Laboratory Accreditation Programmes

Schedule to

CERTIFICATE OF ACCREDITATION

Laboratory	DELTA Utility Services Limited
Address	PO Box 1404, Dunedin, 9054 10 Halsey Street, Dunedin, 9016
Telephone	03 474-0322
Fax	03 479-6694
URL	www.thinkdelta.co.nz
Authorised Representative	Mr Rodney Helm Superintendent - Electrical and Testing
Client No.	4859
Programme	Metrology & Calibration Laboratory
Accreditation Number	583
Initial Accreditation Date	31 October 1995
Conformance Standard	NZS ISO/IEC 17025:2005 General requirements for the competence of testing and calibration laboratories
Testing Services Summary	3.65 Miscellaneous Electrical Tests 5.82 Resistors, Resistance Boxes and Potential Dividers 5.88 Calibrators for Instrumentation 5.89 Indicating Instruments and Recording Instruments 5.91 Frequency Measurement and Time Measurement
Signatories	Mr Stephen Cook — 5.89(l) excluding Site Certification Mr Antony Cuthbertson — 3.65, 5.82, 5.88, 5.89 [excluding (l)], 5.91 Mr Greg Gray — 5.89(l) excluding Site Certification Mr Steven Jenkins — 5.89 [(l) only], Site Certification Cat 1-5 Mr R L Jones — 5.89 [(l) only], Site Certification Cat 1-5 Mr Geoff Simpson — 5.89 Mr Alan Michael Woods — 3.65, 5.82, 5.88, 5.89 [excluding (l)], 5.91

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Calibration temperature 23 °C ± 2 °C in energy meter laboratory and 23 °C ± 5 °C in the general electrical calibration laboratory.
All measurement uncertainties are based on a level of confidence of at least 95 %.
Calibrations are performed at the premises of the accredited laboratory, apart from metering installation measurements which are carried out on site.
Where term ppm is used it refers to *parts per million*, for example µV/V or µΩ/Ω.

3.65 Miscellaneous Electrical Tests

(a) Insulating gloves and tools
(b) High voltage operating equipment
(c) Insulated platform vehicles
(e) Other tests

In service checks on insulating protective equipment including gloves, sleeves, mats, blankets, poles, jumper leads, platform buckets and other types of miscellaneous equipment in accordance with specifications such as ASTM D120, F478, F479, F496, D1048, D1049, D1050, D1051, F711, F712, EEA Dec 2004 and equivalent IEC standards.

5.82 Resistors, Resistance Boxes and Potential Dividers

(a) Precision resistors, resistance boxes and conductance boxes

Refer to 5.89 (i) below using calibrator

Nominal value	Least uncertainty of measurement
100 KΩ	20 ppm
1 MΩ	35 ppm
10 MΩ	70 ppm
100 MΩ	200 ppm
1 GΩ	0.06 %
10 GΩ	0.06 %
100 GΩ	1.0 %
1 TΩ	2.0 %

Where PPM = parts per million, or µΩ/Ω

5.88 Calibrators for Instrumentation

		Least uncertainty of measurement
(a)	DC voltage	
	100 mV	0.0037 % + 0.0035 % of range
	1 V	0.0025 % + 0.0007 % of range
	10 V	0.0024 % + 0.0005 % of range
	100 V	0.0038 % + 0.0006 % of range

