup>-6</sup> * I 22 * 10 <sup>-6</sup> * I	JNMI SMP 48 [Issue No.:(2) Date: 15/2/2020] -  I= measured current



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Measurand	Measuring Range	Calibration and measurement Capability (CMC) <sup>a</sup>	Calibration Methods/ Standards/ Remarks
	100 mA 200 mA 500 mA 1 A 2 A 3 A 5 A 8 A 10 A	$18 * 10^{-6} * I$ $31 * 10^{-6} * I$ $15 * 10^{-6} * I$ $28 * 10^{-6} * I$ $59 * 10^{-6} * I$ $55 * 10^{-6} * I$ $52 * 10^{-6} * I$ $0.15 * 10^{-3} * I$ $0.15 * 10^{-3} * I$	
Sources	10 $\mu$ A to < 0.2 mA 0.2 mA to < 2 mA 2 mA to < 20 mA 20 mA to 0.2 A 2.2 A to 2 A 2 A to 20 A	$44 * 10^{-6} * I + 6$ nA $40 * 10^{-6} * I + 8$ nA $42 * 10^{-6} * I + 60$ nA $66 * 10^{-6} * I + 1$ $\mu$ A $0.2 * 10^{-3} * I + 19$ $\mu$ A $0.55 * 10^{-3} * I + 0.61$ $\mu$ A	JNMI SMP 03 [Issue No.:(2) Date: 15/07/2020] - Calibration of DC Current Source  I=measured current
Clamp Meters	20 A to < 150 A 150 A to 1000 A	$6 * 10^{-3} * I + 0.2$ A $6 * 10^{-3} * I + 0.6$ A	Using 50-turns-coil, Voltage Source 5520A JNMISMP64, Issue (2) Date: 15/07/2020  I: Measured current
<b>DC Resistance (Calibration Location: JNMI/Permanent)</b>			
DC Resistors Measuring Instruments	1 $\Omega$ 1.9 $\Omega$ 10 $\Omega$ 100 $\Omega$ 1 k $\Omega$	$12 * 10^{-6} * R$ $11 * 10^{-6} * R$ $16 * 10^{-6} * R$ $18 * 10^{-6} * R$ $8 * 10^{-6} * R$	JNMI SMP 06 [Issue No.:(2) Date: 15/07/2020] - Calibration of DC Resistance Meters  Euramet cg-15 (V 3.0)  R= measured value  Using 5720 A



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Measurand	Measuring Range	Calibration and measurement Capability (CMC) <sup>a</sup>	Calibration Methods/ Standards/ Remarks
	10 kΩ 19 kΩ 100 kΩ 1 MΩ 10 MΩ 19 MΩ 100 MΩ	$2.5 * 10^{-6} * R$ $3.4 * 10^{-6} * R$ $4.6 * 10^{-6} * R$ $16 * 10^{-6} * R$ $0.13 * 10^{-3} * R$ $0.14 * 10^{-3} * R$ $0.59 * 10^{-3} * R$	Multi-function calibrator
DC Resistors Measuring Instruments	1 GΩ 10GΩ	$18 * 10^{-3} * R$ $31 * 10^{-3} * R$	JNMISMP(06 ), Issue ( 2), Date:15/7/2020 Using Decade Resistance Box
DC Resistors Fixed Values	0.001 0.01 0.1	$0.44 * 10^{-3} * R$ $0.44 * 10^{-3} * R$ $0.1 * 10^{-3} * R$	JNMI SMP 84 [Issue No.:(2) Date: 15/7/2020]
DC Resistors Fixed Values	0.1 Ω 1 Ω 1.9 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ 19 kΩ 100 kΩ 1 MΩ 10 MΩ 19 MΩ 100 MΩ	$45 * 10^{-6} * R$ $9 * 10^{-6} * R$ $8 * 10^{-6} * R$ $16 * 10^{-6} * R$ $9 * 10^{-6} * R$ $4 * 10^{-6} * R$ $2.5 * 10^{-6} * R$ $2.4 * 10^{-6} * R$ $4 * 10^{-6} * R$ $12 * 10^{-6} * R$ $0.11 * 10^{-3} * R$ $0.13 * 10^{-3} * R$ $0.62 * 10^{-3} * R$	JNMI SMP 48 [Issue No.:(2) Date: 15/7/2020]  R= measured resistance



