Annex 25: Measurement Capability of NIMT

Annex 25

Measurement Capability of NIMT

National Institute of Metrology (Thailand)

National Institute of Metrology (Thailand)

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Measurement Capability of NIMT

Item No.	Parameter	Description	Range	Uncertainty	Remark
1	DC Voltage	DC Voltage Standard	1 mV	0.12×10^{-3} *	
			2 mV	60×10^{-6} *	
			3 mV	40×10^{-6} *	
			4 mV	30×10^{-6} *	
			5 mV	25×10^{-6} *	
			6 mV	21×10^{-6} *	
			7 mV	19×10^{-6} *	
			8 mV	17×10^{-6} *	
			9 mV	15×10^{-6} *	
			10 mV	14×10^{-6} *	
			20 mV	10×10^{-6} *	
			30 mV	8×10^{-6} *	
			40 mV	7×10^{-6} *	
			50 mV, 60 mV, 70 mV	6×10^{-6} *	
			80 mV, 90 mV, 100 mV	6×10^{-6} *	
			100 mV	5×10^{-6} *	
			1 V	0.6×10^{-6} *	
			1.018 V	0.9×10^{-6} *	
			10 V	0.4×10^{-6} *	
			100 V	0.5×10^{-6} *	
			1000 V	0.7×10^{-6} *	
			0 V to 10 V	$0.5 \times 10^{-6} \times U + 2\ \mu V$ *	U is the measured voltage

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Item No.	Parameter	Description	Range	Uncertainty	Remark
1	DC Voltage	DC Voltage Standard	>10 V to 100 V	$0.5 \times 10^{-6} \times U + 15\ \mu V$ *	
			>100 V to 1000 V	$0.8 \times 10^{-6} \times U + 0.2$ mV *	
2	DC Resistance	Standard Resistor	0.001 Ω to <0.01 Ω (10 A to 100 A)	0.6×10^{-6} *	In oil 23 ^{0}C
			0.01 Ω to <0.1 Ω (1 A to 10 A)	0.6×10^{-6} *	
			0.1 Ω to <1 Ω (0.1 A to 1 A)	0.6×10^{-6} *	
			1 Ω to <10 Ω (5 mA, 10 mA, 50 mA, 100 mA)	0.5×10^{-6} *	
			10 Ω to <100 Ω (3 mA)	0.7×10^{-6} *	
			100 Ω to <1 kΩ (2 mA, 3 mA)	0.8×10^{-6} *	
			1 kΩ to <10 kΩ (0.3 mA)	1.0×10^{-6} *	
			10 kΩ (0,3 mA)	1.3×10^{-6} *	
			>10 kΩ to 100 kΩ (1 V, 5 V, 10 V, 20 V)	1.4×10^{-6} *	
			>100 kΩ to 1 MΩ (10 V, 100 V)	7.1×10^{-6} *	
			>1 MΩ to 10 MΩ (10 V, 100 V)	12×10^{-6} *	
			>10 MΩ to 100 MΩ (50 V, 100 V)	16×10^{-6} *	In air
			>100 MΩ to 1 GΩ (50 V, 100 V)	0.14×10^{-3} *	
			10 GΩ (50 V)	0.88×10^{-3} *	In air
			100 GΩ to 1 TΩ (100 V)	4.2×10^{-3} *	

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Item No.	Parameter	Description	Range	Uncertainty	Remark
3	AC-DC Voltage Transfer	AC-DC Voltage Transfer Difference (10 mV)	10 Hz, 20 Hz	81×10^{-6} *	
			30 Hz to 10 kHz	66×10^{-6} *	
			20 kHz to 70 kHz	81×10^{-6} *	
			100 kHz	0.10×10^{-3} *	
			200 kHz to 300 kHz	0.14×10^{-3} *	
			500 kHz	0.15×10^{-3} *	
			700 kHz to 800 kHz	0.22×10^{-3} *	
			1 MHz	0.25×10^{-3} *	
		AC-DC Voltage Transfer Difference (20 mV)	10 Hz	76×10^{-6} *	
			20 Hz	61×10^{-6} *	
			30 Hz to 10 kHz	52×10^{-6} *	
			20 kHz to 70 kHz	61×10^{-6} *	
			100 kHz	71×10^{-6} *	
			200 kHz to 300 kHz	0.11×10^{-3} *	
			500 kHz	0.14×10^{-3} *	
			700 kHz to 800 kHz	0.19×10^{-3} *	
			1 MHz	0.20×10^{-3} *	
		AC-DC Voltage Transfer Difference (60 mV)	10 Hz	66×10^{-6} *	
			20 Hz to 300 Hz	47×10^{-6} *	
			400 Hz to 10 kHz	37×10^{-6} *	
			20 kHzto 70 kHz	47×10^{-6} *	

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Item No.	Parameter	Description	Range	Uncertainty	Remark
3	AC–DC Voltage Transfer	AC-DC Voltage Transfer Difference (60 mV)	100 kHz	52×10^{-6} *	
			200 kHz to 300 kHz	71×10^{-6} *	
			500 kHz	0.10×10^{-3} *	
			700 kHz to 800 kHz	0.14×10^{-3} *	
			1 MHz	0.15×10^{-3} *	
		AC-DC Voltage Transfer Difference (100 mV, 200 mV)	10 Hz	37×10^{-6} *	
			20 Hz to 300 Hz	24×10^{-6} *	
			400 Hz to 10 kHz	16×10^{-6} *	
			20 kHz to 70 kHz	24×10^{-6} *	
			100 kHz	32×10^{-6} *	
			200 kHz to 300 kHz	52×10^{-6} *	
			500 kHz	76×10^{-6} *	
			700 kHz to 800 kHz	0.10×10^{-3} *	
			1 MHz	0.12×10^{-3} *	
		AC-DC Voltage Transfer Difference (300 mV, 500 mV)	10 Hz to 300 Hz	16×10^{-6} *	
			400 Hz to 100 kHz	13×10^{-6} *	
			200 kHz to 300 kHz	16×10^{-6} *	
			500 kHz	20×10^{-6} *	
		AC-DC Voltage Transfer Difference (300 mV, 500 mV)	700 kHz to 800 kHz	28×10^{-6} *	
			1 MHz	32×10^{-6} *	

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Item No.	Parameter	Description	Range	Uncertainty	Remark
3	AC–DC Voltage Transfer	AC-DC Voltage Transfer Difference (600 mV, 700 mV)	10 Hz to 100 kHz	13×10^{-6} *	
			200 kHz to 300 kHz	16×10^{-6} *	
			500 kHz	20×10^{-6} *	
			700 kHz to 800 kHz	28×10^{-6} *	
			1 MHz	32×10^{-6} *	
		AC-DC Voltage Transfer Difference (1 V, 2 V)	10 Hz to 100 kHz	13×10^{-6} *	
			200 kHz to 300 kHz	14×10^{-6} *	
			500 kHz	20×10^{-6} *	
			700 kHz to 800 kHz	24×10^{-6} *	
			1 MHz	28×10^{-6} *	
		AC-DC Voltage Transfer Difference (3 V, 4 V)	10 Hz to 300 Hz	14×10^{-6} *	
			400 Hz to 100 kHz	13×10^{-6} *	
			200 kHz to 300 kHz	14×10^{-6} *	
			500 kHz	20×10^{-6} *	
			700 kHz to 800 kHz	24×10^{-6} *	
			1 MHz	28×10^{-6} *	
		AC-DC Voltage Transfer Difference (5 V, 6 V, 7 V)	10Hz to 100 kHz	13×10^{-6} *	
			200 kHz to 300 kHz	14×10^{-6} *	
			500 kHz	20×10^{-6} *	
			700 kHz to 800 kHz	24×10^{-6} *	
			1 MHz	28×10^{-6} *	

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Item No.	Parameter	Description	Range	Uncertainty	Remark
3	AC–DC Voltage Transfer	AC-DC Voltage Transfer Difference (10 V)	10 Hz to 300 Hz	14×10^{-6} *	
			400 Hz to 70 kHz	13×10^{-6} *	
			100 kHz	14×10^{-6} *	
			200 kHz to 300 kHz	15×10^{-6} *	
			500 kHz	21×10^{-6} *	
			700 kHz to 800 kHz	24×10^{-6} *	
			1 MHz	32×10^{-6} *	
		AC-DC Voltage Transfer Difference (20 V)	10 Hz	20×10^{-6} *	
			20 Hz to 300 Hz	16×10^{-6} *	
			400 Hz to 70 kHz	14×10^{-6} *	
			100 kHz	16×10^{-6} *	
			200 kHz to 300 kHz	20×10^{-6} *	
			500 kHz	26×10^{-6} *	
			700 kHz to 800 kHz	28×10^{-6} *	
			1 MHz	37×10^{-6} *	
		AC-DC Voltage Transfer Difference (30 V)	10 Hz	20×10^{-6} *	
			20 Hz to 100 kHz	16×10^{-6} *	
			200 kHz to 300 kHz	20×10^{-6} *	
			500 kHz	30×10^{-6} *	
			700 kHz to 800 kHz	37×10^{-6} *	
			1 MHz	42×10^{-6} *	

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Item No.	Parameter	Description	Range	Uncertainty	Remark
3	AC–DC Voltage Transfer	AC-DC Voltage Transfer Difference (40 V, 50 V)	10 Hz	24×10^{-6} *	
			20 Hz to 300 Hz	20×10^{-6} *	
			400 Hz to 50 kHz	16×10^{-6} *	
			70 kHz to 100 kHz	20×10^{-6} *	
		AC-DC Voltage Transfer Difference (60 V, 70 V, 100 V)	10 Hz	28×10^{-6} *	
			20 Hz to 300 Hz	24×10^{-6} *	
			400 Hz to 50 kHz	16×10^{-6} *	
			70 kHz	20×10^{-6} *	
			100 kHz	24×10^{-6} *	
		AC-DC Voltage Transfer Difference (200 V, 300 V)	10 Hz	32×10^{-6} *	
			20 Hz to 300 Hz	24×10^{-6} *	
			400 Hz to 50 kHz	16×10^{-6} *	
			70 kHz	24×10^{-6} *	
			100 kHz	28×10^{-6} *	
		AC-DC Voltage Transfer Difference (500 V)	10 Hz	42×10^{-6} *	
			20 Hz to 300 Hz	32×10^{-6} *	
			400 Hz to 50 kHz	24×10^{-6} *	
			70 kHz	32×10^{-6} *	
			100 kHz	42×10^{-6} *	

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Item No.	Parameter	Description	Range	Uncertainty	Remark
3	AC–DC Voltage Transfer	AC-DC Voltage Transfer Difference (1000 V)	10 Hz	52×10^{-6} *	
			20 Hz	42×10^{-6} *	
			30 Hz to 300 Hz	32×10^{-6} *	
			400 Hz to 10 kHz	24×10^{-6} *	
			20 kHz to 30 kHz	28×10^{-6} *	
			50 kHz	42×10^{-6} *	
			70 kHz	61×10^{-6} *	
			100 kHz	81×10^{-6} *	
4	Capacitance 2 terminal	Standard Capacitor	1000 pF to 1 μF (1 kHz)	0.12×10^{-3} *	
			1000 pF; 10 nF (2 kHz, 5 kHz, 10 kHz)	0.12×10^{-3} *	
			100 nF (2 kHz, 5 kHz)	0.12×10^{-3} *	
			100 nF (10 kHz)	0.26×10^{-3} *	
			1 μF (2 kHz)	0.12×10^{-3} *	
			1 μF (5 kHz)	0.6×10^{-3} *	
			1 μF (10 kHz)	2.3×10^{-3} *	
5	Capacitance 3 terminal	Standard Capacitor	1 pF (2 kHz, 5 kHz, 10 kHz)	0.15×10^{-3} *	
			10 pF (1 kHz)	36×10^{-6} *	
			100 pF, 1000 pF (1 kHz)	24×10^{-6} *	
			10 pF, 100 pF (2 kHz, 5 kHz, 10 kHz)	0.12×10^{-3} *	
			1000 pF, 10 nF (2 kHz, 5 kHz, 10 kHz)	0.12×10^{-3} *	

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Item No.	Parameter	Description	Range	Uncertainty	Remark
5	Capacitance 3 terminal	Standard Capacitor	100 nF (2 kHz, 5 kHz)	0.12×10^{-3} *	
			100 nF (10 kHz)	0.26×10^{-3} *	
			1 μF (2 kHz)	0.12×10^{-3} *	
			1 μF (5 kHz)	0.6×10^{-3} *	
			1 μF (10 kHz)	2.3×10^{-3} *	
			1 pF to < 10 pF (1 kHz)	0.15×10^{-3} *	
			10 pF to 1 μF (100 Hz, 120 Hz, 200 Hz) 400 Hz, 500 Hz, 1 kHz	0.12×10^{-3} *	
6	Capacitance 3 terminal	Capacitance meter	1 nF, 10 nF (100 Hz, 120 Hz, 200 Hz, 400 Hz, 500 Hz, 1 kHz, 2 kHz, 5 kHz, 10 kHz)	0.19×10^{-3} *	
			100 nF (100 Hz, 120 Hz, 200 Hz, 400 Hz, 500 Hz, 1 kHz, 2 kHz, 5 kHz)	0.19×10^{-3} *	
			100 nF (10 kHz)	0.3×10^{-3} *	
			1 μF (100 Hz, 120 Hz, 200 Hz, 400 Hz, 500 Hz, 1 kHz, 2 kHz)	0.19×10^{-3} *	
			1 μF (5 kHz)	0.62×10^{-3} *	
			1 μF (10 kHz)	2.3×10^{-3} *	
7	Capacitance 4 terminal	Capacitance meter	1 μF, 10 μF, 100 μF (100 Hz)	0.83×10^{-3} *	
			1 μF, 10 μF, 100 μF (120 Hz)	0.72×10^{-3} *	
			1 μF, 10 μF (1 kHz)	0.41×10^{-3} *	

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7	Capacitance 4 terminal	Capacitance meter	100 μF (1 kHz)	0.53×10^{-3} *	
			1 mF (100 Hz)	3.1×10^{-3} *	
			1 mF (120 Hz)	4.0×10^{-3} *	
			1 mF (1 kHz)	2.0×10^{-3} *	
			10 mF(100 Hz, 120 Hz)	4.0×10^{-3} *	
8	Inductance	Standard Inductor	100 μH(1 kHz)	0.35×10^{-3} *	
			10 mH, 100 mH, 1 H, 10 H (1 kHz)	0.23×10^{-3} *	
9	DC Current	Volt amp Method (Current Shunt)	10 μA	8.5×10^{-6} *	
			100 μA	7.5×10^{-6} *	
			1 mA	7×10^{-6} *	
			10 mA, 100 mA, 1 A	8.5×10^{-6} *	
			10 A	9×10^{-6} *	
			100 A	9.5×10^{-6} *	
10	AC/DC Current Transfer	AC Current (2.5 mA to 20 mA)	10 Hz to 20 kHz	50×10^{-6} *	
			50 kHz	71×10^{-6} *	
			70 kHz	73×10^{-6} *	
			100 kHz	75×10^{-6} *	
		AC Current (30 mA, 50 mA)	10 Hz to 20 kHz	50×10^{-6} *	
			50 kHz	73×10^{-6} *	
			70 kHz	75×10^{-6} *	
			100 kHz	77×10^{-6} *	

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Item No.	Parameter	Description	Range	Uncertainty	Remark
10	AC/DC Current Transfer	AC Current (100 mA)	10 Hz to 10 kHz	50×10^{-6} *	
			20 kHz	71×10^{-6} *	
			50 kHz	75×10^{-6} *	
			70 kHz	77×10^{-6} *	
			100 kHz	79×10^{-6} *	
		AC Current (200 mA)	10 Hz to 10 kHz	50×10^{-6} *	
			20 kHz	73×10^{-6} *	
			50 kHz	77×10^{-6} *	
			70 kHz	79×10^{-6} *	
			100 kHz	82×10^{-6} *	
		AC Current (300 mA)	10 Hz to 10 kHz	55×10^{-6} *	
			20 kHz	75×10^{-6} *	
			50 kHz	79×10^{-6} *	
			70 kHz	82×10^{-6} *	
			100 kHz	85×10^{-6} *	
		AC Current (500 mA)	10 Hz to 10 kHz	55×10^{-6} *	
			20 kHz	77×10^{-6} *	
			50 kHz	82×10^{-6} *	
			70 kHz	85×10^{-6} *	
			100 kHz	88×10^{-6} *	

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Item No.	Parameter	Description	Range	Uncertainty	Remark
10	AC/DC Current Transfer	AC Current (1 A)	10 Hz to 10 kHz	55×10^{-6} *	
			20 kHz	79×10^{-6} *	
			50 kHz	85×10^{-6} *	
			70 kHz	88×10^{-6} *	
			100 kHz	91×10^{-6} *	
		AC Current (2 A)	10 Hz to 10 kHz	55×10^{-6} *	
			20 kHz	82×10^{-6} *	
			50 kHz	88×10^{-6} *	
			70 kHz	91×10^{-6} *	
			100 kHz	94×10^{-6} *	
		AC Current (3 A)	10 Hz to 10 kHz	60×10^{-6} *	
			20 kHz	85×10^{-6} *	
			50 kHz	91×10^{-6} *	
			70 kHz	94×10^{-6} *	
			100 kHz	98×10^{-6} *	
		AC Current (5 A)	10 Hz to 10 kHz	65×10^{-6} *	
			20 kHz	91×10^{-6} *	
			50 kHz	98×10^{-6} *	
			70 kHz	0.10×10^{-3} *	
			100 kHz	0.11×10^{-3} *	

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Item No.	Parameter	Description	Range	Uncertainty	Remark
10	AC/DC Current Transfer	AC Current (10 A)	10 Hz to 10 kHz	70×10^{-6} *	
			20 kHz	98×10^{-6} *	
			50 kHz	0.10×10^{-3} *	
			70 kHz, 100 kHz	0.11×10^{-3} *	
		AC Current (20 A)	10 Hz to 10 kHz	80×10^{-6} *	
			20 kHz, 50 kHz, 70 kHz	0.11×10^{-3} *	
			100 kHz	0.12×10^{-3} *	
11	DC Power	DC Wattmeter	1000 V , 20 A , 20 kW	0.1 %	
12	AC Power	AC Wattmeter	600 V , 100 A , 60 kW 50 Hz to 60 Hz Power Factor (±0 to ±1)	103×10^{-6}	
		Phase Source	0.000° to 999.999° 50 mV to 120 Vrms 1 Hz to 100 kHz (10 m° to 100 m°)	100 ppm	
		Phase Meter	0.00° to 360.00° -180° to 180° 50 mV to 120 Vrms (50 m° to 200 m°)	150 ppm to1%	
13	Frequency	Frequency Oscillator	100 kHz, 1 MHz	1×10^{-11} *	
			5 MHz, 10 MHz	1×10^{-12} *	
			1 Hz to 225 MHz	$(1 \times 10^{-11} + 2 \times W_{Tf}) \times f$ *	
14	Mass	Conventional mass	1 mg to 20 kg	E2 *	
		True Mass	1 mg to 20 kg	E2	

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Item No.	Parameter	Description	Range	Uncertainty	Remark
15	Absolute Pressure (P_{abs})	Gas pressure	1.5 kPa to 175 kPa	$2 \times 10^{-5} \times P_{abs}$ but not less than 0.3 Pa	
			3.5 kPa to 350 kPa	$3 \times 10^{-5} \times P_{abs}$ but not less than 0.8 Pa *	
			> 350 kPa to 1.75 MPa	$3 \times 10^{-5} \times P_{abs}$ *	
			> 1.75 MPa to 7 MPa	$4 \times 10^{-5} \times P_{abs}$ *	
			> 7 MPa to 20 MPa	$3 \times 10^{-5} \times P_{abs}$	
			> 20 MPa to 40 MPa	$3.5 \times 10^{-5} \times P_{abs}$	
		Hydraulic pressure	100 kPa to 7.1 MPa	$3 \times 10^{-5} \times P_{abs}$ but not less than 21 Pa *	
			> 7.1 MPa to 70.1 MPa	$4 \times 10^{-5} \times P_{abs}$ *	$P_{abs} = Pe + P_{amb}$
			> 70.1 MPa to 140.1 MPa	$5 \times 10^{-5} \times P_{abs}$ *	
16	Gauge Pressure (P_e)	Gas pressure	- 1 kPa to 3 kPa	$3 \times 10^{-4} \times P_e$ but not less than 0.3 Pa *	
			1.5 kPa to 175 kPa	$2 \times 10^{-5} \times P_e$ but not less than 0.3 Pa	
			3.5 kPa to 350 kPa	$3 \times 10^{-5} \times P_e$ but not less than 0.8 Pa *	
			> 350 kPa to 1.75 MPa	$3 \times 10^{-5} \times P_e$ *	
			> 1.75 MPa to 7 MPa	$4 \times 10^{-5} \times P_e$ *	
			> 7 MPa to 20 MPa	$3 \times 10^{-5} \times P_e$	
			> 20 MPa to 40 MPa	$3.5 \times 10^{-5} \times P_e$	
			>40 MPa to 100 MPa	$5 \times 10^{-5} \times P_e$	

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Item No.	Parameter	Description	Range	Uncertainty	Remark
16	Gauge Pressure (P_e)	Negative pressure	- 100 kPa to 0 kPa	$5 \times 10^{-5} \times P_{amb} + 10^{-5} \times P_{abs}$ *	$Pe = P_{abs} - P_{amb}$
		Hydraulic pressure	57 kPa to 7 MPa	$3 \times 10^{-5} \times P_e$ but not less than 21 Pa *	
			> 7 MPa to 70 MPa	$4 \times 10^{-5} \times P_e$ *	
			> 70 MPa to 140 MPa	$5 \times 10^{-5} \times P_e$ *	
17	Vacuum	Absolute pressure	1×10^{-7} mbar to 1×10^{-6} mbar	6 % to 4.2 %	
			1×10^{-6} mbar to 1×10^{-5} mbar	4.2 % to 1.2 %	
			1×10^{-5} mbar to 1×10^{-4} mbar	1.2 % to 0.5 %	
			1×10^{-4} mbar to 1×10^{-3} mbar	0.5 %	
			1.3×10^{-3} mbar	$7.3 \times 10^{-3} \times P$ *	
			5×10^{-3} mbar	$6.4 \times 10^{-3} \times P$ *	
			7×10^{-2} mbar	$3.7 \times 10^{-3} \times P$ *	
			2×10^{-1} mbar	$2.4 \times 10^{-3} \times P$ *	
			5×10^{-1} mbar	$1.9 \times 10^{-3} \times P$ *	
			2×10^{0} mbar	$1.6 \times 10^{-3} \times P$ *	
			1.3×10^{1} mbar	$2.8 \times 10^{-3} \times P$ *	
			5×10^{1} mbar	$2.4 \times 10^{-3} \times P$ *	
			2×10^{2} mbar to 1×10^{3} mbar	$1.8 \times 10^{-3} \times P$ *	
18	Differential Pressure (Δp)	Gas Pressure	Up to 350 kPa	$3 \times 10^{-5} \times \Delta p$,+ but not less than 2.9 Pa *	Static line pressure 0.5 MPa to 40 MPa

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Item No.	Parameter	Description	Range	Uncertainty	Remark
19	Pressure Sensitivity Level	Absolute Pressure Sensitivity of Standard Microphone	LS1P : 20 Hz	0.05 dB **	
			31.5 Hz ~ 4 KHz	0.04 dB **	
			8 KHz	0.06 dB **	
			10 KHz	0.07 dB **	
			LS2P : 20 Hz	0.10 dB **	
			31.5 Hz	0.05 dB **	
			63 Hz ~ 12.5 KHz	0.04 dB **	
			16 KHz	0.05 dB **	
			20 KHz	0.08 dB **	
20	Sound Pressure Level	Multi-frequency Sound Calibrator	74 dB to 124 dB 31.5 Hz to 16 kHz	0.09 dB **	
		Sound Calibrator and Pistonphone	74 dB to 124 dB 250 Hz, 1 kHz	0.08 dB **	
		Sound Level Meter	Based on IEC 61672	Class 1,2,3 (A)	
		Sound Level Meter (Free-field Frequency Response Level and Absolute sensitivity)	31.5 Hz ~ 63 Hz	0.4 dB **	
			63 Hz ~ 2 KHz	0.2 dB **	
			2 KHz ~ 10 KHz	0.3 dB **	
			10 KHz ~ 16 KHz	0.4 dB **	
21	Vibration	Vibration Meter	10 m/s^2 to 100 m/s^2 20 Hz to 5 kHz	1 %	
		Portable Calibration Exciter	10 m/s^2 , 159.2 m/s^2	1 %	
22	Force	Force Proving Instruments (Load Cells, Proving Rings etc.)	35 kN to 500 kN	0.02 %	Using Deadweight Force Machine (DWM)
			20 kN to 500 kN	0.05 %	Using Built – Up Machine (BM)
			500 kN to 1 MN	0.1 % to 0.2 %	

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Item No.	Parameter	Description	Range	Uncertainty	Remark
23	Torque	Torque wrench	1 N.m to 1000 N.m	4 %	
		Torque screw driver	1 N.m to 1000 N.m	4 %	
24	Flow	Liquid Flow (Water)	0.19 l/m to 190 l/m	0.2 % rdg	
		Gas Flow (Dry Air)	1 sccm to 250 slm	0.3 % rdg	
25	Laser Radiation	Stabilized He-Ne laser wavelength Optical beat frequency	633 nm	5×10^{-11} **	Iodine stabilized He-Ne laser
			633 nm	1×10^{-9} **	Stabilized He-Ne laser
26	End Standards	Gauge Blocks : central length L, (Interferometry, exact fractions)	0.5 mm to 100 mm	21 nm + (0.43×10^{-6} x L)	Steel Gauge Block, grade K/00
			0.5 mm to 100 mm	21 nm + (0.39×10^{-6} x L)	Ceramic Gauge Block, grade K/00
			0.5 mm to 100 mm	21 nm + (0.31×10^{-6} x L)	Carbide Gauge Block, grade K/00
		Gauge Blocks : central length L, Variation (f_o, f_u) (Mechanical comparison to gauge block)	0.5 mm to 100 mm	0.05 µm + (0.5×10^{-6} x L) *	Steel Gauge Block, grade 0
			0.5 mm to 100 mm	0.07 µm + (0.5×10^{-6} x L) *	Ceramic, Carbide Gauge Block, grade 0
			0.5 mm to 100 mm	0.07 µm + (0.8×10^{-6} x L) *	Steel, Ceramic, Carbide Gauge Block, grade 1,2
		Gauge Blocks : central length L, (Mechanical comparison to gauge block)	125 mm to 1000 mm	0.12 µm + (0.7×10^{-6} x L)	Steel Gauge Block, grade 1,2
27	Line Standards	Standard Scale	Up to 500 mm	0.7 µm + (2.3×10^{-6} x L)	
		Working Standard Scale	Up to 1000 mm	1.0 µm + (2.3×10^{-6} x L)	
		Scale lupe	Up to 20 mm	0.01 mm + (2.3×10^{-6} x L)	
		Electronic Scale	Up to 1000 mm	0.001 mm + (0.7×10^{-6} x L)	
		Digimatic Scale Unit	Up to 1000 mm	0.01 mm + (2.3×10^{-6} x L)	
		Steel Ruler	Up to 2000 mm	0.01 mm + (2.3×10^{-6} x L)	
		Steel Tape	Up to 3000 mm	0.02 mm + (2.3×10^{-6} x L)	