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	1000 V		0.0041 % + 0.001 % of range
	0 V to 10 kV		1 % + 1 digit
	10 kV to 100 kV		1 % + 1 digit
(b)	AC voltage		
	100 mV	10 Hz to 20 kHz	0.06 % + 0.04 % of range
		20 kHz to 50 kHz	0.12 % + 0.05 % of range
		50 kHz to 100 kHz	0.6 % + 0.08 % of range
		100 kHz to 300 kHz	4.0 % + 0.50 % of range
	1 V	10 Hz to 20 kHz	0.06 % + 0.03 % of range
		20 kHz to 50 kHz	0.12 % + 0.05 % of range
		50 kHz to 100 kHz	0.6 % + 0.08 % of range
		100 kHz to 300 kHz	4.0 % + 0.50 % of range
	10 V	10 Hz to 20 kHz	0.06 % + 0.03 % of range
		20 kHz to 50 kHz	0.12 % + 0.05 % of range
		50 kHz to 100 kHz	0.6 % + 0.08 % of range
		100 kHz to 300 kHz	4 % + 0.5 % of range
	100 V	10 Hz to 20 kHz	0.06 % + 0.03 % of range
		20 kHz to 50 kHz	0.12 % + 0.05 % of range
		50 kHz to 100 kHz	0.6 % + 0.08 % of range
		100 kHz to 300 kHz	4 % + 0.5 % of range
	1000 V	10 Hz to 20 kHz	0.06 % + 0.022 % of range
		20 kHz to 50 kHz	0.12 % + 0.037 % of range
		50 kHz to 100 kHz	0.6 % + 0.06 % of range
		100 kHz to 300 kHz	4 % + 0.37 % of range
	0 V to 10 kV		1 % + 1 digit
	10 kV to 100 kV		1 % + 1 digit
(c)	DC current		
	100 µA		0.05 % + 0.025 % of range
	1 mA		0.05 % + 0.005 % of range
	10 mA		0.05 % + 0.02 % of range
	100 mA		0.05 % + 0.005 % of range
	400 mA		0.05 % + 0.005 % of range
	1 A		0.05 % + 0.02 % of range
	3 A		0.1 % + 0.02 % of range
	10 A		0.15 % + 0.008 % of range
(d)	AC current		

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	100 µA	10 Hz to 5 kHz 5 kHz to 10 kHz	0.15 % + 0.06 % of range 0.35 % + 0.7 % of range
	1 mA	10 Hz to 5 kHz 5 kHz to 10 kHz	0.1 % + 0.04 % of range 0.2 % + 0.25 % of range
	10 mA	10 Hz to 5 kHz 5 kHz to 10 kHz	0.15 % + 0.06 % of range 0.35 % + 0.7 % of range
	100 mA	10 Hz to 5 kHz 5 kHz to 10 kHz	0.1 % + 0.04 % of range 0.2 % + 0.25 % of range
	400 mA	10 Hz to 1 kHz 1 kHz to 10 kHz	0.1 % + 0.1 % of range 0.2 % + 0.7 % of range
	1 A	10 Hz to 5 kHz 5 kHz to 10 kHz	0.1 % + 0.04 % of range 0.35 % + 0.7 % of range
	3 A	10 Hz to 5 kHz 5 kHz to 10 kHz	0.15 % + 0.06 % of range 0.35 % + 0.7 % of range
	10 A	10 Hz to 5 kHz 5 kHz to 10 kHz	0.15 % + 0.06 % of range 0.35 % + 0.7 % of range
(e)	Resistance		
	10 Ω		0.01 % + 0.03 % of range
	100 Ω		0.01 % + 0.004 % of range
	1 kΩ		0.01 % + 0.001 % of range
	10 kΩ		0.01 % + 0.001 % of range
	100 kΩ		0.01 % + 0.001 % of range
	1 MΩ		0.01 % + 0.001 % of range
	10 MΩ		0.04 % + 0.001 % of range
	100 MΩ		0.8 % + 0.01 % of range
	1 GΩ		2.0 % + 0.01 % of range
(g)	Capacitance		
	1 nF		2 % + 2.5 % of range
	10 nF		1 % + 0.5 % of range
	100 nF		1 % + 0.5 % of range
	1 µF		1 % + 0.5 % of range
	10 µF		1 % + 0.5 % of range
	100 µF		1 % + 0.5 % of range
	1 mF		1 % + 0.5 % of range
	10 mF		1 % + 0.5 % of range
	100 mF		4 % + 0.2 % of range

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(i) Other measurement ranges

Power factor meters

Range -1 to 1	10 Hz to 30 kHz	See formula below

$$Uncertianty(PF) = 100(1 - \frac{cos(cos^{-1}(PF_{set}) + phase\ angle\ uncertianty)}{PF_{set}})$$

Electrical simulation of temperature signal for calibration of resistance temperature device (RTD) calibrators