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Measurand	Measuring Range	Calibration and measurement Capability (CMC) <sup>a</sup>	Calibration Methods/ Standards/ Remarks
DC Resistors Sources	0.1 Ω to < 2 Ω	$17 * 10^{-6} * R + 13 \mu\Omega$	JNMI SMP 05 [Issue No.:(2) Date: 15/07/2020] Calibration of DC Resistance Sources
	2.0 Ω to < 20 Ω	$19 * 10^{-6} * R + 10 \mu\Omega$	
	20 Ω to < 0.2 kΩ	$20 * 10^{-6} * R + 23 \mu\Omega$	
	0.2 kΩ to < 2 kΩ	$11 * 10^{-6} * R + 0.38 \text{ m}\Omega$	
	2 kΩ to < 20 kΩ	$8.3 * 10^{-6} * R + 4.7 \text{ m}\Omega$	
	20 kΩ to < 0.2MΩ	$8.8 * 10^{-6} * R + 44 \text{ m}\Omega$	
	0.2 MΩ to < 2 MΩ	$18 * 10^{-3} * R + 0.6 \Omega$	
	2 MΩ to < 20 MΩ	$0.14 * 10^{-3} * R + 30 \Omega$	
	20MΩ to < 0.2GΩ	$0.58 * 10^{-3} * R + 4.7 \text{ k}\Omega$	
	0.2GΩ to < 2 GΩ	$18 * 10^{-3} * R + 2.4 \text{ k}\Omega$	
2 GΩ to < 20 GΩ	$3 * 10^{-3} * R + 6.8 \text{ M}\Omega$		
<b>AC Voltage (Calibration Location: JNMI/Permanent)</b>			
AC Voltage Sources, fixed values 40 Hz to 1 kHz	0.1 V	$25 * 10^{-6} * U$	JNMI SMP 48 [Issue No. : (2) Date:15/7/2020]  U= measured voltage
	1 V	$24 * 10^{-6} * U$	
	10 V	$25 * 10^{-6} * U$	
	100 V	$27 * 10^{-6} * U$	
	1000 V	$39 * 10^{-6} * U$	
AC Voltage Measuring Instruments 40 Hz to 1 kHz	22 mV to 220 mV	$67 * 10^{-6} * U + 13 \mu\text{V}$	JNMI SMP 08 [Issue No.:(2) Date: 15/07/2020] - Calibration of AC Voltage Meter Euramet cg-15 (V 3.0)  U= measured voltage
	> 220 mV to 2.2 V	$50 * 10^{-6} * U + 12 \mu\text{V}$	
	> 2.2 V to 22 V	$52 * 10^{-6} * U + 46 \mu\text{V}$	
	> 22 V to 220 V	$59 * 10^{-6} * U + 0.56 \text{ mV}$	
	> 220 V to 1000 V	$80 * 10^{-6} * U + 3.2 \text{ mV}$	
AC Voltage Sources 40 Hz to 1 kHz	10 mV to < 0.2V	$1 * 10^{-3} * U + 18 \mu\text{V}$	JNMI SMP 07 [Issue No.: (2); Date: 15/07/2020] - Calibration of AC Voltage Sources  U= measured voltage
	0.2 mV to < 2 V	$0.11 * 10^{-3} * U + 26 \mu\text{V}$	



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Measurand	Measuring Range	Calibration and measurement Capability (CMC) <sup>a</sup>	Calibration Methods/ Standards/ Remarks
	2 V to < 20 V 20 V to < 200 V 200 V to 1000 V	$0.10 * 10^{-3} * U + 0.20$ mV $0.11 * 10^{-3} * U + 2$ mV $0.13 * 10^{-3} * U + 19$ mV	
AC Voltage Source	1 kV to 20 kV	$1.6 \% * U$	JNMISMP82, Issue No.(2), Date: 15/7/2020 Where U is the Measured Voltage
AC Voltage Meter (Probe)	1 kV to 10 kV	$2 \% * U$	JNMISMP82, Issue No.(2), Date: 15/7/2020 Where U is the Measured Voltage
<b>AC Current (Calibration Location: JNMI/Permanent)</b>			
AC Current Sources Fixed Values 40 Hz to 1 kHz	50 mA 0.1 A 0.2 A 0.5 A 1 A 2 A 3 A 5 A 10 A	$29 * 10^{-6} * I$ $26 * 10^{-6} * I$ $35 * 10^{-6} * I$ $26 * 10^{-6} * I$ $33 * 10^{-6} * I$ $67 * 10^{-6} * I$ $62 * 10^{-6} * I$ $61 * 10^{-6} * I$ $0.16 * 10^{-3} * I$	JNMI SMP 48 [Issue No.:(2) Date: 15/7/2020 I is Measured Current
AC Current Measuring Instruments	> 22 mA to 220 mA > 220 mA to 2.2 A > 2.2 A to 5 A	$0.13 * 10^{-3} * I + 2.5 \mu A$ $0.27 * 10^{-3} * I + 34 \mu A$ $0.47 * 10^{-3} * I + 0.17$ mA	JNMI SMP 10 [Issue No.:(2) Date: 15/07/2020] - Calibration of AC Current Meter Euramet cg-15 (V 3.0)





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Measurand	Measuring Range	Calibration and measurement Capability (CMC) <sup>a</sup>	Calibration Methods/ Standards/ Remarks
40 Hz to 1 kHz	> 5 A to 11 A	$0.49 * 10^{-3} * I + 0.16 \text{ mA}$	I= measured Current
AC Current Sources 40 Hz to 1 kHz	10 mA to < 0.2 A 0.2A to < 2A 2 A to 20 A	$0.28 * 10^{-3} * I + 20 \mu\text{A}$ $0.66 * 10^{-3} * I + 0.2 \text{ mA}$ $0.95 * 10^{-3} * I + 1.9 \text{ mA}$	JNMI SMP 09 [Issue No.:(2) Date: 15/07/2020 - Calibration of AC Current Source  I= measured Current
AC Current Clamp Meters 45 Hz to 65 Hz	20 A to < 150 A 150 A to 1000 A	$3 * 10^{-3} * I + 0.1 \text{ A}$ $4 * 10^{-3} * I + 0.5 \text{ A}$	JNMISMP65, Issue (2), Date: 15/7/2020  I: Measured Current Using 50-turns-coil  Calibration of Toroidal Clamp Meters
AC Current Clamp Meters 45 Hz to 65 Hz	20 A to < 150 A 150 A to 1000 A	$7 * 10^{-3} * I + 0.4 \text{ A}$ $7 * 10^{-3} * I + 1.2 \text{ A}$	JNMISMP65, Issue (2), Date: 15/7/2020  I: Measured Current Using 50-turns-coil  Calibration of Non-Toroidal Clamp Meters
Current Transformer	(0 to 100) A	$0.13 \% * I$	Method Used: JNMISMP99, Issue No.(2), Date: 15/7/2020
<b>AC Current (Calibration Location: JNMI/Permanent &amp; On-Site)</b>			
Energy Meter Test Benches & Electrical Sources	(5 to 600) V AC/DC (0 to 20) A AC/DC > (20 to 100) A AC/DC (0 to 6) kW	$0.17 \% * V$ $0.25 \% * I$ $0.2 \% * I$ $0.25 \% * P$	Method Used: JNMISMP100 Issue No.(2), Date: 15/7/2020
<b>Length (Calibration Location: JNMI/Permanent)</b>			



