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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty						NMI Service Identifier	Comments
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?	Matrix uncertainty		
DC voltage sources: single value	Electronic voltage standard	Direct comparison with standard	1	10	V	Fixed voltage	1 V, 1.018 V, 10 V	0.1 to 1.5	µV	2	95%	No	Mx1.1.1	1	Approved on 10 November 2014
						Ambient temperature	20 °C to 25 °C								
DC voltage sources: low values	DC voltage sources, multifunction calibrator: voltage *V*	Comparison with reference standard	0	12	V	Ambient temperature	15 °C to 30 °C	(0.05 + 0.15*V*), *V* in V, values range from 0.05 µV to 1.85 µV	µV	2	95%	No		5	Approved on 22 November 2006
DC voltage sources:intermediate values	DC voltage sources, multifunction calibrator	Comparison with reference standard	12	1100	V	Ambient temperature	15 °C to 30 °C	0.5	µV/V	2	95%	Yes		3	Approved on 22 November 2006
DC voltage meters: very low values	Nanovoltmeter, microvoltmeter	Comparison with reference standard	0	0.001	V	Ambient temperature	15 °C to 30 °C	0.05	µV	2	95%	No		6	Approved on 22 November 2006
DC voltage meters: intermediate values	DC voltmeter, multimeter, multifunction transfer standard	Comparison with reference standard	12	1100	V	Ambient temperature	15 °C to 30 °C	0.5	µV/V	2	95%	Yes		4	Approved on 22 November 2006
DC voltage meters: intermediate values	DC voltmeter, multimeter, multifunction transfer standard: voltage *V*	Comparison with reference standard	0.001	12	V	Ambient temperature	15 °C to 30 °C	(0.05 + 0.15*V*), *V* in V, values range from 0.05 µV to 1.85 µV	µV	2	95%	No		7	Approved on 22 November 2006
DC voltage ratios: up to 1100 V	Resistive dividers, ratio meter	Reference step voltage buildup method	1	1000		Laboratory temperature	20 °C	0.0000004		2	95%	Yes		8	Approved on 22 November 2006
						Output voltage	>= 1 V								
DC resistance standards and sources: low values	Fixed resistors, resistance box	Voltage comparator	10	1000	mΩ	Current	<= 1 A	25	µΩ/Ω	2	95%	Yes		16	Approved on 22 November 2006
						Voltage	>= 10 mV								

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DC resistance standards and sources: low values	Fixed resistor, resistance box	Current comparator bridges	0.1	1	Ω	Temperature	15 °C to 35 °C	0.2	μΩ/Ω	2	95%	Yes		12a	Approved on 22 November 2006
						Current	<= 100 mA								
DC resistance standards and sources: intermediate values	Fixed resistor, resistance box	Current comparator bridges	1	10000	Ω	Temperature	15 °C to 25 °C	0.12	μΩ/Ω	2	95%	Yes		12	Approved on 22 November 2006
						Power dissipation	< 10 mW								
DC resistance standards and sources: intermediate values	Fixed resistor, resistance box	Dual voltage source	0.01	1	MΩ	Applied voltages	5 V to 100 V	0.7	μΩ/Ω	2	95%	Yes		13	Approved on 31 October 2016
						Temperature	15 °C to 25 °C								
DC resistance standards and sources: high values	Fixed resistor, three terminal resistor, resistance box: resistance *R*	Dual voltage source	0.001	1	GΩ	Applied voltages	5 V to 100 V	$(0.7 + 27R - 20R^3)$, R in GΩ, values range from 0.7 μΩ/Ω to 7.7 μΩ/Ω	μΩ/Ω	2	95%	Yes		14	Approved on 31 October 2016
						Temperature	15 °C to 25 °C								
DC resistance standards and sources: high values	Fixed resistor, three terminal resistor, resistance box: resistance *R*	Voltage ratio	1	5000000	MΩ	Applied voltages	100 V to 1000 V	$(35 + 6.9E\text{-}11R^2 + 9.4E\text{-}04R)$, R in MΩ, values range from 35 μΩ/Ω to 6460 μΩ/Ω	μΩ/Ω	2	95%	Yes		15	Approved on 22 November 2006
DC resistance standards and sources: standard for high current	Fixed resistors: resistance *R*	Current comparator	0.1	1000	mΩ	Current	1 A to 875 A	$63R^{-0.35}$, R in mΩ, values range from 141 μΩ/Ω to 6 μΩ/Ω	μΩ/Ω	2	95%	Yes		17	Approved on 22 November 2006
						Voltage	10 mV to 1 V								

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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?	Matrix uncertainty		
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Resistance meters and resistance standards	0	10	Ω	Temperature	15 °C to 25 °C	40	μΩ	2	95%	No		18	Approved on 22 November 2006
DC resistance standards and sources: multiple ranges	Multifunction calibrator	Resistance meters and resistance standards	0.01	1000	kΩ	Temperature	15 °C to 25 °C	3	μΩ/Ω	2	95%	Yes		18a	Approved on 22 November 2006
DC resistance standards and sources: multiple ranges	Multifunction calibrator: resistance *R*	Resistance meters and resistance standards	1	100	MΩ	Temperature	15 °C to 25 °C	$(2 + R^{0.8})$, *R* in MΩ, values range from 3 μΩ/Ω to 42 μΩ/Ω	μΩ/Ω	2	95%	Yes		18b	Approved on 22 November 2006
DC resistance meters: low values	Microohmmeter, multimeter, multifunction transfer standard, resistance bridge: resistance *R*	Resistance meters and resistance standards	0.1	1000	mΩ	Source currents	100 mA to 875 A	$63R^{-0.35}$, *R* in mΩ, values range from 141 μΩ/Ω to 6 μΩ/Ω	μΩ/Ω	2	95%	Yes		21a	Approved on 22 November 2006
DC resistance meters: low values	Ohmmeter, multimeter, multifunction transfer standard, resistance bridge	Resistance meters and resistance standards	0.1	1	Ω			0.2	μΩ/Ω	2	95%	Yes		19a	Approved on 22 November 2006
DC resistance meters: intermediate values	Ohmmeter, multimeter, multifunction transfer standard, resistance bridge	Resistance meters and resistance standards	1	10000	Ω	Temperature	15 °C to 25 °C	0.12	μΩ/Ω	2	95%	Yes		19	Approved on 22 November 2006
DC resistance meters: intermediate values	Ohmmeter, multimeter, multifunction transfer standard, resistance bridge: resistance *R*	Resistance meters and resistance standards	0.00001	1	GΩ	Source voltages	1 V to 100 V	$(1 + 27R - 20R^3)$, *R* in GΩ, values range from 1 μΩ/Ω to 8 μΩ/Ω	μΩ/Ω	2	95%	Yes		21	Approved on 22 November 2006
DC resistance meters: high values	Multimeter, multifunction transfer standard, teraohmmeter, resistance bridge: resistance *R*	Resistance standards	1	100	GΩ	Source voltages	10 V to 1000 V	$(-0.07R^2 + 22R - 15)$, *R* in GΩ, values range from 6.9 μΩ/Ω to 1485 μΩ/Ω	μΩ/Ω	2	95%	Yes		22	Approved on 22 November 2006