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Item No.	Parameter	Description	Range	Uncertainty	Remark
28	Diameter Standards	Plan Ring gauge (Diameter measurement)	0.1 mm to 100 mm	0.1 μm + (3.6×10^{-6} x d)	
		Plan Ring gauge (Diameter measurement)	100 mm to 300 mm	0.3 μm + (2.3×10^{-6} x d)	
		Plan Plug gauge (Diameter measurement)	0.5 mm to 300 mm	0.3 μm + (2.3×10^{-6} x d)	
		Taper Plug Gauge (Maximum, Minimum diameter measurement)	2.0 mm to 300 mm	0.3 μm + (2.3×10^{-6} x d)	
		Taper Ring Gauge (Maximum, Minimum diameter measurement)	6.0 mm to 300 mm	0.3 μm + (2.3×10^{-6} x d)	
29	Screw Standards	Thread Plug Gauge (Pitch diameter measurement)	2 mm to 300 mm (Pitch ≥ 0.3 mm)	0.001 mm + (2.6×10^{-6} x d)	
		Thread Ring Gauge (Pitch diameter measurement)	5 mm to 300 mm (Pitch ≥ 0.3 mm)	0.001 mm + (2.6×10^{-6} x d)	
		Thread Plug, Tapered : Pitch diameter (Pitch diameter measurement)	Up to 300 mm (Pitch ≥ 0.3 mm)	0.001 mm + (2.6×10^{-6} x d)	
30	Angle Standards	Polygon	3 faces to 72 faces	0.5 "	
		Autocollimator	Up to 800 "	0.3 "	
		Indexing Table	Up to 360 ^{0}	0.5 "	
		Angle Gauge Block	0.5 " to 60 ^{0}	0.5 "	
		Electronic Level	0.001 mm/m to 0.15 mm/m	0.001 mm/m	
		Spirit Level	0,02 mm/m to 5 mm/m	0.002 mm/m	
		Master Square (90^{0})	Up to 1000 mm	0.001 mm + (0.7×10^{-6} x L)	
		Engineering Square (90^{0}) I-Section Square Flat-Section Square Beam-Section Square	Up to 1000 mm	0.002 mm + (0.7×10^{-6} x L)	

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Item No.	Parameter	Description	Range	Uncertainty	Remark
31	Flatness Standards	Optical Flat	Up to 45 mm (Diameter)	0.03 μm (Flatness)	
		Optical Parallel	Up to 45 mm (Diameter)	0.03 μm (Flatness) 0.04 μm + 0.6 x 10^{-6} x L : (Parallelism) 0.1 μm + 0.6 x 10^{-6} x L ; (Thickness)	
32	Straightness Standards	Straightness Tester	Up to 1000 mm	0.1 μm + (0.7 x 10^{-6} x L)	
33	Roundness Standards	Glass Hemisphere	Up to 300 mm (Diameter)	0.096 μm (Normal mode) 0.017 μm (High precision mode) 0.009 μm (Multi-step method)	
		Step Height magnification	Up to 300 mm (Diameter)	0.20 μm (Multi-step method)	
34	Gear Standards	Spur gear : profile slope deviation (Standard involute measuring device)	25 mm to 400 mm	3 μm (Base diameter)	
		Spur gear : helix slope deviation (Standard helix measuring device	Up to 45 ^{0}	3 μm (Reference diameter)	
		Spur gear : pitch Standard pitch measuring device	Up to 400 mm	2 μm (Reference diameter)	
		Bevel gear : from deviation	Up to 300 mm	2.0 μm (Tip diameter)	
35	Temperature	- Standard Platinum Resistance	-38.8344 ^{o}C	3 mK *	- Quartz sheath only
		Thermometers (Long stem SPRTs)	0.01 ^{o}C	1.5 mK *	- Minimum sheath length 450 mm
		- Semi-Standard Platinum Resistance	29.7646 ^{o}C	3 mK *	
		Thermometers	231.928 ^{o}C	4 mK *	
		- Platinum Resistance Thermometers	419.527 ^{o}C	4 mK *	
		(Calibration at Fixed Point Temperatures	660.323 ^{o}C	8 mK *	

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Item No.	Parameter	Description	Range	Uncertainty	Remark
35	Temperature	of ITS-90)	961.78 °C	15 mK	
		Resistance Thermometers,	-4 0 °C to 0 °C	20 mK *	- Minimum sheath length 200 mm
		PRT / IPRT Calibration	>0 °C to 250 °C	20 mK *	
		(Comparison in SPRT in stirred Liquid	>250 °C to 420 °C	30 mK *	
		Bath & Furnace)	>420 °C to 550 °C	50 mK *	
		Thermocouples calibration	231.928 °C	0.5 K *	- Rare – metal group only (B,S,R)
		(Calibration at Fixed Point Temperatures of	419.527 °C	0.6 K *	- Minimum sheath length 450 mm
		ITS-90)	660.323 °C	0.7 K *	
			961.78 °C	0.8 K *	
		Thermocouples calibration	0 °C to 700 °C	1.5 K *	- Rare & Base Metal group
		(Comparison with Standard Thermocouples in stirred Liquid Bath & Furnace)	>700 °C to 1100 °C	2.5 K *	- Minimum sheath length 300 mm
		Liquid-in-Glass Thermometers	-40 °C to 100 °C	20 mK *	- Subdivision < 0.2 K
		(Comparison with SPRTs in stirred Liquid Bath)	>100 °C to 250 °C	50 mK *	
			-40 °C to 100 °C	0.1 K	- Subdivision > 0.2 K
			>100 °C to 250 °C	0.5 K	
		Direct Reading Digital Thermometer	-40 °C to 450 °C	50 mK *	- Subdivision < 0.2 K
		(Comparison with SPRTs in stirred Liquid Bath & Furnace)	-40 °C to 450 °C	0.2 K *	- Subdivision > 0.2 K
		Temperature Bath (Comparison with SPRTs)	-40 °C to 420 °C	0.03 mK to 0.1 mK	

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Item No.	Parameter	Description	Range	Uncertainty	Remark
35	Temperature	Dry Block and Temperature Furnace(Comparison with SPRTs)	-40 ^{0}C to 420 ^{0}C	0.1 K	
		Optical Pyrometer (Calibration at Black Body Fixed Point Temperatures of ITS-90)	420 ^{0}C to 1084 ^{0}C	0.3 K to 0.5 K	
		Optical Pyrometer (Comparison with Transfer Standard At Black Body Furnace)	450 ^{0}C to 1100 ^{0}C	1.0 K	
36	Humidity	Dew - Point Hygrometer (Comparison with Chilled Mirror Hygrometer)	-50 ^{0}C to 15 ^{0}C	0.1 ^{0}C to 0.2 ^{0}C	
		Thermo - Hygrometer	Temperature 10 ^{0}C to 50 ^{0}C	0.5 ^{0}C	
		Thermo - Hygrometer	Humidity 30% to 95% RH	1.2% RH to 2% RH	
37	Volume	Volumetric flask	25 mL to 2000 mL	Class A	
		Burette	Up to 100 mL		
		Pipette	1 mL to 50 mL		
		Micropipette	20 µL to1 mL	0.15 µL	
38	PH Measurement	pH meter with associated electrode	0 to14 pH	0.03 pH	
		Phthalate pH Standard Solution	4.01 pH	0.020 pH	
		Phosphate pH Standard Solution	6.86 pH	0.020 pH	
		Tetraborate pH Standard Solution	9.18 pH	0.020 pH	
39	Absorbance (uv/vis spectrophotometry)	Photometric accuracy and linearity	potassium dichromate solutions 20, 40, 60, 80, 100 mg/kg	0.01 A	
		Stray light	Potassium iodide solution 10 g/l	0.5 nm	

Annex 26: List of Appendix C of Global MRA

Annex 26 List in Appendix C of Global MRA

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APPENDIX A | APPENDIX B | APPENDIX D

Appendix C - Search form

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Calibration and Measurement Capabilities Electricity and Magnetism

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KCDB

Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
DC voltage sources: single values	Solid state voltage standard	Compare against DC standard	10	10	V			0.4	µV/V	2	95%	Yes	1
DC voltage sources: single values	Solid state voltage standard, standard cell	Compare against DC standard	1.018	1.018	V			0.9	µV/V	2	95%	Yes	2
DC voltage sources: low values (<=10 V)	DC voltage source, multifunction calibrator	Compare against DC standard	100	100	mV			5	µV/V	2	95%	Yes	3
DC voltage sources: low values (<=10 V)	DC voltage source, multifunction calibrator	Compare against DC standard	1	1	V			0.6	µV/V	2	95%	Yes	4
DC voltage sources: intermediate values (> 10 V to 1100 V)	DC voltage source, multifunction calibrator	Compare against DC standard	100	100	V			0.5	µV/V	2	95%	Yes	5
DC voltage sources: intermediate values (> 10 V to 1100 V)	DC voltage source, multifunction calibrator	Compare against DC standard	1000	1000	V			0.7	µV/V	2	95%	Yes	6
DC voltage sources: low value ranges (<=10 V)	DC voltage source, multifunction calibrator, voltage V	Compare against DC standard	0	10	V			(0.5 v + 2), v in V	µV	2	95%	No	7
DC voltage sources: intermediate values (> 10 V to 1100 V)	DC voltage source, multifunction calibrator, voltage V	Compare against DC standard	> 10	100	V			(0.5 v + 15), v in V	µV	2	95%	No	8
DC voltage sources: intermediate values (> 10 V to 1100 V)	DC voltage source, multifunction calibrator, voltage V	Compare against DC standard	> 100	1000	V			(0.8 v + 200), v in V	µV	2	95%	No	9
DC resistance sources: low values (<= 1 Ω)	Fixed resistor	DCC bridge & range extender	0.001	0.001	Ω	Current	10 A to 100 A	2.8	µΩ/Ω	2	95%	Yes	10

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
						Oil bath temperature	23 °C						
DC resistance sources: low values (<= 1 Ω)	Fixed resistor	DCC bridge & range extender	0.01	0.01	Ω	Current	1 A to 10 A	2.3	μΩ/Ω	2	95%	Yes	11
						Oil bath temperature	23 °C						
DC resistance sources: low values (<= 1 Ω)	Fixed resistor	DCC bridge & range extender	0.1	0.1	Ω	Current	0.1 A to 1 A	2.3	μΩ/Ω	2	95%	Yes	12
						Oil bath temperature	23 °C						
DC resistance sources: low values (<= 1 Ω)	Fixed resistor	DCC bridge	1	1	Ω	Current	100 A	1.5	μΩ/Ω	2	95%	Yes	13
						Oil bath temperature	23 °C						
DC resistance sources: intermediate values (> 1 Ω to 1 MΩ)	Fixed resistor	DCC bridge	10	10	Ω	Current	30 mA	1.6	μΩ/Ω	2	95%	Yes	14
						Oil bath temperature	23 °C						
DC resistance sources: intermediate values (> 1 Ω to 1 MΩ)	Fixed resistor	DCC bridge	100	100	Ω	Current	10 mA	2.2	μΩ/Ω	2	95%	Yes	15
						Oil bath temperature	23 °C						
DC resistance sources: intermediate values (> 1 Ω to 1 MΩ)	Fixed resistor	DCC bridge	1	1	kΩ	Current	3 mA	2.5	μΩ/Ω	2	95%	Yes	16
						Oil bath temperature	23 °C						

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
DC resistance sources: intermediate values (> 1 Ω to 1 MΩ)	Fixed resistor	DCC bridge	10	10	kΩ	Current	1 mA	2.4	μΩ/Ω	2	95%	Yes	17
						Oil bath temperature	23 °C						
DC resistance sources: intermediate values (> 1 Ω to 1 MΩ)	Fixed resistor	DCC bridge	100	100	kΩ	Current	0.1 mA	2.5	μΩ/Ω	2	95%	Yes	18
						Oil bath temperature	23 °C						
DC resistance sources: intermediate values (> 1 Ω to 1 MΩ)	Fixed resistor	Wheastone bridge	1	1	MΩ	Voltage	1 V	18	μΩ/Ω	2	95%	Yes	19
DC resistance sources: high values (> 1 MΩ)	Fixed resistor	Wheastone bridge	10	10	MΩ	Voltage	1 V	32	μΩ/Ω	2	95%	Yes	20
DC resistance sources: high values (> 1 MΩ)	Fixed resistor	Wheastone bridge	100	100	MΩ	Voltage	5 V	0.12	mΩ/Ω	2	95%	Yes	21
DC resistance source: high values (> 1 MΩ)	Fixed resistor	Wheastone bridge	1	1	GΩ	Voltage	20 V	0.69	mΩ/Ω	2	95%	Yes	22
DC resistance sources: high values (> 1 MΩ)	Fixed resistor	Wheastone bridge	10	10	GΩ	Voltage	50 V	0.88	mΩ/Ω	2	95%	Yes	23
DC resistance sources: high values (> 1 MΩ)	Fixed resistor	Wheastone bridge	100	100	GΩ	Voltage	100 V	4.2	mΩ/Ω	2	95%	Yes	24
DC resistance sources: high values (> 1 MΩ)	Fixed resistor	Wheastone bridge	1	1	TΩ	Voltage	100 V	4.2	mΩ/Ω	2	95%	Yes	25

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
DC current sources: low values (<= 0.1 mA)	Current generator, multifunction calibrator	V/A method	10	10	µA			8.5	µA/A	2	95%	Yes	26
DC current sources: low values (<= 0.1 mA)	Current generator, multifunction calibrator	V/A method	100	100	µA			7.5	µA/A	2	95%	Yes	27
DC current sources: intermediate values (> 0.1 mA to 20 A)	Current generator, multifunction calibrator	V/A method	1	1	mA			7	µA/A	2	95%	Yes	28
DC current sources: intermediate values (> 0.1 mA to 20 A)	Current generator, multifunction calibrator	V/A method	0.01	1	A	Current	10 mA, 100 mA, 1 A	8.5	µA/A	2	95%	Yes	29
DC current sources: intermediate values (> 0.1 mA to 20 A)	Current generator, multifunction calibrator	V/A method	10	10	A			9	µA/A	2	95%	Yes	30
DC current sources: high values (> 20 A to 100 A)	Current generator	V/A method	100	100	A			9.5	µA/A	2	95%	Yes	31
Capacitance and dissipation factor: low loss capacitor	Standard capacitor (air, fused silica) 3 terminal	Compare against reference standard	10	10	pF	Frequency	1 kHz	36	µF/F	2	95%	Yes	32
Capacitance and dissipation factor: low loss capacitor	Standard capacitor (air, fused silica) 3 terminal	Compare against reference standard	100	100	pF	Frequency	1 kHz	24	µF/F	2	95%	Yes	33
Capacitance and dissipation factor: low loss capacitor	Standard capacitor (air, fused silica) 3 terminal	Compare against reference standard	1000	1000	pF	Frequency	1 kHz	24	µF/F	2	95%	Yes	34
Capacitance and dissipation factor: dielectric capacitor	Fixed capacitor, capacitance box (3 terminal)	Compare against reference standard	1	1	pF	Frequency	2 kHz, 5 kHz, 10 kHz	0.15	mF/F	2	95%	Yes	35

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Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
Capacitance and dissipation factor: dielectric capacitor	Fixed capacitor, capacitance box (3 terminal)	Compare against reference standard	10	10	pF	Frequency	2 kHz, 5 kHz, 10 kHz	0.12	mF/F	2	95%	Yes	36
Capacitance and dissipation factor: dielectric capacitor	Fixed capacitor, capacitance box (3 terminal)	Compare against reference standard	100	100	pF	Frequency	2 kHz, 5 kHz, 10 kHz	0.12	mF/F	2	95%	Yes	37
Capacitance and dissipation factor: dielectric capacitor	Fixed capacitor, capacitance box (3 terminal)	Compare against reference standard	1000	1000	pF	Frequency	2 kHz, 5 kHz, 10 kHz	0.12	mF/F	2	95%	Yes	38
Capacitance and dissipation factor: dielectric capacitor	Fixed capacitor, capacitance box (3 terminal)	Compare against reference standard	10	10	nF	Frequency	2 kHz, 5 kHz, 10 kHz	0.12	mF/F	2	95%	Yes	39
Capacitance and dissipation factor: dielectric capacitor	Fixed capacitor, capacitance box (3 terminal)	Compare against reference standard	100	100	nF	Frequency	2 kHz, 5 kHz	0.12	mF/F	2	95%	Yes	40
Capacitance and dissipation factor: dielectric capacitor	Fixed capacitor, capacitance box (3 terminal)	Compare against reference standard	100	100	nF	Frequency	10 kHz	0.26	mF/F	2	95%	Yes	41
Capacitance and dissipation factor: dielectric capacitor	Fixed capacitor, capacitance box (3 terminal)	Compare against reference standard	1	1	µF	Frequency	2 kHz	0.12	mF/F	2	95%	Yes	42
Capacitance and dissipation factor: dielectric capacitor	Fixed capacitor, capacitance box (3 terminal)	Compare against reference standard	1	1	µF	Frequency	5 kHz	0.6	mF/F	2	95%	Yes	43
Capacitance and dissipation factor: dielectric capacitor	Fixed capacitor, capacitance box (3 terminal)	Compare against reference standard	1	1	µF	Frequency	10 kHz	2.3	mF/F	2	95%	Yes	44
Capacitance and dissipation factor: dielectric capacitor	Fixed capacitor, capacitance box (3 terminal)	Compare against reference standard	1	< 10	pF	Frequency	1 kHz	0.15	mF/F	2	95%	Yes	45
Capacitance and dissipation factor: dielectric capacitor	Fixed capacitor, capacitance box (3 terminal)	Compare against reference standard	0.01	1000	nF	Frequency	100 Hz, 120 Hz, 200 Hz, 400 Hz, 500 Hz, 1 kHz	0.12	mF/F	2	95%	Yes	46

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
Capacitance and dissipation factor: dielectric capacitor	Fixed capacitor, capacitance box (2 terminal)	Compare against reference standard	1	1000	nF	Frequency	1 kHz	0.12	mF/F	2	95%	Yes	47
Capacitance and dissipation factor: dielectric capacitor	Fixed capacitor, capacitance box (2 terminal)	Compare against reference standard	1000	1000	pF	Frequency	2 kHz, 5 kHz, 10 kHz	0.12	mF/F	2	95%	Yes	48
Capacitance and dissipation factor: dielectric capacitor	Fixed capacitor, capacitance box (2 terminal)	Compare against reference standard	10	10	nF	Frequency	2 kHz, 5 kHz, 10 kHz	0.12	mF/F	2	95%	Yes	49
Capacitance and dissipation factor: dielectric capacitor	Fixed capacitor, capacitance box (2 terminal)	Compare against reference standard	100	100	nF	Frequency	2 kHz, 5 kHz	0.12	mF/F	2	95%	Yes	50
Capacitance and dissipation factor: dielectric capacitor	Fixed capacitor, capacitance box (2 terminal)	Compare against reference standard	100	100	nF	Frequency	10 kHz	0.26	mF/F	2	95%	Yes	51
Capacitance and dissipation factor: dielectric capacitor	Fixed capacitor, capacitance box (2 terminal)	Compare against reference standard	1	1	µF	Frequency	2 kHz	0.12	mF/F	2	95%	Yes	52
Capacitance and dissipation factor: dielectric capacitor	Fixed capacitor, capacitance box (2 terminal)	Compare against reference standard	1	1	µF	Frequency	5 kHz	0.6	mF/F	2	95%	Yes	53
Capacitance and dissipation factor: dielectric capacitor	Fixed capacitor, capacitance box (2 terminal)	Compare against reference standard	1	1	µF	Frequency	10 kHz	2.3	mF/F	2	95%	Yes	54
Inductance: self inductance and equivalent series resistance, low values (< 1 mH)	Fixed inductor	Compare against reference standard	100	100	µH	Frequency	1 kHz	0.35	mH/H	2	95%	Yes	55
Inductance: self inductance and equivalent series resistance, intermediate values (>= 1 mH to 1 H)	Fixed inductor	Compare against reference standard	10	10	mH	Frequency	1 kHz	0.23	mH/H	2	95%	Yes	56

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
Inductance: self inductance and equivalent series resistance, intermediate values (>= 1 mH to 1 H)	Fixed inductor	Compare against reference standard	100	100	mH	Frequency	1 kHz	0.23	mH/H	2	95%	Yes	57
Inductance: self inductance and equivalent series resistance, intermediate values (>= 1 mH to 1 H)	Fixed inductor	Compare against reference standard	1	1	H	Frequency	1 kHz	0.23	mH/H	2	95%	Yes	58
Inductance: self inductance and equivalent series resistance, high values (> 1 H)	Fixed inductor	Compare against reference standard	10	10	H	Frequency	1 kHz	0.23	mH/H	2	95%	Yes	59
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	10	10	mV	Frequency	10 Hz to 20 Hz	106	µV/V	2	95%	Yes	60
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	10	10	mV	Frequency	30 Hz to 300 Hz	85	µV/V	2	95%	Yes	61
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	10	10	mV	Frequency	400 Hz to 30 kHz	81	µV/V	2	95%	Yes	62

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	10	10	mV	Frequency	50 kHz to 70 kHz	81	µV/V	2	95%	Yes	63
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	10	10	mV	Frequency	100 kHz	100	µV/V	2	95%	Yes	64
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	10	10	mV	Frequency	200 kHz to 500 kHz	150	µV/V	2	95%	Yes	65
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	10	10	mV	Frequency	700 kHz to 1 MHz	250	µV/V	2	95%	Yes	66
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	20	20	mV	Frequency	10 Hz to 20 Hz	76	µV/V	2	95%	Yes	67
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	20	20	mV	Frequency	30 Hz to 300 Hz	61	µV/V	2	95%	Yes	68
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	20	20	mV	Frequency	400 Hz to 30 kHz	61	µV/V	2	95%	Yes	69

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	20	20	mV	Frequency	50 kHz to 70 kHz	61	µV/V	2	95%	Yes	70
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	20	20	mV	Frequency	100 kHz	71	µV/V	2	95%	Yes	71
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	20	20	mV	Frequency	200 kHz to 500 kHz	140	µV/V	2	95%	Yes	72
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	20	20	mV	Frequency	700 kHz to 1 MHz	200	µV/V	2	95%	Yes	73
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	60	60	mV	Frequency	10 Hz to 20 Hz	66	µV/V	2	95%	Yes	74
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	60	60	mV	Frequency	30 Hz to 300 Hz	47	µV/V	2	95%	Yes	75
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	60	60	mV	Frequency	400 Hz to 30 kHz	47	µV/V	2	95%	Yes	76

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	60	60	mV	Frequency	50 kHz to 70 kHz	47	µV/V	2	95%	Yes	77
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	60	60	mV	Frequency	100 kHz	52	µV/V	2	95%	Yes	78
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	60	60	mV	Frequency	200 kHz to 500 kHz	100	µV/V	2	95%	Yes	79
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	60	60	mV	Frequency	700 kHz to 1 MHz	150	µV/V	2	95%	Yes	80
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	100	200	mV	Voltage	100 mV, 200 mV	37	µV/V	2	95%	Yes	81
						Frequency	10 Hz to 20 Hz						
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	100	200	mV	Voltage	100 mV, 200 mV	24	µV/V	2	95%	Yes	82
						Frequency	30 Hz to 300 Hz						

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	100	200	mV	Voltage	100 mV, 200 mV	24	µV/V	2	95%	Yes	83
						Frequency	400 Hz to 30 kHz						
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	100	200	mV	Voltage	100 mV, 200 mV	24	µV/V	2	95%	Yes	84
						Frequency	50 kHz to 70 kHz						
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	100	200	mV	Voltage	100 mV, 200 mV	32	µV/V	2	95%	Yes	85
						Frequency	100 kHz						
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	100	200	mV	Voltage	100 mV, 200 mV	76	µV/V	2	95%	Yes	86
						Frequency	200 kHz to 500 kHz						
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	100	200	mV	Voltage	100 mV, 200 mV	120	µV/V	2	95%	Yes	87
						Frequency	700 kHz to 1 MHz						

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	300	500	mV	Voltage	300 mV, 500 mV	16	µV/V	2	95%	Yes	88
						Frequency	10 Hz to 20 Hz						
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	300	500	mV	Voltage	300 mV, 500 mV	16	µV/V	2	95%	Yes	89
						Frequency	30 Hz to 300 Hz						
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	300	500	mV	Voltage	300 mV, 500 mV	13	µV/V	2	95%	Yes	90
						Frequency	400 Hz to 30 kHz						
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	300	500	mV	Voltage	300 mV, 500 mV	13	µV/V	2	95%	Yes	91
						Frequency	50 kHz to 70 kHz						
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	300	500	mV	Voltage	300 mV, 500 mV	14	µV/V	2	95%	Yes	92
						Frequency	100 kHz						
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	300	500	mV	Voltage	300 mV, 500 mV	21	µV/V	2	95%	Yes	93