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Measurand	Measuring Range	Calibration and measurement Capability (CMC) <sup>a</sup>	Calibration Methods/ Standards/ Remarks
Micrometer for External Measurements	0 mm to 250 mm	$3 \mu\text{m} + 10 * 10^{-6} * \ell$	JNMISMP (36), Issue (2), Date:15/07/2020 VDI/VDE/DGQ 2618 Part 10.1 $\ell$ : is measured length
Vernier Caliper for external, internal, & depth measurements (Including digital & dial Indicators)	0 mm to 400 mm > 400 mm to 500 mm	$30 \mu\text{m} + 30*10^{-6}* \ell$ $60 \mu\text{m} + 30*10^{-6}* \ell$	JNMISMP (39), Issue (2), Date:15/7/2020 VDI/VDE/DGQ 2618 Part 9.1 $\ell$ : is measured length
Dial Gauges	0 mm to 100 mm	$6 \mu\text{m} + 10*10^{-6}* \ell$	JNMISMP (32), Issue (2), Date:15/7/2020 VDI/VDE/DGQ 2618 Part 11.1 $\ell$ : is measured length
Gauge Blocks made of Steel or Ceramics	0.5 mm to 100 mm	For the central length $0.08 \mu\text{m} + 0.8*10^{-6}* \ell$  l is the length of the gauge block For the deviations fo and fu from the central length $0.05 \mu\text{m}$	JNMISMP (35), Issue (2), Date: 15/7/2020 VDI/VDE/DGQ 2618 Part 3.1  Measurement of the Deviation of the central length lc from the nominal length ln by comparison method. Standard and gauge block under test must be of same nominal length and made of the same material.  Measurement of the deviations fo and fu from the central length lc by 5 point comparison method.  Quality of the measuring faces according to the commitments in the Laboratory Quality Manual and the Calibration Procedure  L is the length of the gauge block





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Measurand	Measuring Range	Calibration and measurement Capability (CMC) <sup>a</sup>	Calibration Methods/ Standards/ Remarks
Gauge Blocks made of Tungsten Carbide	0.5 mm to 100 mm	For the central length $0.08 \mu\text{m} + 0.5 * 10^{-6} * L$ For the deviations $f_o$ and $f_u$ from the central length $0.05 \mu\text{m}$	JNMISMP (35), Issue (2), Date: 15/7/2020 VDI/VDE/DGQ 2618 Part 3.1  Measurement of the Deviation of the central length $l_c$ from the nominal length $l_n$ by comparison method. Standard and gauge block under test must be of same nominal length and made of the same material.  Measurement of the deviations $f_o$ and $f_u$ from the central length $l_c$ by 5 point comparison method.  Quality of the measuring faces according to the commitments in the Laboratory Quality Manual and the Calibration Procedure  L is the length of the gauge block
<b>Length (Calibration Location: On-Site)</b>			
Extensometer	(0 to 5) mm	$0.4 \mu\text{m}$	JNMISMP (35), Issue (2), Date: 15/7/2020 VDI/VDE/DGQ 2618 Part 3.1 Measurement of the Deviation of the central length $l_c$ from the nominal length $l_n$ by comparison method. Standard and gauge block under test must be of same nominal length and made of the same material.  Measurement of the deviations $f_o$ and $f_u$ from the central length $l_c$ by 5 point comparison method.  Quality of the measuring faces according to the commitments in the



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Measurand	Measuring Range	Calibration and measurement Capability (CMC) <sup>a</sup>	Calibration Methods/ Standards/ Remarks
			Laboratory Quality Manual and the Calibration Procedure  L is the length of the gauge block JNMISMP87, Issue (2), Date:15/7/2020 ISO 9513: 2012 ASTM E83-16:2016
<b>Length (Rulers and Linear Scales) – (Calibration Location: JNMI/Permanent)</b>			
Rulers and Tape Measures	Up to 10 m	0.5 mm	JNMISMP(46), Issue (2), Date:15/7/2020
Linear Scale	Up to 2 m	0.16 mm	JNMISMP(51), Issue (2), Date:15/7/2020
Calibration Device for Extensometers	(0 to 25) mm	0.25 µm	JNMISMP(88), Issue (2), Date:15/7/2020
<b>Mass (Calibration Location: JNMI/Permanent)</b>			
Conventional Mass	1 mg, 2mg, 5 mg	0.003 mg	JNMISMP43 [Issue No.:(2) Date: 15/7/2020]  JNMISMP44 [Issue No.:(1) ; Date: 15/7/2020]  Class E2
	10 mg, 20 mg	0.003 mg	
	50 mg	0.004 mg	
	100 mg	0.005 mg	
	200 mg	0.006 mg	
	500 mg	0.008 mg	
	1 g	0.010 mg	
	2 g	0.012 mg	
	5 g	0.016 mg	
	10 g	0.020 mg	
	20 g	0.025 mg	