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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?	Matrix uncertainty		
DC resistance meters: high values	Multimeter, multifunction transfer standard, teraohmmeter, resistance bridge: resistance *R*	Resistance standards	100	1200	GΩ	Source voltages	10 V to 1000 V	(1300 + 2.2*R*), *R* in GΩ, values range from 1520 μΩ/Ω to 3940 μΩ/Ω	μΩ/Ω	2	95%	Yes		23	Approved on 22 November 2006
						Source currents	> 100 pA								
DC resistance: ratios	Temperature bridge, resistance ratio bridge: nominal full-scale ratio ρ	Resistance Bridge Calibrator (RBC)	0	13	Ω/Ω	Temperature	15 °C to 25 °C	2E-08 ρ		2	95%	No		49b	Approved on 31 October 2016
DC current sources: low values	Current generator, multifunction calibrator	Voltage across resistor	1.00E-11	1.00E-04	A			560 to 5	μA/A	2	95%	Yes	Mx3	24	Approved on 22 November 2006
DC current sources: intermediate values	Current generator, multifunction calibrator	Voltage across resistor	1.00E-04	20.0	A			5 to 18	μA/A	2	95%	Yes	Mx3	27	Approved on 22 November 2006
DC current sources: high values	Current generator	Voltage across resistor	20	100	A			18 to 36	μA/A	2	95%	Yes	Mx3	31	Approved on 22 November 2006
DC current meters: low values	Picoammeter, nanoammeter, multimeter, multifunction transfer standard	Voltage across resistor	1.00E-11	1.00E-04	A			560 to 5	μA/A	2	95%	Yes	Mx3	25	Approved on 22 November 2006
DC current meters: intermediate values	Current comparator, multimeter	Voltage across resistor	1.00E-04	20.0	A			5 to 18	μA/A	2	95%	Yes	Mx3	29	Approved on 22 November 2006
DC current meters: high values	Current transducer, dedicated equipment for heavy current	Voltage across resistor	20	100	A			18 to 36	μA/A	2	95%	Yes	Mx3	33	Approved on 22 November 2006
AC resistance, real component and imaginary component	Fixed resistor: resistance *R*	Universal impedance bridge	0	1	MΩ	Frequency *f*	40 Hz to 2 kHz	(2000/*f* + 19*R*), *f* in Hz, *R* in Ω, values range from 1 μΩ to 19 Ω	μΩ	2	95%	No		46	Approved on 22 November 2006

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty						NMI Service Identifier	Comments
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?	Matrix uncertainty		
AC resistance, real component	Fixed resistor: resistance *R*	Resistance ratio bridge	0	400	Ω	Frequency	0.01 Hz to 100 Hz	(6 + 0.3*R*), *R* in Ω, values range from 6 μΩ to 126 μΩ	μΩ	2	95%	No		46a	Approved on 22 November 2006
AC resistance: AC-DC difference	Fixed resistor: resistance *R*	Universal impedance bridge	0	1	MΩ	Frequency *f*	40 Hz to 2 kHz	(2000/*f* + 19*R*), *f* in Hz, *R* in Ω, values range from 1 μΩ to 19 Ω	μΩ	2	95%	No		47	Approved on 22 November 2006
AC resistance: resistors for high current	AC current shunt: resistance *R*	Universal impedance bridge	0	100	Ω	Frequency *f*	40 Hz to 2 kHz	(2000/*f* + 19*R*), *f* in Hz, *R* in Ω, values range from 1 μΩ to 1900 μΩ	μΩ	2	95%	No		48	Approved on 22 November 2006
AC resistance: meters	LCR meter, temperature bridge, resistance ratio bridge: nominal full-scale ratio ρ	Resistance Bridge Calibrator (RBC)	0	13	Ω/Ω	Frequency	0 Hz to 100 Hz	2E-08 ρ		2	95%	No		49a	Approved on 22 November 2006
Capacitance: capacitance for dielectric capacitors	Fixed capacitor, switched capacitor, capacitance box: capacitance *C*	Universal impedance bridge	0	100	μF	Frequency *f*	40 Hz to 2 kHz	(0.2/*f* + 22*C*), f in Hz, *C* in μF, values range from 0.0001 pF to 2200 pF	pF	2	95%	No		39	Approved on 22 November 2006
Capacitance: dissipation factor for dielectric capacitors	Fixed capacitor, switched capacitor, capacitance box	Universal impedance bridge	0	0.2		Frequency	40 Hz to 2 kHz	(0.000027 + 0.00027/*C*), *C* in pF, values range from 0.000567 to 0.000027		2	95%	No		39a	Approved on 22 November 2006
						Capacitance *C*	0.5 pF to 100 μF								
Capacitance: meters	Capacitance bridge, LCR Meter: capacitance *C*	Comparison	0	100	μF	Frequency *f*	40 Hz to 2 kHz	(0.2/*f* + 22*C*), *f* in Hz, *C* in μF, values range from 0.0001 pF to 2200 pF	pF	2	95%	No		40	Approved on 22 November 2006

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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?	Matrix uncertainty		
Inductance: self inductance, low values	Fixed inductor, variable inductor, inductance box: inductance	Universal impedance bridge	0	1	mH	Frequency	40 Hz to 2 kHz	0.0001 to 5288	µH	2	95%	No	Inductance	41	Approved on 22 November 2006
						Series resistance	0 Ω to 1 MΩ								
Inductance: equivalent series resistance, low values	Fixed inductor, variable inductor, inductance box	Universal impedance bridge	0	1	MΩ	Frequency	40 Hz to 2 kHz	0.000001 to 53	Ω	2	95%	No	Series Resistance of Inductor	41a	Approved on 22 November 2006
						Series inductance	0 mH to 1 mH								
Inductance: self inductance, intermediate values	Fixed inductor, variable inductor, inductance box: inductance	Universal impedance bridge	0.001	1	H	Frequency	40 Hz to 2 kHz	0.001 to 5288	µH	2	95%	No	Inductance	42	Approved on 22 November 2006
						Series resistance	0 Ω to 1 MΩ								
Inductance: equivalent series resistance, intermediate values	Fixed inductor, variable inductor, inductance box	Universal impedance bridge	0	1	MΩ	Frequency	40 Hz to 2 kHz	0.00001 to 53	Ω	2	95%	No	Series Resistance of Inductor	42a	Approved on 22 November 2006
						Series inductance	0.001 H to 1 H								
Inductance: self inductance, high values	Fixed inductor, variable inductor, inductance box: inductance	Universal impedance bridge	1	100	H	Frequency	40 Hz to 2 kHz	1 to 5288	µH	2	95%	No	Inductance	43	Approved on 22 November 2006
						Series resistance	0 Ω to 1 MΩ								
Inductance: equivalent series resistance, high values	Fixed inductor, variable inductor, inductance box	Universal impedance bridge	0	1	MΩ	Frequency	40 Hz to 2 kHz	0.01 to 53	Ω	2	95%	No	Series Resistance of Inductor	43a	Approved on 22 November 2006
						Series inductance	1 H to 100 H								

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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?	Matrix uncertainty		
Inductance: mutual inductance	Fixed mutual inductor: inductance *H*	Universal impedance bridge	0	100	H	Frequency *f*	40 Hz to 2 kHz	(0.2/*f* + 14*H*), *f* in Hz, *H* in H, values range from 0.0001 µH to 1400 µH	µH	2	95%	No		44	Approved on 22 November 2006
AC-DC voltage transfer: AC-DC transfer difference at low voltages	Thermal converter with amplifier, micropotentiometer, AC-DC transfer standard	Comparison with calibrated source or meter	0.002	0.6	V	Frequency	10 Hz to 1 MHz	11 to 321	µV/V	2	95%	Yes	AC-DC Voltage	50	Approved on 25 August 2008
AC-DC voltage transfer: AC-DC transfer difference at medium voltages	Thermal converter (directly connected), AC-DC transfer standard	Comparison with calibrated source or meter	> 0.6	6	V	Frequency	10 Hz to 1 MHz	6 to 77	µV/V	2	95%	Yes	AC-DC Voltage	51	Approved on 25 August 2008
AC-DC voltage transfer: AC-DC transfer difference at higher voltages voltages	Thermal converter with range extender, AC-DC transfer standard	Comparison with calibrated source or meter	> 6	1000	V	Frequency	10 Hz to 1 MHz	9 to 76	µV/V	2	95%	Yes	AC-DC Voltage	52	Approved on 25 August 2008
AC voltage up to 1000 V: sources	Multifunction calibrator	Comparison with calibrated source or meter	0.002	1000	V	Frequency	10 Hz to 1 MHz	6 to 649	µV/V	2	95%	Yes	ACV Sources	53	Approved on 22 November 2006
AC voltage up to 1000 V: meters	AC voltmeter, multimeter, multifunction transfer standard	Comparison with calibrated source or meter	0.002	1000	V	Frequency	10 Hz to 1 MHz	9 to 862	µV/V	2	95%	Yes	ACV Meters	54	Approved on 25 August 2008
AC-DC current transfer: AC-DC transfer difference	Thermal converter plus shunt, AC-DC transfer standard plus shunt	Calibrated shunts, thermal converters and sources	0.0001	20	A	Frequency	40 Hz to 100 kHz	15 to 71	µA/A	2	95%	Yes	AC-DC Current	57	Approved on 22 November 2006
AC current up to 100 A: sources	Multifunction calibrator, transconductance amplifier	Calibrated shunts, thermal converters and sources	0.0001	2	A	Frequency	40 Hz to 2 kHz	35 to 170	µA/A	2	95%	Yes		58	Approved on 22 November 2006. For defined burden

