

CERTIFICATE OF ACCREDITATION



Trescal (New Zealand) Ltd

Client Number 927

38J Angle Street, Onehunga, Auckland, 1061

Telephone 09 636-4999

www.cps.co.nz

Authorised Representative

Kirsty Russell
Laboratory Manager

Programme

Metrology & Calibration Laboratory

Accreditation Number 271

Initial Accreditation Date 18 December 1985

Conformance Standard

ISO/IEC 17025:2017

General requirements for the competence of testing and calibration laboratories

Laboratory Services Summary

- 5.22 Precision Laboratory Balances
- 5.23 Industrial Balances
- 5.24 Industrial Weighing Appliances
- 5.41 Barometric indicators or transducers
- 5.42 Differential Pressure Measuring Devices (including Manometers)
- 5.43 Pressure Gauge Testers and Pressure Balances
- 5.44 Pressure and Vacuum
- 5.45 Pressure Equipment Tests
- 5.50 Torque Measuring Equipment
- 5.51 Force Measuring Devices
- 5.52 Strain and Displacement
- 5.53 Testing Machines
- 5.54 Mechanical Testing Equipment
- 5.61 Temperature Measuring Equipment
- 5.88 Calibrators for Instrumentation
- 5.89 Indicating Instruments and Recording Instruments
- 5.91 Time and Frequency

Key Technical Personnel

Richard Ettema	5.50, 5.61, 5.88, 5.89, 5.91
Michael Feigler	5.44
Jerome Fryer	5.50, 5.61, 5.88, 5.89, 5.91

Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page 1 of 41

CERTIFICATE OF ACCREDITATION



Michael MacAulay	5.61, 5.88, 5.89
Chris Marlow	5.22, 5.23, 5.24, 5.51, 5.52, 5.53, 5.54
Jane Robinson	5.44
Kirsty Russell	5.22, 5.23, 5.41, 5.42, 5.43, 5.44, 5.45, 5.61

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Operations Manager Authorisation:		Issue 72	Date:13/05/26	Page 2 of 41
--------------------------------------	--	----------	---------------	--------------



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

Calibration and Measurement Capability (CMC) uncertainties are expressed as an expanded uncertainty corresponding to a level of confidence of 95 % ^{Note1}

Measurement results are traceable to the International System of Units (SI) via an unbroken chain of comparisons to the New Zealand National Standards or to the National Standards of other Signatories to the CIPM MRA

Many calibrations of working instruments can be carried out on-site. Refer to the specific class of test information below for further information

Branch laboratories are maintained at the following addresses:

CPS Labs: 38J Angle Street, Onehunga

CPS Labs: Unit 8, 16 Cory John Place, Bell Block, New Plymouth 4312. Phone (06) 755 4949

Calibration Connect: 11A Leslie Hills Road, Riccarton, Christchurch 8011. Phone (03) 963 9244

Measurand

Parameters

CMC Uncertainty

5.22 Precision Laboratory Balances

Calibration of precision laboratory balances having a nominal measurement uncertainty equal to or less than 1 part in 100,000 of maximum capacity, in accordance with in-house methods based on MSL Technical Guide 25 and OIML R111-1 (on-site calibration service)

Ranges and CMC uncertainties as under class 5.23

5.23 Industrial Balances

Calibration of industrial balances having a nominal measurement uncertainty larger than 1 part in 100,000 of maximum capacity, in accordance with in-house methods based on MSL Technical Guide 25 and OIML R111-1 (on-site calibration service)

1 mg to 5 g	10 µg
5 g to 10 g	11 µg
10 g to 1 kg	1 µg/g
1 kg to 5 kg	1.6 µg/g
5 kg to 10 kg	6 µg/g
10 kg to 60 kg	50 µg/g

5.24 Industrial Weighing Appliances

Calibration of industrial weighing appliances having a nominal measurement uncertainty larger than 1 part in 100,000 of maximum capacity, in accordance with in-house methods based on MSL Technical Guide 25 (on-site calibration service)

Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page 3 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