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Measurand	Measuring Range	Calibration and measurement Capability (CMC) <sup>a</sup>	Calibration Methods/ Standards/ Remarks
	50 g	0.030 mg	
	100 g	0.050 mg	
	200 g	0.10 mg	
	500 g	0.25 mg	
	1 kg	0.5 mg	
	2 kg	1.0 mg	
	5 kg	2.5 mg	
	10 kg	5 mg	
Conventional Mass	20 kg	30 mg	OIML recommendation R -111
	50 kg	80 mg	Class F1
Conventional Mass	1 mg to 100 mg	0.005 mg	For free nominal values m <sub>c</sub> : conventional mass
	> 100 mg to 200 mg	0.006 mg	
	> 200 mg to 500 mg	0.008 mg	
	> 500 mg to 1 g	0.010 mg	
	> 1 g to 2 g	0.012 mg	
	> 2 g to 5 g	0.015 mg	
	> 5 g to 10 g	0.020 mg	
	> 10 g to 20 g	0.025 mg	
	> 20 g to 50 g	0.030 mg	
	> 50 g to 100 g	0.05 mg	
	> 100 g to 10 kg	5 * 10 <sup>-7</sup> * m <sub>c</sub>	
	> 10 kg to 50 kg	1.6 * 10 <sup>-6</sup> * m <sub>c</sub>	
<b>Mass (Calibration Location: JNMI/Permanent &amp; On-Site)</b>			
Conventional Mass	5 kg	25 mg	OIML recommendation R 111, class F2
	10 kg	50 mg	For free nominal values



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Measurand	Measuring Range	Calibration and measurement Capability (CMC) <sup>a</sup>	Calibration Methods/ Standards/ Remarks
	20 kg 50 kg 5 kg to 50 kg	0.1 g 0.25 g $5 * 10^{-6} * m_c$	mc: conventional mass
Non-Automatic weighing instruments	Up to 60 kg	$2 * 10^{-6} * m$	EURAMET / cg – 18, Version 4.0 JNMISMP(45), Issue (2), Date: 15/7/2020 For weight pieces according to OIML R 111, class E2 Where m is the measured mass
	> 60 kg to 100 kg	$6 * 10^{-6} * m$	EURAMET / cg – 18, Version 4.0 JNMISMP(45), Issue (2), Date: 15/7/2020 For weight pieces according to OIML R 111, class F1
	> 100 to 770 kg	$3 * 10^{-5} * m$	EURAMET / cg – 18 JNMISMP(45), Issue (2), Date: 15/7/2020 For weight pieces according to OIML R 111, class M1 and other weights
<b>Temperature (Calibration Location: JNMI/Permanent)</b>			
Temperature Fixed point cells Resistance Thermometers, direct-reading thermometers & data loggers with external sensors	0.01 °C	5 mK	JNMISMP(58), Issue (2), Date:15/7/2020 Comparison with TPW
	- 95 °C to -85 °C	65 mK	JNMISMP(59), Issue (2), Date:15/7/2020 Comparison with standard platinum resistance thermometer  Heat Sources used are Ethanol Bath, Oil Bath, Salt Bath, Dry Block Calibrators, three Zone Furnace, as well as a TPW and a Gallium Cell
	> - 85 °C to 50 °C	25 mK	
	> 50 °C to 300 °C	35 mK	
	> 180 °C to 550 °C	50 mK	
	> 550 °C to 660 °C	0.4 K	
0.01 °C	5 mK		
	29.7646 °C	12 mK	
Liquid in Glass			JNMISMP(62), Issue (2),



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Measurand	Measuring Range	Calibration and measurement Capability (CMC) <sup>a</sup>	Calibration Methods/ Standards/ Remarks
Thermometers	- 85 °C to 300 °C > 300 °C to 550 °C	50 mK 60 mK	Date:15/7/2020 Comparison with standard platinum resistance thermometer Heat Sources used are stirred liquid baths
Noble Metal Thermocouples (B,R,S)	-85 °C to 50 °C 50 °C to 660 °C 350 °C to 700 °C 350 °C to 1100 °C	1.1 K 1.2 K 1.3 K 2.2 K	JNMISMP(60), Issue (2), Date:15/7/2020 Comparison with standard platinum resistance thermometer Heat Sources used are Ethanol Bath, Oil Bath, and Dry Block Calibrators Comparison with noble metal thermocouples Heat Sources are Dry Block Calibrators and Three Zone Furnace
Base Metal Thermocouples with direct reading devices (internal CJC)	-85 °C to 50 °C > 50 °C to 300 °C 180 °C to 550 °C -95 °C to 140 °C -25 °C to 150 °C 50 °C to 400 °C > 400 °C to 660 °C > 660 °C to 1100 °C	50 mK 62 mK 83 mK 62 mK 0.18 K 0.37 K 0.4 K 2.8 K	JNMISMP(61), Issue (2), Date:15/7/2020 Calibration using Ethanol bath, Oil bath, Salt bath, Dry block calibrators and 3-zone furnace Reference Standards used are PT-100 up to 550 °C, and Noble Metal TCs up to 1100 °C
Data loggers with air type sensors	-85 °C to -10 °C > -10 °C to 15 °C > 15 °C to 35 °C > 35 °C to 50 °C	0.3 K 0.5 K 0.3 K 0.6 K	JNMISMP (63), Issue (2), Date:15/7/2020 Comparison with PT-100 Heat Source used is a Climatic Chamber