-200 °C	0.09 °C
-100 °C	0.08 °C
0 °C	0.06 °C
100 °C	0.08 °C
300 °C	0.12 °C
600 °C	0.22 °C

Frequency (over the range 100 mV to 1000 V)

3 Hz to 5 Hz	0.1 %
5 Hz to 10 Hz	0.05 %
10 Hz to 40 Hz	0.03 %
40 Hz to 300 kHz	0.01 %
300 kHz to 1 MHz	0.01 %

5.89 Indicating Instruments and Recording Instruments

			Least uncertainty of measurement
(a)	DC voltmeters		
	0 mV to 330 mV		15 ppm + 0.75 µV
	0.33 V to 3.3 V		8.3 ppm +1.5 µV
	3.3 V to 33 V		9.1 ppm + 15 µV
	30 V to 330 V		13 ppm + 110 µV
	330 V to 1020 V		13 ppm + 1100 µV
(b)	AC voltmeters		
	1.0 mV to 33 mV	10 Hz to 45 Hz	600 ppm + 4.5 µV
		45 Hz to 10 kHz	110 ppm + 4.5 µV
		10 kHz to 20 kHz	150 ppm + 4.5 µV
		20 kHz to 50 kHz	750 ppm + 4.5 µV
		50 kHz to 100 kHz	2600 ppm + 9.1 µV
		100 kHz to 450 kHz	6000 ppm + 37 µV

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33 mV to 330 mV	10 Hz to 45 Hz	220 ppm + 6.0 µV
	45 Hz to 10 kHz	110 ppm + 6.0 µV
	10 kHz to 20 kHz	120 ppm + 6.0 µV
	20 kHz to 50 kHz	260 ppm + 6.0 µV
	50 kHz to 100 kHz	610 ppm + 24 µV
0.33 V to 3.3 V	10 Hz to 45 Hz	220 ppm + 37 µV
	45 Hz to 10 kHz	110 ppm + 45 µV
	10 kHz to 20 kHz	140 ppm + 45 µV
	20 kHz to 50 kHz	220 ppm + 37 µV
	50 kHz to 100 kHz	530 ppm + 95 µV
	100 kHz to 450 kHz	1800 ppm + 450 µV
3.3 V to 33 V	10 Hz to 45 Hz	220 ppm + 490 µV
	45 Hz to 10 kHz	110 ppm + 450 µV
	10 kHz to 20 kHz	180 ppm + 450 µV
	20 kHz to 50 kHz	260 ppm + 450 µV
	50 kHz to 90 kHz	680 ppm + 1200 µV
33 V to 330 V	45 Hz to 1 kHz	140 ppm + 1500 µV
	1 kHz to 10 kHz	150 ppm + 4500 µV
	10 kHz to 20 kHz	180 ppm + 4500 µV
	20 kHz to 50 kHz	1500 ppm + 3700 µV
330 V to 1020 V	45 Hz to 1 kHz	220 ppm + 7500 µV
	1 kHz to 5 kHz	180 ppm + 7500 µV
	5 kHz to 8 kHz	220 ppm + 7500 µV

(c) DC ammeters including clamp-meters

0 mA to < 330 µA	110 ppm + 0.015 µA
0.33 mA to < 3.3 mA	75 ppm+ 0.038 µA
3.3 mA to < 33 mA	75 ppm + 0.19 µA
33 mA to < 330 mA	75 ppm + 1.9 µA
0.33 A to < 1.1 A	150 ppm + 30 µA
1.1 A to < 3.0 A	280 ppm + 30 µA
3.0 A to < 11.0 A	370 ppm + 370 µA
11.0 A to 20.5 A	750 ppm + 560 µA

Fluke 5500A coil (non-toroidal)

10 A to 16.5 A	0.38 % of reading + 0.015 A
16.5 A to 150 A	0.38 % of reading + 0.10 A
150 A to 1025 A	0.38 % of reading + 0.38 A