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
						Frequency	200 kHz to 500 kHz						
AC/DC voltage transfer: AC/DC transfer difference at low voltages (<= 0.5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	300	500	mV	Voltage	300 mV, 500 mV	32	µV/V	2	95%	Yes	94
						Frequency	700 kHz to 1 MHz						
AC/DC voltage transfer: AC/DC transfer difference at medium voltages (0.5 V to 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	0.6	5	V	Voltage	600 mV, 700 mV, 1 V, 2 V, 3 V, 4 V, 5 V	16	µV/V	2	95%	Yes	95
						Frequency	10 Hz to 20 Hz						
AC/DC voltage transfer: AC/DC transfer difference at medium voltages (0.5 V to 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	0.6	5	V	Voltage	600 mV, 700 mV, 1 V, 2 V, 3 V, 4 V, 5 V	16	µV/V	2	95%	Yes	96
						Frequency	30 Hz to 300 Hz						
AC/DC voltage transfer: AC/DC transfer difference at medium voltages (0.5 V to 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	0.6	5	V	Voltage	600 mV, 700 mV, 1 V, 2 V, 3 V, 4 V, 5 V	13	µV/V	2	95%	Yes	97
						Frequency	400 Hz to 30 kHz						
AC/DC voltage transfer: AC/DC transfer difference at medium voltages (0.5 V to 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	0.6	5	V	Voltage	600 mV, 700 mV, 1 V, 2 V, 3 V, 4 V, 5 V	13	µV/V	2	95%	Yes	98
						Frequency	50 kHz to 70 kHz						

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
AC/DC voltage transfer: AC/DC transfer difference at medium voltages (0.5 V to 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	0.6	5	V	Voltage	600 mV, 700 mV, 1 V, 2 V, 3 V, 4 V, 5 V	14	µV/V	2	95%	Yes	99
						Frequency	100 kHz						
AC/DC voltage transfer: AC/DC transfer difference at medium voltages (0.5 V to 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	0.6	5	V	Voltage	600 mV, 700 mV, 1 V, 2 V, 3 V, 4 V, 5 V	21	µV/V	2	95%	Yes	100
						Frequency	200 kHz to 500 kHz						
AC/DC voltage transfer: AC/DC transfer difference at medium voltages (0.5 V to 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	0.6	5	V	Voltage	600 mV, 700 mV, 1 V, 2 V, 3 V, 4 V, 5 V	32	µV/V	2	95%	Yes	101
						Frequency	700 kHz to 1 MHz						
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	7	10	V	Voltage	7 V, 10 V	16	µV/V	2	95%	Yes	102
						Frequency	10 Hz to 20 Hz						
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	7	10	V	Voltage	7 V, 10 V	16	µV/V	2	95%	Yes	103
						Frequency	30 Hz to 300 Hz						

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	7	10	V	Voltage	7 V, 10 V	13	µV/V	2	95%	Yes	104
						Frequency	400 Hz to 30 kHz						
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	7	10	V	Voltage	7 V, 10 V	13	µV/V	2	95%	Yes	105
						Frequency	50 kHz to 70 kHz						
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	7	10	V	Voltage	7 V, 10 V	14	µV/V	2	95%	Yes	106
						Frequency	100 kHz						
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	7	10	V	Voltage	7 V, 10 V	21	µV/V	2	95%	Yes	107
						Frequency	200 kHz to 500 kHz						
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	7	10	V	Voltage	7 V, 10 V	32	µV/V	2	95%	Yes	108
						Frequency	700 kHz to 1 MHz						

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	20	30	V	Voltage	20 V, 30 V	24	µV/V	2	95%	Yes	109
						Frequency	10 Hz to 20 Hz						
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	20	30	V	Voltage	20 V, 30 V	23	µV/V	2	95%	Yes	110
						Frequency	30 Hz to 300 Hz						
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	20	30	V	Voltage	20 V, 30 V	16	µV/V	2	95%	Yes	111
						Frequency	400 Hz to 30 kHz						
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	20	30	V	Voltage	20 V, 30 V	19	µV/V	2	95%	Yes	112
						Frequency	50 kHz to 70 kHz						
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	20	30	V	Voltage	20 V, 30 V	19	µV/V	2	95%	Yes	113
						Frequency	100 kHz						
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	20	30	V	Voltage	20 V, 30 V	30	µV/V	2	95%	Yes	114

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
						Frequency	200 kHz to 500 kHz						
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	20	30	V	Voltage	20 V, 30 V	42	µV/V	2	95%	Yes	115
						Frequency	700 kHz to 1 MHz						
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	40	300	V	Voltage	40 V, 50 V, 60 V, 70 V, 100 V, 200 V, 300 V	32	µV/V	2	95%	Yes	116
						Frequency	10 Hz to 20 Hz						
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	40	300	V	Voltage	40 V, 50 V, 60 V, 70 V, 100 V, 200 V, 300 V	24	µV/V	2	95%	Yes	117
						Frequency	30 Hz to 300 Hz						
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	40	300	V	Voltage	40 V, 50 V, 60 V, 70 V, 100 V, 200 V, 300 V	16	µV/V	2	95%	Yes	118
						Frequency	400 Hz to 30 kHz						
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	40	300	V	Voltage	40 V, 50 V, 60 V, 70 V, 100 V, 200 V, 300 V	24	µV/V	2	95%	Yes	119
						Frequency	50 kHz to 70 kHz						

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	40	300	V	Voltage	40 V, 50 V, 60 V, 70 V, 100 V, 200 V, 300 V	28	µV/V	2	95%	Yes	120
						Frequency	100 kHz						
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	500	500	V	Frequency	10 Hz to 20 Hz	42	µV/V	2	95%	Yes	121
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	500	500	V	Frequency	30 Hz to 300 Hz	32	µV/V	2	95%	Yes	122
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	500	500	V	Frequency	400 Hz to 30 kHz	24	µV/V	2	95%	Yes	123
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	500	500	V	Frequency	50 kHz to 70 kHz	32	µV/V	2	95%	Yes	124
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	500	500	V	Frequency	100 kHz	42	µV/V	2	95%	Yes	125

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	1000	1000	V	Frequency	10 Hz to 20 Hz	52	µV/V	2	95%	Yes	126
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	1000	1000	V	Frequency	30 Hz to 300 Hz	45	µV/V	2	95%	Yes	127
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	1000	1000	V	Frequency	400 Hz to 30 kHz	28	µV/V	2	95%	Yes	128
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	1000	1000	V	Frequency	50 kHz to 70 kHz	61	µV/V	2	95%	Yes	129
AC/DC voltage transfer: AC/DC transfer difference at higher voltages (> 5 V)	Thermal converters, AC/DC transfer standard	AC/DC voltage transfer	1000	1000	V	Frequency	100 kHz	81	µV/V	2	95%	Yes	130
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	10	10	mV	Frequency	10 Hz to 20 Hz	110	µV/V	2	95%	Yes	131
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	10	10	mV	Frequency	30 Hz to 300 Hz	93	µV/V	2	95%	Yes	132
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	10	10	mV	Frequency	400 Hz to 30 kHz	93	µV/V	2	95%	Yes	133
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	10	10	mV	Frequency	50 kHz to 70 kHz	93	µV/V	3	95%	Yes	134
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	10	10	mV	Frequency	100 kHz	110	µV/V	2	95%	Yes	135

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	10	10	mV	Frequency	200 kHz to 500 kHz	280	µV/V	2	95%	Yes	136
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	10	10	mV	Frequency	700 kHz to 1 MHz	340	µV/V	3	95%	Yes	137
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	20	20	mV	Frequency	10 Hz to 20 Hz	82	µV/V	2	95%	Yes	138
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	20	20	mV	Frequency	30 Hz to 300 Hz	69	µV/V	2	95%	Yes	139
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	20	20	mV	Frequency	400 Hz to 30 kHz	69	µV/V	2	95%	Yes	140
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	20	20	mV	Frequency	50 kHz to 70 kHz	69	µV/V	2	95%	Yes	141
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	20	20	mV	Frequency	100 kHz	80	µV/V	2	95%	Yes	142
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	20	20	mV	Frequency	200 kHz to 500 kHz	270	µV/V	2	95%	Yes	143
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	20	20	mV	Frequency	700 kHz to 1 MHz	310	µV/V	2	95%	Yes	144
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	60	60	mV	Frequency	10 Hz to 20 Hz	71	µV/V	2	95%	Yes	145
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	60	60	mV	Frequency	30 Hz to 300 Hz	53	µV/V	2	95%	Yes	146
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	60	60	mV	Frequency	400 Hz to 30 kHz	53	µV/V	2	95%	Yes	147
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	60	60	mV	Frequency	50 kHz to 70 kHz	53	µV/V	2	95%	Yes	148
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	60	60	mV	Frequency	100 kHz	61	µV/V	2	95%	Yes	149
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	60	60	mV	Frequency	200 kHz to 500 kHz	250	µV/V	2	95%	Yes	150
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	60	60	mV	Frequency	700 kHz to 1 MHz	280	µV/V	2	95%	Yes	151
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	100	200	mV	Voltage	100 mV, 200 mV	45	µV/V	2	95%	Yes	152
						Frequency	10 Hz to 20 Hz						

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	100	200	mV	Voltage	100 mV, 200 mV	34	µV/V	2	95%	Yes	153
						Frequency	30 Hz to 300 Hz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	100	200	mV	Voltage	100 mV, 200 mV	34	µV/V	2	95%	Yes	154
						Frequency	30 Hz to 300 Hz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	100	200	mV	Voltage	100 mV, 200 mV	34	µV/V	2	95%	Yes	155
						Frequency	400 Hz to 30 kHz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	100	200	mV	Voltage	100 mV, 200 mV	47	µV/V	2	95%	Yes	156
						Frequency	100 kHz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	100	200	mV	Voltage	100 mV, 200 mV	240	µV/V	2	95%	Yes	157
						Frequency	200 kHz to 500 kHz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	100	200	mV	Voltage	100 mV, 200 mV	260	µV/V	2	95%	Yes	158
						Frequency	700 kHz to 1 MHz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	300	700	mV	Voltage	300 mV to 500 mV, 600 mV, 700 mV	23	µV/V	2	95%	Yes	159
						Frequency	10 Hz to 20 Hz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	300	700	mV	Voltage	300 mV to 500 mV, 600 mV, 700 mV	23	µV/V	2	95%	Yes	160
						Frequency	30 Hz to 300 Hz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	300	700	mV	Voltage	300 mV to 500 mV, 600 mV, 700 mV	21	µV/V	2	95%	Yes	161
						Frequency	400 Hz to 30 kHz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	300	700	mV	Voltage	300 mV to 500 mV, 600 mV, 700 mV	21	µV/V	2	95%	Yes	162

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
						Frequency	50 kHz to 70 kHz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	300	700	mV	Voltage	300 mV to 500 mV, 600 mV, 700 mV	31	µV/V	2	95%	Yes	163
						Frequency	100 kHz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	300	700	mV	Voltage	300 mV to 500 mV, 600 mV, 700 mV	230	µV/V	2	95%	Yes	164
						Frequency	200 kHz to 500 kHz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	300	700	mV	Voltage	300 mV to 500 mV, 600 mV, 700 mV	230	µV/V	2	95%	Yes	165
						Frequency	700 kHz to 1 MHz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	1	7	V	Voltage	1 V, 2 V, 3 V, 4 V, 5 V, 6 V, 7 V	20	µV/V	2	95%	Yes	166
						Frequency	10 Hz to 20 Hz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	1	7	V	Voltage	1 V, 2 V, 3 V, 4 V, 5 V, 6 V, 7 V	20	µV/V	2	95%	Yes	167
						Frequency	30 Hz to 300 Hz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	1	7	V	Voltage	1 V, 2 V, 3 V, 4 V, 5 V, 6 V, 7 V	20	µV/V	2	95%	Yes	168
						Frequency	400 Hz to 30 kHz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	1	7	V	Voltage	1 V, 2 V, 3 V, 4 V, 5 V, 6 V, 7 V	20	µV/V	2	95%	Yes	169
						Frequency	50 kHz to 70 kHz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	1	7	V	Voltage	1 V, 2 V, 3 V, 4 V, 5 V, 6 V, 7 V	29	µV/V	2	95%	Yes	170
						Frequency	100 kHz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	1	7	V	Voltage	1 V, 2 V, 3 V, 4 V, 5 V, 6 V, 7 V	180	µV/V	2	95%	Yes	171
						Frequency	200 kHz to 500 kHz						

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	1	7	V	Voltage	1 V, 2 V, 3 V, 4 V, 5 V, 6 V, 7 V	350	µV/V	2	95%	Yes	172
						Frequency	700 kHz to 1 MHz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	10	30	V	Voltage	10 V, 20 V, 30 V	29	µV/V	2	95%	Yes	173
						Frequency	10 Hz to 20 Hz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	10	30	V	Voltage	10 V, 20 V, 30 V	29	µV/V	2	95%	Yes	174
						Frequency	30 Hz to 300 Hz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	10	30	V	Voltage	10 V, 20 V, 30 V	23	µV/V	2	95%	Yes	175
						Frequency	400 Hz to 30 kHz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	10	30	V	Voltage	10 V, 20 V, 30 V	24	µV/V	2	95%	Yes	176
						Frequency	50 kHz to 70 kHz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	10	30	V	Voltage	10 V, 20 V, 30 V	24	µV/V	2	95%	Yes	177
						Frequency	100 kHz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	10	30	V	Voltage	10 V, 20 V, 30 V	230	µV/V	2	95%	Yes	178
						Frequency	200 kHz to 500 kHz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	10	30	V	Voltage	10 V, 20 V, 30 V	580	µV/V	2	95%	Yes	179
						Frequency	700 kHz to 1 MHz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	40	300	V	Voltage	40 V, 50 V, 60 V, 70 V, 100 V, 200 V, 300 V	35	µV/V	2	95%	Yes	180
						Frequency	10 Hz to 20 Hz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	40	300	V	Voltage	40 V, 50 V, 60 V, 70 V, 100 V, 200 V, 300 V	27	µV/V	2	95%	Yes	181
						Frequency	30 Hz to 300 Hz						

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	40	300	V	Voltage	40 V, 50 V, 60 V, 70 V, 100 V, 200 V, 300 V	21	µV/V	2	95%	Yes	182
						Frequency	400 Hz to 30 kHz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	40	300	V	Voltage	40 V, 50 V, 60 V, 70 V, 100 V, 200 V, 300 V	26	µV/V	2	95%	Yes	183
						Frequency	50 kHz to 70 kHz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	40	300	V	Voltage	40 V, 50 V, 60 V, 70 V, 100 V, 200 V, 300 V	31	µV/V	2	95%	Yes	184
						Frequency	100 kHz						
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	500	500	V	Frequency	10 Hz to 20 Hz	44	µV/V	2	95%	Yes	185
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	500	500	V	Frequency	30 Hz to 300 Hz	35	µV/V	2	95%	Yes	186
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	500	500	V	Frequency	400 Hz to 30 kHz	27	µV/V	2	95%	Yes	187
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	500	500	V	Frequency	50 kHz to 70 kHz	35	µV/V	2	95%	Yes	188
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	500	500	V	Frequency	100 kHz	44	µV/V	2	95%	Yes	189
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	1000	1000	V	Frequency	10 Hz to 20 Hz	54	µV/V	2	95%	Yes	190
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	1000	1000	V	Frequency	30 Hz to 300 Hz	47	µV/V	2	95%	Yes	191
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	1000	1000	V	Frequency	400 Hz to 30 kHz	31	µV/V	2	95%	Yes	192
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	1000	1000	V	Frequency	50 kHz to 70 kHz	63	µV/V	2	95%	Yes	193
AC voltage up to 1000 V: sources	Multifunction calibrator	AC/DC voltage transfer	1000	1000	V	Frequency	100 kHz	82	µV/V	2	95%	Yes	194
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	10	10	mV	Frequency	10 Hz to 20 Hz	110	µV/V	2	95%	Yes	195

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	10	10	mV	Frequency	30 Hz to 300 Hz	93	µV/V	2	95%	Yes	196
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	10	10	mV	Frequency	400 Hz to 30 kHz	90	µV/V	2	95%	Yes	197
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	10	10	mV	Frequency	50 kHz to 70 kHz	90	µV/V	2	95%	Yes	198
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	10	10	mV	Frequency	100 kHz	110	µV/V	2	95%	Yes	199
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	10	10	mV	Frequency	200 kHz to 500 kHz	280	µV/V	2	95%	Yes	200
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	10	10	mV	Frequency	700 kHz to 1 MHz	340	µV/V	2	95%	Yes	201
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	20	20	mV	Frequency	10 Hz to 20 Hz	79	µV/V	2	95%	Yes	202
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	20	20	mV	Frequency	30 Hz to 300 Hz	65	µV/V	2	95%	Yes	203
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	20	20	mV	Frequency	400 Hz to 30 kHz	65	µV/V	2	95%	Yes	204
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	20	20	mV	Frequency	50 kHz to 70 kHz	65	µV/V	2	95%	Yes	205
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	20	20	mV	Frequency	100 kHz	74	µV/V	2	95%	Yes	206
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	20	20	mV	Frequency	200 kHz to 500 kHz	270	µV/V	2	95%	Yes	207
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	20	20	mV	Frequency	700 kHz to 1 MHz	310	µV/V	2	95%	Yes	208
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	60	60	mV	Frequency	10 Hz to 20 Hz	67	µV/V	2	95%	Yes	209
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	60	60	mV	Frequency	30 Hz to 300 Hz	48	µV/V	2	95%	Yes	210
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	60	60	mV	Frequency	400 Hz to 30 kHz	48	µV/V	2	95%	Yes	211
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	60	60	mV	Frequency	50 kHz to 70 kHz	48	µV/V	2	95%	Yes	212

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	60	60	mV	Frequency	100 kHz	57	µV/V	2	95%	Yes	213
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	60	60	mV	Frequency	200 kHz to 500 kHz	250	µV/V	2	95%	Yes	214
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	60	60	mV	Frequency	700 kHz to 1 MHz	280	µV/V	2	95%	Yes	215
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	100	200	mV	Voltage	100 mV, 200 mV	38	µV/V	2	95%	Yes	216
						Frequency	10 Hz to 20 Hz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	100	200	mV	Voltage	100 mV, 200 mV	25	µV/V	2	95%	Yes	217
						Frequency	30 Hz to 300 Hz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	100	200	mV	Voltage	100 mV, 200 mV	25	µV/V	2	95%	Yes	218
						Frequency	400 Hz to 30 kHz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	100	200	mV	Voltage	100 mV, 200 mV	25	µV/V	2	95%	Yes	219
						Frequency	50 kHz to 70 kHz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	100	200	mV	Voltage	100 mV, 200 mV	41	µV/V	2	95%	Yes	220
						Frequency	100 kHz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	100	200	mV	Voltage	100 mV, 200 mV	240	µV/V	2	95%	Yes	221
						Frequency	200 kHz to 500 kHz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	100	200	mV	Voltage	100 mV, 200 mV	260	µV/V	2	95%	Yes	222
						Frequency	700 kHz to 1 MHz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	300	700	mV	Voltage	300 mV to 500 mV, 600 mV, 700 mV	20	µV/V	2	95%	Yes	223
						Frequency	10 Hz to 20 Hz						

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	300	700	mV	Voltage	300 mV to 500 mV, 600 mV, 700 mV	20	µV/V	2	95%	Yes	224
						Frequency	30 Hz to 300 Hz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	300	700	mV	Voltage	300 mV to 500 mV, 600 mV, 700 mV	18	µV/V	2	95%	Yes	225
						Frequency	400 Hz to 30 kHz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	300	700	mV	Voltage	300 mV to 500 mV, 600 mV, 700 mV	18	µV/V	2	95%	Yes	226
						Frequency	50 kHz to 70 kHz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	300	700	mV	Voltage	300 mV to 500 mV, 600 mV, 700 mV	29	µV/V	2	95%	Yes	227
						Frequency	100 kHz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	300	700	mV	Voltage	300 mV to 500 mV, 600 mV, 700 mV	230	µV/V	2	95%	Yes	228
						Frequency	200 kHz to 500 kHz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	300	700	mV	Voltage	300 mV to 500 mV, 600 mV, 700 mV	230	µV/V	2	95%	Yes	229
						Frequency	700 kHz to 1 MHz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	1	7	V	Voltage	1 V, 2 V, 3 V, 4 V, 5 V, 6 V, 7 V	16	µV/V	2	95%	Yes	230
						Frequency	10 Hz to 20 Hz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	1	7	V	Voltage	1 V, 2 V, 3 V, 4 V, 5 V, 6 V, 7 V	16	µV/V	2	95%	Yes	231
						Frequency	30 Hz to 300 Hz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	1	7	V	Voltage	1 V, 2 V, 3 V, 4 V, 5 V, 6 V, 7 V	16	µV/V	2	95%	Yes	232
						Frequency	400 Hz to 30 kHz						

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	1	7	V	Voltage	1 V, 2 V, 3 V, 4 V, 5 V, 6 V, 7 V	16	µV/V	2	95%	Yes	233
						Frequency	50 kHz to 70 kHz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	1	7	V	Voltage	1 V, 2 V, 3 V, 4 V, 5 V, 6 V, 7 V	27	µV/V	2	95%	Yes	234
						Frequency	100 kHz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	1	7	V	Voltage	1 V, 2 V, 3 V, 4 V, 5 V, 6 V, 7 V	180	µV/V	2	95%	Yes	235
						Frequency	200 kHz to 500 kHz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	1	7	V	Voltage	1 V, 2 V, 3 V, 4 V, 5 V, 6 V, 7 V	350	µV/V	2	95%	Yes	236
						Frequency	700 kHz to 1 MHz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	10	30	V	Voltage	10 V, 20 V, 30 V	29	µV/V	2	95%	Yes	237
						Frequency	10 Hz to 20 Hz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	10	30	V	Voltage	10 V, 20 V, 30 V	29	µV/V	2	95%	Yes	238
						Frequency	30 Hz to 300 Hz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	10	30	V	Voltage	10 V, 20 V, 30 V	23	µV/V	2	95%	Yes	239
						Frequency	400 Hz to 30 kHz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	10	30	V	Voltage	10 V, 20 V, 30 V	24	µV/V	2	95%	Yes	240
						Frequency	50 kHz to 70 kHz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	10	30	V	Voltage	10 V, 20 V, 30 V	24	µV/V	2	95%	Yes	241
						Frequency	100 kHz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	10	30	V	Voltage	10 V, 20 V, 30 V	230	µV/V	2	95%	Yes	242
						Frequency	200 kHz to 500 kHz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	10	30	V	Voltage	10 V, 20 V, 30 V	580	µV/V	2	95%	Yes	243

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
						Frequency	700 kHz to 1 MHz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	40	300	V	Voltage	40 V, 50 V, 60 V, 70 V, 100 V, 200 V, 300 V	33	µV/V	2	95%	Yes	244
						Frequency	10 Hz to 20 Hz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	40	300	V	Voltage	40 V, 50 V, 60 V, 70 V, 100 V, 200 V, 300 V	25	µV/V	2	95%	Yes	245
						Frequency	30 Hz to 300 Hz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	40	300	V	Voltage	40 V, 50 V, 60 V, 70 V, 100 V, 200 V, 300 V	18	µV/V	2	95%	Yes	246
						Frequency	400 Hz to 30 kHz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	40	300	V	Voltage	40 V, 50 V, 60 V, 70 V, 100 V, 200 V, 300 V	25	µV/V	2	95%	Yes	247
						Frequency	50 kHz to 70 kHz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	40	300	V	Voltage	40 V, 50 V, 60 V, 70 V, 100 V, 200 V, 300 V	29	µV/V	2	95%	Yes	248
						Frequency	100 kHz						
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	500	500	V	Frequency	10 Hz to 20 Hz	43	µV/V	2	95%	Yes	249
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	500	500	V	Frequency	30 Hz to 300 Hz	33	µV/V	2	95%	Yes	250
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	500	500	V	Frequency	400 Hz to 30 kHz	25	µV/V	2	95%	Yes	251
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	500	500	V	Frequency	50 kHz to 70 kHz	33	µV/V	2	95%	Yes	252
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	500	500	V	Frequency	100 kHz	43	µV/V	2	95%	Yes	253
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	1000	1000	V	Frequency	10 Hz to 20 Hz	52	µV/V	2	95%	Yes	254
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	1000	1000	V	Frequency	30 Hz to 300 Hz	43	µV/V	2	95%	Yes	255

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	1000	1000	V	Frequency	400 Hz to 30 kHz	29	µV/V	2	95%	Yes	256
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	1000	1000	V	Frequency	50 kHz to 70 kHz	63	µV/V	2	95%	Yes	257
AC voltage up to 1000 V: meters	AC voltmeter, multimeter	AC/DC voltage transfer	1000	1000	V	Frequency	100 kHz	81	µV/V	2	95%	Yes	258
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	2.5	20	mA	Current	5 mA, 10 mA, 20 mA	69	µA/A	2	95%	Yes	259
						Frequency	10 Hz to 20 kHz						
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	2.5	20	mA	Current	5 mA, 10 mA, 20 mA	71	µA/A	2	95%	Yes	260
						Frequency	50 kHz						
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	2.5	20	mA	Current	5 mA, 10 mA, 20 mA	73	µA/A	2	95%	Yes	261
						Frequency	70 kHz						
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	2.5	20	mA	Current	5 mA, 10 mA, 20 mA	75	µA/A	2	95%	Yes	262
						Frequency	100 kHz						
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	30	50	mA	Current	30 mA, 50 mA	70	µA/A	2	95%	Yes	263
						Frequency	10 Hz to 20 kHz						
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	30	50	mA	Current	30 mA, 50 mA	73	µA/A	2	95%	Yes	264
						Frequency	50 kHz						
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	30	50	mA	Current	30 mA, 50 mA	75	µA/A	2	95%	Yes	265
						Frequency	70 kHz						
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	30	50	mA	Current	30 mA, 50 mA	77	µA/A	2	95%	Yes	266
						Frequency	100 kHz						
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	100	100	mA	Frequency	10 Hz to 10 kHz	70	µA/A	2	95%	Yes	267
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	100	100	mA	Frequency	20 kHz	71	µA/A	2	95%	Yes	268