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Measurand	Measuring Range	Calibration and measurement Capability (CMC) <sup>a</sup>	Calibration Methods/ Standards/ Remarks
	> 50 °C to 70 °C	0.8 K	
Dry block calibrators	-95 °C to 400 °C > 400 °C to 660 °C > 900 °C to 1100 °C	0.2 K 4 K 8 K	Euramet cg-13, Version 3.0 (02/2015) JNMISMP90, Issue (2), Date:15/7/2020 Comparison with SPRTs and Noble Metal TCs
Resistance thermometers, direct-reading thermometers and data loggers with external sensors	- 95 °C to -85 °C > - 85 °C to 50 °C > 50 °C to 300 °C > 180 °C to 550 °C > 550 °C to 660 °C	62 mK 50 mK 55 mK 70 mK 0.4 K	JNMISMP (61), Issue (2), Date:15/7/2020 Comparison with standard platinum resistance thermometer Heat Sources used are Ethanol Bath, Oil Bath, Salt Bath, Dry Block Calibrators, three Zone Furnace
IR/Radiation Thermometers	-8 °C to 120 °C > 120 °C to 250 °C > 250 °C to 500 °C > 500 °C to 982 °C	0.6 °C 1.1 °C 2.3 °C 2.9 °C	VDI/VDE 3511, Part 4.4:2005 and JNMISMP92, Issue (2), Date: 15/7/2020
IR/Radiation Thermometers (Medical)	30 °C to 45 °C	0.2 °C	JNMISMP92, Issue (2), Date: 15/7/2020
<b>Temperature (Calibration Location: JNMI/Permanent &amp; On-Site)</b>			
Thermocouple simulators	-200 °C to 200 °C	0.7 K	Euramet cg-11, Version 2.0 (03/2011)





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Measurand	Measuring Range	Calibration and measurement Capability (CMC) <sup>a</sup>	Calibration Methods/ Standards/ Remarks
	> 200 °C to 500 °C > 500 °C to 1200 °C	0.5 K 0.35 K	JNMISMP89, Issue (2), Date:15/7/2020
RTD simulators	-200 °C to 400 °C > 400 °C to 800 °C	0.05 K 0.08 K	Calibration using Multifunction Calibrator, Nano Voltmeter or Reference DMM
Thermocouple Indicators	-200 °C to 200 °C > 200 °C to 500 °C > 500 °C to 1200 °C	0.8 K 0.6 K 0.8 K	
RTD indicators	-200 °C to 400 °C > 400 °C to 800 °C	0.05 K 0.3 K	
Climatic Chambers with air circulation systems	-95 °C to 0 °C > 0 °C to 60 °C > 60 °C to 100 °C -85 °C to 0 °C > 0 °C to 60 °C > 60 °C to 100 °C	0.6 K 0.45 K 1.4 K 0.6 K 0.4 K 0.7 K	
Climatic chambers without air circulation systems	-95°C to 0 °C > 0 °C to 60 °C > 60 °C to 100 °C -85°C to 0 °C > 0 °C to 60 °C > 60 °C to 100 °C	0.7 K 0.5 K 1.6 K 0.7 K 0.5 K 0.8 K	Mapping using PT-100 Sensors or Thermocouples  If loaded, type and arrangement of loading has to be specified exactly in the calibration certificate
Heat Enclosures (ovens, Furnaces, Incubators, Autoclaves,	-95 °C to 20 °C > 20 °C to 250 °C	80 mK 90 mK	PT-100 Sensors TC Sensors JNMISMP79, Issue No.(2)



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Measurand	Measuring Range	Calibration and measurement Capability (CMC) <sup>a</sup>	Calibration Methods/ Standards/ Remarks
Freezers, Baths)	> 250 °C to 400 °C > 400 °C to 1100 °C	1.3 K 6 K	15/7/2020
Air Type Temperature Sensors	5 °C to 50 °C	0.15 K	JNMISMP97, Issue (2), Date:15/7/2020 Reference is capacitive sensor Uncertainty is an absolute value of relative humidity Calibration Medium: Portable Climatic Chamber (10 to 95) % RH
<b>Temperature (Calibration Location: JNMI/Permanent &amp; On-Site)</b>			
Calibration of industrial thermometers (RTD, TC and direct reading devices)	-95 °C to 140 °C > 125 °C to 400 °C > 400 °C to 1100 °C	0.2 K 0.4 K 5 K	JNMISMP (72), Issue No. (2), Rev, (1) Date:15/7/2020 Comparison with RTD
Climatic chambers with air circulation system (On-site)	( 5 to 11 ) % RH ( > 11 to 20 ) % RH ( > 20 to 30 ) % RH ( > 30 to 50 ) % RH ( > 50 to 75 ) % RH ( > 75 to 90 ) % RH	0.6 % RH 0.9 % RH 1.1 % RH 1.9 % RH 2.5 % RH 2.8 % RH	JNMISMP(71), Issue (2), Date:15/7/2020 Euramet cg-20, Version 5.0 (09/2017) Method C Measurement with capacitive