10 mg to 10 g	20 µg
10 g to 1 kg	3 µg/g
1 kg to 5 kg	3 µg/g
5 kg to 10 kg	6 µg/g
10 kg to 60 kg	50 µg/g

5.41 Barometric indicators or transducers

Aneroid barometers (including digital barometers) in accordance with an in-house method by comparison with reference devices, in the Auckland and New Plymouth laboratories

80 kPa to 120 kPa	0.23 Pa + 0.0014 % reading
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5.42 Differential Pressure Measuring Devices (including Manometers)

- (a) Diaphragm types
- (b) Liquid column types, inclined and vertical
- (c) Transducers and transmitters
- (d) Pressure recorders

In accordance with an in-house method by comparison with reference devices, in the Auckland and New Plymouth laboratories

Gauge mode

-100 kPa to -15 kPa	0.019 kPa or ¹ 0.008 % reading
-15 kPa to -7.5 kPa	1.5 Pa or ¹ 0.03 % reading
-7.5 kPa to +4 kPa	0.042 Pa or ¹ 0.01 % reading
4 kPa to 350 kPa	0.23 Pa + 0.0014 % reading
350 kPa to 1778 kPa	2 Pa + 0.005 % reading
1778 kPa to 20,000 kPa	0.018 kPa + 0.0041 % reading
20,000 kPa to 200,000 kPa	0.19 kPa + 0.0049 % reading

Calibrations in the following ranges are available onsite (gauge mode)

-95 kPa to 100 kPa	0.25 Pa or ¹ 0.06 % reading
100 kPa to 70,000 kPa	0.06 % reading

or¹ = whichever is greater

5.43 Pressure Gauge Testers and Pressure Balances

Pressure calibrators and testers in accordance with an in-house method by comparison with reference devices, in the Auckland and New Plymouth laboratories

Gauge mode

-100 kPa to -15 kPa	0.019 kPa or ¹ 0.008 % reading
-15 kPa to -7 kPa	1.5 Pa or ¹ 0.03 % reading

Operations Manager
Authorisation:

Issue 72

Date: 13/05/26

Page 4 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

-7 kPa to +4 kPa
4 kPa to 350 kPa

0.042 Pa or¹ 0.01 % reading
0.23 Pa + 0.0014 % reading

or¹ = whichever is greater

Gauge mode or absolute mode
350 kPa to 1778 kPa
1778 kPa to 20,000 kPa
20,000 kPa to 200,000 kPa

2 Pa + 0.005 % reading
0.018 kPa + 0.0041 % reading
0.19 kPa + 0.0049 % reading

Absolute mode
7 kPa to 350 kPa

0.23 Pa + 0.0014 % reading

5.44 Pressure and Vacuum

- (a) Pressure gauges
- (b) Vacuum gauges
- (c) Pressure transducers
- (d) Pressure recorders

Accuracy classes: 0.1, 0.25, 0.6, 1.0, 1.6, 2.5, 4.0 in accordance with AS 1349:1986 and BS EN 837-1:1998; gauges of accuracy 4A, 3A, 2A, 1A and below as defined in ASME B40.100-2013 By comparison with reference devices, in the Auckland and New Plymouth laboratories

Gauge mode

-100 kPa to -15 kPa
-15 kPa to -7.5 kPa
-7.5 kPa to +4 kPa
4 kPa to 350 kPa

0.019 kPa or¹ 0.008 % reading
1.5 Pa or¹ 0.03 % reading
0.042 Pa or¹ 0.01 % reading
0.23 Pa + 0.0014 % reading

Gauge mode or absolute mode
350 kPa to 1778 kPa
1778 kPa to 20,000 kPa
20,000 kPa to 200,000 kPa

2 Pa + 0.005 % reading
0.018 kPa + 0.0041 % reading
0.19 kPa + 0.0049 % reading

Absolute mode
7 kPa to 350 kPa

0.23 Pa + 0.0014 % reading

Calibrations in the following ranges are available onsite (gauge mode)