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AC current up to 100 A: sources	Multifunction calibrator, transconductance amplifier	Calibrated shunts, current transformers, and ac voltmeters	0.01	100	A	Frequency	47 Hz to 75 Hz	25	µA/A	2	95%	Yes		58a	Approved on 22 November 2006
AC current up to 100 A: meters	AC ammeter, multimeter, multifunction transfer standard	Calibrated shunts, thermal converters and sources	0.0001	2	A	Frequency	40 Hz to 2 kHz	60 to 140	µA/A	2	95%	Yes		59	Approved on 22 November 2006
AC current up to 100 A: meters	AC ammeter, multimeter, multifunction transfer standard	Calibrated shunts, current transformers, and ac voltmeters	0.2	100	A	Frequency	47 Hz to 75 Hz	25	µA/A	2	95%	Yes		59a	Approved on 22 November 2006
AC power and energy: single phase (frequencies below or equal to 400 Hz), active power	Power meter, energy meter, power converter, wattmeter, single phase source	Power bridge	0	24000	W	Power factor, *PF*	1 to 0, inductive or capacitive	(40 + 6(1 - *PF*)), values range from 40 µW/VA to 46 µW/VA	µW/VA	2	95%	Yes		60	Approved on 10 November 2014
						Voltage	60 V to 240 V								
						Current	0.01 A to 100 A								
						Frequency	45 Hz to 75 Hz								
AC power and energy: single phase (frequencies below or equal to 400 Hz), reactive power	Power meter, energy meter, power converter, wattmeter, VAR meters, single phase source	Power bridge	0	24000	var	Reactive power factor, *QF*	1 to 0, inductive or capacitive	(40 + 90*QF*), values range from 40 µvar/VA to 130 µvar/VA	µvar/VA	2	95%	Yes		60b	Approved on 10 November 2014
						Voltage	60 V to 240 V								
						Current	0.01 A to 100 A								
						Frequency	45 Hz to 75 Hz								

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AC power and energy: three phase, active power	Power meter, energy meter, power converter, wattmeter, three phase source	Power bridge	0	72000	W	Power factor, *PF*	1 to 0, inductive or capacitive	(40 + 6(1 - *PF*)), values range from 40 µW/VA to 46 µW/VA	µW/VA	2	95%	Yes		61	Approved on 10 November 2014. Voltage and current ranges are per phase
						Voltage	60 V to 240 V								
						Current	0.01 A to 100 A								
						Frequency	45 Hz to 75 Hz								
AC power and energy: three phase, reactive power	Power meter, energy meter, power converter, wattmeter, VAR meters, three phase source	Power bridge	0	72000	var	Reactive power factor, *QF*	1 to 0, inductive or capacitive	(40 + 90*QF*), values range from 40 µvar/VA to 130 µvar/VA	µvar/VA	2	95%	Yes		61b	Approved on 10 November 2014. Voltage and current ranges are per phase
						Voltage	60 V to 240 V								
						Current	0.01 A to 100 A								
						Frequency	45 Hz to 75 Hz								
Phase angle: sources	Phase source	Power bridge	-3.14	3.14	rad	Voltage	0.7 V to 7 V, 42 V to 240 V	40	µrad	2	95%	No		87	Approved on 19 March 2012
						Current	0.01 A to 100 A								
						Frequency	45 Hz to 75 Hz								
Phase angle: meters	Phase meter	Power bridge	-3.14	3.14	rad	Voltage	0.7 V to 7 V, 42 V to 240 V	40	µrad	2	95%	No		88	Approved on 19 March 2012
						Current	0.01 A to 100 A								
						Frequency	45 Hz to 75 Hz								
High DC voltage: high voltage sources	DC kilovolt source	Reference divider	1100	50000	V	Laboratory temperature	20 °C	0.5 to 3	mV/V	2	95%	Yes	Mx8.1.1	9	Approved on 10 November 2014
High DC voltage: high voltage meters	DC kilovoltmeter, dedicated set-up for high voltage	Reference divider	1100	50000	V	Laboratory temperature	20 °C	3	mV/V	2	95%	Yes		10	Approved on 10 November 2014

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High DC voltage: ratios	High voltage resistive divider, DC high voltage probe	Reference divider	2.0E-05	1		Input voltage	1 kV to 50 kV	3	mV/V	2	95%	Yes		11	Approved on 10 November 2014
AC high voltage: sources	High voltage AC source	Capacitive divider and source	1	35	kV rms	Frequency	50 Hz to 3 kHz	1	mV/V	2	95%	Yes		55	Approved on 22 November 2006
AC high voltage: meters	AC high voltage meter, dedicated set-up for high voltage measurements (resistive and capacitive dividers)	Capacitive divider and source	1	35	kV rms	Frequency	50 Hz to 3 kHz	1	mV/V	2	95%	Yes		56	Approved on 22 November 2006
AC high voltage and voltage transformers: voltage transformers: ratio error	Voltage transformer bridge	Inject known error voltage	-0.2	0.2		Frequency	45 Hz to 65 Hz	5E-07 to 8E-05		2	95%	No	Mx8.3.4	75	Approved on 31 October 2016
						Voltage	5 V to 300 V								
AC high voltage and voltage transformers: voltage transformers: phase displacement	Voltage transformer bridge	Inject known error voltage	-0.2	0.2	rad	Frequency	45 Hz to 65 Hz	5E-07 to 9E-05	rad	2	95%	No	Mx8.3.4	78	Approved on 31 October 2016
						Voltage	5 V to 300 V								

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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?	Matrix uncertainty		
High AC current: ratio error	Current transformer	Arnold test set and calibrated current transformers	-25	25	%	Ratio	0.2 A/A to 4000 A/A	0.0010 to 0.13	%	2	95%	No	Mx8.6.3	73	Approved on 22 November 2006. Uncertainty dependent on the standard transformer and the range of the test set
						Primary current	1 A to 4000 A								
						Secondary current	1 A, 5 A								
						Frequency	50 Hz								
High AC current: Phase error	Current transformer	Arnold test set and calibrated current transformers	-36	36	crad	Ratio	0.2 A/A to 4000 A/A	0.0010 to 0.18	crad	2	95%	No	Mx8.6.3	74	Approved on 22 November 2006. Uncertainty dependent on the standard transformer and the range of the test set
						Primary current	1 A to 4000 A								
						Secondary current	1 A, 5 A								
						Frequency	50 Hz								
High AC current and current tranformers: current tranformers: ratio error	Current transformer bridge	Inject known error current	-0.2	0.2		Frequency	45 Hz to 65 Hz	5E-07 to 8E-05		2	95%	No	Mx8.6.3a	81	Approved on 31 October 2016
						Current	0.01 A to 10 A								

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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?	Matrix uncertainty		
High AC current and current tranformers: current tranformers: phase displacement	Current transformer bridge	Inject known error current	-0.2	0.2	rad	Frequency	45 Hz to 65 Hz	5E-07 to 9E-05	rad	2	95%	No	Mx8.6.3a	84	Approved on 31 October 2016
						Current	0.01 A to 10 A								
High DC current: sources	Current generator	Voltage across resistor	100	1000	A			36 to 100	µA/A	2	95%	Yes	Mx8.7	31a	Approved on 31 October 2016
High DC current: meters	Current transducer, dedicated equipment for heavy current	Voltage across resistor	100	875	A			36 to 90	µA/A	2	95%	Yes	Mx8.7	33a	Approved on 31 October 2016
Signal and pulse characteristics: pulse amplitude	Pulse generator	Sampling voltmeter	0	10	V	Voltmeter range, *Vr*	10 mV, 100 mV, 1 V, 10 V	(30 + 100*Va* + 420*Vr*) , applied voltage *Va* in V, values range from 34.2 µV to 5230 µV	µV	2	95%	No		89	Approved on 25 August 2008
						Pulse length	greater than 200 µs								
Signal and pulse characteristics: pulse time parameters, pulse risetime	Pulse generator: risetime *T*	Calibrated oscilloscope	0.005	1.00E+06	µs	Pulse amplitude	10 mV to 10 V	Q[2 ns, 0.05*T*], *T* in s	s	2	95%	No		90	Approved on 19 March 2012
						Risetime, *T*	Greater than 5 ns								
RF voltage and current: RF-DC difference	Thermal voltage converter	Comparison with calibrated thermal voltage converter	1	3	V	Frequency	1 MHz to 100 MHz	0.16 to 2.6	mV/V	2	95%	Yes	RF-DC Voltage	64	Approved on 10 November 2014
RF voltage and current: RF voltage sources	RF generator	Comparison with calibrated source or meter	1	3	V	Frequency	1 MHz to 100 MHz	0.3 to 8	mV/V	2	95%	Yes		65	Approved on 10 November 2014