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Measurand	Measuring Range	Calibration and measurement Capability (CMC) <sup>a</sup>	Calibration Methods/ Standards/ Remarks
	(> 90 to 95) % RH	3.5 % RH	reference humidity sensor
Climatic chambers without air circulation system (On-site)	(5 to 11) % RH	0.6 % RH	If loaded, type and arrangement of loading has to be specified exactly in the calibration certificate Measurement uncertainty is an absolute value Methods A and B Air temperature 20°C
	(> 11 to 20) % RH	1.0 % RH	
	(> 20 to 30) % RH	1.2 % RH	
	(> 30 to 50) % RH	2.1 % RH	
	(> 50 to 75) % RH	2.9 % RH	
	(> 75 to 90) % RH	3.2 % RH	
	(> 90 to 95) % RH	3.9 % RH	
<b>Humidity (Calibration Location: JNMI/Permanent)</b>			
Hygrometers / Humidity Sensors, Humidity Indicators	(10 to 20) % RH	0.28 % RH	JNMISMP (56), Issue (2), Date:15/7/2020 0 °C to 70 °C
	(> 20 to 30) % RH	0.37 % RH	
	(> 30 to 50) % RH	0.67 % RH	
	(> 50 to 75) % RH	0.90 % RH	
	(> 75 to 90) % RH	1.0 % RH	
	(> 90 to 95) % RH	1.2 % RH	
Hygrometers/ Humidity Sensors, Humidity Indicators	(10 to 20) % RH	0.50 % RH	JNMISMP (57), Issue (2), Date: [15/7/2020] Reference is capacitive sensor Uncertainty is an absolute value of relative humidity 0 °C to 70 °C
	(> 20 to 30) % RH	0.66 % RH	
	(> 30 to 50) % RH	1.2 % RH	
	(> 50 to 75) % RH	1.6 % RH	
	(> 75 to 90) % RH	1.8 % RH	
	(> 90 % to 95) % RH	2.2 % RH	



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Measurand	Measuring Range	Calibration and measurement Capability (CMC) <sup>a</sup>	Calibration Methods/ Standards/ Remarks
Hygrometers / Humidity Sensors, Humidity Indicators	(10 to 30) % RH (> 30 to 50) % RH (> 50 to 75) % RH (> 75 to 90) % RH (> 90 to 95) % RH	0.7 % RH 1.1 % RH 1.4 % RH 1.6 % RH 1.8 % RH	JNMISMP97, Issue (2), Date:15/7/2020 Reference is capacitive sensor Uncertainty is an absolute value of relative humidity Calibration Medium: Portable Climatic Chamber (5 to 50) °C
<b>Force (Calibration Location: JNMI/Permanent)</b>			
Load cells (Compression)	10 kN to 100 kN 50 kN to 500 kN 100 kN to 1MN 200 kN to 2MN	0.034 % * Fi 0.32 % * Fi 0.28 % * Fi 0.11 % * Fi	ISO 376:2011 ASTM E74:2018 JNMISMP(77), Issue (2), Date: 15/7/2020
Load cells (Tension)	10 kN to 100 kN 50 kN to 500 kN 100 kN to 1MN 200 kN to 2MN	0.034 % * Fi 0.32 % * Fi 0.28 % * Fi 0.11 % * Fi	ISO 376:2011 ASTM E74:2018 JNMISMP(77), Issue (2), Date: 15/7/2020
Torque Wrenches and Torque Measuring Tools	(0.565 to 5.65) N.m (11.3 to 113) N.m (81.35 to 813.5) N.m	0.3 % * Fi 0.3 % * Fi 0.72 % * Fi	ISO 6789:2017, parts 1 and 2 JNMISMP (91), Issue (2), Date: 15/7/2020 where Fi indicate Force
Force Measuring Instruments in Tension Mode	(5 to 2000) N > 2 kN to 50 kN	0.15 % * Fi 0.3 % * Fi	Masses (Class M1) Reference Load Cells Method Used: VDI/VDE 2624 Part 2.1 (2008) & JNMISMP101 Issue No.(2), 15/7/2020
Force Measuring Instruments in	100 N to 50 kN	0.3 % * Fi	Masses (Class M1) Reference Load Cells



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Measurand	Measuring Range	Calibration and measurement Capability (CMC) <sup>a</sup>	Calibration Methods/ Standards/ Remarks
compression			Method Used: VDI/VDE 2624 Part 2.1 (2008) & JNMISMP101 Issue No.(2), 15/7/2020
<b>Force (Calibration Location: On-Site)</b>			
Compression Machines	0.1 kN to 100 kN > 100 kN to 1 MN > 1 MN to 2 MN	0.04 % * Fi 0.056 % * Fi 0.074 % * Fi	Masses (Class M1) Reference Load Cells Method Used: VDI/VDE 2624 Part 2.1 (2008) & JNMISMP101 Issue No.(2), 15/7/2020 ISO 7500-1:2018 ASTM E4:2020.
Tensile Machines	10 N to 100 kN > 100 kN to 1 MN > 1 MN to 2 MN	0.04 % * Fi 0.05 % * Fi 0.074 % * Fi	JNMISMP (78), Issue (2), Date: 15/7/2020 ISO 7500-1:2018 ASTM E4:2020.  JNMISMP(78), Issue (2), Date: 15/7/2020
<b>Pressure (Calibration Location: JNMI/Permanent)</b>			
Absolute pressure p <sub>abs</sub>	0.1 bar to 3.5 bar > 3.5 bar to 35 bar > 35 bar to 201 bar	4.6 * 10 <sup>-5</sup> * p <sub>abs</sub> but not less than 12 μbar 4.6 * 10 <sup>-5</sup> * p <sub>abs</sub> 7.5 * 10 <sup>-5</sup> * p <sub>abs</sub>	DAkkS-DKD R 6-1 EURAMET/cg-17 JNMISMP (55), Issue (2), Date: 15/7//2020 JNMISMP (74) Pressure medium: Gas The uncertainty of the residual pressure has to be taken into