-95 kPa to 100 kPa
100 kPa to 70,000 kPa

0.25 Pa or¹ 0.06 % reading
0.06 % reading

or¹ = whichever is greater

Maximum vacuum achievable is subject to ambient barometric pressure

Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page 5 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

5.45 Pressure Equipment Tests

- (e) Pressure relief valve tests

The testing of Pressure Relief Valves and Pressure Switches up to 120000 kPa, in accordance with in-house methods, on-site or in the Auckland and New Plymouth laboratories

5.50 Torque Measuring Equipment

- (a) Hand torque tools (including wrenches and screwdriver types)
(b) Torque multipliers and powered torque tools

Calibration in accordance with the performance requirements of ISO 6789:2003, ISO 5393:1994, or manufacturer's specification, on-site or in the Christchurch laboratory

0.1 N.m to 1 N.m	0.51 % to 3.0 %
1 N.m to 10 N.m	0.21 % to 0.72 %
10 N.m to 100 N.m	0.21 % to 0.33 %
100 N.m to 1000 N.m	0.25 % to 0.30 %
1000 N.m to 1500 N.m	0.28 %

5.51 Force Measuring Devices

- (a) Proving devices
(b) Elastic force measuring devices and force dynamometers

Calibration of force measuring devices, such as proving rings, load cells (whether alone or as part of a testing machine), spring balances and digital force measuring instruments, to an in-house method based on AS 2193 and EN ISO 7500-1, in the Auckland laboratory or on-site)

0.01 N to 10000 kN in compression	0.25 %
0.01 N to 3000 kN in tension	0.25 %

5.52 Strain and Displacement

- (a) Extensometers

In accordance with ISO 9513 on-site

Length	12 μ m
Extension	0.4 μ m

- (c) Dial gauges

In accordance with AS 2103 except for clauses 2.4.2 and 3.4.2 and BS 907 except clause 9.3 on-site

Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page 6 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

5.53 Testing Machines

(a) Tension and universal machines in tension

In accordance with ASTM E4, EN ISO 7500-1 and AS 2193 grade A on-site

0.01 N to 3000 kN 0.25 %

(b) Compression and universal machines in compression

In accordance with ASTM E4, EN ISO 7500-1 and AS 2193 grade A on-site

0.01 N to 10000 kN 0.25 %

(c) Vickers hardness machines

In accordance with EN ISO 6507: Part 2 and AS 1817.2 except clause 4.2 on-site 0.5 %

(d) Rockwell hardness machines

In accordance with EN ISO 6508: Part 2 and AS 1815.2 except clauses 4.3 and 4.4 and ASTM E18 on-site 0.5 %

(e) Brinell hardness machines

In accordance with EN ISO 6506: Part 2 and AS 1816.2 except clause 4.3 on-site

HBW (10/3000)
150 1.1 %
390 1.2 %
570 1.2 %

(g) Charpy impact machines

In accordance with ISO 148-2 and ISO 13802 (for plastics) on-site

Machines of nominal capacities ranging from 150 J to 600 J (for metallic materials) 1 % at 10 % capacity
to 0.3 % at 80 % capacity

5.54 Mechanical Testing Equipment

(a) Portable Brinell measuring microscopes

In accordance with AS 1816.2 and EN ISO 6506: Part 2 on-site

5.61 Temperature Measuring Equipment

Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page 7 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

- (a) Rare metal thermocouples
- (b) Base metal thermocouples
- (c) Platinum (and other metallic) resistance thermometers
- (e) Thermistors and other semi-conductor thermometers
- (f) Liquid-in-glass thermometers
- (g) Clinical thermometers
- (j) Radiation thermometers
- (k) Vapour pressure thermometers
- (l) Filled metal systems
- (m) Bimetallic systems
- (n) Digital quartz frequency units
- (o) Indicators, recorders and controllers
- (p) Other direct reading temperature measuring systems

Range applies to all of the above, except (j) (see further below), including digital thermometers and single position calibration of dry well calibrators, in the Auckland and New Plymouth laboratories

Ice-point	0.01 °C
-100 °C to -60 °C	0.080 °C
-60 °C to -20 °C	0.028 °C
-20 °C to 200 °C	0.015 °C
200 °C to 660 °C	0.17 °C