Electricity and Magnetism, New Zealand, MSL (Measurement Standards Laboratory)

Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/Independent Variable		Expanded Uncertainty						NMI Service Identifier	Comments
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?	Matrix uncertainty		
RF voltage and current: RF voltage meters	RF voltmeter	Comparison with calibrated source or meter	1	3	V	Frequency	1 MHz to 100 MHz	0.3 to 8	mV/V	2	95%	Yes		66	Approved on 10 November 2014
Radio frequency power: calibration factor on coaxial lines	Thermistor and power sensor	Substitution	0.9	1		Power level	1 mW	0.004 to 0.005		2	95%	No		70	Approved on 22 November 2006
						Frequency	30 MHz to 3000 MHz								
						Connector	Type N								

New Zealand, MSL (Measurement Standards Laboratory)

Uncertainty matrix: Mx1.1.1

	Expanded uncertainty / μV
1 V	0.1
1.018 V	0.1
10 V	1.5

New Zealand, MSL (Measurement Standards Laboratory)

Uncertainty matrix: Mx3

	Expanded uncertainty / (μA/A)
10 pA	560
100 pA	540
1 nA	150
10 nA	20
100 nA	10
1 μA	10
10 μA	5
100 μA	5
1 mA	5
10 mA	5
100 mA	5
1 A	5
10 A	13
20 A	18
100 A	36

New Zealand, MSL (Measurement Standards Laboratory)

Uncertainty matrix: Inductance

	100 µH	1 mH	10 mH	100 mH	1 H	10 H	100 H
1 Ω	Q[0.000014*L* , 0.001*R* , 0.2/*f*]. Values range from 0.0001 µH to 0.0053 µH						
10 Ω		Q[0.000014*L* , 0.001*R* , 2/*f*]. Values range from 0.001 µH to 0.053 µH					
100 Ω			Q[0.000014*L* , 0.001*R* , 20/*f*]. Values range from 0.01 µH to 0.53 µH				
1 kΩ				Q[0.000014*L* , 0.001*R* , 200/*f*]. Values range from 0.1 µH to 5.3 µH			
10 kΩ					Q[0.000014*L* , 0.001*R* , 2000/*f*]. Values range from 1 µH to 53 µH		
100 kΩ						Q[0.000014*L* , 0.001*R* , 20000/*f*]. Values range from 10 µH to 529 µH	
1 MΩ							Q[0.000014*L* , 0.001*R* , 200000/*f*]. Values range from 100 µH to 5288 µH

Inductance expanded uncertainty expressed in µH as a function of range of the Universal Impedance Bridge

L and *R* are the measured values. *L* is expressed in µH, *R* in Ω and *f* in Hz

New Zealand, MSL (Measurement Standards Laboratory)

Uncertainty matrix: Series Resistance of Inductor

	100 µH	1 mH	10 mH	100 mH	1 H	10 H	100 H
1 Ω	Q[0.000014*R* , 0.0000001*L* , 0.002/*f*]. Values range from 0.000001 Ω to 0.000053 Ω						
10 Ω		Q[0.000014*R* , 0.0000001*L* , 0.02/*f*]. Values range from 0.00001 Ω to 0.00053 Ω					
100 Ω			Q[0.000014*R* , 0.0000001*L* , 0.2/*f*]. Values range from 0.0001 Ω to 0.0053 Ω				
1 kΩ				Q[0.000014*R* , 0.0000001*L* , 2/*f*]. Values range from 0.001 Ω to 0.053 Ω			
10 kΩ					Q[0.000014*R* , 0.0000001*L* , 20/*f*]. Values range from 0.01 Ω to 0.53 Ω		
100 kΩ						Q[0.000014*R* , 0.0000001*L* , 200/*f*]. Values range from 0.1 Ω to 5.3 Ω	
1 MΩ							Q[0.000014*R* , 0.0000001*L* , 2000/*f*]. Values range from 1 Ω to 53 Ω

Resistance expanded uncertainty expressed in Ω as a function of range of the Universal Impedance Bridge

L and *R* are the measured values. *L* is expressed in µH, *R* in Ω and *f* in Hz

New Zealand, MSL (Measurement Standards Laboratory)

Uncertainty matrix: AC-DC Voltage

	10 Hz	20 Hz	40 Hz	53 Hz	100 Hz	1 kHz	5 kHz	10 kHz	20 kHz	30 kHz	50 kHz	100 kHz	200 kHz	300 kHz	500 kHz	800 kHz	1 MHz
2 mV	-	-	-	-	193	179	-	172	172	-	187	184	-	211	237	-	321
10 mV	130	87	61	60	59	60	61	61	61	-	64	72	-	99	141	189	205
20 mV	114	66	45	45	45	46	-	48	48	-	51	64	-	94	129	-	189
100 mV	83	43	28	28	28	29	31	32	33	-	34	39	-	60	80	132	143
200 mV	76	37	25	25	24	25	-	28	30	-	31	40	-	63	85	-	167
300 mV	58	31	-	-	21	21	-	26	28	-	29	37	-	57	71	-	133
600 mV	41	25	-	-	11	11	-	11	11	-	14	18	-	33	40	-	66
1 V	29	18	7	7	7	7	-	8	9	-	14	18	-	32	41	52	58
2 V	36	18	6	7	6	6	-	6	8	-	13	16	-	27	36	-	49
3 V	29	18	-	6	6	6	-	6	8	-	13	16	-	38	48	-	54
6 V	31	18	-	9	9	9	-	9	10	-	14	18	-	38	52	-	77
10 V	32	18	9	9	9	9	-	9	10	-	13	18	-	36	46	65	76
20 V	31	19	9	10	9	9	-	10	11	-	14	19	-	39	56	-	-
30 V	31	19	-	-	13	12	-	14	13	-	17	22	36	-	-	-	-
60 V	31	19	-	-	14	13	-	14	13	-	18	24	-	-	-	-	-
100 V	33	20	13	13	13	13	-	13	13	-	18	24	-	-	-	-	-
200 V	31	20	14	14	15	14	-	15	14	-	19	26	-	-	-	-	-
300 V	-	22	-	-	-	-	-	15	-	-	-	27	-	-	-	-	-
600 V	-	-	16	16	16	16	-	18	19	21	28	39	-	-	-	-	-
1000 V	-	-	18	17	17	17	-	19	22	26	36	51	-	-	-	-	-

The expanded uncertainties given in this table are expressed in µV/V

New Zealand, MSL (Measurement Standards Laboratory)