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Measurand	Measuring Range	Calibration and measurement Capability (CMC) <sup>a</sup>	Calibration Methods/ Standards/ Remarks
			<p>account.</p> <p>in connection with a gas/ oil volume</p> <p>Principle of measurement:  <math>p_{abs} = p_e + p_{amb}</math>.</p> <p>Where <math>P_{amb}</math> is considered to be 0.8 bar</p> <p>The uncertainty of the measured atmospheric pressure has to be taken into account.</p> <p>In case of atmospheric pressure, comparison using JNMISMP74</p>
Absolute pressure $p_{abs}$	0.8 bar ; 20.8 bar to 700.8 bar	$7.5 * 10^{-5} * p_{abs}$ but not less than 4.8 mbar	<p>DAkKS-DKD R 6-1</p> <p>EURAMET/cg-17</p> <p>JNMISMP (55), Issue (2), Date: 15/7//2020</p> <p>Pressure medium: Oil</p> <p>Principle of measurement:  <math>p_{abs} = p_e + p_{amb}</math>.</p> <p>Where <math>P_{amb}</math> is considered to be 0.8 bar</p> <p>The uncertainty of the measured atmospheric pressure has to be taken into account.</p>
Gauge pressure	-0.7 bar to -0.2 bar > -0.2 bar to 0 bar > 0 bar to 0.2 bar	0.07 mbar 0.011 mbar 0.008 mbar	<p>DAkKS-DKD R 6-1</p> <p>EURAMET/cg-17</p> <p>JNMISMP(55), Issue (2), Date: 15/7//2020</p>





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Measurand	Measuring Range	Calibration and measurement Capability (CMC) <sup>a</sup>	Calibration Methods/ Standards/ Remarks
	> 0.2 bar to 3.5 bar > 3.5 bar to 35 bar > 35 bar to 200 bar	4.6 * 10 <sup>-5</sup> * pe but not less than 12 μbar 4.6 * 10 <sup>-5</sup> * pe 7.5 * 10 <sup>-5</sup> * pe	Pressure medium: Gas in connection with a gas/ oil volume
Gauge pressure P <sub>e</sub>	0 bar; 20 bar to 700 bar	7.5*10 <sup>-5</sup> *pe but not less than 4.8 mbar	DAkKS-DKD R 6-1 EURAMET/cg-17 JNMISMP(55), Issue (2), Date: 15/7/2018 Pressure medium: Oil
Pressure	-0.8 to -0.2 bar 9 to 172 bar 10 to 100 bar > 100 to 1000 bar	0.024 mbar 2.4 mbar 1.2 mbar 21 mbar	Fluke 725xi Fluke 7250xi E-DWT EDWT In JNMI Labs JNMISMP55, Issue (2) Date : 15/7/2020
Pressure Pressure (Calibration Location: On- Site)	-1 to -0.2 bar 0.2 to 3.5 bar	0.12 mbar 0.12 mbar	Pace6000, Druck, DAkKS-DKD R 6-1:2014 DAkKS-DKD R 6-1 JNMISMP(55), Issue (2), Date:15/7/2020
<b>Pressure (Calibration Location: On-Site)</b>			
Pressure Pressure (Calibration Location: On- Site) Gauge pressure	-0.8 bar to 0 bar > 0 bar to 20 bar > 20 bar to 200 bar	0.08 mbar 1.0 mbar 29 mbar	DAkKS-DKD R 6-1 EURAMET/cg-17 JNMISMP(37), Issue (2), Date:15/7/2020 Pressure medium: Gas



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Measurand	Measuring Range	Calibration and measurement Capability (CMC) <sup>a</sup>	Calibration Methods/ Standards/ Remarks
$p_e$ Gauge pressure $p_e$	0 bar to 700 bar	29 mbar	DAkKS-DKD R 6-1:2014 EURAMET/cg-17 JNMISMP (37), Issue (2), Date:15/7/2020 Pressure medium: Oil
Pressure	-1 to -0.2 bar 0.2 to 3.5 bar	0.13 mbar 0.13 mbar	Pace6000, Druck, DAkKS-DKD R 6-1:2014 JNMISMP(55), Issue (2), Date:15/7/2020
<b>Barometric Measurement (Calibration Location: JNMI/Permanent)</b>			
Absolute pressure (barometric pressure) $p_{abs}$	90 kPa	0.01 kPa	JNMISMP(74), Issue (2), Date: 15/7/2020
<b>Barometric Measurement (Calibration Location: On-Site)</b>			
Absolute pressure (barometric pressure) $p_{abs}$	84 kPa - 110 kPa	0.01 kPa	JNMISMP(74), Issue (2), Date: 15/7/2020
<b>Electrical- Earth Testers &amp; Meggers (Calibration Location: JNMI/Permanent)</b>			
Earth Testers	1 m $\Omega$ to 10 k $\Omega$	0.26 %	JNMISMP83, Issue No.(2), Date: 15/7/2020
Meggers & Insulation Testers	1 k $\Omega$ to 100 G $\Omega$	0.26 %	JNMISMP83, Issue No.(2), Date: 15/7/2020
<b>Sound Level Meters (Calibration Location: JNMI/Permanent)</b>			
Sound Level Meters & Acoustic Calibrators	94 dB, 114 dB	0.4 dB	JNMISMP85, Issue No.(2), Date: 15/7/2020
<b>Electrical- Power Meters (Calibration Location: JNMI/Permanent)</b>			