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	100	100	mA	Frequency	50 kHz	75	µA/A	2	95%	Yes	269
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	100	100	mA	Frequency	70 kHz	77	µA/A	2	95%	Yes	270
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	100	100	mA	Frequency	100 kHz	79	µA/A	2	95%	Yes	271
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	200	200	mA	Frequency	10 Hz to 10 kHz	71	µA/A	2	95%	Yes	272
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	200	200	mA	Frequency	20 kHz	73	µA/A	2	95%	Yes	273
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	200	200	mA	Frequency	50 kHz	77	µA/A	2	95%	Yes	274
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	200	200	mA	Frequency	70 kHz	79	µA/A	2	95%	Yes	275
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	200	200	mA	Frequency	100 kHz	82	µA/A	2	95%	Yes	276
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	300	300	mA	Frequency	10 Hz to 10 kHz	71	µA/A	2	95%	Yes	277
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	300	300	mA	Frequency	20 kHz	75	µA/A	2	95%	Yes	278
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	300	300	mA	Frequency	50 kHz	79	µA/A	2	95%	Yes	279
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	300	300	mA	Frequency	70 kHz	82	µA/A	2	95%	Yes	280
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	300	300	mA	Frequency	100 kHz	85	µA/A	2	95%	Yes	281
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	500	500	mA	Frequency	10 Hz to 10 kHz	71	µA/A	2	95%	Yes	282
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	500	500	mA	Frequency	20 kHz	77	µA/A	2	95%	Yes	283
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	500	500	mA	Frequency	50 kHz	82	µA/A	2	95%	Yes	284
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	500	500	mA	Frequency	70 kHz	85	µA/A	2	95%	Yes	285

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	500	500	mA	Frequency	100 kHz	88	µA/A	2	95%	Yes	286
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	1	1	A	Frequency	10 Hz to 10 kHz	73	µA/A	2	95%	Yes	287
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	1	1	A	Frequency	20 kHz	79	µA/A	2	95%	Yes	288
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	1	1	A	Frequency	50 kHz	91	µA/A	2	95%	Yes	289
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	1	1	A	Frequency	70 kHz	98	µA/A	2	95%	Yes	290
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	1	1	A	Frequency	100 kHz	113	µA/A	2	95%	Yes	291
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	2	2	A	Frequency	10 Hz to 10 kHz	73	µA/A	2	95%	Yes	292
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	2	2	A	Frequency	20 kHz	83	µA/A	2	95%	Yes	293
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	2	2	A	Frequency	50 kHz	98	µA/A	2	95%	Yes	294
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	2	2	A	Frequency	70 kHz	105	µA/A	2	95%	Yes	295
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	2	2	A	Frequency	100 kHz	121	µA/A	2	95%	Yes	296
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	3	3	A	Frequency	10 Hz to 10 kHz	75	µA/A	2	95%	Yes	297
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	3	3	A	Frequency	20 kHz	94	µA/A	2	95%	Yes	298
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	3	3	A	Frequency	50 kHz	121	µA/A	2	95%	Yes	299
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	3	3	A	Frequency	70 kHz	142	µA/A	2	95%	Yes	300
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	3	3	A	Frequency	100 kHz	165	µA/A	2	95%	Yes	301
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	5	5	A	Frequency	10 Hz to 10 kHz	79	µA/A	2	95%	Yes	302

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty					
Quantity	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage factor	Level of confidence	Is the expanded uncertainty a relative one?	NMI Service Identification
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	5	5	A	Frequency	20 kHz	98	μA/A	2	95%	Yes	303
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	5	5	A	Frequency	50 kHz	130	μA/A	2	95%	Yes	304
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	5	5	A	Frequency	70 kHz	156	μA/A	2	95%	Yes	305
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	5	5	A	Frequency	100 kHz	202	μA/A	2	95%	Yes	306
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	10	10	A	Frequency	10 Hz to 10 kHz	85	μA/A	2	95%	Yes	307
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	10	10	A	Frequency	20 kHz	98	μA/A	2	95%	Yes	308
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	10	10	A	Frequency	50 kHz	0.1	mA/A	2	95%	Yes	309
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	10	10	A	Frequency	70 kHz, 100 kHz	0.11	mA/A	2	95%	Yes	310
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	20	20	A	Frequency	10 Hz to 10 kHz	70	μA/A	2	95%	Yes	311
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	20	20	A	Frequency	20 kHz, 50 kHz, 70 kHz	0.11	mA/A	2	95%	Yes	312
AC current up to 100 A: sources	Multifunction calibrator	AC/DC current transfer	20	20	A	Frequency	100 kHz	0.12	mA/A	2	95%	Yes	313

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Mass and Related Quantities, Thailand, NIMT (National Institute of Metrology (Thailand))

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty						
Class	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Comments	NMI Service Identifier
Mass	Weight, class E2	Comparison in air	1	10	mg	Mass	OIML-R-111	2	µg	2	95%	No	Approved on 18 April 2006	1
Mass	Weight, class E2	Comparison in air	20	20	mg	Mass	OIML-R-111	3	µg	2	95%	No	Approved on 18 April 2006	2
Mass	Weight, class E2	Comparison in air	50	50	mg	Mass	OIML-R-111	4	µg	2	95%	No	Approved on 18 April 2006	3
Mass	Weight, class E2	Comparison in air	100	100	mg	Mass	OIML-R-111	5	µg	2	95%	No	Approved on 18 April 2006	4
Mass	Weight, class E2	Comparison in air	200	200	mg	Mass	OIML-R-111	6	µg	2	95%	No	Approved on 18 April 2006	5
Mass	Weight, class E2	Comparison in air	500	500	mg	Mass	OIML-R-111	8	µg	2	95%	No	Approved on 18 April 2006	6
Mass	Weight, class E2	Comparison in air	1	1	g	Mass	OIML-R-111	10	µg	2	95%	No	Approved on 18 April 2006	7
Mass	Weight, class E2	Comparison in air	2	2	g	Mass	OIML-R-111	12	µg	2	95%	No	Approved on 18 April 2006	8
Mass	Weight, class E2	Comparison in air	5	5	g	Mass	OIML-R-111	16	µg	2	95%	No	Approved on 18 April 2006	9
Mass	Weight, class E2	Comparison in air	10	10	g	Mass	OIML-R-111	20	µg	2	95%	No	Approved on 18 April 2006	10
Mass	Weight, class E2	Comparison in air	20	20	g	Mass	OIML-R-111	25	µg	2	95%	No	Approved on 18 April 2006	11
Mass	Weight, class E2	Comparison in air	50	50	g	Mass	OIML-R-111	30	µg	2	95%	No	Approved on 18 April 2006	12
Mass	Weight, class E2	Comparison in air	100	100	g	Mass	OIML-R-111	50	µg	2	95%	No	Approved on 18 April 2006	13
Mass	Weight, class E2	Comparison in air	200	200	g	Mass	OIML-R-111	100	µg	2	95%	No	Approved on 18 April 2006	14
Mass	Weight, class E2	Comparison in air	500	500	g	Mass	OIML-R-111	250	µg	2	95%	No	Approved on 18 April 2006	15
Mass	Weight, class E2	Comparison in air	1	1	kg	Mass	OIML-R-111	500	µg	2	95%	No	Approved on 18 April 2006	16
Mass	Weight, class E2	Comparison in air	2	2	kg	Mass	OIML-R-111	1000	µg	2	95%	No	Approved on 18 April 2006	17
Mass	Weight, class E2	Comparison in air	5	5	kg	Mass	OIML-R-111	2500	µg	2	95%	No	Approved on 18 April 2006	18
Mass	Weight, class E2	Comparison in air	10	10	kg	Mass	OIML-R-111	5000	µg	2	95%	No	Approved on 18 April 2006	19
Absolute pressure, gas medium	Pressure gauge	Direct comparison with pressure standard	3.5	1750	kPa			3E-05*P*, *P* pressure in kPa, or 0.8 Pa whichever is greater	kPa	2	95%	No	Approved on 18 April 2006. Uncertainty values range from 0.8 Pa to 52.5 Pa	20

Mass and Related Quantities, Thailand, NIMT (National Institute of Metrology (Thailand))

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty						
Class	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Comments	NMI Service Identifier
Absolute pressure, gas medium	Pressure gauge	Direct comparison with pressure standard	1.75	7	MPa			4E-05*P*, *P* pressure in MPa	MPa	2	95%	No	Approved on 18 April 2006. Uncertainty values range from 70 Pa to 280 Pa	21
Absolute pressure, oil medium	Pressure gauge	Direct comparison with pressure standard	0.1	7.1	MPa			3E-05*P*, *P* pressure in MPa, or 21 Pa whichever is greater	MPa	2	95%	No	Approved on 18 April 2006. Uncertainty values range from 21 Pa to 213 Pa	22
Absolute pressure, oil medium	Pressure gauge	Direct comparison with pressure standard	7.1	70.1	MPa			4E-05*P*, *P* pressure in MPa	MPa	2	95%	No	Approved on 18 April 2006. Uncertainty values range from 2.1E+02 Pa to 2.8E+03 Pa	23
Absolute pressure, oil medium	Pressure gauge	Direct comparison with pressure standard	70.1	140.1	MPa			5E-05*P*, *P* pressure in MPa	MPa	2	95%	No	Approved on 18 April 2006. Uncertainty values range from 2.8E+03 Pa to 7.0E+03 Pa	24
Gauge pressure, gas medium	Pressure gauge	Direct comparison with pressure standard	-1	3	kPa			3E-04*P*, *P* pressure in kPa, or 0.3 Pa whichever is greater	kPa	2	95%	No	Approved on 18 April 2006. Uncertainty values range from 0.3 Pa to 0.9 Pa	25
Gauge pressure, gas medium	Pressure balance	Direct comparison with pressure standard: crossfloat	3.5	1750	kPa			3E-05*P*, *P* pressure in kPa, or 0.8 Pa whichever is greater	kPa	2	95%	No	Approved on 18 April 2006. Uncertainty values range from 0.8 Pa to 52.5 Pa	26
Gauge pressure, gas medium	Pressure balance	Direct comparison with pressure standard: crossfloat	1.75	7	MPa			4E-05*P*, *P* pressure in MPa	MPa	2	95%	No	Approved on 18 April 2006. Uncertainty values range from 70 Pa to 280 Pa	27
Gauge pressure, oil medium	Pressure balance	Direct comparison with pressure standard: crossfloat	0.57	7	MPa			3E-05*P*, *P* pressure in MPa, or 21 Pa whichever is greater	MPa	2	95%	No	Approved on 18 April 2006. Uncertainty values range from 21 Pa to 210 Pa	28
Gauge pressure, oil medium	Pressure balance	Direct comparison with pressure standard: crossfloat	7	70	MPa			4E-05*P*, *P* pressure in Mpa	MPa	2	95%	No	Approved on 18 April 2006. Uncertainty values range from 2.1E+02 Pa to 2.8E+03 Pa	29

Mass and Related Quantities, Thailand, NIMT (National Institute of Metrology (Thailand))

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty						
Class	Instrument or Artifact	Instrument Type or Method	Minimum value	Maximum value	Units	Parameter	Specifications	Value	Units	Coverage Factor	Level of Confidence	Is the expanded uncertainty a relative one?	Comments	NMI Service Identifier
Gauge pressure, oil medium	Pressure balance	Direct comparison with pressure standard: crossfloat	70	140	MPa			5E-05*P*, *P* pressure in MPa	MPa	2	95%	No	Approved on 18 April 2006. Uncertainty values range from 2.8E+03 Pa to 7.0E+03 Pa	30

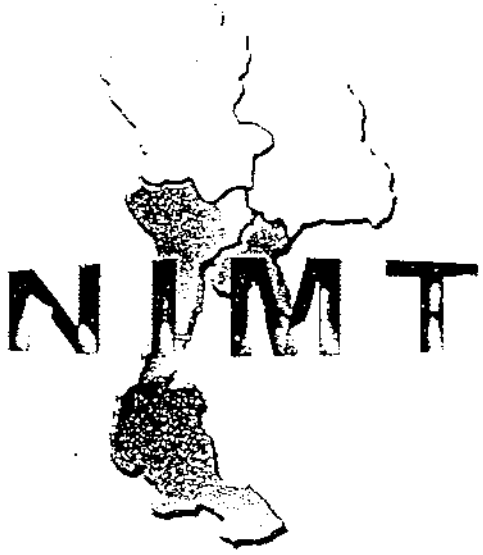
Annex 27: Calibration Laboratories in Thailand

Annex 27

สถาบันมาตรวิทยาแห่งชาติ
National Institute of Metrology (Thailand)

ห้องปฏิบัติการสอบเทียบในประเทศไทย

Calibration Laboratories *in Thailand*



กันยายน 2546

บริการ > Calibration Laboratory Directory

ค้นหาห้องปฏิบัติการ

ภาค ทั้งหมด

สาขาห้องปฏิบัติการ
- 1 - สาขามวล
- 2 - สาขาอุณหภูมิ
- 3 - สาขาไฟฟ้าและความถี่
- 4 - สาขามิติ
- 5 - สาขาแรงและแรงบิด
- 6 - สาขาความดันและสุญญากาศ
- 7 - สาขาเคมี
- 8 - สาขาปริมาตรและการไหล
- 9 - สาขาเสียงและการสั่นสะเทือน
- 10 - เครื่องวัดปริมาณแอลกอฮอล์ในเลือดโดยวิธีเป่าลมหายใจ
- 11 - รังสี
- 12 - ลม
- 13 - สนามแม่เหล็ก
- 14 - เครื่องมือแพทย์
- 15 - สาขาแรง

ค้นหาห้องปฏิบัติการตามการอ้างอิงมาตรฐาน ISO/IEC 17025

- ISO/IEC17025
- NIMT's network
- ภาครัฐ
- เอกชน

คำค้น

ค้นหา

ผลการค้นหาห้องปฏิบัติการ

คำค้น " " พบจำนวน **78** รายการ

หมายเลข	ห้องปฏิบัติการ	สาขาห้องปฏิบัติการ
1	ศูนย์สอบเทียบเครื่องมือวัดธุรกิจปาร์งรักษา การไฟฟ้าฝ่ายผลิตแห่งประเทศไทย ISO/IEC17025	4, 2, 1, 3, 5 8, 9
2	ศูนย์สอบเทียบเครื่องมือวัดสำหรับอุตสาหกรรม มหาวิทยาลัยบูรพา ISO/IEC17025	4
3	ศูนย์ทดสอบและมาตรวิทยา สถาบันวิจัยวิทยาศาสตร์และเทคโนโลยีแห่งประเทศไทย ISO/IEC17025	4, 2, 1, 3, 5 7, 8, 9
4	หน่วยปฏิบัติการสอบเทียบเครื่องมือวัด สถาบันค้นคว้าและพัฒนาเทคโนโลยีการผลิตทางอุตสาหกรรม มหาวิทยาลัยเกษตรศาสตร์ ISO/IEC17025	4
5	หน่วยปฏิบัติการสอบเทียบเครื่องมือวัดปริมาณแอลกอฮอล์ในเลือด โดยวิธีเป่าลมหายใจ กองรังสีและเครื่องมือแพทย์ กรมวิทยาศาสตร์การแพทย์ กระทรวงสาธารณสุข ISO/IEC17025	10
6	ห้องปฏิบัติการมาตรวิทยาด้านรังสี กองการวัดกัมมันตรังสี สำนักงานพลังงานปรมาณูเพื่อสันติ ISO/IEC17025	11
7	บริษัทการบินไทย จำกัด (มหาชน) ISO/IEC17025	4, 2, 1, 3, 5
8	บริษัท เอเชีย ไบโอ ซิสเต็มส์ (ประเทศไทย) จำกัด	2, 1, 5, 1
9	กองปรับมาตรฐานเครื่องวัด บริษัท วิทยุการบินแห่งประเทศไทย จำกัด ISO/IEC17025	3
10	ศูนย์สอบเทียบเครื่องมือวัดอุตสาหกรรม สถาบันส่งเสริมเทคโนโลยี (ไทย-ญี่ปุ่น) ISO/IEC17025	4, 2, 1, 3, 5 7, 8
11	บริษัท แคล.แล็บ.เมทโทรโลยี่ จำกัด ISO/IEC17025	4, 2, 1, 6

12	บริษัท แคลลิเบรเทค ISO/IEC17025	4, 2, 1, 7,
13	บริษัท ชมิดท์ อิเล็กโทรนิกส์ (ประเทศไทย) จำกัด ISO/IEC17025	3
14	บริษัท ไซแอนติฟิค โปรโมชั่น จำกัด ISO/IEC17025	2, 1, 7, 8
15	บริษัท เทคโนโลยี อินสตรูเมนท์ จำกัด ISO/IEC17025	4, 2, 1, 3, 5 7
16	บริษัท ไทยโพลิเอทธีลีน จำกัด ISO/IEC17025	2, 1, 3, 6
17	บริษัท พรีเมียร์ซิสเต็ม เอ็นจิเนียริ่ง จำกัด ISO/IEC17025	4, 2, 1, 3, 6
18	บริษัท มาร์คส์ แมชชีน (ประเทศไทย) จำกัด ISO/IEC17025	4, 2, 3, 6
19	บริษัท มาสเตอร์คาลิเบรชั่น จำกัด ISO/IEC17025	4, 2, 1, 5,
20	บริษัท โยโกกาวา (ประเทศไทย) จำกัด ISO/IEC17025	2, 3, 6
21	บริษัท ศูนย์สอบเทียบเครื่องมือไฮเทค จำกัด ISO/IEC17025	4, 2, 1, 5,
22	บริษัท แสงชัยมิเตอร์ จำกัด ISO/IEC17025	2, 1, 3, 6
23	บริษัท เอกรัฐวิศวกรรม จำกัด (มหาชน) ISO/IEC17025	4, 1, 3
24	บริษัท เอ็น.เอ็ม.เทคนิคอล เซ็นเตอร์ จำกัด ISO/IEC17025	2
25	บริษัท เอ็นอีซี คอร์ปอเรชั่น (ประเทศไทย) จำกัด ISO/IEC17025	4, 2, 1, 3, 5
26	บริษัท แอ็ดแวนเทจ เซ็นเตอร์ จำกัด ISO/IEC17025	4, 2, 1, 3, 5 7
27	ศูนย์มาตรวิทยา บริษัท ปูนซิเมนต์ไทยอุตสาหกรรม จำกัด ISO/IEC17025	4, 2, 1, 3, 6,
28	ส่วนควบคุมคุณภาพ บริษัท การปิโตรเลียมแห่งประเทศไทย จำกัด (มหาชน) ISO/IEC17025	4, 2, 1, 6,
29	ห้องปฏิบัติการสอบเทียบมวลและเครื่องชั่ง บริษัท ไทยเครื่องชั่ง จำกัด ISO/IEC17025	1
30	กลุ่มสอบเทียบเครื่องมือวัด วิเคราะห์ทดสอบ กรมวิทยาศาสตร์บริการ ISO/IEC17025	4, 1, 3, 6,
31	แผนกซ่อมปรับเทียบมาตรฐานเครื่องวัด กรมสื่อสารทหารอากาศ กองทัพอากาศ (นครราชสีมา) ISO/IEC17025	4, 2, 1, 3, 5
32	ฝ่ายบริการทดสอบ สถาบันอาหาร ISO/IEC17025	2, 1, 8
33	ศูนย์เครื่องมือวัดละเอียดและสอบเทียบขนาด สถาบันเทคโนโลยีพระจอมเกล้าพระนครเหนือ ISO/IEC17025	4
34	ศูนย์มาตรฐานความถี่และเวลาเพื่อการปรับเทียบ กรมไปรษณีย์โทรเลข ISO/IEC17025	3
35	ศูนย์สอบเทียบเครื่องมือวัด มหาวิทยาลัยสงขลานครินทร์ ISO/IEC17025	2, 1, 3, 6
36	ศูนย์สอบเทียบเครื่องมือวัดอุตสาหกรรม มหาวิทยาลัยเทคโนโลยีพระจอมเกล้าธนบุรี ISO/IEC17025	4, 2, 1, 3,
37	สำนักชั่งตวงวัด กระทรวงพาณิชย์ ISO/IEC17025	4, 2, 1, 8
38	ห้องปฏิบัติการสอบเทียบ ฝ่ายวิจัยและพัฒนาเทคนิค กองซ่อมและปรับเทียบ องค์การโทรศัพท์แห่งประเทศไทย ISO/IEC17025	3
39	ห้องปฏิบัติการสอบเทียบเครื่องวัดรังสีมาตรฐานทุติยภูมิ (SSDL) กรมวิทยาศาสตร์การแพทย์ กระทรวงสาธารณสุข ISO/IEC17025	11
40	ห้องสอบเทียบเครื่องตรวจอากาศ กรมอุตุนิยมวิทยา ISO/IEC17025	2, 6, 12
41	Hitachi Consumer Service Co., Ltd. ISO/IEC17025	4, 2, 1, 3, 5
42	SKIP Calibration Engineering	4, 2, 1

43	บริษัท คณิต เอ็นจิเนียริ่ง จำกัด • ISO/IEC17025	2, 6
44	บริษัท ควอลิตี้ คาลิเบรชั่น จำกัด • ISO/IEC17025	4, 2, 1, 3, 6
45	บริษัท แคลลิเบรชั่น แมเนจเมนท์ จำกัด	2, 3, 6, 8
46	บริษัท แคลิเบรชั่น แลบอราทอรี่ จำกัด	4, 2, 1, 3, 5 9
47	บริษัท ไดเนติกส์ คอร์ปอเรชั่น จำกัด	6
48	บริษัท ซิเมนส์ จำกัด	4, 2, 3, 5,
49	บริษัท ถิรไทย จำกัด	4, 3
50	บริษัท ฟอร์ธ แคลเบรชั่น แอนด์ เซอร์วิส จำกัด	4, 2, 1, 6
51	บริษัท มิงเด้ง เมโทรโลยี เซอร์วิส (ไทยแลนด์) จำกัด	4, 2, 3, 5
52	บริษัท มิตตูโตโย (ประเทศไทย) จำกัด	4, 5
53	บริษัท เมเซอร์โทรนิกซ์ จำกัด	2, 3
54	บริษัท เมทเล่อร์-โทเลโด (ประเทศไทย) จำกัด	2, 1, 7
55	บริษัท เมโทรโลยี จำกัด	2, 3, 13
56	บริษัท เมโทรโลยี เทคนิคคอล จำกัด	2, 1, 7
57	บริษัท ยู-แคล จำกัด	1, 2, 3, 4, 5 7, 8
58	บริษัท ยูนิไทยกรุ๊ป จำกัด	2, 1, 3, 6,
59	บริษัท ยูไนเต็ดเทเลคอมเซลส์แอนด์เซอร์วิสเซส จำกัด	3
60	บริษัท รีอคเกอร์เทค (ไทยแลนด์) จำกัด	4, 2, 3, 6
61	บริษัท ระยองวิศวกรรมและซ่อมบำรุง จำกัด	2, 3, 6
62	บริษัท ลีโอนิคส์ จำกัด	4, 3
63	บริษัท วี แอนด์ เอ ไฮ-เทค จำกัด	2, 3, 6
64	บริษัท สยามลีดเดอร์เทค จำกัด	4, 2, 1, 5, 6 8
65	บริษัท สามมิตรมอเตอร์แมนูแฟคเจอริ่ง จำกัด	4, 5
66	บริษัท อินชัเทค เมทโทรโลยี่ จำกัด	4, 2, 1, 3,
67	บริษัท อินโทร เอ็นเตอร์ไพรส์ จำกัด	5
68	บริษัท อิสเทิร์น เอนเนอยี เซอร์วิส (ประเทศไทย) จำกัด	8
69	บริษัท เอจิเลนต์ เทคโนโลยี (ประเทศไทย) จำกัด	3
70	บริษัท ไอโซแคล เทคโนโลยี จำกัด	2, 1, 3, 6
71	บริษัท ไอโซเทค อินสตรูเมนท์ (ไทยแลนด์) จำกัด	14
72	บริษัท ไทย สแตนดาร์ด คาลิเบรชั่น จำกัด	4, 2, 1, 3, 5 7, 8
73	H.P.G. Cal-Centre (Thailand) Co., Ltd	2, 3, 6
74	บริษัท สยามเมดิคอล แมนเนจเมนท์ จำกัด	14

75	**บริษัท ท๊อป โกลบอล เทค จำกัด**	4, 2, 1, 8
76	**บริษัท ซีเมนส์ จำกัด**	2, 3, 5, 6
77	**บริษัท ดับบลิวอาร์บี แลบอราทอรี่ จำกัด**	4, 2, 1, 8
78	**CMS Technology Co.,Ltd.**	2, 8, 12

ข้อมูลที่นำเสนอจากฐานข้อมูลนี้ เป็นเพียงการรวบรวมฐานข้อมูลห้องปฏิบัติการสอบเทียบ เพื่อใช้ประกอบการพิจารณาตัดสินใจเลือกใช้บริการสอบเทียบเท่านั้น มิใช่การรับรองว่าห้องปฏิบัติการสอบเทียบเหล่านี้ได้รับการรับรอง จากสถาบันมาตรวิทยาแห่งชาติ ดังนั้นสถาบันฯจะไม่รับผิดชอบใดๆ จากผลอันเกิดจากการนำข้อมูลไปใช้

สถาบันฯจะทำการรวบรวมข้อมูลอย่างต่อเนื่องและปรับปรุงข้อมูลให้ทันสมัย
ห้องปฏิบัติการสอบเทียบใด ประสงค์ที่จะทำการเปลี่ยนแปลง แก้ไขหรือเพิ่มเติมข้อมูล
ติดต่อฝ่ายนโยบายและยุทธศาสตร์ โทร 0 2577 5100 โทรสาร 0 2577 2859

⇧ ข้างบน

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Annex 28: NIMT's Calibration Laboratory Network in Thailand