(d) AC ammeters including clamp-meters

0.029 mA to 0.33 mA	10 Hz to 20 Hz	0.15 ppm + 0.076 µA

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	20 Hz to 45 Hz	0.11 ppm + 0.076 µA
	45 Hz to 1 kHz	0.095 ppm + 0.076 µA
	1 kHz to 5 kHz	0.22 ppm + 0.11 µA
	5 kHz to 10 kHz	0.60 ppm + 0.15 µA
	10 kHz to 30 kHz	1.2 ppm + 0.30 µA
0.33 mA to 3.3 mA	10 Hz to 20 Hz	0.15 ppm + 0.11 µA
	20 Hz to 45 Hz	0.095 ppm + 0.11 µA
	45 Hz to 1 kHz	0.076 ppm + 0.11 µA
	1 kHz to 5 kHz	0.15 ppm + 0.15 µA
	5 kHz to 10 kHz	0.15 ppm + 0.15 µA
	10 kHz to 30 kHz	0.76 ppm + 0.45 µA
3.3 mA to 33 mA	10 Hz to 20 Hz	0.13 ppm + 1.5 µA
	20 Hz to 45 Hz	0.068 ppm + 1.5 µA
	45 Hz to 1 kHz	0.03 ppm + 1.5 µA
	1 kHz to 5 kHz	0.06 ppm + 1.5 µA
	5 kHz to 10 kHz	0.15 ppm + 2.2 µA
	10 kHz to 30 kHz	0.30 ppm + 3.0 µA
33 mA to 330 mA	10 Hz to 20 Hz	0.13 ppm + 15 µA
	20 Hz to 45 Hz	0.068 ppm + 15 µA
	45 Hz to 1 kHz	0.03 ppm + 15 µA
	1 kHz to 5 kHz	0.076 ppm + 37 µA
	5 kHz to 10 kHz	0.15 ppm + 76 µA
	10 kHz to 30 kHz	0.30 ppm + 150 µA
0.33 A to 1.1 A	10 Hz to 45 Hz	0.13 ppm + 76 µA
	45 Hz to 1 kHz	0.046 ppm + 76 µA
	1 kHz to 5 kHz	0.45 ppm + 760 µA
	5 kHz to 10 kHz	1.9 ppm + 3700 µA
1.1 A to 3.0 A	10 Hz to 45 Hz	0.13 ppm + 76 µA
	45 Hz to 1 kHz	0.046 ppm + 76 µA
	1 kHz to 5 kHz	0.46 ppm + 760 µA
	5 kHz to 10 kHz	1.9 ppm + 3700 µA
3.0 A to 11 A	45 Hz to 100 Hz	0.046 ppm + 1500 µA
	100 Hz to 1 kHz	0.076 ppm + 1500 µA
	1 kHz to 5 kHz	2.2 ppm + 1500 µA
11 A to 20.5 A	45 Hz to 100 Hz	0.091 ppm + 3700 µA
	100 Hz to 1 kHz	0.11 ppm + 3700 µA
	1 kHz to 5 kHz	2.2 ppm + 3700 µA
Fluke 5500A coil (non-toroidal)		
10 A to 16.5 A	45 Hz to 65 Hz	0.42 % of reading + 0.023 A

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16.5 A to 150 A	45 Hz to 65 Hz	0.42 % of reading + 0.19 A
150 A to 1025 A	45 Hz to 65 Hz	0.42 % of reading + 0.68 A
10 A to 16.5 A	65 Hz to 440 Hz	0.76 % of reading + 0.023 A
16.5 A to 150 A	65 Hz to 440 Hz	0.76 % of reading + 0.19 A
150 A to 1025 A	65 Hz to 440 Hz	0.76 % of reading + 0.68 A

Fluke 5500A coil (toroidal)

10 A to 16.5 A	45 Hz to 65 Hz	0.21 % of reading + 0.0023 A
16.5 A to 150 A	45 Hz to 65 Hz	0.21 % of reading + 0.019 A
150 A to 1025 A	45 Hz to 65 Hz	0.21 % of reading + 0.068 A
10 A to 16.5 A	65 Hz to 440 Hz	0.58 % of reading + 0.0023 A
16.5 A to 150 A	65 Hz to 440 Hz	0.58 % of reading + 0.20 A
150 A to 1025 A	65 Hz to 440 Hz	0.58 % of reading + 0.076 A

(e) Wattmeters

Least uncertainty for power (W and VA) is calculated as the root sum of squares of the uncertainties for the appropriate voltage and current values (and power factor, if applicable).