Uncertainty matrix: ACV Sources

	10 Hz	20 Hz	40 Hz	53 Hz	100 Hz	1 kHz	10 kHz	20 kHz	30 kHz	50 kHz	100 kHz	200 kHz	300 kHz	500 kHz	1 MHz
2 mV					241	190	224	195		205	210		250	435	605
10 mV	133	88	65	65	61	61	61	62		65	96		194	244	564
20 mV	115	66	45	45	46	46	48	49		53	77		178	269	454
100 mV	86	45	29	29	28	29	33	33		36	40		67	97	195
200 mV	76	37	25	25	24	25	29	30		31	40		63	79	147
300 mV					21	21	26	28		29	37		72	138	533
600 mV	41	25			11	11	11	11		14	18		54	140	525
1 V	33	18	7	7	7	7	8	9		13	17	25	50	144	536
2 V	36	18	6	7	6	6	7	9		12	15	22	51	150	587
3 V	32	19		6	6	6	7	8		12	16	22	197	321	649
6 V	31	18		10	9	9	9	10		13	18		196	293	648
10 V	47	18	9	9	9	9	9	10		13	17		192	285	616
20 V	31	19	9	10	9	9	10	11		14	19	31	194	295	
30 V	40	32			13	13	14	13		17	22	38			
60 V	31	19			13	14	14	13		17	23				
100 V	36	20	14	13	13	14	14	13		18	24				
200 V	30	20	14	14	15	14	15	14		19	26				
300 V				16		16									
600 V				16	16	17									
1000 V				17	17	17									

The expanded uncertainties given in this table are expressed in µV/V

New Zealand, MSL (Measurement Standards Laboratory)

Uncertainty matrix: ACV Meters

	10 Hz	20 Hz	40 Hz	53 Hz	100 Hz	1 kHz	10 kHz	20 kHz	30 kHz	50 kHz	100 kHz	200 kHz	300 kHz	500 kHz	1 MHz
2 mV	-	-	-	-	238	227	221	221	-	233	270	-	364	593	862
6 mV	223	153	113	111	110	111	113	113	-	118	130	-	172	298	433
10 mV	135	94	70	69	68	69	70	70	-	73	80	-	104	145	208
20 mV	115	68	49	48	48	49	51	51	-	54	66	-	96	130	189
60 mV	139	73	48	48	48	49	54	56	-	58	66	-	100	134	239
100 mV	84	44	30	30	30	31	34	35	-	36	40	-	61	81	144
200 mV	76	38	26	26	25	26	29	31	-	32	41	-	64	86	168
300 mV	58	32	-	-	23	23	27	29	-	30	38	-	58	71	133
600 mV	41	26	-	-	13	12	12	12	-	15	19	-	34	41	66
1 V	31	21	13	13	13	13	13	14	-	17	21	-	34	42	59
2 V	36	19	9	9	9	9	9	10	-	14	17	-	28	36	50
3 V	30	20	-	10	10	10	10	12	-	15	18	-	39	48	54
6 V	32	20	-	12	12	12	12	13	-	16	20	-	39	52	78
10 V	33	20	12	12	12	12	12	13	-	15	19	-	37	47	77
20 V	32	21	12	13	12	12	13	14	-	16	20	-	39	57	-
30 V	32	20	-	-	15	14	16	16	-	19	23	37	-	-	-
60 V	32	21	-	-	16	15	16	15	-	19	25	-	-	-	-
100 V	34	21	16	16	15	15	16	15	-	20	25	-	-	-	-
200 V	32	22	16	16	17	16	17	16	-	20	27	-	-	-	-
300 V	-	23	-	-	-	-	17	-	-	-	28	-	-	-	-
600 V	-	-	18	18	18	18	19	20	22	29	39	-	-	-	-
1000 V	-	-	20	19	19	19	21	24	28	37	51	-	-	-	-

The expanded uncertainties given in this table are expressed in µV/V

New Zealand, MSL (Measurement Standards Laboratory)

Uncertainty matrix: AC-DC Current

	40 Hz	53 Hz	400 Hz	1 kHz	2 kHz	5 kHz	10 kHz	20 kHz	50 kHz	100 kHz
0.1 mA	26	38		26	26					
1 mA	24	24		24	24					
10 mA	15	15	15	15	15	15	15	15	32	33
20 mA	15	15	15	15	15	15	15	23	32	32
50 mA	18	18	18	18	19	18	18	22	32	51
100 mA	18	18	18	18	18	18	21	30	37	
200 mA	23	23	23	22	25	22	25	34	43	
500 mA	27	28	27	27	27	27	28	54		
1 A	27	27	27	27	27	32	43			
2 A	27	27	27	27	27	32	41			
5 A	27	27	27	27	27	51	71			
10 A	27	27	27	28	27	51	71			
20 A	27	28	27	29	27	51				

The expanded uncertainties given in this table are expressed in µA/A

New Zealand, MSL (Measurement Standards Laboratory)

Uncertainty matrix: Mx8.1.1

	Expanded uncertainty / (mV/V)
1100 V to 1500 V	0.5
1500 V to 50 kV	3

New Zealand, MSL (Measurement Standards Laboratory)

Uncertainty matrix: Mx8.3.4

	Expanded uncertainty	
Ratio error or (Phase error) / rad	Ratio	Phase / rad
±(0 to 0.002)	5E-07 to 1.0E-06	5E-07 to 1.0E-06
±(0.002 to 0.02)	2E-06 to 8E-06	5E-06 to 9E-06
±(0.02 to 0.2)	2E-05 to 8E-05	5E-05 to 9E-05

New Zealand, MSL (Measurement Standards Laboratory)

Uncertainty matrix: Mx8.6.3

		Expanded Uncertainty			
		1 A to 500 A Primary		>500 A to 4000 A Primary	
Ratio Error	Phase Displacement	Ratio Error	Phase Displacement	Ratio Error	Phase Displacement
Magnitude	Magnitude				
(%)	(crad)	(%)	(crad)	(%)	(crad)
0	0	0.0010	0.0010	0.0041	0.0041
0.5	0.7	0.0027	0.0038	0.0048	0.0055
1	1	0.0051	0.0073	0.0065	0.0084
5	7	0.025	0.036	0.025	0.037
7.5	11	0.10	0.11	0.10	0.11
25	36	0.13	0.18	0.13	0.18

New Zealand, MSL (Measurement Standards Laboratory)

Uncertainty matrix: Mx8.6.3a

	Expanded uncertainty	
Ratio error or (Phase error) / rad	Ratio	Phase / rad
±(0 to 0.002)	5E-07 to 1.0E-06	5E-07 to 1.0E-06
±(0.002 to 0.02)	2E-06 to 8E-06	5E-06 to 9E-06
±(0.02 to 0.2)	2E-05 to 8E-05	5E-05 to 9E-05

New Zealand, MSL (Measurement Standards Laboratory)

Uncertainty matrix: Mx8.7

	Expanded uncertainty / (μA/A)
100 A	36
200 A	50
500 A	70
875 A	90
1000 A (8.7.1 only)	100

New Zealand, MSL (Measurement Standards Laboratory)

Uncertainty matrix: RF-DC_Voltage

	1 MHz	3 MHz	10 MHz	30 MHz	50 MHz	70 MHz	100 MHz
1 V	0.16	0.30	0.7	1.6	2.5	2.5	2.6
3 V	0.16	0.30	0.7	1.6	2.5	2.5	2.6

The expanded uncertainties given in this table are expressed in mV/V

Thermometry, New Zealand, MSL (Measurement Standards Laboratory)

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		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?**	**Comments**	**NMI Service Identifier**
Temperature	Mercury triple point cell	Comparison with reference cell(s)	234.3156	234.3156	K	Cryostat		0.38	mK	2	95%	No	Approved on 24 June 2004 Modified on 09 February 2015	T1
Temperature	Gallium melting point cell	Comparison with reference cell(s)	29.7646	29.7646	°C	Temperature controlled furnace		0.13	mK	2	95%	No	Approved on 24 June 2004 Modified on 09 February 2015	T3
Temperature	Indium freezing point cell	Comparison with reference cell(s)	156.5985	156.5985	°C	Temperature controlled furnace		0.52	mK	2	95%	No	Approved on 24 June 2004 Modified on 09 February 2015	T4
Temperature	Tin freezing point cell	Comparison with reference cell(s)	231.928	231.928	°C	Temperature controlled furnace		0.82	mK	2	95%	No	Approved on 24 June 2004 Modified on 09 February 2015	T5
Temperature	Zinc freezing point cell	Comparison with reference cell(s)	419.527	419.527	°C	Temperature controlled furnace		1.90	mK	2	95%	No	Approved on 24 June 2004 Modified on 09 February 2015	T6
Temperature	SPRT	Mercury triple point cell	-38.8344	-38.8344	°C	Fixed point cell		0.40	mK	2	95%	No	Approved on 24 June 2004 Modified on 09 February 2015	T7
Temperature	SPRT	Gallium melting point cell	29.7646	29.7646	°C	Fixed point cell		0.19	mK	2	95%	No	Approved on 24 June 2004 Modified on 09 February 2015	T9
Temperature	SPRT	Indium freezing point cell	156.5985	156.5985	°C	Fixed point cell		0.56	mK	2	95%	No	Approved on 24 June 2004 Modified on 09 February 2015	T10
Temperature	SPRT	Tin freezing point cell	231.928	231.928	°C	Fixed point cell		0.85	mK	2	95%	No	Approved on 24 June 2004 Modified on 09 February 2015	T11
Temperature	SPRT	Zinc freezing point cell	419.527	419.527	°C	Fixed point cell		1.90	mK	2	95%	No	Approved on 24 June 2004 Modified on 09 February 2015	T12