Annex 28 NIMT's Calibration Laboratory Network in Thailand

1. Industrial equipment Calibration Center
   King's Mongkut University of Technology, Thonburi, Bangkok

2. Calibration Laboratory Co., Ltd./ Bangkok

3. Metrological Cneter/ Siam Cement Industry Co., Ltd./ Bangkok

4. NEC Corporation Co., Ltd./ Pratumthani province

5. Rockertek (Thailand) Co., Ltd./ Bangkok

6. Sammitr Motor Co., Ltd./ Samutsakorn province

7. Marks Machine (Thailand) Co., Ltd./ Rayong province

8. Calibration Measurement Center
   Faculty of Food Science/ Songkla University/ Songkla province

9. Electrical Generator Authority of Thailand/ Bangkok

10. Technology Promotion Association (Thailand-Japan)

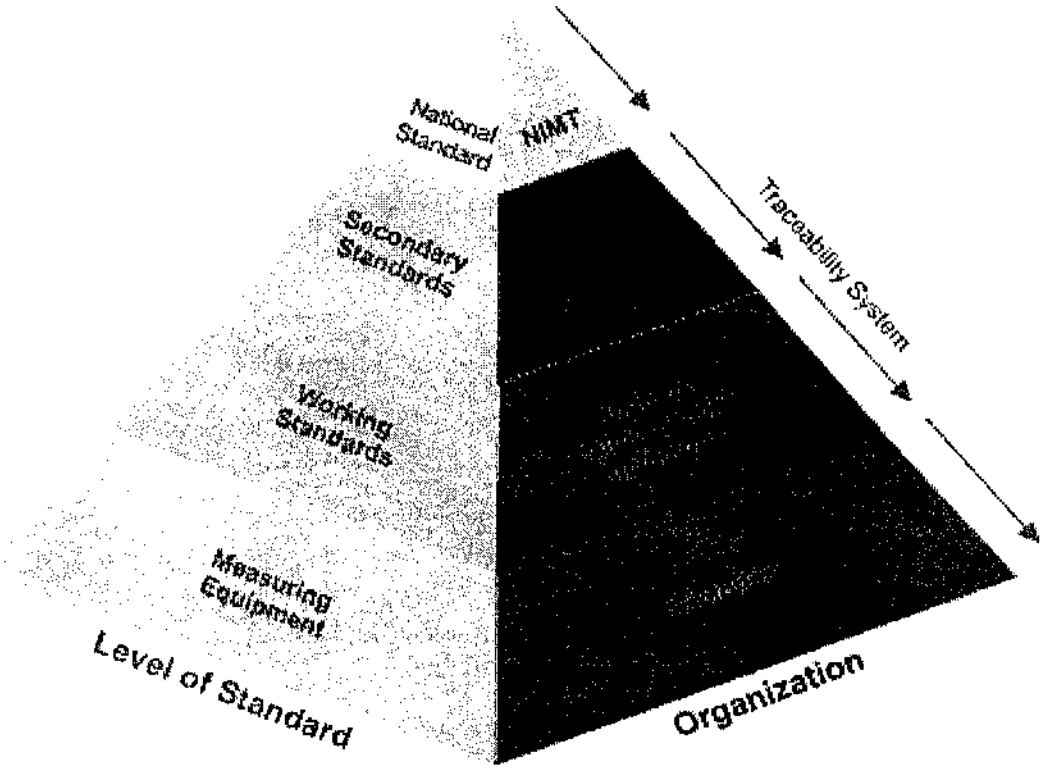
11. Suranaree University of Technology/ Nakornrachasima province

12. Chiangmai University/ Chiangmai province

Annex 29: Traceability Chain and Roles of Respective Organization

Annex 29

Traceability Chain and Roles of Respective Organization



Annex 30: Summary of the Number of Metrology Trainee

Annex 30 Summary of the Number of Metrology Trainee, 2003

No.	Course	Location	Date/Month/Year	Accepted Number	No. of Trainee	No. of Passed Trainee
1	1. NIMT-08 Electrical Measuring Instrument Calibration	Chon Chan Pattaya Resort	10-11 Mar. 03	24	27	27
	2. NIMT-01 Measuring Instrument Calibration System According to ISO 9000:2000		13-14 Mar. 03	35	49	49
	3. NIMT-03 Electronic Balance Calibration		25-26 Mar. 03	24	28	28
	4. NIMT-11 Uncertainty of Measurement for Technician		3-4 Apr. 03	35	36	36
	5. NIMT-06 Micrometer and Vernier Calibration	Mitutoyo Co., Ltd., Chonburi	20-21 May 03	24	28	28
	6. NIMT-07 Dial Gauge & Height Guage Calibration		22-23 May 03	24	26	26
	Total trainees of the 1st training			**166**	**194**	**194**
2	1. NIMT-02 Uncertainty of Measurement	Century Park Hotel	22-23 Jul. 03	35	34	32
	2. NIMT-08 Electrical Measuring Instrument Calibration		24-25 Jul. 03	24	23	23
	3. NIMT-05 Calibration of Pressure Measuring Instrument According to DKD R 6-1		5-6 Aug. 03	24	29	29
	4. NIMT-10 General Requirements for the Competence of Testing and Calibration Laboratories		7-8 Aug. 03	35	39	39
	5. NIMT-04 Calibration of Weight According to OIML R-111		19-20 Aug. 03	24	25	25
	6. NIMT-06 Micrometer and Vernier Calibration		21-22 Aug. 03	24	26	26
	7. NIMT-03 Electronic Balance Calibration		2-3 Sep. 03	24	30	30
	8. NIMT-03 Calibration of Liquid-IN-Glass Thermometer		4-5 Sep. 03	24	28	28
	9. NIMT-07 Dial Gauge & Height Guage Calibration		16-17 Sep. 03	24	22	22
	10. NIMT-13 Time and Frequency Measurement		18-19 Sep. 03	24	26	26
	11. NIMT-14 Rockwell Testing Machine Calibration According to ISO 6508		23-24 Sep. 03	15	14	14
	12. NIMT-06 Micrometer and Vernier Calibration (2)		24 Sep. 03	24	24	24
	13. NIMT-14 Rockwell Testing Machine Calibration According to ISO 6508 (2)		25-26 Sep. 03	15	10	10
	Total trainees of the 2nd training			**316**	**330**	**328**
	Total trainees of both 1st and 2nd training			**482**	**524**	**522**

Annex 30 Summary of the Number of Metrology Trainee, 2004

No.	Course	Location	Date/Month/Year	Accepted Number	No. of Trainee	No. of Passed Trainee
1	1.NIMT-06 Micrometer and Vernier Calibration	Century Park Hotel	1-2 Mar.04	24	26	26
	2. NIMT-15 Digital Thermometer & Temperature Source Calibration		3-4 Mar. 04	24	27	27
	3. NIMT-03 Electronic Balance Calibration		9-10 Mar. 04	24	27	27
	4. NIMT-10 Quality System of Laboratory according to ISO/IEC 17025		11-12 Mar. 04	35	49	49
	5. NIMT-02 Uncertainty of Measurement		16-17 Mar. 04	35	46	46
	6. NIMT-07 Dial Gauge & Height Gauge Calibration		18-19 Mar. 04	24	24	24
	7. NIMT-08 Basic Calibration of Electronic Measuring Instrument		23-24 Mar. 04	24	27	27
	8. NIMT-04 Calibration of Standard Weight according to OIML R-111		25-26 Mar. 04	24	28	28
	9. NIMT-05 Basic Calibration of Pressure Measuring Instrument		30-31 Mar. 04	24	27	27
	10. NIMT-13 Time and Frequency Calibration		27-28 Apr. 04	24	20	20
	Total trainees of the training			**262**	**301**	**301**

Annex 30 Summary of the Number of Metrology Trainee, 2005

No.	Course	Location	Date/Month/Year	Accepted Number	No. of Trainee	No. of Passed Trainee
1	1. NIMT-06 Micrometer and Vernier Calibration	Miracle Grand Hotel	6-7 Jan. 05	24	25	25
	2. NIMT-02 Uncertainty of Measurement		10-11 Jan. 05	35	38	38
	3. NIMT-07 Dial Gauge & Height Guage Calibration		12-13 Jan. 05	24	24	24
	4. NIMT-08 Electrical Measuring Instrument Calibration		13-14 Jan. 05	24	25	25
	5. NIMT-10 Quality System according to ISO/IEC 17025		17-18 Jan. 05	35	38	38
	6. NIMT-04 Calibration of Standard Weight		19-20 Jan. 05	24	23	23
	7. NIMT-13 Frequency & RF Power Calibration		20-21 Jan. 05	24	24	24
	8. NIMT-05 Basic Calibration of Pressure Measuring Instrument		24-25 Jan. 05	24	23	23
	9. NIMT-15 Digital Thermometer & Temperature Source Calibration		26-27 Jan. 05	24	25	25
	10. NIMT-03 Electronic Balance Calibration		27-28 Jan. 05	24	27	27
	Total trainees of the 1st training			**262**	**272**	**272**
2	1. NIMT-02 Uncertainty of Measurement	The Twin Tower Hotel	15-16 Mar. 05	35	42	42
	2. NIMT-15 Digital Thermometer & Temperature Source Calibration		17-18 Mar. 05	24	30	30
	3. NIMT-03 Electronic Balance Calibration		21-22 Mar. 05	24	30	30
	4. NIMT-10 Quality System according to ISO/IEC 17025		22-23 Mar. 05	35	42	42
	5. NIMT-06 Micrometer and Vernier Calibration		29-30 Mar. 05	24	27	27
	6. NIMT-05 Basic Calibration of Pressure Measuring Instrument		31 Mar. - 1 Apr. 05	24	18	18
	Total trainees of the 2nd training			**166**	**189**	**189**
	Total trainees of both 1st and 2nd training			**428**	**461**	**461**

Summary of the Number of Metrology Trainee, 2007

No.	Course	Location	Date/Month/Year	Accepted Number	No. of Trainee
1	1. Uncertainty of Measurement	Amari Airport Hotel	6-7 Mar. 07	35	48
	2. Metrology for pH Measurement and pH Meter Calibration		8-9 Mar. 07	24	18
	3. Micrometer and Vernier Calibration		12-14 Mar. 07	24	27
	4. Quality System according to ISO/IEC 17025 : 2005		15-16 Mar. 07	35	45
	5. Electronic Balance Calibration		19-21 Mar. 07	24	37
	6. Dial Gauge & Height Gauge Calibration		21-23 Mar. 07	24	15
	7. Digital Thermometer & Temperature Source Calibration		27-28 Mar. 07	24	25
	8. Basic Calibration of Pressure Measuring Instrument		29-30 Mar. 07	24	26
	9. Platinum Resistance Thermometer & Thermocouple Calibration		2-3 Apr. 07	24	24
	10. Liquid in Glass Thermometer Calibration		4-5 Apr. 07	24	15
	11. Calibration of Standard Weight		10-11 Apr. 07	24	21
	12. Uncertainty of Dimension Measuring Instrument	NIMT	3-5 Apr. 07	24	28
	13. Digital Multimeter Calibration		3-5 Apr. 07	15	22
	14. Basic Impedance Calibration		9-11 Apr. 07	15	7
	15. Calibration of Calibrator		9-11 Apr. 07	15	18
	16. Standard Resistance Calibration Training		18-20 Apr. 07	15	10
	17. AC-DC Power Calibration		18-20 Apr. 07	15	14
	18. Calibration of DC High Voltage Measuring Instrument		23-24 Apr. 07	15	12
	19. DC Calibration Training (100mV - 1000V)		23-24 Apr. 07	15	10
	20. Calibration of AC-DC Transfer Measuring Instrument		25-27 Apr. 07	15	15
	21. Clibration of RF Microwave and Internet Time Comparison		25-27 Apr. 07	15	15
	Total trainees of the training			**445**	**452**

Annex 31: Number of Meeting

Annex 31 Number of Meeting

<Monthly Meeting>

No.	Year	Date	Thai side	Japanese side	Secretary	Total
1	**2002**	Dec. 17	9	4	1 (AIST site)	14
2	**2003**	Jan. 14	8	4	1	13
3		Feb. 12	8	4	1	13
4		Mar.21	6	3	1	10
5		Apr. 10	8	4	1	13
6		May 13	8	4	1	13
7		Jul. 8	9	4	1	14
8		Aug. 18	8	3	1	12
9		Sep. 10	10	5	1	16
10		Oct. 8	9	5	1	15
11		Nov. 4	8	5	1	14
12		Dec. 22	8	5	1	14
13	**2004**	Jan. 13	9	4	1	14
14		Feb. 10	9	4	1	14
15		Mar. 2	8	4	1	13
16		Apr. 20	11	3	1	15
17		May 18	6	3	1	10
18		Jun. 22	9	4	1	14
19		Jul. 22	7	3	1	11
20		Sep. 22	11	4	1	16
21		Nov. 24	12	5	1	18
22		Dec. 27	13	6	1	20
23	**2005**	Jan. 18	12	6	1	19
24		Feb. 24	10	6	1	17
25		Apr. 21	12	5	1	18
26		Jun. 9	12	5	1	18
27		Jul. 28	13	5	1	19
28		Aug. 30	8	4	1	13
29		Sep. 16	10	5	1	16
30		Oct. 26	9	5	1	15
31	**2006**	Jan. 11	11	5	1	17
32		Mar. 9	13	5	2	20
33		May 9	12	4	2	18
34		Jun. 8	11	5	2	18
35		Sep. 11	13	5	2	20
36		Dec. 8	11	4	2	17
37	**2007**	Feb. 19	11	2	2	15
38		Mar. 20	13	3	2	18
39		May 17	9	3	2	14

<JCC Meeting>

No.	Year	Date	Thai side	Japanese side	Secretary	Total
1	2003	Apr. 30	16	8	1	25
2	2003	Nov. 6	16	9	1	26
3	2004	Mar. 12	18	14	1	33
4	2004	Oct. 13	21	8	1	30
5	2005	May 4	20	10	2	32
6	2006	Feb. 8	26	9	2	37
7	2006	Oct. 5	23	10	2	35

Annex 32: Schedule of Delivery of Equipment Procured by ODA Loan

Annex 32 Schedule of Delivery of Equipment procured by ODA Loan

National Metrology System Development Project (II)

Date: June 15, 2007

No.	Item No.	Description	Contract No.	Delivery Date
1	EM-1/100	Superconducting Magnet and Cryostat for QHR	NIMT/2549/22	07/08/07
2	EM-1/108	Liquid Nitrogen Vessel	NIMT/2549/22	07/08/07
3	EM-1/109	Low Thermal EMF Shielded Cable 100 m	NIMT/2549/22	07/08/07
4	EM-1/111	High Vacuum Pumping Set	NIMT/2549/22	07/08/07
5	M-4/005	Standard Weight (Mass: 100 kg)	NIMT/2549/34	8/07
6	M-4/007	Standard Weight (Mass: 500 kg)	NIMT/2549/34	8/07
7	M-4/008	Standard Weight (Mass: 1000 kg)	NIMT/2549/34	8/07

Annex 33: Record of Joint Training

Annex 33 Record of Joint Training

List of Participants for 1st Joint Training on Measurement Standards in Thailand

No.	Countries	Details of Participants			Standard		
					Dimensional		Chemical
		Name-Surname	Position	Age	Basic	Advance	
1.	Cambodia	Mr. SEA KIMHOUN	Deputy Chief	36			√
2.	Cambodia	Mr. CHOU BUNSEANG	Official	36	√		
3.	India	Dr. Nahar Singh	Scientist-B	38			√
4.	India	Mr. Shri M. Arif Sanjid	Technical Assistant	29		√	
5.	Indonesia	Mr. Nurul ALFIYATI	Staff of Length Lab.	28	√		
6.	LAO PDR	Mr. Oneta SULITHONE	Director, DISM, STEA	41	√		
7.	LAO PDR	Mr. Khamphay PHOUMANIVONG	Official analysis	41			√
8.	Malaysia	Mr. Khirul Anuar bin Mohd. Amin	Associate Metrologist	29			√
9.	Malaysia	Mr. Razman bin Mohd. Halim	Associate Metrologist	26	√		
10.	Mongolia	Ms. Lkhagvasuren Zoljargal	Researcher	27			√
11.	Myanmar	Dr. WAR WAR	Principal Scientist	32			√
12.	Myanmar	Dr. THAN THAN SOE	Principal Scientist	33		√	
13.	Nepal	Mr. Shailessh Kumar Jha	Chemist	36			√
14.	Pakistan	Mr. Zahid Mahmood	Scientific Officer	30			√
15.	Pakistan	Mr. MUHAMMAD SHAMSHAD	Senior Officer	33	√		
16.	Philippines	Ms. MA. THERESA E. EMPLEO	Science Research Specialist	28		√	
17.	Singapore	Dr. Wang Shihua	Senior Metrologist	39		√	
18.	Sri Lanka	Mrs. R.A.R.W. Rajamanthri	Experimental Officer	35			√
19.	Vietnam	Mr. TONG CONG DUNG	Staff of Length Lab.	24	√		
20.	Vietnam	Mr. NGUYEN TRUONG CHINH	Staff of Physical Chemical Lab.	28			√
21.	Thailand	Mr. Kitti Singson	Sales Manager	27		√	
22.	Thailand	Mr. Saksipong Lurksompoch	Senior Technician	30	√		
23.	Thailand	Mr. Montri Cammuan	Engineer	32			√
24.	Thailand	Mr. Jedsada Sela	Technician	28	√		
25.	Thailand	Mr. Pongtorn Kampangkaew	Metrology Engineer			√	

Schedule of 1st Joint Training on Measurement Standards in Thailand – CHEMICAL STANDARD
AUGUST 1-5, 2005

DATE	TIME	DESCRIPTION	PERSON IN CHARGE	VENUE
31/7/05		Arrive Bangkok: Pick up at the airport by NIMT's car Ariston Hotel: 19 Sukhumvit Soi 24, Sukhumvit Road, Bangkok 10110	NIMT's car	Ariston Hotel Tel. (662) 259 0960-9
1/8/05	08.45-09.00	Registration	IRO	Reun Thai, 4th Floor, Ariston Hotel
	09.00-10.00	Orientation	Dr. Pian, Dr. Akimoto, Dr. Nomura & Mr. Matsuda	
	10.00-10.15	Refreshment	IRO	
	10.15-12.00	**Presentation of Country Report** (10 minutes per country) Cambodia, India, Indonesia, Lao PDR, Malaysia,Mongolia, Myanmar, Nepal, Pakistan, Philippines, Singapore, Thailand, Vietnam	Representative of each country	
	12.00-13.00	Lunch	IRO	1st Floor, Ariston Hotel
	13.00-13.30	Transfer from hotel to NIMT	NIMT's car	
	13.30-15.00	Lecture 1: Significance of pH measurement and its Application in economy	Dr. Chainarong CHERDCHU	Room 321, 3rd Floor, IACTB
	15.00-15.15	Refreshment	IRO	
	15.15-16.30	Practice 1: How to use pH meter (Participants divided into Group A, B, & C)		
	17.30-20.00	Reception Dinner	IRO	Rachada Room, 3rd Floor, Chaophya Park Hotel
2/8/05	08.00-08.30	Pick up at hotel's lobby to NIMT	NIMT's car	
	08.30-10.00	Group Discussion	Dr. Chainarong CHERDCHU	Room 321, 3rd Floor, IACTB
		Lecture 2: Principles of pH measurement – Potentiometric measurement and related topics	Dr. Charun YAFA	
	10.00-10.15	Refreshment	IRO	
	10.15-12.00	Lecture 3: pH meter calibration	Ms. Nongluck TANGPAISARNKUL	
	13.00-14.30	Practice 2: pH meter calibration		
	14.30-14.45	Refreshment	IRO	
	14.45-16.00	Practice 2: pH meter calibration (cont.)		
	16.00-16.30	Transfer from NIMT to the hotel	NIMT's car	
3/8/05	08.00-08.30	Pick up at hotel's lobby to NIMT	NIMT's car	
	08.30-10.00	Lecture 4: How to obtain accurate pH measurement	Dr. Susumu NAKAMURA	Room 321, 3rd Floor, IACTB
	10.00-10.15	Refreshment	IRO	
	10.15-12.00	Lecture 5: Buffer solutions	Ms. Nongluck TANGPAISARNKUL	
	13.00-16.00	Laboratory Visit: Department of Medical Science, Ministry of Public Health	NIMT's car	
	16.00-17.00	Transfer back to the hotel	NIMT's car	

Schedule of 1st Joint Training on Measurement Standards in Thailand – CHEMICAL STANDARD
AUGUST 1-5, 2005

DATE	TIME	DESCRIPTION	PERSON IN CHARGE	VENUE
4/8/05	08.00-08.30	Pick up at hotel's lobby to NIMT	NIMT's car	
	08.30-10.00	Group Discussion	Dr. Chainarong CHERDCHU	Room 321, 3rd Floor, IACTB
		Lecture 6: Traceability system in pH measurement	Dr. Susumu NAKAMURA	
	10.00-10.15	Refreshment	IRO	
	10.15-12.00	Lecture 7: Traceability system in pH measurement (cont.)	Dr. Susumu NAKAMURA	
	13.00-14.30	Practice 3: Harned Cell (Demonstration)		
	14.30-14.45	Refreshment	IRO	
	14.45-16.00	Practice 3: Harned Cell (Demonstration) (cont.)	Dr. Susumu NAKAMURA	Room 321, 3rd Floor, IACTB
	16.00-16.30	Transfer from NIMT to the hotel	NIMT's car	
5/8/05	08.00-08.30	Pick up at hotel's lobby to NIMT	NIMT's car	
	08.30-10.00	Group Discussion	Dr. Chainarong CHERDCHU	Room 321, 3rd Floor, IACTB
	10.00-10.15	Refreshment	IRO	
	10.15-12.00	Paper Preparation	All participants	
	13.00-17.00	Paper Preparation (cont.)		
	17.00-20.00	Closing Ceremony & Farewell Dinner		Krua Mahanak, 31st Floor, Prince Palace Hotel
		Summary of Training (10 minutes): Chemical:	Dr. Chainarong CHERDCHU	
		Dimensional:	Mr. Somsak CHARKKIAN	
		Group Presentation: Chemical 2 Groups & Length 2 Groups (10 minutes each)	Representative of the group	
		Comments: Chemical:	Dr. Susumu NAKAMURA	
		Length:	Dr. Kazuya NAOI	
		Closing Address	Dr. Pian TOTARONG	
	20.00-21.30	Transfer back to the hotel	NIMT's car	
6/8/05		Transfer from the hotel to the airport	NIMT's car	

Schedule of 1st Joint Training on Measurement Standards in Thailand – LENGTH STANDARD
AUGUST 1-5, 2005

DATE	TIME	DESCRIPTION	PERSON IN CHARGE	VENUE
31/7/05		Arrive Bangkok: Pick up at the airport by NIMT's car Ariston Hotel: 19 Sukhumvit Soi 24, Sukhumvit Road, Bangkok 10110	NIMT's car	Ariston Hotel Tel. (662) 259 0960-9
1/8/05	08.45-09.00	Registration	IRO	Reun Thai, 4th Floor, Ariston Hotel
	09.00-10.00	Orientation	Dr. Pian, Dr. Akimoto, Dr. Nomura & Mr. Matsuda	
	10.00-10.15	Refreshment	IRO	
	10.15-12.00	**Presentation of Country Report** (10 minutes per country) Cambodia, India, Indonesia, Lao PDR, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Singapore, Thailand, Vietnam	Representative of each country	
	12.00-13.00	Lunch	IRO	1st Floor, Ariston Hotel
	13.00-13.30	Transfer from hotel to NIMT	NIMT's car	
	13.30-15.00	Lecture: World Trend on Roughness Standard	Dr. Kazuya NAOI	Metrology Technology Building, NIMT
	15.00-15.15	Refreshment		
	15.15-16.30	Lecture: Introduction & Maintenance of Contact Type Roughness Tester	Mr. Samana PIANGBANGYANG	
	15.15-16.30	Lecture: Introduction External Micrometer Calibration (JIS B 7502: 1991)	Mr. Anusorn TONMEANWAI	Library, NIMT
	17.30-20.00	Reception Dinner	IRO	Rachada Room, 3rd Floor, Chaophya Park Hotel
2/8/05	08.00-08.30	Pick up at hotel's lobby to NIMT	NIMT's car	
	08.30-12.00	Basic: Lecture: Calibration of External Micrometer Using Gauge Block (I & II)	Mr. Anusorn TONMEANWAI	Length Laboratory, NIMT
		Advance: Lecture: How to Carry out Int'l Comparison of Roughness Standard (I&II)	Mr. Samana PIANGBANGYANG	
	10.00-10.15	Refreshment	IRO	
	13.00-14.30	Basic: Lecture: Vernier Caliper Calibration (JIS B 7507: 1993)	Mr. Anusorn TONMEANWAI	
		Advance: Lecture: Terms, Definitions and Surface Texture Parameters (ISO 4287)	Mr. Samana PIANGBANGYANG	
	14.30-14.45	Refreshment	IRO	
	14.45-16.00	Basic: Lecture: Calibration of Vernier Caliper Using Gauge Blocks	Mr. Anusorn TONMEANWAI	
		Advance: Lecture: Metrological Characteristics of Phase Correct Filters (ISO 11562)	Mr. Samana PIANGBANGYANG	
	16.00-16.30	Transfer from NIMT to the hotel	NIMT's car	

Schedule of 1st Joint Training on Measurement Standards in Thailand – LENGTH STANDARD
AUGUST 1-5, 2005

DATE	TIME	DESCRIPTION	PERSON IN CHARGE	VENUE
3/8/05	08.00-08.30	Pick up at hotel's lobby to NIMT	NIMT's car	
	08.30-10.30	Basic: Lecture: Introduction of Dial Gauge & Calibration Tester	Mr. Anusorn TONMEANWAI	Length Laboratory, NIMT
		Advance: Lecture: Rules and Procedures for Assessment of Surface Texture (ISO 4288)	Mr. Samana PIANGBANGYANG	
	10.30-10.45	Refreshment	IRO	
	10.45-12.00	Basic: Lecture: Calibration of Dial Gauge Using Calibration Tester	Mr. Anusorn TONMEANWAI	
		Advance: Practice: Calibration Method of Specimens (R_a and R_y)		
	13.00-16.00	Basic & Advance: Laboratory Visit: Toyota Motors (Thailand) Co., Ltd.	NIMT's car	
	16.00-17.00	Transfer back to the hotel	NIMT's car	
4/8/05	08.00-08.30	Pick up at hotel's lobby to NIMT	NIMT's car	
	08.30-10.00	Basic: Practice: Calibration of External Micrometer	Mr. Anusorn TONMEANWAI	Length Laboratory, NIMT
		Advance: Practice: Calibration Method of Specimens (R_z)		
	10.00-10.15	Refreshment	IRO	
	10.15-12.00	Basic: Practice: Calibration of Vernier Caliper and Dial Gauge		
		Advance: Practice: Evaluation of Measurement Results		
	13.00-16.00	Basic & Advance: Practice: Uncertainty Evaluation of Measurements		
	14.30-14.45	Refreshment	IRO	
	16.00-16.30	Transfer from NIMT to the hotel	NIMT's car	
5/8/05	08.00-08.30	Pick up at hotel's lobby to NIMT	NIMT's car	
	08.30-10.00	Group Discussion	Mr. Somsak CHARKKIAN	Length Laboratory, NIMT
	10.00-10.15	Refreshment	IRO	
	10.15-12.00	Paper Preparation	All participants	
	13.00-17.00	Paper Preparation (cont.)		
	17.00-20.00	Closing Ceremony & Farewell Dinner		Krua Mahanak, 31st Floor, Price Palace Hotel
		Summary of Training (10 minutes): Chemical:	Dr. Chainarong CHERDCHU	
		Dimensional:	Mr. Somsak CHARKKIAN	
		Group Presentation: Chemical 2 Groups & Length 2 Groups (10 minutes each)	Representative of the group	
		Comments: Chemical:	Dr. Susumu NAKAMURA	
		Length:	Dr. Kazuya NAOI	
		Closing Address	Dr. Pian TOTARONG	
	20.00-21.30	Transfer back to the hotel	NIMT's car	
6/8/05		Transfer from the hotel to the airport	NIMT's car	