Voltage limitations: 33 mVac to 1000 Vac, or 0 V to 1000 Vdc.
Current limitations: 3.3 mAac to 11 Aac, or 0 A to 11 Adc.
Auxiliary voltage limitations: 10 mVac to 3.3 Vac, or 0 V to 3.3 Vdc.

The range of direct output is from 108.9 µWac through to 120 kWac, or 108.9 µWdc through to 100 kWdc, and from 108.9 µVAac through to 120 kVAac, or 108.9 µVAdc through to 100 kVAdc.

Power can be simulated over greater ranges for equipment incorporating current clamps or current transformers. (Maximum output available for the voltage input is 1000 V, and maximum output available for the “current” input is 20 A or 3.3 V).

(f) Varmeters

Least uncertainty for reactive power (VAr) is calculated as the root sum of squares of the uncertainties for the appropriate voltage, current, and power factor values.

Voltage and current limitations apply as for Wattmeters above.

(g) Phase angle indicators

0° to 179.98°	10 Hz to 65 Hz	0.076°
	65 Hz to 500 Hz	0.19°
	500 Hz to 1 kHz	0.38°
	1 kHz to 5 kHz	1.9°
	5 kHz to 10 kHz	3.8°
	10 kHz to 30 kHz	7.6°

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(i) Ohmmeters and Resistors

0 Ω to 11 Ω	30 ppm + 0.76 mΩ
11 Ω to 33 Ω	22 ppm + 1.1 mΩ
33 Ω to 110 Ω	21 ppm + 1.0 mΩ
110 Ω to 330 Ω	21 ppm + 1.5 mΩ
330 Ω to 1.1 kΩ	21 ppm + 1.5 mΩ
1.1 kΩ to 3.3 kΩ	21 ppm + 1.5 mΩ
3.3 kΩ to 11 kΩ	21 ppm + 1.5 mΩ
11 kΩ to 33 kΩ	21 ppm + 0.15 Ω
33 kΩ to 110 kΩ	21 ppm + 0.15 Ω
110 kΩ to 330 kΩ	24 ppm + 1.5 Ω
330 kΩ to 1.1 MΩ	24 ppm + 1.5 Ω
1.1 MΩ to 3.3 MΩ	45 ppm + 22 Ω
3.3 MΩ to 11 MΩ	98 ppm + 38 Ω
11 MΩ to 33 MΩ	190 ppm + 1.9 kΩ
33 MΩ to 110 MΩ	380 ppm + 2.2 kΩ
110 MΩ to 330 MΩ	2200 ppm + 7.5 kΩ
330 MΩ to 1100 MΩ	11000 ppm + 379 kΩ

(j) LCR meters

Capacitance meters and Capacitors

	Frequency range	
220 pF to 400 pF	10 Hz to 10 kHz	0.38 % + 7.6 pF
0.4 nF to 1.1 nF	0 Hz to 10 kHz	0.38 % + 7.6 pF
1.1 nF to 3.3 nF	10 Hz to 3 kHz	0.38 % + 7.6 pF
3.3 nF to 11 nF	10 Hz to 1 kHz	0.19 % + 7.6 pF
11 nF to 33 nF	10 Hz to 1 kHz	0.19 % + 7.6 pF
33 nF to 110 nF	10 Hz to 1 kHz	0.19 % + 7.6 pF
110 nF to 330 nF	10 Hz to 1 kHz	0.19 % + 0.03 nF
0.33 µF to 1.1 µF	10 Hz to 600 Hz	0.19 % + 0.76 nF
1.1 µF to 3.3 µF	10 Hz to 300 Hz	0.19 % + 2.2 nF
3.3 µF to 11 µF	10 Hz to 150 Hz	0.19 % + 7.6 nF
11 µF to 33 µF	10 Hz to 120 Hz	0.30 % + 22 nF
33 µF to 110 µF	10 Hz to 80 Hz	0.34 % + 76 nF
110 µF to 330 µF	0 Hz to 50 Hz	0.34 % + 220 nF
330 µF to 1.1 mF	0 Hz to 20 Hz	0.34 % + 0.76 µF
1.1 mF to 3.3 mF	0 Hz to 6 Hz	0.34 % + 2.2 µF
3.3 mF to 11 mF	0 Hz to 2 Hz	0.34 % + 7.6 µF
11 mF to 33 mF	0 Hz to 0.6 Hz	0.75 % + 22 µF
33 mF to 110 mF	0 Hz to 0.2 Hz	0.84 % + 76 µF