Thermometry, New Zealand, MSL (Measurement Standards Laboratory)

Calibration or Measurement Services			Measurand Level or Range			Measurement Conditions/Independent variables		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?**	**Comments**	**NMI Service Identifier**
Temperature	SPRT	Water triple point cell	0.01	0.01	°C			0.12	mK	2	95%	No	Approved on 23 November 2009 Modified on 09 February 2015	
Temperature	IPRTs	Comparison with SPRT in mineral oil bath	-40	60	°C			(2 + 2E-05|*t*|), *t* in °C	mK	2	95%	No	Interpolation equation used. Minimum 16 points. Hysteresis measurement. Approved on 16 March 2011	
Temperature	IPRTs	Comparison with SPRT in mineral oil bath	60	200	°C			(2 + 2E-05*t*), *t* in °C	mK	2	95%	No	Interpolation equation used. Minimum 16 points. Hysteresis measurement. Approved on 16 March 2011	
Temperature	IPRTs	Comparison with SPRT in salt oil bath	200	420	°C			(2 + 2E-05*t*), *t* in °C	mK	2	95%	No	Interpolation equation used. Minimum 16 points. Hysteresis measurement. Approved on 16 March 2011	

Photometry and Radiometry, New Zealand, MSL (Measurement Standards Laboratory)

Note: Approval dates are shown only for the CMCs approved after 24 May 2004

Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/ Independent Variable		Expanded Uncertainty						
Quantity	**Instrument or Artefact**	**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 Identifier**	**Comments**
Luminous intensity	Tungsten lamp	Reference photometer	10	5000	cd	Correlated colour temperature	2700 K to 3000 K	0.8	%	4.3	95%	Yes	MSLT.O.025	
Illuminance responsivity, tungsten source	Illuminance meter	Standard lamp			A/lx, V/lx, Reading/lx	Illuminance	10 lx to 3000 lx	0.8	%	4.3	95%	Yes	MSLT.O.001 MSLT.O.016	
						Correlated colour temperature	2700 K to 3000 K							
Illuminance responsivity, tungsten source	Illuminance meter	Standard lamp			A/lx, V/lx, Reading/lx	Illuminance	0.005 lx to 10 lx	3	%	2.3	95%	Yes	MSLT.O.001 MSLT.O.016	Approved on 29 November 2012
						Correlated colour temperature	2700 K to 3000 K							
Luminance responsivity	Luminance meter	Tungsten-based source			A/(cd m^{-2}), V/(cd m^{-2}), Reading/(cd m^{-2})	Luminance	2 cdm^{-2} to 800 cdm^{-2}	1.4	%	2.4	95%	Yes	MSLT.O.002	Approved on 27 September 2004
						Type of source used	Illuminant A							
Responsivity, Spectral Power	Broadband detector	Monochromator and reference detectors			A/W	Wavelength range	240 nm to 300 nm	5.3 to 1.1, varies with wavelength	%	2.8 to 2.1	95%	Yes	MSLT.O.040 or MSLT.O.009	Approved on 20 0ctober 2005
						Bandwidth	1 nm to 5 nm							
						Power level	0.1 µW to 10 µW							
Responsivity, Spectral Power	Broadband detector	Monochromator and reference detectors			A/W	Wavelength range	300 nm to 420 nm	1.1	%	2.1	95%	Yes	MSLT.O.040 or MSLT.O.009	Approved on 20 0ctober 2005
						Bandwidth	1 nm to 5 nm							
						Power level	0.1 µW to 10 µW							

Photometry and Radiometry, New Zealand, MSL (Measurement Standards Laboratory)

Note: Approval dates are shown only for the CMCs approved after 24 May 2004

Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/ Independent Variable		Expanded Uncertainty						
Quantity	**Instrument or Artefact**	**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 Identifier**	**Comments**
Responsivity, Spectral Power	Broadband detector	Monochromator and reference detectors			A/W	Wavelength range	420 nm to 680 nm	0.06	%	2.1	95%	Yes	MSLT.O.040 or MSLT.O.009	Approved on 20 0ctober 2005
						Bandwidth	1 nm to 5 nm							
						Power level	0.1 µW to 10 µW							
Responsivity, Spectral Power	Broadband detector	Monochromator and reference detectors			A/W	Wavelength range	680 nm to 800 nm	0.08	%	2.1	95%	Yes	MSLT.O.040 or MSLT.O.009	Approved on 20 0ctober 2005
						Bandwidth	1 nm to 5 nm							
						Power level	0.1 µW to 10 µW							
Responsivity, Spectral Power	Broadband detector	Monochromator and reference detectors			A/W	Wavelength range	800 nm to 950 nm	0.14 to 0.16, varies with wavelength	%	2.1	95%	Yes	MSLT.O.040 or MSLT.O.009	Approved on 20 0ctober 2005
						Bandwidth	1 nm to 5 nm							
						Power level	0.1 µW to 10 µW							
Responsivity, spectral, power	Broadband detectors, silicon diode or silicon diode trap	Cryogenic radiometer & laser			A/W	Wavelengths	Ar & Kr lines 488 nm to 752 nm	0.022	%	2.2	95%	Yes	MSLT.O.023	Approved on 27 September 2004
						Bandwidth	1 nm to 5 nm							
						Power level	50 µW to 250 µW							
Irradiance, spectral	Tungsten lamp	Standard lamp & spectroradiometer	0.001	0.5	$W\ m^{-2}\ nm^{-1}$	Wavelength range	250 nm to 350 nm	2.6 to 1.6, varies with wavelength	%	2.1	95%	Yes	MSLT.O.032	Approved on 20 0ctober 2005
						Bandwidth	1 nm to 3 nm							
Irradiance, spectral	Tungsten lamp	Standard lamp & spectroradiometer	0.001	0.5	$W\ m^{-2}\ nm^{-1}$	Wavelength range	350 nm to 850 nm	1.6 to 1.4, varies with wavelength	%	2.1	95%	Yes	MSLT.O.032	Approved on 20 0ctober 2005
						Bandwidth	1 nm to 3 nm							

Photometry and Radiometry, New Zealand, MSL (Measurement Standards Laboratory)

Note: Approval dates are shown only for the CMCs approved after 24 May 2004

Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/ Independent Variable		Expanded Uncertainty						
Quantity	**Instrument or Artefact**	**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 Identifier**	**Comments**
Transmittance, regular, spectral	Spectrally-neutral material	Spectrophotometer	0.01	1.0		Wavelength range	240 nm to 380 nm	0.5	%	2	95%	Yes	MSLT.O.006	Approved on 16 January 2011
						Bandwidth	1 nm to 3 nm							
Transmittance, regular, spectral	Spectrally-neutral material	Spectrophotometer	0.0001	0.01		Wavelength range	380 nm to 1000 nm	0.00005		2	95%	No	MSLT.O.006	Approved on 27 September 2004
						Bandwidth	1 nm to 3 nm							
Transmittance, regular, spectral	Spectrally-neutral material	Spectrophotometer	0.01	0.1		Wavelength range	380 nm to 1000 nm	0.00005 to 0.0001 varies with transmittance		2	95%	No	MSLT.O.006	Approved on 16 January 2011
						Bandwidth	1 nm to 3 nm							
Transmittance, regular, spectral	Spectrally-neutral material	Spectrophotometer	0.1	1.0		Wavelength range	380 nm to 1000 nm	0.1	%	2	95%	Yes	MSLT.O.006	Approved on 16 January 2011
						Bandwidth	1 nm to 3 nm							
Transmittance, diffuse, spectral	Spectrally-neutral material	Spectrophotometer, integrating sphere	0.0001	0.1		Wavelength range	300 nm to 400 nm	0.005 to 0.0002 (varies with wavelength)		2	95%	No	MSLT.O.020	Approved on 20 0ctober 2005
						Bandwidth	1 nm to 3 nm							
						Specific measurement conditions	0/d							
Transmittance, diffuse, spectral, *T*	Spectrally-neutral material	Spectrophotometer, integrating sphere	0.1	1		Wavelength range	300 nm to 400 nm	0.05*T*		2	95%	Yes	MSLT.O.020	Approved on 20 0ctober 2005
						Bandwidth	1 nm to 3 nm							
						Specific measurement conditions	0/d							