List of Participants for 2nd Joint Training on Measurement Standards in Thailand (Mass)

No.	Countries	Details of Nominees		
		Name-Surname	Position	Age
1.	Bangladesh	Md.Mazaharul Haque	Inspector (Metrology)	38
2.	Cambodia	Mr.PHOENG Sam-Ang	Officer of Department of Metrology	36
3.	Fiji	Mr.Bimal Kant SINGH	Divisional Inspector	43
4.	Fiji	Mr.Anand Kishore Rohit	Senior Technical Assistant	36
5.	India	Mr.Shri Gautam Mandal	Scientist 'B'	31
6.	Indonesia	Mr.Gigin Ginanjar	Staff of Mass Metrology Sub Division; especially in Mass and Pressure Laboratory	27
7.	Lao PDR	Mr.Kadingthong SINGDALA	Head of Mechanics Sector	37
8.	Malaysia	Mr.Mukhtar bin Sawi	Senior Metrologist	42
9.	Mongolia	Ms.Darmaa Unurbileg	Researcher, Mass Standard Laboratory	38
10.	Nepal	Mr.Dinanath Mishra	Metrologist	37
11.	Pakistan	Mr.Muhammad Rafique	Technical Officer	43
12.	Philippines	Mr.Jerome G Engay	Science Research Specialist -1	23
13.	Vietnam	Mr.Duong Xuan Thien	Engineer	30
14.	Thailand	Mr.Surachai Sangsrikaew	Head of Northern Weights and Measures Center (Thailand)	45

List of Participants for 2nd Joint Training on Measurement Standards in Thailand (Acoustics)

No.	Countries	Details of Nominees		
		Name-Surname	Position	Age
1.	Cambodia	Mr.MENG Sereyvath	Deputy Director, Department of Metrology	35
2.	India	Dr.Mahavir SINGH	Scientist 'E-I'	44
3.	Indonesia	Mr.Denny Hermawanto	Acoustical & Vibration Metrology Laboratory Staff	25
4.	Lao PDR	Mr.Viengkham SINGSONEXAY	Deputy Director of Metrology Division	36
5.	Malaysia	Mr.Wan Aziz bin Wan Salleh	Senior Metrologist	37
6.	Mongolia	Mr.Batmonkh Zorigkhuu	Researcher, Electric Standard Laboratory	38
7.	Vietnam	Ms.Nguyen Thi Hang	Engineer	25
8.	Thailand	Mr.Prawetch KLUAYPA	Research Officer	34
9.	Thailand	Ms.Katesara In-nurak	Scientist	29

SCHEDULE OF 2nd JOINT TRAINING ON MEASUREMENT STANDARDS IN THAILAND
September 18 – 22, 2006

DATE	TIME	DESCRIPTION	PERSON IN CHARGE	VENUE
17/9/06		Arrive Bangkok : Pick up at the airport by Amari Airport Hotel's Staff Amari Airport Hotel: 333 Chert Wudthakas Road, Moo 10, Srikan, Don Muang, Bangkok 10210	Amari Airport Hotel's Staff	Amari Airport Hotel Tel. (662) 566 1020 Fax. (662) 566 1941
18/9/06	08.00 – 08.15	Registration	IRO	At Yukondhorn Room, Amari Airport Hotel
	08.15 – 08.45	Orientation	Dr.Pian, Dr.Akimoto, Mr.Uchikawa & Mr.Fujimori	
	08.45 – 10.15	Training in "Uncertainty on Measurement"	Mr.Bunjob, Mrs.Ajchara	
	10.15 – 10.30	Refreshment	IRO	
	10.30 – 12.20	Training in "Uncertainty on Measurement" (cont.)	Mr.Bunjob, Mrs.Ajchara	
	12.20 – 13.00	Lunch	IRO	
	13.00 – 14.30	Training in "Uncertainty on Measurement" (cont.)	Mr.Bunjob, Mrs.Ajchara	
	14.30 – 14.45	Refreshment	IRO	
	14.45 – 17.30	Training in "Uncertainty on Measurement" (cont.)	Mr.Bunjub, Mrs.Ajchara	

DATE	TIME	Acoustics Standard	Mass Standard	Acoustics	Mass	
19/9/06	08.00 – 09.00	Pick up at hotel's lobby to NIMT		NIMT's car		Acoustics – Rama 6 Mass - Technothani
	09.00 – 10.30	Lecturer 1: Introduction - Traceability of acoustic standard - Laboratory Standard Microphone	Lecturer 1: Introduction (new definition, Some research works or interesting in your point of view)	Mr.Takeshi FUJIMORI	Mr.Keizaburo UCHIKAWA	
	10.30 – 10.45	Refreshment		IRO		
	10.45 – 12.00	Lecturer 1: Introduction (cont.) - Traceability of acoustic standard - Laboratory Standard Microphone	Lecturer 1: Metrological and Technical Requirements	Mr.Takeshi FUJIMORI	Mr.Keizaburo UCHIKAWA	
	12.00 – 13.00	Lunch		IRO		
	13.00 – 14.30	Lecturer 1: Primary Calibration and Its Uncertainty for Laboratory Standard Microphones	Lecturer 1: Metrological and Technical Requirements (cont.)	Mr.Takeshi FUJIMORI	Mr.Keizaburo UCHIKAWA	
	14.30 – 14.45	Refreshment		IRO		
	14.45 – 16.00	Lecturer 1: Primary Calibration and Its Uncertainty for Laboratory Standard Microphones (cont.)	Lecturer 2: Demonstrate/ Practice in volume and magnetism	Mr.Takeshi FUJIMORI	Mrs.Rungsiya SUKHON	
	16.00 – 17.00	Transfer from NIMT to the hotel		NIMT's car		

SCHEDULE OF JOINT TRAINING ON MEASUREMENT STANDARDS IN THAILAND
September 18 – 22, 2006

DATE	TIME	Acoustics Standard	Mass Standard	Acoustics	Mass	VENUE
20/9/06	08.00 – 09.00	Pick up at hotel's lobby to NIMT		NIMT's car		Acoustics – Rama 6 Mass - Technothani
	09.00 – 10.30	Lecturer 1: Free-field calibration and its uncertainty for acoustic instruments (Uncertainty caused by the reflected wave in the anechoic room)	Lecturer 2: Traceability of Mass Standard	Mr.Takeshi FUJIMORI	Mrs.Rungsiya SUKHON	
	10.30 – 10.45	Refreshment		IRO		
	10.45 – 12.00	Lecturer 1: Free-field calibration and its uncertainty for acoustic instruments (Uncertainty caused by the reflected wave in the anechoic room) (cont.)	Lecturer 1: Mass determination (Direct Comparison and Subdivision)	Mr.Takeshi FUJIMORI	Mr.Keizaburo UCHIKAWA	
	12.00 – 13.00	Lunch		IRO		
	13.00 – 14.30	Lecturer 2: Calibration of LS microphone at NIMT	Lecturer 1: Mass determination (Direct Comparison and Subdivision) (cont.)	Mr.Virat PLANGSANGMAS	Mr.Keizaburo UCHIKAWA	
	14.30 – 14.45	Refreshment		IRO		
	14.45 – 16.00	Lecturer 2: Lecturer 3: Lecturer 4: } Workshop on LS Microphone Calibration	Lecturer 2: Mass determination for 1kg : Transfer Standard of Mass	Mr.Virat PLANGSANGMAS Ms.Surat PATTARACHINDANU WONG Mr.Priwann PROMASA	Mrs.Rungsiya SUKHON	
	16.00 – 17.00	Transfer from NIMT to the hotel		NIMT's car		
21/9/06	08.00 – 09.00	Pick up at hotel's lobby to NIMT		NIMT's car		
	09.00 – 10.30	Lecturer 2: Calibration of Sound calibrator	Lecturer 2: Uncertainty Calculation and an approximation formular	Mr.Virat PLANGSANGMAS	Mr.Keizaburo UCHIKAWA	
	10.30 – 10.45	Refreshment		IRO		
	10.45 – 12.00	Lecturer 3: Lecturer 4: } Workshop on Sound calibration	Lecturer 2: Uncertainty Calculation and an approximation formular (cont.)	Ms.Surat PATTARACHINDANU WONG Mr.Priwann PROMASA	Mr.Keizaburo UCHIKAWA	
	12.00 – 13.00	Lunch		IRO		
	13.00 – 14.30	Lecturer 2: Calibration of Sound level meter	Lecturer 2: Practice on Mass Measurement – Uncertainty Calculation	Mr.Virat PLANGSANGMAS	Mrs. Rungsiya SUKHON and mass staff	
	14.30 – 14.45	Refreshment		IRO		

SCHEDULE OF JOINT TRAINING ON MEASUREMENT STANDARDS IN THAILAND
September 18 – 22, 2006

DATE	TIME	Acoustics Standard	Mass Standard	Acoustics	Mass	VENUE
21/9/06	14.45 – 16.00	Lecturer 3: } Workshop on Lecturer 4: } sound level meter and paper preparation for September 22, 2006	Lecturer 2: Practice on Mass Measurement – Uncertainty Calculation (cont.) and paper preparation for September 22, 2006	Ms.Surat PATTARACHINDANU WONG Mr.Priwann PROMASA	Mrs. Rungsiya SUKHON and mass staff	Acoustics – Rama 6 Mass - Technothani
	16.00 – 17.00	Transfer from NIMT to the hotel		NIMT's car		
22/9/06	08.00 – 09.00	Pick up at hotel's lobby to NIMT		NIMT's car		NIMT Technothani
	09.00 – 10.30	Lab Visit		All participants		
	10.30 – 10.45	Refreshment		IRO		
	10.45 – 12.00	Group Discussion		All Participants		
	12.00 – 13.00	Lunch		IRO		
	13.00 – 17.00	Paper Preparation		All Participants		
	17.00 – 21.00	**Closing Ceremony & Farewell Dinner at Anodard, Amari Airport Hotel**				Anodard, Amari Airport Hotel
		Presentation of Country Report (5 minutes per country) Bangladesh, Cambodia, Fiji, India, Indonesia, Lao PDR, Malaysia, Mongolia, Nepal, Pakistan, Philippines, Thailand, Vietnam		Representative of each country		
		Group Presentation (10 minutes per group) : Acoustic 2 Groups : Mass 2 Groups		Representative of the group		
		Summary of Training (10 minutes): Acoustics:		Mr.Virat PLANGSANGMAS		
		Mass:		Mrs.Rungsiya SUKHON		
		Comments: Acoustics:		Mr.Takeshi FUJIMORI		
		Mass:		Mr.Keizaburo UCHIKAWA		
		Closing Address		Dr.Pian TOTARONG		
23/9/06		Transfer from the hotel to the airport		Amari Airport Hotel's staff		

※20/9 was sudden holiday due to coup d'etat, therefore, the schedule of 20/9 was carried out by combining with the schedule of 21/9 and 22/9.

3rd Joint Training on Measurement Standards in Thailand : June 4-8, 2007
List of Counterparts : by Laboratory

FORCE STANDARD

No.	Countries	Details of Counterparts			
		Name-Surname	Age	Position	Address
1.	Cambodia	Mr. Many KETH	27	Technical Officer	Department of Metrology, Ministry of Industry, Mimes and Energy 45, Preah Norodom Blvd., Khan Duan Penh, Phnom Penh, Cambodia Tel. 855 12 791 127 Fax 855 23 428 263 E-mail: Dom-mime@camitel.com
2.	India	Mr. Rajesh KUMAR	39	Scientist C	Force & Hardness Standards, National Physical Laboratory Dr. K.S. Krishnan Marg, New Delhi-110012 India Tel. 91-11-25744369 Fax 91-11-25726938 E-mail: kumarr@mail.nplindia.ernet.in
3.	Indonesia	Mr. Hafid	25	Researcher	PUSLIT KIM LIPI, Kompleks PUSPIPTEK Cisauk, Tangerang 15314, Indonesia Tel. 62 21 756 0562 Ext. 3080 Fax 62 21 756 0568 E-mail: hafid@kim.lipi.go.id
4.	Lao PDR	Mr. Viengkham SINGSONEXAY	37	Deputy Director	Metrology Division, Science Technology and Environment Agency (STEA) Nahaidyo Road, P.O. Box 2279, Vientiane, Lao PDR Tel. (856-21) 732331 Fax (856-21) 213472 E-mail: sviengkham@yahoo.com
5.	Malaysia	Mrs. Hairani NORDIN	30	Metrologist	National Metrology Laboratory, SIRIM-BERHAD Lot PT4803, Bandar Baru Salak Tinggi, 43900 Sepang, Selangor Darul Ehsan, Malaysia Tel. 603 8778 1600 Fax 603 8778 1661 E-mail: hairani@sirim.my
6.	Mongolia	Mr. Delgerbayar URTNASAN	29	Researcher	Mongolian Agency for Standardization and Metrology Peace Avenue – 46A, Ulaanbaatar-51, Mongolia Tel. 976-11-263792 Fax 976-11-458032 E-mail: masm@mongol.net
7.	Myanmar	Dr. Win Win ZAW	26	Principal Scientist	Myanma Scientific and Technological Research Department No. 6, Kaba Aye Pagoda Road, Yankin P.O., Yangon, Myanmar Tel. 95-1-664817 Fax 95-1-668033 E-mail: most19@myanmar.com.mm
8.	Thailand	Mr. Kridsana IAMDARA	32	Metrologist	Thai Reference Standards Laboratory, Technical Department, Thai Airways International Public Company Limited 89 Vibhavadi Rangsit Road, Bangkok 10900 Thailand Tel. (662) 563 8361 Fax (662) 563 9183 E-mail: kridsana.i@thaiairways.com
9.	Thailand	Mr. Pramote RAMRONG	33	Supervisor	Technology Promotion Association (Thailand-Japan) 534/4 Pattanakarn Road, Soi 18, Suanluang, Suanluang, Bangkok 10250 Tel. (662) 717 3000-24 Ext. 24 Fax (662) 719 9484 E-mail: promote@tpa.or.th

3rd Joint Training on Measurement Standards in Thailand : June 4-8, 2007
List of Counterparts : by Laboratory

PRESSURE STANDARD

No.	Countries	Details of Counterparts			
		Name-Surname	Age	Position	Address
1.	Cambodia	Mr. Khin CHHEANG	29	Officer, Legal Metrology	Department of Metrology, Ministry of Industry, Mimes and Energy 45, Preah Norodom Blvd., Khan Duan Penh, Phnom Penh, Cambodia Tel. 855 12 230 025 Fax 855 23 428 263 E-mail: Dom-mime@camitel.com
2.	India	Mr. Virandra Kumar GUPTA	38	STA	Pressure & Vacuum Standards, National Physical Laboratory Dr. K.S. Krishnan Marg, New Delhi-110012 India Tel. 91-11-25746270 Fax 91-11-25726953 E-mail: virendra@mail.nplindia.ernet.in
3.	Indonesia	Mr. R. Rudi Anggoro SAMODRO	25	Researcher	PUSLIT KIM LIPI, Kompleks PUSPIPTEK Cisauk, Tangerang 15314, Indonesia Tel. 62 21 756 0562 Ext. 3080 Fax 62 21 756 0568 E-mail: anggarov@kim.lipi.go.id
4.	Malaysia	Mr. Mohd Mazid MANSOR	31	Metrologist	National Metrology Laboratory, SIRIM-BERHAD Lot PT4803, Bandar Baru Salak Tinggi, 43900 Sepang, Selangor Darul Ehsan, Malaysia Tel. 603 8778 1600 Fax 603 8778 1661 E-mail: mazid@sirim.my
5.	Mongolia	Mrs. Baigalmaa BAASANJAV	36	Researcher	Mongolian Agency for Standardization and Metrology Peace Avenue – 46A, Ulaanbaatar-51, Mongolia Tel. 976-11-263792 Fax 976-11-458032 E-mail: masm@mongol.net
6.	Philippines	Mr. Radley Flores MANALO	39	Science Research Specialist I	National Metrology Laboratory, ITDI Metrology Bldg., DOST Cpd., Gen. Santos Ave., Upper Bicutan Taguig City 1631 Philippines Tel. (632) 837 2071 Ext. 2264 Fax (632) 837 3167 E-mail: radleymanalo@yahoo.com
7.	Philippines	Ms. Maryness Ildefonzo SALAZAR	26	Science Research Specialist I	National Metrology Laboratory, ITDI Metrology Bldg., DOST Cpd., Gen. Santos Ave., Upper Bicutan Taguig City 1631 Philippines Tel. (632) 837 2071 Ext. 2264 Fax (632) 837 3167 E-mail: radleymanalo@yahoo.com
8.	Sri Lanka	Ms. Sunali DISSANAYAKE	39	Metrology Experimental Officer	Measurement Unit, Standards and Services Department 101, Park Road, Colombo 05, Sri Lanka Tel. 94 112577190 Fax 94 112597756 E-mail: sunali.dissanayake@yahoo.com
9.	Vietnam	Mr. HOANG LE Tuan	30	Staff, Pressure Lab	Vietnam Metrology Institute No. 08 Hoang Quoc Viet Road, Cau Giay District, Hanoi, Vietnam Tel. +844 936 2030 Fax +844 756 4260 E-mail: hoangletuanbk@yahoo.com
10.	Thailand	Mr. Wichan WONGWET	32	Metrologist	Thai Reference Standards Laboratory, Technical Dept., Thai Airways International Plc.,Co.,Ltd. 89 Vibhavadi Rangsit Road, Bangkok 10900 Thailand Tel. (662) 563 9484 Fax (662) 563 9183 E-mail: wichan.w@thaiairways.com
11.	Thailand	Mr. Attapol PANURACH	31	Head of Pressure Lab	Technology Promotion Association (Thailand-Japan) 534/4 Pattanakarn Road, Soi 18, Suanluang, Suanluang, Bangkok 10250 Tel. (662) 717 3000-24 Fax (662) 719 9484 E-mail: attapol@tpa.or.th

3rd Joint Training on Measurement Standards in Thailand : June 4-8, 2007
List of Counterparts : by Laboratory

VOLUME & FLOW STANDARDS

No.	Countries	Details of Counterparts			
		Name-Surname	Age	Position	Address
1.	Bangladesh	Mr. Md. Shafiullah KHAN	43	Assistant Director	Divisional Metrology Inspectorate, Bangladesh Standards and Testing Institution 116/KA, Tejgaon Industrial Area, Dhaka – 1208, Bangladesh Tel. 88-02-9899631 Fax 88-02-9131581 E-mail: bsti@bangla.net
2.	Cambodia	Mr. Pheng VUTH	41	Chief Officer	Ministry of Industry, Mimes and Energy 45, Preah Norodom Blvd., Khan Duan Penh, Phnom Penh, Cambodia Tel. 855 12 924 952 Fax 855 23 426 603 E-mail: Dom-mime@camitel.com
3.	Fiji Island	Mr. Emitai D Bulivakarua		Assistant Inspector	Ministry of Commerce and Industry Naibati House, 9 Goodenough St., Suva, Fiji Tel (679) 3305 411 Fax (679) 3302 617 E-mail: iraikoso@govnet.gov.fj
4.	India	Dr. Sanjeev SINHA (Invited Lecturer)	49	Scientist E-I	Mass Standards, National Physical Laboratory Dr. K.S. Krishnan Marg, New Delhi-110012 India Tel. 91-11-25742610 Ext. 2348/2209 Fax 91-11-25726938 E-mail: ssinha@mail.nplindia.ernet.in
5.	Indonesia	Mr. Bernadus Herdi SIRENDEN	28	Researcher	PUSLIT KIM LIPI, Kompleks PUSPIPTEK Cisauk, Tangerang 15314, Indonesia Tel. 62 21 756 0562 Ext. 3080 Fax 62 21 756 0568 E-mail: ben@kim.lipi.go.id
6.	Lao PDR	Mr. Kadingthong SINGDALA	37		Metrology Division, Science Technology and Environment Agency (STEA) Nahaidyo Road, P.O. Box 2279, Vientiane, Lao PDR Tel. (856-21) 732331 Fax (856-21) 213472 E-mail: kadingthong@yahoo.com
7.	Malaysia	Mr. Mohamad Nor KAMARUDIN	33	Associate Metrologist	National Metrology Laboratory, SIRIM-BERHAD Lot PT4803, Bandar Baru Salak Tinggi, 43900 Sepang, Selangor Darul Ehsan, Malaysia Tel. 603 8778 1600 Fax 603 8778 1661 E-mail: kddin@sirim.my

3rd Joint Training on Measurement Standards in Thailand : June 4-8, 2007
List of Counterparts : by Laboratory

VOLUME & FLOW STANDARDS

No.	Countries	Details of Counterparts			
		Name-Surname	Age	Position	Address
8.	Myanmar	Dr. Thit Thit LWIN	35	Principal Scientist	Myanma Scientific and Technological Research Department No. 6, Kaba Aye Pagoda Road, Yankin P.O., Yangon, Myanmar Tel. 95-1-664817 Fax 95-1-668033 E-mail: most19@myanmar.com.mm
9.	Pakistan	Mr. Waheed Ali SIYAL	30	Senior Technician	National Physical and Standards Laboratory Plot #16, Sector H-9, Islamabad, Pakistan Tel. 92-51-9257462-7 Fax 92-51-9258162 E-mail: ahabhayo@yahoo.com, npsllab@comsats.net.pk
10.	Philippines	Ms. Rhea Bumatay BANGLAY	25	Science Research Specialist I	National Metrology Laboratory, Industrial Technology Development Institute Metrology Bldg., DOST Cpd., Gen. Santos Ave., Upper Bicutan Taguig City 1631 Philippines Tel. (632) 837 2071 local 2255 Fax (632) 837 3167 E-mail: rbangla@yahoo.com
11.	Sri Lanka	Ms. Anusha Jeewani BOGAHAWATTA	38	Metrology Experimental Officer	Measurement Unit, Standards and Services Department 101, Park Road, Colombo 05, Sri Lanka Tel. 94 112577190 Fax 94 112597756 E-mail: anushabogahawatte@yahoo.com
12.	Vietnam	Mr. NGUYEN AN Vinh	28	Technician	Vietnam Metrology Institute No. 08 Hoang Quoc Viet Road, Cau Giay District, Hanoi, Vietnam Tel. +844 936 2030 Fax +844 756 4260 E-mail: anvinh45@gmai.com
13.	Thailand	Mr. Vikorn RUJIWATCHARA-OLUN	43	Metrology Engineer	Thai Reference Standards Laboratory, Technical Dept., Thai Airways International Plc. Co., Ltd. 89 Vibhavadi Rangsit Road, Bangkok 10900 Thailand Tel. (662) 563 8361 Fax (662) 563 9183 E-mail: Vikorn.r@thaiairways.com
14.	Thailand	Ms. Chatnapa TONGPACHUM	25	Metrologist Trainee	National Institute of Metrology (Thailand) 3/4-5, Moo 3, Klong 5, Klong Luang, Pathumthani 12120 Thailand Tel. (662) 577 5100 Fax (662) 577 2823 E-mail:

SCHEDULE OF 3rd JOINT TRAINING ON MEASUREMENT STANDARDS IN THAILAND
JUNE 4-8, 2007

DATE	TIME	DESCRIPTION		
3/6/07		Arrive Bangkok: Pick up at the airport by NIMT's car **Remark: Amari Don Muang Airport Hotel:** 333 Chert Wudthakas Road, Moo 10, Srikan, Don Muang, Bangkok 10210 Thailand Tel. 0 2566 1020 Fax 0 2566 1941		
4/6/07	08.00-08.15	Registration at Ballroom 2, Amari Donmuang Airport Hotel		
	08.15-09.00	Orientation		
	09.00-16.00	Lecture on Uncertainty on Measurement		
5-8/6/07	08.15-09.00	Pick up at hotel's lobby to NIMT		
5/6/07	09.00-10.30 10.40-11.20	**Presentation of Country Report** (10 minutes per country): Bangladesh, Cambodia, Fiji, India, Indonesia, Lao PDR, Malaysia, Mongolia, Myanmar, Pakistan, Philippines, Sri Lanka, Thailand, Vietnam **Venue:** Room No. 224-225, 2nd Fl., Administration Building, NIMT **Remark:** Each country is required to make a ten minutes presentation of country report. Any country with 2-3 nominees accepted, please discuss with your colleague for the representative of the presentation. Presentation file in Power Point (if any) should be e-mail to iro@nimt.or.th. by Friday, June 1, 2007.		
	11.20-12.00	Laboratory Visit		
	Training Program	Force Room No. 1-309, NIMT	Pressure Room No. 1-312, NIMT	Volume & Flow Room No. 2-315, NIMT
	1300-16.00	- Traceability System and Force Standard in NIMT - Basic on Force Measurement	Pressure Balances, Theory and its use	Volume: Volume according to OIML R-111: Method B)
6/6/07	09.00-12.00	Calibration of Force, according to ISO376: 2004 (E)	Pressure Balances, Theory and its use	Volume: - Density Standard (Over view, Solid & Liquid Standards, Hydrometer Calibration) - Hydrostatic Weighting Method: Theory - Practice
	13.00-16.00	Workshop on Force Calibration by Comparator Machine	Requirements of EA-10/03	
7/6/07	09.00-12.00	Evaluation of Uncertainty on Force Measurement	Cross-floating technique (hands-on)	Flow: - Principle of Gas Flow (Influencing Factors, Fluid Property, Gas Law, etc.) - Principle of Rotameter Operation
	13.00-16.00	Workshop on Force Calibration by Deadweight Force Machine	Calculation on the measurement results	Flow: Calibration of Air Flow (Rotameter) Measurement Uncertainty
8/6/07	09.00-12.00	Evaluation of Uncertainty on Force Measurement	Measurement Uncertainty Evaluation	Flow: Workshop on Air Rotameter Calibration
	13.00-16.00	Group Discussion & Paper Preparation	Group Discussion & Paper Preparation	Group Discussion & Paper Preparation
	16.00-17.00	Closing Ceremony at Room No. 224-225, 2nd Fl., Administration Building, NIMT - Group Presentation by Representative of the Group (10 minutes each) - Summary of Training by Head and Assistant Head of Mechanical Metrology Department, NIMT		
	17.00-20.00	Farewell Dinner		
9/6/07		Transfer from the hotel to the airport by NIMT's car		

Annex 34: Financial Operation Report of NIMT

Annex 34 Financial Operation Report of NIMT

National Institution of Metrology (Thailand)
Financial Operation Report
at December 31, 2004 and 2005

	Remark	2005 (Baht)	2004 (Baht)
Operating Revenue			
From government:			
Budget allocation		97,691,671.21	105,997,025.31
Government loans	3.12	5,499,889.44	8,585,626.93
Total		103,191,560.65	114,582,652.24
From other sources:			
Services		10,956,583.39	10,718,712.56
Donation		428,801.73	333,667.88
Interest		1,926,582.73	2,833,609.27
Others	3.13	695,646.57	280,282.92
Total		14,007,614.42	14,166,272.63
Grand total		117,199,175.07	128,748,924.87
Operating Expense			
Personnel	3.14	38,136,024.17	29,769,033.09
Operation	3.15	36,405,593.05	25,871,420.23
Value depreciation and disposal		48,552,194.36	35,998,255.42
Total		123,093,811.58	91,638,708.74
Revenue higher/ (lower) than operating expense		**(5,894,636.51)**	**37,110,216.13**
Profit/(loss) from foreign currency exchange (net)		123,180.60	(58,786.91)
Total non-operating revenue/(expense)		123,180.60	(58,786.91)
Revenue higher/ (lower) than net expense		**(5,771,455.91)**	**37,051,429.22**

Data Source: Annual Report of NIMT 2005

Annex 35: List of International Comparison

Annex 35 List of International Comparison

APMP Key Comparisons

<Acoustics>
- Acoustics standard (AUV.A-K1)

<Length>
- Short Gauge Blocks (less than 100 mm) (L-K1)
- Short Gauge Blocks (L-K1.1)
- Angle standard (L-K3)
- 1-D CMM (Step Gauge by Interferometer and CMM) (L-K5)
- 2-D CMM (Sphere Ball Plate and Hole Plate by Interferometer and CMM) (L-K6)
- Laser Frequency: 633 & 543 nm He-Ne laser (Wavelength standard) (L-K11)
- Surface roughness (Multiple-lateral)

<Mass>
- Mass standard (Comparison of 1kg) (M.M-K1)
- Mass standard (100mg, 2g, 20g, 500g, 10kg: E_1 class) (M.M-K2)
- Mass standard (200mg, 1g, 50g, 200g, 2kg) (M.M-K5)
  ※Planned to run after CCM.M-K5
- Mass standard (E_2 class) (M.M-K6)

<Hardness>
- Vickers Hardness standard (H-K1)
- Hardness Rockwell C scale (H-S1)
  ※Draft A in Appendix B on Rockwell Hardness standard (HRC) is approved and published.