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Measurand	Measuring Range	Calibration and measurement Capability (CMC) <sup>a</sup>	Calibration Methods/ Standards/ Remarks
AC Power Meters	0.001 kW to 20 kW	0.1 %	JNMISMP86 , Issue No.(2), Date: 15/7/2020 Where P is the indicated power
<b>Volume (Calibration Location: JNMI/Permanent)</b>			
Pipettes	10uL ≤ V ≤ 500 uL 500uL < V ≤ 1000 mL	0.024 μL 2.14 * 10 <sup>-5</sup> * V + 0.019 uL	JNMISMP52 Issue No.(2), Date : 15/7/2020 Euramet cg-19, Version 3 (09/2018) & ISO Series 8655:2002  Where V is Measured Volume
Volumetric Apparatus	10 mL ≤ V ≤ 500 mL 500 mL < V ≤ 1000 mL V > 1 L	0.004 % 0.003 % 0.002 %	JNMISMP52 Issue No.(2), Date: 15/7/2020 Euramet cg-19, Version 3 (09/2018) & ISO Series 8655:2002
<b>Time, Frequency and PF (Calibration Location: JNMI/Permanent)</b>			
Oscilloscope Vertical Deflection Rise Time Bandwidth Horizontal Deflection	(0 to 100) V 100 ps to 1 ms (0 to 1000) MHz 2 ns to 5 s	0.6 % * V 5 % * T 7 % * F 0.1 % * T	1) MPC 5520A 2) Signal Generator MG 3601 A Euramet cg-07: Version 1:2011 JNMISMP93, Issue No.(2) Date: 15/7/2020  Where V is Voltage, T is Time and F is Frequency
Time-primary	(0 to 60) s	38 ms	Tektronix Timer/Counter Analyzer FCA 3103



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Measurand	Measuring Range	Calibration and measurement Capability (CMC) <sup>a</sup>	Calibration Methods/ Standards/ Remarks
	(1 to 15) minute (15 to 30) minute (30 to 420) minute 7 hour to 24 hour	0.1 s 0.1 s 0.1 s 5.2 s	JNMISMP98, Issue No.(2), Date: 15/7/2020
Rotational Speed Sources & Tachometers	60 rpm – 600000 rpm	0.6 rpm + 0.01% * Sp	Fluke 5520A and Optical Tacho Adaptor JNMISMP38, Issue No.(2), Rev.(1): 15/7/2020 Where Sp is the speed value
<b>Time, Frequency &amp; PF (Calibration Location: JNMI/Permanent &amp; On-Site)</b>			
Power Factor Meter (Lead/Lag)	1 PF 0.9 PF 0.8 PF 0.7 PF 0.6 PF 0.5 PF 0.4 PF 0.3 PF 0.2 PF 0.0 PF	0.0004 PF 0.005 PF 0.006 PF 0.007 PF 0.008 PF 0.008 PF 0.008 PF 0.009 PF 0.01 PF 0.013 PF	Fluke 5720A JNMISMP94, Issue No.(2) 15/7/2020 Where PF is the Power factor
Function/Signal Generators (Frequency)	(0 to 3) GHz	$50 * 10^{-6} * F$ Where F is the measured Frequency	Tektronix Timer/Counter/Analyzer FCA 3103 Calibration of Frequency Only JNMISMP95, Issue No.(2) Date: 15/7/2020
Frequency Counters	(0 to 1000) MHz	$80 * 10^{-6} * F$	Fluke 5520A Signal Generator MG 3601 A JNMISMP96, Issue No. (2) Date:



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Measurand	Measuring Range	Calibration and measurement Capability (CMC) <sup>a</sup>	Calibration Methods/ Standards/ Remarks
		Where F is the measured Frequency	15/7/2020
(Stop watch, Timer, chronograph)	1 second to 7 hours 7 hours to 24 hours	0.6 s 12 s	Reference Stop Watch JNMISMP98, Issue No.(2), Date: 15/7/2020
<b>Dimensional (Calibration Location: JNMI/Permanent &amp; On-Site)</b>			
Dial Gauges	0 to 25 mm	0.01 mm	Ceramic Gauge Blocks JNMSMP32, Issue No. (1), Calibration using Gauge Blocks Date: : 15/2/2018

**a) The reported CMCs are expressed at approximately the 95 % level of confidence, 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.**

List of employees in the laboratory who are technically responsible for issuing the calibration certificates in the scope of accreditation:

1. Director of JNMI/ Eng. Fawaz M. Al-Labadi.
2. Head of Physical and Mechanical Metrology Division/ Eng. Loai M. Qdairat.
3. Head of Electrical Metrology Division/ Eng. Mustafa F. Flaifel.
4. Head of Physical Calibration Laboratory / Eng. Sukaina Deebajeh
5. Head of Mechanical Calibration Laboratory/ Eng. Mariam Bishtawi
6. Calibration Engineer/ Eng. Manal Abu Khalaf.
7. Calibration Engineer/ Eng. Dua'a Flaifel
8. Calibration Technician/ Mahmoud Sayyah
9. Calibration Technician/ Tareq Mofadi
10. Calibration Technician/ Omar Al-Omari
11. Calibration Technician/ Waheed Al-Ali
12. Calibration Technician/ Fadi Al-Husban