(l) Energy meters

Calibration of single and multiple phase energy meters to the accuracy requirements of classes

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0.2, 0.5, 1.0 and 2.0 as defined in IEC 61036, 60687, 60521 (or 62053 - 22, 62053 - 21 and 62053 - 11) in accordance with in-house methods and EIPC 2010 Part 10 Metering

Active Meters (units Wh/Vah)

Power factor (PF)	
1.0	0.052 %
0.5 lag	0.066 %
0.8 lead	0.072 %

Certification of metering installations in accordance with EIPC 2010 Part 10 Metering Cat 1, 2, 3, 4, and 5

(q) Other specified devices

Voltage simulation of temperature by simulated thermocouple output and thermocouple measurement.

Thermocouple Type

B	600 °C to 800 °C	0.33 °C
	800 °C to 1000 °C	0.25 °C
	1000 °C to 1550 °C	0.22 °C
	1550 °C to 1820 °C	0.25 °C
C	0 °C to 150 °C	0.22 °C
	150 °C to 650 °C	0.19 °C
	650 °C to 1000 °C	0.23 °C
	1000 °C to 1800 °C	0.38 °C
	1800 °C to 2316 °C	0.64 °C
E	-250 °C to -100 °C	0.38 °C
	-100 °C to -25 °C	0.12 °C
	-25 °C to -350 °C	0.10 °C
	350 °C to 650 °C	0.12 °C
	650 °C to 1000 °C	0.15 °C
J	-210 °C to -100 °C	0.20 °C
	-100 °C to -30 °C	0.12 °C
	-30 °C to 150 °C	0.10 °C
	150 °C to 760 °C	0.12 °C
	760 °C to 1200 °C	0.17 °C
K	-200 °C to -100 °C	0.25 °C
	-100 °C to -25 °C	0.13 °C
	-25 °C to 120 °C	0.12 °C
	120 °C to 1000 °C	0.19 °C
	1000 °C to 1372 °C	0.30 °C

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N	-200 °C to -100 °C	0.30 °C
	-100 °C to -25 °C	0.16 °C
	-25 °C to 120 °C	0.14 °C
	120 °C to 410 °C	0.13 °C
	410 °C to 1300 °C	0.20 °C
R	0 °C to 250 °C	0.43 °C
	250 °C to 400 °C	0.26 °C
	400 °C to 1000 °C	0.25 °C
	1000 °C to 1767 °C	0.30 °C
S	0 °C to 250 °C	0.35 °C
	250 °C to 1000 °C	0.27 °C
	400 °C to 1400 °C	0.28 °C
	1400 °C to 1767 °C	0.34 °C
T	-250 °C to -150 °C	0.47 °C
	-150 °C to 0 °C	0.18 °C
	0 °C to 120 °C	0.12 °C
	120 °C to 400 °C	0.10 °C

5.91 Frequency Measurement and Time Measurement

(a) Frequency meters

	Least uncertainty of measurement
0.01 Hz to 120 Hz	1.9 ppm + 3.8 µHz
120 Hz to 1200 Hz	1.9 ppm + 3.8 µHz
1.2 kHz to 12 kHz	1.9 ppm + 3.8 µHz
12 kHz to 120 kHz	1.9 ppm + 3.8 µHz
120 kHz to 1200 kHz	1.9 ppm + 3.8 µHz
1.2 MHz to 2 MHz	1.9 ppm + 3.8 µHz