<Pressure>
- Effective area of piston-cylinder; gas, gauge (P-K1.c1)
- Effective area of piston-cylinder; gas, gauge (P-K6.1)
- Pressure Transducers; gas, absolute (P-K4)
  ※Protocol complete
- Pressure transducers, Pressure: 10MPa to 100MPa (P-K7)
- Pressure, gas, gauge; Effective area of piston-cylinder (P-S1)

<Thermometry>

- Mercury in glass & PRTs (T-S3-03)

<Photometry>

- Luminous flux with lamp transfer standards

  ※NIMT will participate in this comparison in 2007.

<Chemical>

- Draft A in APMP Pilot study on pH standard (QM-P06) is issued.
- NIMT participated in APMP Pilot study on Surface Analysis (QM-P08).

APMP COMPARISONS

Name of Comparison	Field	Pilot Lab	Participating Laboratory	Period or Status
APMP.AUV.A-K1	Acoustics	NMIJ (Japan)	NMIJ, KRISS, NIMT, CMS/ITRI, NMIA, NIM, NPLI, SCL, NML-SIRIM	April 2004 to Feb. 2005: Measurement completed
P1-APMP.EM.RF-S4	Calibration factor for a thermistor mount power sensor	NMIA	2	Approved and Published in KCDB
P2-APMP.EM-S6	Resistance 0.1 Ohm to 100 MOhm	NMIA	2	Approved and Published in KCDB
P1-APMP.EM.BIPM-K11.1	DCV 1.018 V, 10 V	NMIA	2	Approved and Published in KCDB
P3-APMP.EM-S5	AC/DC (0.5 V to 1000 V)	NMIA	2	Approved and Published in KCDB
P1-APMP.EM.BIPM-K11.2	DC Voltage 10 V	KIM-LIPI	2	Comparisons finished, reports being prepared
P1-APMP.EM-K6.a	AC/DC 3 V	NMIA	15	Comparisons finished, reports being prepared
P1-APMP.EM-K9	AC/DC 500 V, 1000 V	CMS	12	Comparisons finished, reports being prepared
P2-APMP.EM-K4.1	Capacitance 10 pF	NMIA	14	Ongoing
P2-APMP.EM-S7	Capacitance 100 pF	NMIA	14	Ongoing
P1-APMP.EM.RF-S3	50 Ohm coaxial mismatch	NPLI	6	Ongoing
P1-APMP.EM-S4	AC/DC (3 V to 1000V)	NMIA	2	Ongoing
P1-APMP.EM-S5	Standards for DCV, ACV, DCI, ACI, R meters	NMIA		Preparing Protocol and Schedule
P1-APMP.EM-S8	Multimeter comparison	NPLI		Preparing Protocol and Schedule
APMP.EM-K1	DC resistance; 1 Ohm, 10 kOhm	NMIA/KRISS		New Comparisons planned
APMP.EM-K10	DC resistance; 100 Ohm	SPRING		New Comparisons planned
APMP.EM-K5	AC Power; 120 V, 5 A, 53 Hz; Power factor 1.0, 0.5 Lead, 0.5 Lag, 0.0 Lead and 0.0 Lag	NIM		New Comparisons planned
APMP.EM.M-K1	Magnetic quantities; DC to 20 kHz	KRISS		New Comparisons planned
APMP.EM-K8	DC voltage ratio; 100 V/10 V and 1000 V/10 V	NMIJ		New Comparisons planned
APMP.EM.RF-K8.CL	RF power; 10 MHz to 18 GHz	NMIJ		New Comparisons planned
APMP.EM.RF-K19.CL	Attenuation; 60 MHz and 5 GHz	NIM		New Comparisons planned
TCFF-K1	Water Flow	KRISS		Planning
TCFF-K2	Hydrocarbon	CMS	NMIJ	Starting at the end of 2005
TCFF-K3	Air Speed	NMIJ	?	Planning
TCFF-K5b	High pressure Gas Flow	KRISS	CMS	Preparing Report A
TCFF-K6	Low Pressure Gas Flow	NMIJ		Planning
APMP.L-K1	Length: Short gauge blocks	NMIJ/AIST	11 laboratories	Draft B is completed and in circulation.
APMP.L-K1.1	Length: Short gauge blocks	NMIJ/AIST	7 laboratories	Started in May, 2005
APMP.L-K2	Length: Long gauge blocks	NMIA	12 laboratories	Draft B is approved, and waited for publish in KCDB

APMP.L-K3	Length: Angle standards	CSIR	12 laboratories	Started in Apr 2005
APMP.L-K4	Length: Diameter standards	NIM	n/a	Planning and Surveying
APMP.L-K5	Length: 1-D CMM	KRISS	n/a	Planning
APMP.L-K6	Length: 2-D CMM	NMIJ/AIST	n/a	Planning
APMP.L-K11	Laser Frequency: 633 & 543 nm He-Ne laser	NIM	8 laboratories	Comparison completed
Bi-lateral	Length: Step Height	NMIJ/AIST	NMIJ/AIST, CMS/ITRI	Comparison report completed
Bi-lateral	Diameter Standard	NMIA	NMIJ NMIA	Comparison report completed
Multiple-lateral	Surface roughness	NIMT	NIMT CMS NMIJ NMIA	Planning
APMP.M.M-K1 (APMP-IC-3-96)	Comparison of 1 kg mass standards	NIMT	CMS-ITRI (tw), CSIR-NML (za), NMIA (au), ITDI (ph), KRISS (kr), NIMT (th), NIS (eg), NMIJ (jp), NPLI (in), NSCL (sy), MSL (nz), PSB (sg), SCL (hk), SIRIM (my), VMI (vn)	Finished; approved for equivalence
APMP.M.M-K2	Mass: 100 mg, 2g, 20 g, 500 g, 10 kg	NPLI	CMS-ITRI (tw), NMIA (au), KRISS (kr), NIS (eg), NMIJ (jp), NPLI (in), MSL (nz), MUSSD (lk), SCL (hk), SIRIM (my), SPRING (sg), NML-CSIR (za)	Measurem-ents underway
APMP.M.M-K5	Mass: 200 mg, 1 g, 50 g, 200 g, 2 kg	NMIA	Expressions of interest to participate from CMS-ITRI (tw), NMIA (au), KRISS (kr), MUSSD (lk), NIMT (th), NIS (eg), NMIJ (jp), NPLI (in), MSL (nz), SCL (hk), SIRIM (my), SPRING (sg)	Planned to run after CCM.M-K5
APMP.M.P-K1.c (APMP-IC-2-97)	Effective area of piston-cylinder; gas, gauge	NPLI	CSIR-NML (za), NMIA (au), KRISS (kr), NIS (eg), NMIJ (jp), NPLI (in), MSL (nz), PSB (sg), SCL (hk), SIRIM (my), PTB (de)	Finished; approved for equivalence
APMP.M.P-K4	Pressure transducers; gas, absolute	NPLI	CMS-ITRI (tw), KRISS (kr), NIM (cn), NIMT (th), NMIJ (jp), NML (au), NPLI (in), SPRING (sg)	Protocol complete
APMP.M.P-K6 (APMP-IC-2-97)	Effective area of piston-cylinder; gas, gauge	NPLI	CSIR-NML (za), NMIA (au), KRISS (kr), NMIJ (jp), NPLI (in), MSL (nz), PSB (sg), SCL (hk), SIRIM (my), PTB (de)	Report in progress draft B
APMP.M.P-K7-TRI	Effective area of piston-cylinder	NMIJ	NIS (eg), NIST (us), NMIJ (jp)	Report in progress
APMP.M.P-K7	Pressure transducers Pressure: 10 MPa to 100 MPa	NMIJ	CMS-ITRI (tw), CSIR-NML (za), NMIA (au), KIM-LIPI (id), KRISS (kr), NIM (cn), NIMT (th), NIS (eg), NMIJ (jp), NPLI (in), NSCL (sy), MSL (nz), SCL (hk), SIRIM (my), SPRING (sg), VMI (vn)	Report draft B finished
APMP.M.P-K1.c.1	similar to APMP.M.P-K1c	CMS/ITRI	CMS/ITRI, NIMT, SPRING	?
APMP.M.P-K6.1	similar to APMP.M.P-K6	CMS/ITRI	CMS/ITRI, NIMT, SPRING	?
APMP.M.P-S1	Pressure, gas, gauge Effective area of piston/cylinder		CMS/ITRI, SPRING	?
APMP.COO.EUR.M.P-K2.TRI	gas, gauge and absolute Effective area of piston/cylinder 10 kPa to 120 kPa	NPL, UK	Japan, UK, Russia	Effective area of piston/cylinder

APMP.M.H-K1.b	Hardness (Vickers 1) 200 HV, 600 HV, 900 HV		CMS/ITRI, KRISS, NIM, NIMT, NMIJ, SCL, VMI	In progress
APMP.M.H-K1.c	Hardness (Vickers 30) 200 HV, 600 HV, 900 HV		CMS/ITRI, KRISS, NIM, NIMT, NMIJ, SCL, VMI	In progress
Not yet registered	Mass: 100 mg, 2g, 20 g, 500 g, 1 kg	VMI with NMIA assistance	DEC NMIs plus others interested	planned
Not yet registered APMP.M.F-K2 APMP.M.F-K3 APMP.M.F-K4	Force: 100 kN 1 MN 2MN		All APMP members welcome to participate	planned
UVA detector responsivity	Radiometry	SPRING	NMIJ, KRISS, NIM, CMS, CSIR, CSIRO (MSL)	Started: Jan 04. Measurements completed May 05. Draft report expected: July 05 Final report expected: Oct 05
Luminous flux	Photometry	NIM	NIM, KRISS, CMS, SIRIM, SPRING, CSIR-NML, NPLI, NMIJ	Not yet started
Luminous intensity	Photometry	NMIJ	NMIJ, KRISS, NPLI, CMS, SIRIM, CSIR-NML, (MSL)	Schedule submitted Proposed: Jun 05 - Apr 2007
Spectral diffused reflectance	P&R	KRISS	KRISS, CMS , SPRING, CSIR-NML, NMIJ, (MSL, NIM)	Schedule submitted Proposed: Jan 05 - Apr 2007
Fibre optic power responsivity (1310, 1550 nm)	P&R	KRISS	KRISS, CMS, NIM, SPRING, SIRIM, CSIR-NML, (NMIA, NMIJ)	Schedule submitted Proposed: Dec 04 - Dec 2006
Gravimetric Preparation of Gas	KRISS		Starts Apr 2005, Report on December 2005	Gravimetric Preparation of Gas
Purity Assessment of Gas (methane)	NMIJ		Jun 2005, Sep 2006	Purity Assessment of Gas (methane)
(Automobile Emission Gas)			published in KCDB	(Automobile Emission Gas)
(Ethanol in nitrogen)			published in KCDB	(Ethanol in nitrogen)
APMP-T-S3-03	Mercury in glass & PRTs	NIMT	9	Draft-B awaiting participant approval
APMP-T-K4-03	Al and Ag fixed points	KRISS	8	Measurements Continuing
APMP-T-K3-00	SPRTs from Hg to Zn	NMIA	12	Draft-B in CCT-WG7 review
APMP-T-K7-04	Triple point of water	CMS	5	Awaiting CCT-KC7 draft-B
APMP-T-B2-04	Ear thermometry BBs	NMIJ/ NMIA	2	draft-A in preparation
APMP-T-S4-??	Ear thermometry BBs	NMIA	5	Awaiting pilot comparison results
APMP-T-B1-03	Pt-Au thermocouples	KRISS	3	Draft-A awaiting approval
APMP-T-K5-97	Radiation thermometer at 650nm	NMIJ	7	Awaiting CCT-KC5 draft-B
APMP-T-S2-00	IR Radiation thermometer at 850nm	NMIJ	6	Draft-A in discussion
APMP-IC-1-97 (APMP-K6)	Dew Point meter	NMC	8	Draft-B awaiting CCT-K6 for KC linkage
APMP-T-S1-04	Type-R thermocouples	NMIA	12	Participants performing measurements
Not allocated yet	High Humidity	MSL	5(?)	Protocol in discussion
Not allocated yet	Industrial radiation	CSIR	7(?)	Protocol in

	thermometers			discussion
APMP-T-S1-04	Pt-Pt/Rh thermocouples	NMIA	12	Comparison underway. Expect completion mid-2005

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Key and supplementary comparisons - Results of the search

KCDB

Contextual links

- Find my NMI
- CIPM MRA
- Participants in the CIPM MRA
- Metrologia
- Guidelines for key comparisons
- Nomenclature
- Glossary

Contact us

- BIPM.KCDB@bipm.org

Search criteria : Mass, Hardness, Thailand
Your request produced **3** result(s)

List of comparisons

Click on a comparison identifier to view more

APMP.M.H- K1.b	**Hardness (Vickers 1)** **2003 - 2004**
Comparison type, Field	Key comparison in Mass, Hardness Hardness: 200 HV, 600 HV and 900 HV
Status	**In progress**
APMP.M.H- K1.c	**Hardness (Vickers 30)** **2003 - 2004**
Comparison type, Field	Key comparison in Mass, Hardness Hardness: 200 HV, 600 HV and 900 HV
Status	**In progress**
APMP.M.H- S1	**Hardness (Rockwell C)** **2004 - 2005**
Comparison type, Field	Supplementary comparison in Mass, Hardness Hardness: 20 HRC to 60 HRC
Status	**Approved and published**

Print this list Top of the page

Search criteria : Mass, Hardness
Your request produced **15** result(s)

List of comparisons

Click on a comparison identifier to view more

CCM.H- K1.a	**Hardness (Vickers 0.2)** **2001 - 2003**
Comparison type, Field	Key comparison in Mass, Hardness Hardness: 240 HV, 540 HV and 840 HV
Status	**Approved for equivalence**, Results available
CCM.H- K1.b	**Hardness (Vickers 1)** **2001 - 2002**
Comparison type, Field	Key comparison in Mass, Hardness Hardness: 240 HV, 540 HV and 840 HV
Status	**Approved for equivalence**, Results available
CCM.H- K1.c	**Hardness (Vickers 30)** **2001 - 2002**
Comparison type, Field	Key comparison in Mass, Hardness Hardness: 240 HV, 540 HV and 840 HV
Status	**Approved for equivalence**, Results available
CCM.H- K2	**Brinell Hardness** **2003 -**
Comparison type, Field	Key comparison in Mass, Hardness
Status	**Report in progress, Draft A**
CCM.H- S1.a	**Hardness (Rockwell C)** **1998 - 1999**
Comparison type, Field	Supplementary comparison in Mass, Hardness
Status	**Report in progress, Draft B**
CCM.H- S1.b	**Hardness (Rockwell A)** **1998 - 1999**
Comparison type, Field	Supplementary comparison in Mass, Hardness
Status	**Report in progress, Draft B**
CCM.H- S1.c	**Hardness (Rockwell D)** **1998 - 1999**
Comparison type, Field	Supplementary comparison in Mass, Hardness
Status	**Report in progress, Draft B**
CCM.H- S1.d	**Hardness (Rockwell 15N)** **1998 - 1999**
Comparison type, Field	Supplementary comparison in Mass, Hardness
Status	**Report in progress, Draft B**
CCM.H- S1.e	**Hardness (Rockwell 30N)** **1998 - 1999**
Comparison type, Field	Supplementary comparison in Mass, Hardness
Status	**Report in progress, Draft B**
CCM.H- S1.f	**Hardness (Rockwell 45N)** **1998 - 1999**
Comparison type, Field	Supplementary comparison in Mass, Hardness
Status	**Report in progress, Draft B**
APMP.M.H- K1.b	**Hardness (Vickers 1)** **2003 - 2004**
Comparison type, Field	Key comparison in Mass, Hardness Hardness: 200 HV, 600 HV and 900 HV
Status	**In progress**
APMP.M.H- K1.c	**Hardness (Vickers 30)** **2003 - 2004**

Comparison type, Field	Key comparison in Mass, Hardness Hardness: 200 HV, 600 HV and 900 HV
Status	**In progress**

APMP.M.H- S1 — **Hardness (Rockwell C)**
2004 - 2005

Comparison type, Field	Supplementary comparison in Mass, Hardness Hardness: 20 HRC to 60 HRC
Status	**Approved and published**

COOMET.M.H- K1.b — **Hardness (Vickers 1)**
2004

Comparison type, Field	Key comparison in Mass, Hardness Hardness: 240 HV, 540 HV and 840 HV
Status	**Report in progress, Draft B**

COOMET.M.H- K1.c — **Hardness (Vickers 30)**
2004

Comparison type, Field	Key comparison in Mass, Hardness Hardness: 240 HV, 540 HV and 840 HV
Status	**Report in progress, Draft B**

Annex 36: Questionnaire for the Evaluation and Its Result

Japan International Cooperation Agency

Terminal Evaluation Study on the Project for Technical Strengthening for National Institute of Metrology (Thailand) Phase 2

Questionnaire

Name of correspondent: _____

Division/Section: _____ **Position:** _____

Position: _____ **Contact Tel No.:** _____

Period involved in the Project: _____

Share of working hours for the Project activities: (Approx.) _____ **%**

This questionnaire is prepared for the Terminal Evaluation Study on the project mentioned above. Your answers would help analyse whether or not the Project has been carried out properly as it was planned and generated a certain achievement.

This questionnaire is prepared for **'Relevance", Effectiveness", "Efficiency", "Impact", and "Sustainability"** questions of the Project.

Besides, if you cannot fulfil your comments and/or suggestions on this paper, please prepare additional papers and write down onto them.

Finally, after fulfilling this questionnaire, please send back to 'Ms. Thanyatorn Singrueng" of the JICA Terminal Evaluation Study Team not later than 03:00PM, 13th June, 2007 with the following way;

By fax: *02-937-0704*

By e-mail: *belong2b@gmail.com*

We should be glad if you would share your time for this work. Thank you for your cooperation in advance.

I. Relevance

1. Does the overall project goal coincide with the Thai national policies?

	Very much	Much	Fairly	Not so	Not at all
Count	2	3	3		
%	25.0	37.5	37.5		

Please specify the Thai national policies, you think, which coincide with the overall goal if your answer is more than fairly.

- The Thai national policies are developed in automobile industry that consistent with the topics of the training.
- Detriot of Asia and Kitchen of the world

2. Is the project purpose consistent with the policy of NIMT?

	Very much	Much	Fairly	Not so	Not at all
Count	4	2	2		
%	50.0	25.0	25.0		

Please give us the reason of your rate.

- After I came back from Japan, I can set up the traceability of roundness and roughness standard to international standard.
- Because NIMT policy also focus on the dissemination of measurement traceability and establishment of primary standards

3. Did the contents (activities) of the project support NIMT's performances in comparison with international level of accuracy?

	Very much	Much	Fairly	Not so	Not at all
Count	1	5	2		
%	37.5	62.5	25.0		

Please give us the reason of your rate.

- I can use knowledge from the training to join with APMP key-comparison of roughness measurement.
- NIMT can partcipate in APMP intercomparison by these activities

4. Is there any other institute/ organization which should correspond to National Measurement Systems in Thailand?

	More than 5	2 to 4	Just one other	No	Yes, but in future
Count		4	3	1	
%		50.0	37.5	12.5	

Please specify the name of institution/ organization corresponding to National Measurement Systems if you rate more than just one other

- Department of Medical Science, Department of Science Service, National Food Institute
- National Metrology Institute of Indonesia
- Office of Atoms for Peach (Designated Lab)
- PTB Germany, JEMIC Japan

5. Is there any other institute/ organization involved consequently in the project?

	More than 5	2 to 4	Just one other	No
Count			1	7
%			12.5	87.5

Please specify the name of institution/ organization involved during the project period if you rate more than just one other

6. Is there any other donor or supporting agency cooperating in the field of the national measurement systems?

	More than 5	2 to 4	Just one other	No	Yes, but in future
Count		1	1	6	
%		12.5	12.5	75.0	

Please specify the name of donors supporting NIMT and the field of their assistance if you rate more than just one other

II. Effectiveness

1. Is the set up of the project purpose appropriate in accordance with the nature of NIMT?

	Very much	Much	Fairly	Not so	Not at all
Count	3	2	3		
%	37.5	25.0	37.5		

Please provide us the relevance supporting your answer.

- In some field such as chemical metrology, photometry, there are no lab at that time but the project purpose need more output on them.

2. Did NIMT staff have trainings in 8 fields of measurement standards sufficiently?

	Very much	Much	Fairly	Not so	Not at all
Count		2	4	2	
%		25.0	50.0	25.0	

Please give us the reason of your rate.

- We still lack of some field of chemical metrology such as coulometric titration.
- Fields of measurement are okay but there are many parameters in each fields which are also very important and needed for Thai community.

3. Are the number, accuracy and range of calibration services improved by the project?

	Very much	Much	Fairly	Not so	Not at all
Count	1	5	1	1	
%	12.5	62.5	12.5	12.5	

Please give us the reason of your rate.

- NIMT can provide services in the filed of roughness and roundness after training in the Project.
- The staff use the training knowledge to develop their calibration procedure and improve the accuracy of measurement by getting the new equipment in this project.
- To support industrial in Thailand

4. Is there any change in C/P employment plan during the project?

	Very much	Much	Fairly	Not so	Not at all
Count		2	2	3	1
%		25.0	25.0	37.5	12.5

Please explain more about the change of employment plan if you rate more than fairly.

- Many counterparts have quited and changed their field.

5. Is there any significant change in budget allocation and policy during the project?

	Very much	Much	Just little	No	Not sure
Count		1	3	3	1
%		12.5	37.5	37.5	12.5

Please describe how budget allocation and policy have changed from your point of view.

- I think during the project some equipment can be added and removed.

6. Is there any change in organizational structure?

	Very much	Much	Just little	No	Not sure
Count		2	2	4	
%		25.0	25.0	50.0	

Please describe how the organizational structure of NIMT changed since the project started.

- Changing of Director and Head of Department; rearrange the lab.
- There are more parameters extended, more metrologists.

7. Are procurement and installation of the all machineries properly completed?

	Yes	No
Count	5	3
%	62.5	37.5

Please give us the reason if you answer “No”.

- My second training is in gas standard. Now there is no space to set up the filling system and mass comparator. NIMT tries to improve and extend the laboratory.

8. Are NIMT staffs trained by the project still working in NIMT?

	Yes	Resigned a few	Resigned lots
Count	6	2	
%	75.0	25.0	

Please describe your idea why trained staffs resigned, if you rate less than resigned a few.