Photometry and Radiometry, New Zealand, MSL (Measurement Standards Laboratory)

Note: Approval dates are shown only for the CMCs approved after 24 May 2004

Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/ Independent Variable		Expanded Uncertainty						
Quantity	**Instrument or Artefact**	**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 Identifier**	**Comments**
Transmittance, diffuse, spectral	Spectrally-neutral material	Spectrophotometer, integrating sphere	0.0001	0.004		Wavelength range	400 nm to 1000 nm	0.0002		2	95%	No	MSLT.O.020	Approved on 20 0ctober 2005
						Bandwidth	1 nm to 3 nm							
						Specific measurement conditions	0/d							
Transmittance, diffuse, spectral, *T*	Spectrally-neutral material	Spectrophotometer, integrating sphere	0.004	1		Wavelength range	400 nm to 1000 nm	0.05*T*		2	95%	Yes	MSLT.O.020	Approved on 20 0ctober 2005
						Bandwidth	1 nm to 3 nm							
						Specific measurement conditions	0/d							
Reflectance, diffuse, spectral	Spectrally-neutral material	Spectrophotometer	0.05	0.8		Wavelength range	360 nm to 820 nm	0.008		2	95%	No	MSLT.O.024	Approved on 20 0ctober 2005
						Bandwidth	1 nm to 3 nm							
						Specific measurement conditions	0 deg / diffuse, 6 deg / diffuse							
Reflectance, diffuse, spectral	Spectrally-neutral material	Spectrophotometer	0.8	1	1	Wavelength range	360 - 820 nm	1	%	2	95%	Yes	MSLT.O.024	Approved on 27 September 2004
						Bandwidth	1 - 3 nm							
						Specific measurement conditions	0 deg / diffuse, 6 deg / diffuse.							
Reflectance, regular, spectral	Spectrally-neutral material	Spectrophotometer	0.05	1		Wavelength range	280 nm to 800 nm	1	%	2	95%	Yes	MSLT.O.026	Approved on 27 September 2004
						Bandwidth	1 nm to 3 nm							

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Calibration or Measurement Service			Measurand Level or Range			Measurement Conditions/ Independent Variable		Expanded Uncertainty						
Quantity	**Instrument or Artefact**	**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 Identifier**	**Comments**
						Specific measurement conditions	0 deg / 0 deg							
Wavelength	Spectrally selective transmitting material	Spectrophotometer	240	800	nm	Bandwidth	0.1 nm to 0.2 nm	0.13	nm	2	95%	No	MSLT.O.006	Approved on 16 January 2011
Wavelength	Spectrally selective transmitting material	Spectrophotometer	800	1100	nm	Bandwidth	0.1 nm to 0.2 nm	0.13 to 0.25, varies with wavelength	nm	2	95%	No	MSLT.O.006	Approved on 20 0ctober 2005
Correlated colour temperature	Tungsten lamp	Standard lamp & spectroradiometer	2700	3000	K			50	K	2	95%	No	MSLT.O.013	
Colour, surface x,y	Diffusely-reflecting material	Spectroradiometer	CIE x,y colour space			Specific measurement conditions	45 deg / 0 deg	0.003		2	95%	No	MSLT.O.010	Approved on 27 September 2004
Y	Diffusely-reflecting material	Spectroradiometer	Y: 0.1	1		Specific measurement conditions	45 deg / 0 deg	5	%	2	95%	Yes	MSLT.O.010	Approved on 27 September 2004
Colour transmitted x,y	General material	Spectrophotometer/ spectroradiometer	CIE x,y colour space			Specific measurement conditions	0 deg / 0 deg	0.005		2	95%	No	MSLT.O.005 MSLT.O.006	Approved on 27 September 2004
Y	General material	Spectrophotometer/ spectroradiometer	Y: 0.1	1		Specific measurement conditions	0 deg / 0 deg	5	%	2	95%	Yes	MSLT.O.005 MSLT.O.006	Approved on 27 September 2004

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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?**	**NMI internal service identifier**	**Comments**
Mass	Mass standard	Comparisons in air	1	100	mg			0.4 to 0.7	µg	2.1	95%	No	1	Approved on 14 April 2005
Mass	Mass standard	Comparisons in air	0.1	1	g			0.7 to 1.6	µg	2.1	95%	No	2	Approved on 14 April 2005
Mass	Mass standard	Comparisons in air	1	10	g			1.6 to 4	µg	2.1	95%	No	3	Approved on 14 April 2005
Mass	Mass standard	Comparisons in air	10	100	g			4 to 8	µg	2.1	95%	No	4	Approved on 14 April 2005
Mass	Mass standard	Comparisons in air	0.1	1	kg			8 to 40	µg	2.1	95%	No	5	Approved on 14 April 2005
Mass	Mass standard	Comparisons in air	1	10	kg			1.1E-07		2.1	95%	Yes	6	Approved on 14 April 2005
Mass	Mass standard	Comparisons in air	10	20	kg			1.6E-07		2.1	95%	Yes	7	Approved on 14 April 2005
Mass	Mass standard	Comparisons in air	20	300	kg			1.5E-06		2.0	95%	Yes	8	Approved on 14 April 2005
Mass	Mass standard	Comparisons in air	300	1000	kg			10 to 16	g	2.1	95%	No	9	Approved on 14 April 2005
Density of solid	Solid density artifact	Comparison in liquid	1400	2500	kg m^{-3}	Mass	400 g to 200 g	1.0E-05		2	95%	Yes	10	Approved on 14 April 2005
						Temperature	17 °C to 23 °C							
Density of solid	Mass standard	Comparison in liquid	7800	8200	kg m^{-3}	Mass	1 kg	1.5E-05		2	95%	Yes	11	Approved on 14 April 2005
						Temperature	17 °C to 23 °C							
Density of liquid	Liquid density artifact	Weighing in liquid	600	2000	kg m^{-3}	Temperature	17 °C to 23 °C	2.0E-05		2	95%	Yes	12	Approved on 14 April 2005

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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?**	**NMI internal service identifier**	**Comments**
Absolute pressure, gas medium	Pressure measuring device, standard pressure generator	Direct comparison with standard, crossfloat	2	35	kPa			1.3E-05		2	95%	Yes	13	Approved on 14 April 2005
Absolute pressure, gas medium	Pressure measuring device, standard pressure generator	Direct comparison with standard, crossfloat	35	350	kPa			2.0E-05		2	95%	Yes	14	Approved on 14 April 2005
Absolute pressure, gas medium	Pressure measuring device, standard pressure generator	Direct comparison with standard, crossfloat	350	3500	kPa			6.0E-05		2	95%	Yes	15	Approved on 14 April 2005
Gauge pressure: gas medium	Pressure measuring device, standard pressure generator	Direct comparison with standard, crossfloat	2	350	kPa			2.0E-05		2	95%	Yes	16	Approved on 14 April 2005