On-site temperature calibration is offered over the ranges below

Ice-point	0.01 °C
-30 °C to -20 °C	0.10 °C
-20 °C to 80 °C	0.03 °C
80 °C to 150 °C	0.046 °C
150 °C to 350 °C	0.51 °C

Radiation thermometers, including infrared thermometers and infrared imaging cameras, in the Auckland laboratory

-15 °C to 0 °C	1.0 °C
0 °C to 130 °C	0.24 °C
130 °C to 500 °C	0.75 °C

Electrical calibration of temperature calibrators (resistance and thermocouples) is described in COT 5.88 (i)

Electrical simulation or measurement of temperature (resistance and thermocouples), including transducers and transmitters with electrical 4-20 mA, 1-10 Vdc and 1-5 Vdc outputs, is described in COT 5.89 (q)

5.88 Calibrators for Instrumentation

Operations Manager Authorisation:		Issue 72	Date:13/05/26	Page 8 of 41
--------------------------------------	--	----------	---------------	--------------



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

In accordance with in-house methods based on manufacturer's recommendations, in the Auckland and Christchurch laboratories

(a) DC voltage

200 mV range

0 mV

0.2 μ V

29.9 mV

12 μ V/V + 0.2 μ V

100 mV

9.4 μ V/V

190 mV

9.6 μ V/V

2 V range

0.2 V

4.6 μ V/V

0.329 V

3.5 μ V/V

1 V

3.1 μ V/V

1.9 V

2.9 μ V/V

20 V range

2 V

3.7 μ V/V

3.29 V

3.7 μ V/V

5 V

3.9 μ V/V

10 V

3.9 μ V/V

15 V

3.9 μ V/V

19 V

3.9 μ V/V

200 V range

20 V

2.9 μ V/V

32.9 V

2.8 μ V/V

50 V

2.7 μ V/V

100 V

2.6 μ V/V

190 V

2.6 μ V/V

1000 V range

200 V

2.8 μ V/V

329 V

2.8 μ V/V

334 V

2.8 μ V/V

900 V

2.5 μ V/V

1020 V

2.5 μ V/V

Hewlett Packard 3458A Multimeter Reference Instrument

0 mV to 120 mV

4 μ V/V + 300 nV

0 V to 1.2 V

6 μ V/V + 300 nV

0 V to 12 V

6 μ V/V + 1 μ V

0 V to 120 V

8 μ V/V + 60 μ V

0 V to 1050 V

10 μ V/V + 100 μ V

Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page 9 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

Fluke 8846A Multimeter Reference Instrument

0 mV to 100 mV	26 $\mu\text{V/V}$ + 3.5 μV
0 V to 1 V	12 $\mu\text{V/V}$ + 7 μV
0 V to 10 V	18 $\mu\text{V/V}$ + 50 μV
0 V to 100 V	26 $\mu\text{V/V}$ + 600 μV
0 V to 1000 V	7 $\mu\text{V/V}$ + 10 mV

(b) AC voltage

All values in $\mu\text{V/V}$

		10 Hz	20 Hz	45 Hz	200 Hz	1 kHz	3 kHz	8 kHz	10 kHz	18 kHz	20 kHz	25 kHz	50 kHz	100 kHz	450 kHz	500 kHz	1 MHz
2	mV		2300		1100	4400						4500	10000				
3	mV		2300	270	460					4400							
10	mV					310	460				1100			2700			
20	mV		330		200					950		720	1700				
30	mV	160		190		180	200			200		160		160	1500		
300	mV	180		41		39	43			42		62		140	1700		
3	V	180		36		33	55			56		170		260	1900		7000
30	V	190		44		36	47			170		220		300			
200	V			53		40	52			170	160			330			
300	V																
1000	V			130		40	48	83									
1020	V					40	83										

Hewlett Packard 3458A Multimeter Reference Instrument (RMS sinusoidal voltage given)