9. Is there any incident positively/ negatively influencing the achievement of the project purpose?

	Very lots	Lot	Just few	No	Not sure
Count		1	4	3	
%		12.5	50.0	37.5	

Please describe incidents you can identify during the project period.

- The delay and inspection of the NIMT new building was too long.
- There were four Luminous Intensity Standard Lamps had defected and NIMT sent to claim from manufacturer. The claim period took long time and caused the follow-up counterpart cannot finish on schedule.

III. Efficiency

1. Is the allocation of Japanese experts and Thai C/P sufficient in terms of number and timing?

	Very much	Much	Just little	No	Not sure
Count	1	4	2	1	
%	12.5	50.0	25.0	12.5	

Please describe your idea which could encourage more the implementation of the project.

- The experts could not teach some part of measurement procedure because of time limited.

2. Is the budget for operation and maintenance of the project allocated as planned?

	Yes, as planned	No, little short	No, rather short	Not at all	Not sure
Count	4	1		1	2
%	50.0	12.5			

Please explain your opinion if your rate is no.

3. Are all equipment, which are mainly procured by ODA loan, installed as planned?

	Yes, as planned	No, late (Time)	No, short (Quantity)	No, both (Time and Quantity)	Not sure
Count	4	4			
%	50.0	50.0			

Please explain your opinion if your rate is “No”.

- Because the QM rooms are not ready for equipment installation; we got only empty room with no facilities or chemical laboratory such as fume hood and sink.
- In chemical lab, the new building does not provide the facilities like a chemical lab but it looks like the physic lab. Then NIMT should be constructed and furnished by itself.

4. Are these equipments utilized effectively?

	Yes, used and maintained often	Yes, used but not well maintained	Not used often	Not at all	Not sure
Count	6		2		
%	75.0		25.0		

Please explain your observation how equipments are used in NIMT.

- We use the equipment for many jobs such as preparation of reference materials, participation in international laboratory comparison.

5. Is there any internal training system in NIMT?

	Yes	No	Not sure
Count	6	1	1
%	75.0	12.5	12.5

If yes, please give us the general description of the internal training system of NIMT.

If no, please give us your idea about the importance of the internal training system of NIMT.

- When NIMT incruits new staff, they are trained by metrologist.
- There is no system for internal training. The course is organized by case. I think the internal training course must be set to refresh the staff knowledge.
- Quality System
- The training courses were organized for new staff of the department for both theoretical and practical.
- Quality System, ISO 17025, Uncertainty evaluation, etc.

6. Are measurement standards established and maintained as planned?

	Yes, established and maintained often	Yes, established but not well maintained	Not established	Not sure
Count	5	3		
%	62.5	37.5		

Please explain more about your answer if necessary.

- To maintain this parameter, it must be cooperated with other governmental officers.

7. Is the environmental management system of laboratories improved during the project?

	Very much	Much	Fairly	Not so	Not sure
Count		3	4	1	
%		37.5	50.0	12.5	

Please explain more about your answer if necessary.

- The environmental management system of temperature and humidity laboratories was controled better than the old building but still not stable.
- The lab should be improved the condition following ISO standard.
- The temperature of the radiometry room is not stable – vary about 2-5 ^{o}C

8. How many times were international comparisons conducted?

	More than 5	2 to 4 times	Just one time	Not at all	Not sure
Count		4		3	1
%		50.0		37.5	12.5

Please explain more about your answer if necessary.

- Chemical metrology participate in APMP comparison 2 times: APMP.QM P06, APMP.QM P09
- Glass hemisphere calibration by multi-step method; ring gauge and plug gauge calibration by IDM with JQA; roughness calibration by stylus instrument with APMP region
- APMP.P06 and APMP.P09 in pH measurement field
- We dicided to participate in luminous flux and luminous intensity international comparison which are provided by APMP.

9. Is the calibration technology for reference standard improved?

	Very much	Much	Fairly	Not really	Not sure
Count	3	3	1	1	
%	37.5	37.5	12.5	12.5	

Please describe more about your answer if your rate is less than not really.

10. Did NIMT still take any countermeasure to prevent the resignation of C/P trained in the project?

	Yes, extensively	Yes, fairly	Yes, but not effectively	Not really	Not at all	No answer
Count	2	1	1		3	1
%	25.0	12.5	12.5		37.5	12.5

Please give us more about your idea or opinion if necessary

11. Is there any factor enhancing/ hindering the project outputs?

	Yes	No	Not sure
Count	2	2	4
%	25.0	25.0	50.0

Please describe more about your answer if yes.

- NIMT staff has many instruments to be calibrated from customer so the project may be late to finish.

12. Are the operation and administration of the project enhanced?

	Very much	Much	Fairly	Not so	Not sure
Count		3	4		1
%		37.5	50.0		12.5

Please describe more about your answer if necessary.

13. Are the equipments operated and maintained properly?

	Very much	Much	Fairly	Not so	Not sure
Count	1	4	2	1	
%	12.5	50.0	25.0	12.5	

Please describe more about your answer if necessary.

14. Is the technical capability of C/P upgraded?

	Very much	Much	Fairly	Not so	Not sure
Count	4	3	1		
%	50.0	37.5	12.5		

Please describe more about your answer if necessary.

- NIMT expanded the calibration service range.

15. Is the accuracy of measurement standards improved?

	Very much	Much	Fairly	Not so	Not sure
Count	2	4	2		
%	25.0	50.0	25.0		

Please describe more about your answer if necessary.

- By getting the new equipment

16. Does NIMT disseminate national measurement standards properly?

	Very much	Much	Fairly	Not so	Not sure
Count	2	4	2		
%	25.0	50.0	25.0		

Please describe more about your answer if necessary.

- Preparing seminar for new measurement or disseminate information about technique and knowledge of measurement.

IV. Impact

1. How many were calibration laboratories increasingly registered during the project?

	More than 5	2 to 4	Just one	Not at all	Not sure	No answer
Count			1		6	1
%			12.5		75.0	12.5

Please give us your opinion or idea if you have any.

- The secondary laboratory was set up for calibration of roundness and roughness standard and this lab was accredited from TISI.

2. How much is the measurement network in Thailand established?

	Very much	Much	Fairly	Not so	Not sure	No answer
Count		1	3	1	2	1
%		12.5	37.5	12.5	25.0	12.5

Please give us your opinion or idea if you have any.

- Chemical metrology has its network.
- A few secondary laboratories were established since they need a lot of investment. On the other hand, the laboratories in manufacturer were established more than secondary laboratories.
- Set up national chemical metrology committee
- There used to be the network about 2-3 years ago but discontinue at the present.

3. Is there any change in the role of NIMT as the institute for maintaining national measurement standard?

	Very much	Much	Fairly	Not so	Not sure	No answer
Count	1	1	1	3	1	1
%	12.5	12.5	12.5	37.5	12.5	12.5

Please describe your opinion or idea if you rate is more than faily.

4. Is there any unexpected factor on attainment of the overall goal, either positively or negatively?

	Yes	No	Not sure	No answer
Count		5	2	1
%		62.5	25.0	12.5

Please specify the unexpected factor from your point of view if you rate “Yes”.

5. Is there any unexpected positive or negative influences including ripple effects[1]?

	Yes	No	Not sure	No answer
Count		5	2	1
%		62.5	25.0	12.5

Please specify the unexpected factor from your point of view if you rate “Yes”.

V. Sustainability

1. Is the technology of equipments and knowledge installed by the project appropriate for the technical capacity of C/P?

	Very much	Much	Fairly	Less	Not at all	No answer
Count		6	1			1
%		75.0	12.5			12.5

Please give us your opinion or idea if you have any.

2. Are the technical and maintenance manuals prepared in the project utilized effectively?

	Very much	Much	Fairly	Less	Not at all	No answer
Count		6	1			1
%		75.0	12.5			12.5

Please give us your opinion or idea if you have any.

3. Did NIMT take any countermeasure to prevent the resignation of C/P trained in the project?

	Very much	Much	Fairly	Less	Not at all	No answer
Count		2	3	1	1	1
%		25.0	37.5	12.5	12.5	12.5

Please give us your opinion or idea if you have any..

[1] Ripple effect; Intended or unintended effect on personnel or group excluded from target group

4. Does the 10th National Economic and Social Development Plan still emphasize the significance of the metrology system in Thai industry?

	Very much	Much	Fairly	Less	Not at all	No answer
Count	1	3	3			1
%	12.5	37.5	37.5			12.5

Please give us your opinion or idea if you have any.

5. Is the National Metrology System Development Act (1995, enacted in 1997) still effective to encourage the activities of NIMT?

	Very much	Much	Fairly	Less	Not at all	No answer
Count	1	3	1	1	1	1
%	12.5	37.5	12.5	12.5	12.5	12.5

Please give us your opinion or idea if you have any.

6. Is the financial assistant from Thai Government to NIMT for the coming years secured enough to operate and maintain the facilities?

	Very much	Much	Fairly	Less	Not at all	No answer
Count			4	3		1
%			50.0	37.5		12.5

Please give us your opinion or idea if you have any.

7. Is the status of revenue from the calibration services improving?

	Very much	Much	Fairly	Less	Not at all	No answer
Count		4	3			1
%		50.0	37.5			12.5

Please give us your opinion or idea if you have any.

8. Does the community of the Thai industry still need NIMT as the high level measurement standards as before?

	Very much	Much	Fairly	Not so	Not at all
Count	3	3	1		
%	37.5	37.5	12.5		

Please give us your opinion or idea if you have any.

Suggestions and/or Comments:

- I think the technical cooperation especially the intercomparison or bilateral comparison should be done in the fields which are benefit for Thai community. In chemical fields, there is a problem in volatile organic compound (VOC) measurement right now. The next project for doing the comparison is very necessary to get the reliability in measurement results.

--- End ---

Annex 37: List of Recipients for the Questionnaire Survey

Annex 37: List of Recipients for the Questionnaire Survey

Section	Name	During of Training in Japan (month/year)	Response
1. Humidity	Ms. Thasorn Sinhaneti	1.5/2001	O
2. pH Standard Solution	Mr. Bunthoon Laongsri	3.0/2001	O
3. Hardness	Mr. Tassanai Sanponput	2.5/2002	X
4. Time & Frequency	Mr. Somchai Nuamsettee	2.5/2002	X
5. Form	Mr. Samana Piengbangyang	4.0/2002	O
6. DC High Voltage	Mr. Danai Pattarkijkul	3.0/2003	O
7. Inorganic Standard	Ms. Nongluck Tangpaisarnkul	3.0/2004	O
8. Fixed Point	Ms. Charuayrat Yaokulbodee	3.0/2004	O
9. Pressure Standard	Mr. Likit Sainoo	3.0/2005	O
10. Flux/Intensity	Mr. Arkom Krachangmol	3.0/2005	O
11. QHR Standard	Mr. Chaiwat Jessadajin	1.5/2006	X
12. Standard Scale	Mr. Yuttana Hongaromkij	3.0/2006	X

Annex 38: List of Interviewees and Summary of Interview Result

Annex 38: List of Interviewees and Summary of Interview Result

Organization	Name	Position	Date of Interview
1. Thailand Institute of Scientific and Technological Research (TISTR)	Dr. Luxsamee Plangsangmas	Director	12 June 2007
2. Department of Science Service (DSS)	Dr. Sompote Boonsanit	Senior Scientist	12 June 2007
3. Ministry of Science and Technology (MOST)	Dr. Saksit Tridech	Permanent Secretary	14 June 2007
4. NEC Corporation (Thailand) Ltd.	Mr. Koji Kikawada	Deputy president of NEC calibration center (Thailand)	15 June 2007
5. National Institute of Metrology (Thailand)	Dr. Pian Totarong	Director	18 June 2007

1. Thailand Institute of Scientific and Technological Research (TISTR)
Interviewee: Dr. Luxsamee Plangsangmas

1. What kind of benefit did TISTR gain from the Project and what is the direction of TISTR toward the measurement standards development in Thailand?

Overall, the establishment of NIMT is a big step for the measurement standards development in Thailand. This can enhance the reliability of export goods of Thailand and strengthen the international competitiveness of domestic industries. In terms of the direction of TISTR development toward this change, we believe that the Project would support TISTR one way or another to strengthen our calibration service capability and expand our customer base.

Moreover, the direct benefit for TISTR and other calibration laboratories caused by the Project is the reduction of calibration service costs from having to refer to other international accreditation bodies in the past due to the lack of a core body of the national metrology system in Thailand.

In addition, the accreditation system established by the Project also contributed to other secondary measurement standard organizations in terms of trustworthiness in the traceability chain at the domestic level.

2. What do you think about the needs of the industrial community toward the NIMT's activities and measurement standard development of Thailand?

After the accreditation system was applied to the industrial sector of Thailand, many entrepreneurs, particularly the exporters, raised their awareness to build products that meet the requirements of their customers. Therefore, it is important for NIMT to provide national measurement standards to more calibration laboratories all over the country. In

the meantime, the recognized international Accreditation Bodies (ABs), including the Thai Industrial Standard Institute (TISI), also play an important role in the traceability system of NIMT in order to maintain reliable performance. Nonetheless, the financial burden of NIMT should be a factor in the selection of AB, but ultimately, the key will be the requirement of NIMT's target customers.

3. In your opinion, what kind of measures should NIMT take to sustain and disseminate the technical transfer gained from the Project?

NIMT should maintain its role as a core body of national measurement standards and conduct more research to widen their global recognition in the future. In the financial aspect, NIMT should not emphasise raising its own funds by providing more calibration services to many levels, but focus on secondary measurement standards organization due to the fact that the government is fully responsible to support the implementation of NIMT.

However, the establishment of NIMT is still in the beginning stages compared to other countries, and thus the accreditation system is essential for the recognition of NIMT among the industrial communities, at both domestic and international levels. For this reason, after the process of technical transfer of the Project has been completed, it is necessary for NIMT to apply for and assess accreditation in all quantities as planned. So it would be recommended that NIMT should continue the collaboration with JICA to facilitate the completion of this process since JICA experts have more experience and are familiar with NIMT activities.

4. What is the prospect of TISTR to collaborate with NIMT and other related organizations in the future?

After the Project is completed, NIMT should play the important role of disseminating the knowledge transferred by the Project to other secondary measurement standard organizations in order to bring them up-to-date on the trend of new technologies and strengthen their capability service to conform to NIMT, the primary measurement standard organization. Otherwise, most customers may turn to NIMT, creating a negative impact to the structure of measurement standard bodies of Thailand.

At this moment, there is no doubt about the capability of NIMT's staff to transfer the knowledge and technical skills gained from the Project to other related organizations. However, the main obstacle is getting support from the government for hardware development.

2. Department of Science Service (DSS)
Interviewee: Dr. Sompote Boonsanit

1. What do you think about the needs of the industrial community toward the NIMT's activities and development of a measurement standard of Thailand?

Although the design of NIMT's structure is not based on marketing research that reflects the true demand of the local industrial community, one may assume that demand for a measurement standard in Thailand has been increasing as a result of the requirement for a quality assurance system which is used as a management tool to strengthen the competitiveness of domestic industries in the global market.

It is important for NIMT to promote their activities and themselves as a core body to provide the national measurement standard. Therefore, once the project is completed, accreditation will be crucial for NIMT through authentication by a third party. For this reason, the selection of an accreditation body becomes a supporting factor to create the international credibility necessary for its measurement traceability. In my opinion, in order for NIMT to become reputable in society, they should apply for accreditation from a recognized international accreditation body like IA Japan. Later, it would be a practical alternative for NIMT to switch accreditation from IA Japan to the Thai Laboratory Accreditation Scheme (TLAS) in order to diminish its financial burden.

2. What kind of benefit did DSS and other calibration laboratories gain from the Project?

From my point of view, the impact in terms of customer base might not have changed much. However, there have been some positive impacts that NIMT contributed to the industrial community, such as the availability of reliable national measurement standards for local calibration laboratories and contributing to a positive image of Thai industry that will be recognized among both domestic and international industrial communities.

The direct benefit for DSS and other calibration laboratories gained by the project is the reduction of calibration services costs due to the fact that, previously, we had to use the service from other international accreditation bodies since Thailand lacked a core body of the national metrology system.

3. In your opinion, what kind of measures should NIMT take to sustain and disseminate the technical transfer gained from the Project?

First of all, after the completion of the Project, it is important for NIMT to continue its efforts to achieve the accreditation assessment in all quantities applicable during the Project period. Otherwise the establishment of the national measurement system might not be thoroughly completed as aimed for in the overall goal of the Project. In this regard, it is reasonable to say that NIMT should lengthen their collaboration with JICA in order to achieve that goal since JICA experts have already been working with NIMT for a certain period and they are familiar with the technologies and equipment supplied by the Project.

The NIMT staff should aim to provide their customers with high quality calibration services and agile response times after the Project is completed through continuous practice, which can also lead to the strengthening of their service capability, in order to reduce the gap between the primary and secondary measurement standard organizations.

On the other hand, all of the knowledge and technologies transferred by the Project should be maintained and disseminated properly to the secondary measurement standard organization in order to strengthen their capability and competency. In response, NIMT should reflect on the priority quantities according to market needs in parallel with the preparation of qualified trainers and an evaluation system to ascertain the result of the dissemination process.

Lastly, I agree with the idea that NIMT should provide more calibration services - not only secondary measurement standard laboratories, but also working measurement standard laboratories - in order to raise funds to sustain organizational management over the long run. It is a matter of fact that the operation and maintenance costs of NIMT activities are very high due to the restricted lifespan of some of the machinery and equipment and the limited number of professional technicians in specific fields. This means that NIMT should utilize its existing resources efficiency and effectively, as long as a wider scope of services does not effect its primary standard measurement development. Although broadening their scope of services might garner some criticism in terms of an overlapping role with other secondary calibration laboratories, NIMT should set the price of its services at a higher rate than others due to their preparedness in both technology and capable staff. Contrary to any criticism, NIMT would play a central role to support the marketing mechanism by controlling the price of calibration services of secondary calibration laboratories so as not to be higher than the standard price set by NIMT.

3. Ministry of Science and Technology (MOST)
Interviewee: Dr. Saksit Tridech

1. Is there any change in national policy in terms of metrology and related industry in Thailand?

There will be no much change in the policy in terms of metrology and related industry; however, the execution and management will be operated as the whole system of Metrology, Standard, Testing and Quality (MSTQ) in order to cover all needs of the Thai industries.

2. Do you think is there any change in the needs of industry toward the establishment of internationally recognized measurement standard?

According to the strategy of the Tenth National and Social Development Economic Plan to focus on the agricultural restructuring to concentrate on economic crops and the Industrial restructuring to encourage agro-industry, bio-industry, herbal medicine and pharmacueticals, the establishment of Metrology in Chemistry and Biology will be needed.

Morever, in order to enhance and strengthen the international competitiveness of Thai industries to be recognized in the global market, the reliability in national measurement standard is an important factor. Since Thailand has been engaged in several international economic agreements with other countries recently, for example “the agreement between the Kingdom of Thailand and Japan for an economic partnership,” this agreement requires the standardize system to control and assure the quality of products.

3. What do you expect the NIMT to play its role in both domestic and international level?

Domestic level:	To be a supporter of trade, industry, export and legal metrology for Thai industrial communities.
International level:	To play its role as a metrology training and calibration center of ASEAN.

However, due to the capability of NIMT in the field of Chemistry and Biology is considered quite small compared to Japan. For this reason, the technical support from Japan or other countries is still needed.

4. What is the prospect of the Ministry to support NIMT's activity to achieve that such role?

It is one of the policy of MOST to support NIMT to play its role as the key institute to develop metrology system and procure national measurement standard and disseminate to the secondary laboratories. The secondary laboratory, particulary the DSS which is the organization under MOST also has its duty to disseminate and extend its knowledge to any other laboratories including academical and private sector. As a result, the network and capability of calibration service laborotories in Thailand will be strengthened.

By all means, NIMT will gain full support from MOST to maintain its function as a core body of national measurement standards and conduct more research to widen its global recognition.

5. In your opinion, are there any positive and negative impact happened as the result of the Project?

Positive: The development of national metrology system of Thailand runs very fast and systematic

4. NEC Corporation (Thailand) Ltd.
Interviewee: Mr. Koji Kikawada

Main topic: Impact either positive or negative derived from the implementation of NIMT project

Summary of interview result

1. He is personally admiring the effort and achievement of the Project. It is because NIMT has become the finest institution of primary standards in this region, where lots of equipments unaffordable for private institutions are available.
2. Actual benefit from the Project is still limited due to the range of calibration service available in NIMT. NEC still has to send its equipments (not all but some) to Japan, which requires higher cost.
3. The quality of NIMT calibration services reached the acceptable level in terms of accuracy and time. It took several months before equipments were returned to NEC in the past.
4. As in NEC's wish upon the prospect of NIMT, it should be the primarily authorized institution like NMIJ (National Metrology Institute of Japan). Therefore, there should be secondary calibration institutions which can provide calibration services to users.
5. By the second half of the last year, one group of secondary calibration institutions called NIMT's was resolved. This group worked under NIMT supervision as the calibration service providers to Thai domestic industries.
6. Without these secondary institution, thousands users may contact directly to NIMT for calibration services. This could disturb NIMT activities.
7. From the calibration engineer's point of view, NIMT has reached the international level of calibration institution although continuous upgrade of facilities and human resources is indispensable. In this manner, the support from Japan has great deal still in the development of NIMT.
8. Accreditation from Japanese authority may gives indirectly the sense of security to users.
9. As far as ISO has the common quality standards of Thailand, the need of calibration will never decline. Therefore, the presence of NIMT will never change.

5. National Institute of Metrology (Thailand) (NIMT)
Interviewee: Dr. Pian Totarong

Main topic: The future aspect in terms of Impact and Sustainability derived from the implementation of NIMT project

1. The National Metrology System Development Act still effective to encourage the activities of NIMT very well as a core body to procure and maintain national standards of the country.

2. There is no change in the recruitment policy of NIMT, which would have a negative influence on the project. NIMT still takes a countermeasure to prevent the resignation of C/Ps trained in the Project strictly.

3. Referring to the chart of traceability chain and roles of respective organization, the organization related to the secondary standard consists of DSS, TISTR and existing 130 calibration laboratories all over Thailand including private sector.

4. NIMT does not have any policy to control the performance quality of other secondary laboratories in Thailand since the requirement of ISO 17025 which those laboratories have to apply can play that such role.

5. At the first step, NIMT set up the NIMT's calibration laboratory network, which consist of 12 calibration laboratories as the member in order to provide technical training for them free of charge. Morever, the member could get the lower price of calibration service from NIMT. However, we decided to terminate this network because it is unfair for other laboratories that did not participate in this network. Furthermore, we set up a new network called Metrology Club in each area and we still provide technical trainings for all calibration laboratories, which have 130 laboratories approximately at the moment, about 20 courses in every year.

Annex 39: Field Observation Report of Terminal Evaluation Team

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Team member: Yoji Matsui

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1. Interview to Director of NIMT

After the kick-of meeting conducted in the first day of the study, we had an opportunity to ask the vision and future direction of NIMT from Dr. Pian of Director of NIMT. The questions focused on the various topics such as the maintenance of quality system, the possibility of collaboration with TISI, the schedule of accreditation assessment, the selection of standards to be maintained, prospect of NIMT budget, etc.

His comments to our questions are as follows:

- Regarding the maintenance of quality system, there are two choices. One is the accreditation by the third party and the other is the self declaration. In regard to the former choice, NIMT requested accreditation to IAJapan for such quantities which technical transfer was conducted in the Project, while the accreditation was assessed by DKD in some other quantities before this project. NIMT would like to consider the appropriate approaches on each quantity for future maintenance of quality system.
- Regarding the accreditation assessment with the collaboration of IAJapan and TISI, there is no problem for NIMT because this is just a matter of applicant.
- NIMT considers that accreditation assessment of 20 unfinished quantities or more will be executed including all necessary preparation and consequently completed within one year.
- Quantities established as National Measurement Standards are quite important. Therefore, we are planning to apply for accreditations for all of them.
- At present, 90% of the calibration services of NIMT are provided for calibration laboratories, there are a few for private companies.
- In the budgetary report of NIMT shows the significant change in terms of the amount

between 2006 and 2007 because it is including the return of Japanese ODA Loan by JBIC. Apart from this, the annual budget of NIMT is quite stable in any aspect.

Besides, especially his strong intention of the accreditation assessment and stability of NIMT budget implies much confidence on NIMT's sustainable development and the achievement at the satisfactory level.

2. Sampling survey on the quantities included in the technical transfer program

The evaluation team visited laboratories of NIMT and conducted the interview survey directly to NIMT staff in charge of the following four quantities.

（1） Magnetic

Technical transfer of this quantity was completed on March, 2007 by Mr. Tominaga of JEMIC. All necessary equipments seem installed properly. In the operation of these equipments, there was a minor problem as the delay of assembly for the probe but all manuals were prepared well. By assessing the conditions observed totally, it could be possible that this quantity would be accredited within this year.

（2） Inorganic

The primary standard in this quantity is provided from NMIJ. The secondary standards are evaluated by the comparison with this primary standard in NIMT. The technical transfer has been implemented by Mr. Hioki of NMIJ and NIMT staff in charge of this quantity is very well trained. In the future, it is expected that the allocation of more staff in this quantity will be quite necessary. Besides, the obtainment of ISO GUIDE 34 for the provision of the standards will need more than one year of the time based on the observation result of the current situation. However, it was quite impressive that all staff in this laboratory was very motivated. Therefore, the development program for this laboratory such as training for the management, etc should be scheduled in the earliest manner.

Photo 1
Standard magnetic field generation system
（Tamakawa Works Co. Ltd.）

Photo 2
Primary standard from NMIJ

（３） Force

All necessary equipments are installed. There are three staff for this quantity. The capability of them was assessed good enough. The comparison of measurement values between NMIJ and NIMT could be completed soon. Therefore, it is assessed with confidence that the accreditation assessment will be achieved within this Japanese fiscal year. We are very impressed.

（４） Standard Gas

Staff of this laboratory has already participated in the training for gas analysis. All necessary equipments are installed. In terms of handling gases, it could be assess good enough. In future the expansion of facilities is planned particularly in the gas filling system and the gas weighing system. For time-being the calibration service will be provided under ISO/IEC 17025. The application of ISO GUIDE34 will be executed after the expansion of facilities is completed.


JICA