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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?**	**NMI internal service identifier**	**Comments**
Gauge pressure: gas medium	Pressure measuring device, standard pressure generator	Direct comparison with standard, crossfloat	350	11000	kPa			6.0E-05		2	95%	Yes	17	Approved on 14 April 2005
Gauge pressure: liquid medium	Pressure measuring device, standard pressure generator, p	Direct comparison with standard, crossfloat	0.2	17	MPa			(1E-04 + 6.6E-05p), p in MPa	MPa	2	95%	No	18	Approved on 14 April 2005
Gauge pressure: liquid medium	Pressure measuring device, standard pressure generator, p	Direct comparison with standard, crossfloat	17	280	MPa			(6.6E-05p + 7E-07p^2), p in MPa	MPa	2	95%	No	19	Approved on 14 April 2005
Differential pressure: gas medium	Pressure measuring device p	Direct comparison with standard	1	9000	Pa			(6E-03 + 4.5E-05p), p in Pa	Pa	2	95%	No	20	Approved on 14 April 2005

Length, New Zealand, MSL (Measurement Standards Laboratory)

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**
Laser radiations	Stabilized laser of the mise en pratique: absolute frequency	Optical beat frequency	633	633	nm			0.025	MHz	2	95%	No		1
Laser radiations	Other stabilized lasers	Optical beat frequency	633	633	nm			0.27	fm	2	95%	No	Approved on 28 January 2010	4
Laser radiations	Other stabilized lasers	Optical beat frequency	474	474	THz			0.2	MHz	2	95%	No	Approved on 28 January 2010	5
End standards	Gauge blocks: central length L	Fringe fraction interferometer	0.5	100	mm			Q[30, 0.4L], L in mm, values range from 30 nm to 50 nm	nm	2	95%	No		3
End standards	Gauge blocks: central length L	Mechanical comparison	0.1	100	mm			Q[40, 1.5L], L in mm, varies from 40 nm to 155 nm	nm	2	95%	No		5
Length instruments	Electronic distance meter	Laser interferometer	1	206	m			Q[0.13, 7E-04L], L in m	mm	2	95%	No	Approved on 28 January 2010	6
End standards	Gauge block	Comparison with end standards	100	300	mm			Q[120, 2L], L in mm	nm	2	95%	No	Approved on 28 January 2010	7
End standards	Length bar	Comparator with laser interferometer	300	1500	mm			Q[370, 0.48L], L in mm	nm	2	95%	No	Approved on 28 January 2010	8
Line standards	Micrometer scale	Laser interferometer	0.5	10	mm			0.5	µm	2	95%	No	Approved on 28 January 2010	9
Line standards	Surveyor or engineer tape	Laser interferometer	4	50	m			Q[10, 10.5L], L in m	µm	2	95%	No	Approved on 28 January 2010	10

Length, New Zealand, MSL (Measurement Standards Laboratory)

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**
Line standards	Surveyor levelling rod	Laser interferometer	0.5	3	m			Q[10, 10*L*], *L* in m	µm	2	95%	No	Approved on 28 January 2010	11
Line standards	Engineer or machinist scale	Laser interferometer	0.1	4	m			Q[10, 8.2*L*], *L* in m	µm	2	95%	No	Approved on 28 January 2010	12
Diameter standards	External cylinder	Comparison with end standards	0.5	300	mm			Q[175, 2.4*L*], *L* in mm	nm	2	95%	No	Approved on 28 January 2010	13
Diameter standards	Internal cylinder	Comparison with end standards	0	300	mm			Q[175, 2.4*L*], *L* in mm	nm	2	95%	No	Approved on 28 January 2010	14
Flatness standard	Optical flat	Comparison with reference flat	0	2.5	µm	Diameter	10 mm to 35 mm	0.07	µm	2	95%	No	Approved on 28 January 2010	15
Flatness standard	Optical parallel	Comparator	0	10	µm	Diameter	10 mm to 35 mm	0.08	µm	2	95%	No	Approved on 28 January 2010	16
End standards	Step gauge	Comparison with end standards on CMM	90	700	mm			Q[0.70, 1.2E-03*L*], *L* in mm	µm	2	95%	No	Approved on 28 January 2010	17
CMM artefacts	Ball plate, hole plate	Comparison with end standards on CMM	100 x 100	600 x 600	mm^2			Q[0.90, 1.3E-03*L*], *L* in mm	µm	2	95%	No	Approved on 28 January 2010	18
Roundness standards	External cylinder	Stylus on spindle roundness instrument	0	400	µm	Diameter	1 mm to 300 mm	Q[0.14, 0.05*R*], *R* in µm	µm	2	95%	No	Approved on 28 January 2010	19
Roundness standards	Internal cylinder	Stylus on spindle roundness instrument	0	400	µm	Diameter	1 mm to 300 mm	Q[0.14, 0.05*R*], *R* in µm	µm	2	95%	No	Approved on 28 January 2010	20
Roundness standards	Sphere	Stylus on spindle roundness instrument	0	400	µm	Diameter	1 mm to 300 mm	Q[0.14, 0.05*R*], *R* in µm	µm	2	95%	No	Approved on 28 January 2010	21

Time and Frequency, New-Zealand, MSL (Measurement Standards Laboratory)

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 Identifier**	**Comments**
Time scale difference	Local clock vs. UTC(MSL)	Timer interval counter	-1	+1	s	Amplitude	> 0.5 V (50 Ω)	2	ns	2	95%	No	1	Excluded DUT's effect Approved on 12 February 2008
						Measurement time	10 s							
						Rise time	< 50 ns for 5 V							
Time scale difference	Local clock vs. UTC	Timer interval counter	-1	+1	s	Amplitude	> 0.5 V (50 Ω)	50	ns	2	95%	No	2	Excluded DUT's effect Postprocessed Approved on 12 February 2008
						Measurement time	5 days							
						Rise time	< 50 ns for 5 V							
Frequency	Local frequency standard	Phase comparison	0.1	10	MHz	Measurement time	3 days	2E-13	Hz/Hz	2	95%	Yes	3	Excluded DUT's effect Approved on 12 February 2008
						Amplitude	> 0.5 V (50 Ω)							
Frequency	General frequency standard	Direct frequency measurement	1	10	MHz	Gate time	100 s	1E-10	Hz/Hz	2	95%	Yes		Excluded DUT's effect Approved on 12 February 2008
						Number of measurements	10							
						Amplitude	> 0.5 V (50 Ω)							
Frequency	Frequency counter	Frequency synthesis	1	40	GHz	Gate time	100s	1E-10	Hz/Hz	2	95%	Yes	4	Excluded DUT's effect Approved on 12 February 2008
						Number of measurements	10							

Time and Frequency, New-Zealand, MSL (Measurement Standards Laboratory)

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 Identifier**	**Comments**
						Amplitude	-0.5 dBm to 10 dBm							
Time interval	Period source	Period measurement	0.001	1	s	Number of measurements	10	1	ns	2	95%	No	5	Excluded DUT's effect Approved on 12 February 2008
						Amplitude	> 0.5 V (50 Ω)							
Time interval	Time difference source	Direct time interval measurement	1.0E-07	86400	s	Trigger level	> 0.5 V (50 Ω)	2	ns	2	95%	No	6	Excluded DUT's effect Approved on 12 February 2008
						Number of measurements	10							
						Pulse rise time	< 50 ns for 5 V							
Time interval	Delay source	Direct time interval measurement	1.0E-07	86400	s	Trigger level	> 0.5 V (50 Ω)	2	ns	2	95%	No	7	Influence of DUT performance excluded Approved on 12 February 2008
						Number of measurements	10							
						Rise time	< 50 ns for 5 V							
Time interval	Period meter	Timer interval counter	1	1000	s	Trigger level	> 0.5 V (50 Ω)	1	ns	2	95%	No	8	Influence of DUT performance excluded Approved on 12 February 2008
						Number of measurements	10							
						Rise time	< 50 ns for 5 V							

Time and Frequency, New-Zealand, MSL (Measurement Standards Laboratory)

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 Identifier**	**Comments**
Time interval	Time difference meter	Timer interval counter	10	100000	ns	Trigger level	> 0.5 V (50 Ω)	2	ns	2	95%	No	9	Excluded DUT's effect Approved on 12 February 2008
						Number of measurements	10							
						Rise time	< 50 ns for 5 V							
Time interval	Delay source	Delay generator	10	100000	ns	Trigger level	> 0.5 V (50 Ω)	2	ns	2	95%	No	10	Excluded DUT's effect Approved on 12 February 2008
						Number of measurements	10							
						Rise time	< 50 ns for 5 V							