1.2 mV to 12 mV	1 Hz to 40 Hz	0.03 % + 3 μV
	40 Hz to 1 kHz	0.02 % + 3 μV
	1 kHz to 20 kHz	0.03 % + 1.1 μV
	20 kHz to 300 kHz	0.01 % + 1.1 μV^*
6 mV to 120 mV	1 Hz to 40 Hz	70 $\mu\text{V/V}$ + 4 μV
	40 Hz to 1 kHz	20 $\mu\text{V/V}$ + 4 μV
	1 kHz to 20 kHz	70 $\mu\text{V/V}$ + 2 μV
	20 kHz to 2 MHz	0.016 % + 2 μV^*
0.06 V to 1.2 V	1 Hz to 40 Hz	70 $\mu\text{V/V}$ + 40 μV
	40 Hz to 1 kHz	40 $\mu\text{V/V}$
	1 kHz to 20 kHz	20 $\mu\text{V/V}$
	20 kHz to 2 MHz	20 μV^*
0.6 V to 12 V	1 Hz to 40 Hz	70 $\mu\text{V/V}$ + 400 μV

Operations Manager
Authorisation:

Issue 72

Date: 13/05/26

Page 10 of 41

CERTIFICATE OF ACCREDITATION



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

6 V to 120 V	40 Hz to 1 kHz	70 $\mu\text{V/V}$ + 400 μV
	1 kHz to 20 kHz	200 μV
	20 kHz to 2 MHz	200 μV^*
35 V to 700 V	1 Hz to 40 Hz	0.02 % + 4 mV
	40 Hz to 1 kHz	4 mV
	1 kHz to 20 kHz	2 mV
	20 kHz to 1 MHz	2 mV *
	1 Hz to 40 Hz	0.04 % + 28 mV
	40 Hz to 1 kHz	0.04 % + 28 mV
	1 kHz to 20 kHz	0.06 % + 14 mV
	20 kHz to 100 kHz	14 mV *

This is an abbreviated table.

* best available over several discrete ranges combined (values given are typically from the lower end of the frequency range)

Fluke 8846A Multimeter Reference Instrument (RMS sinusoidal voltage given)

>5 mV to 100 mV	3 Hz to 5 Hz	1 % + 40 μV
	5 Hz to 10 Hz	0.35 % + 40 μV
	10 Hz to 20 Hz	40 μV
	20 Hz to 40 Hz	40 μV
	40 Hz to 100 Hz	40 μV
	100 Hz to 200 Hz	40 μV
	200 Hz to 1 kHz	40 μV
	1 kHz to 20 kHz	40 μV
	20 kHz to 50 kHz	0.1 % + 50 μV
	50 kHz to 100 kHz	80 μV
	100 kHz to 300 kHz	2 % + 500 μV
>0.05 V to 1 V	3 Hz to 5 Hz	1 % + 300 μV
	5 Hz to 10 Hz	0.35 % + 300 μV
	10 Hz to 20 Hz	0.04 % + 300 μV
	20 Hz to 40 Hz	0.02 % + 300 μV
	40 Hz to 100 Hz	0.01 % + 300 μV
	100 Hz to 200 Hz	0.01 % + 300 μV
	200 Hz to 1 kHz	0.01 % + 300 μV
	1 kHz to 20 kHz	300 μV
	20 kHz to 50 kHz	500 μV
	50 kHz to 100 kHz	800 μV
	100 kHz to 300 kHz	1 % + 5 mV
>0.5 V to 10 V	3 Hz to 5 Hz	1 % + 3 mV
	5 Hz to 10 Hz	0.35 % + 3 mV
	10 Hz to 20 Hz	0.09 % + 3 mV

Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page 11 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

	20 Hz to 40 Hz	0.04 % + 3 mV
	40 Hz to 100 Hz	0.04 % + 3 mV
	100 Hz to 200 Hz	0.04 % + 3 mV
	200 Hz to 1 kHz	0.04 % + 3 mV
	1 kHz to 20 kHz	0.04 % + 3 mV
	20 kHz to 50 kHz	0.06 % + 5 mV
	50 kHz to 100 kHz	0.2 % + 8 mV
	100 kHz to 300 kHz	1 % + 50 mV
	>5 V to 100 V	
	3 Hz to 5 Hz	1 % + 30 mV
	5 Hz to 10 Hz	0.35 % + 30 mV
	10 Hz to 20 Hz	0.31 % + 30 mV
	20 Hz to 40 Hz	0.08 % + 30 mV
	40 Hz to 100 Hz	0.06 % + 30 mV
	100 Hz to 200 Hz	0.06 % + 30 mV
	200 Hz to 1 kHz	0.05 % + 30 mV
	1 kHz to 20 kHz	0.03 % + 30 mV
	20 kHz to 50 kHz	0.05 % + 50 mV
	50 kHz to 100 kHz	0.1 % + 80 mV
	100 kHz to 300 kHz	500 mV
	>50 V to 1000 V	
	3 Hz to 5 Hz	1 % + 220 mV
	5 Hz to 10 Hz	0.35 % + 220 mV
	10 Hz to 20 Hz	0.31 % + 220 mV
	20 Hz to 40 Hz	0.08 % + 220 mV
	40 Hz to 100 Hz	0.07 % + 220 mV
	100 Hz to 200 Hz	0.06 % + 220 mV
	200 Hz to 1 kHz	0.06 % + 220 mV
	1 kHz to 20 kHz	0.06 % + 220 mV
	20 kHz to 50 kHz	370 mV
(c)	50 kHz to 100 kHz	600 mV
	100 kHz to 300 kHz	3.70 V
	DC current	
	330 µA range	
	0 µA	0.15 nA
	190 µA	11 µA/A + 0.15 nA
	329 µA	21 µA/A
	3.3 mA range	
	1.9 mA	9.9 µA/A
	3.29 mA	22 µA/A
	33 mA range	
	19 mA	23 µA/A
	32.9 mA	28 µA/A

Operations Manager
Authorisation:

Issue 72

Date: 13/05/26

Page 12 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

330 mA range
190 mA
329 mA

16 μ A/A
50 μ A/A

3 A range
1.09 A
2.99 A

23 μ A/A
170 μ A/A

20 A range
10.9 A
19.9 A

98 μ A/A
78 μ A/A

Hewlett Packard 3458A Multimeter Reference Instrument

0 nA to 120 nA
0 μ A to 1.2 μ A
0 μ A to 12 μ A
0 μ A to 120 μ A
0 mA to 1.2 mA
0 mA to 12 mA
0 mA to 120 mA
0 A to 1.05 A

50 μ A/A + 5.2 nA
41 μ A/A + 5.2 nA
41 μ A/A + 5.2 nA
41 μ A/A + 5.4 nA
37 μ A/A + 7 nA
32 μ A/A + 50 nA
62 μ A/A + 500 nA
90 μ A/A + 10 μ A

Fluke 8846A Multimeter Reference Instrument

0 μ A to 100 μ A
0 mA to 1 mA
0 mA to 10 mA
0 mA to 100 mA
0 mA to 400 mA
0 A to 1 A
0 A to 3 A
0 A to 10 A

0.02 % + 0.025 μ A
0.02 % + 0.05 μ A
0.02 % + 2 μ A
0.01 % + 5 μ A
0.02 % + 20 μ A
0.06 % + 200 μ A
0.1 % + 600 μ A
0.03 % + 800 μ A

(d) AC current

All values in μ A/A

		10 Hz	20 Hz	45 Hz	65 Hz	200 Hz	500 Hz	1 kHz	5 kHz	10 kHz	30 kHz
10	μA					3400			3100		
33	μA					3400		310	1000		1300
100	μA					72	290			860	820
190	μA			110				100	860		
199	μA		590	170	140				410	890	1200
330	μA	249									

Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page 13 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

1.9	mA	320	300					82	440		800
3.3	mA							120	360	1000	1200
19	mA	370					45	380		800	
33	mA						100	140	360	1200	
190	mA	1200	160					57	77		710
330	mA							130	480	680	3500
1.09	A	120	110					70	520	380	
3	A	1400	100	120					170	430	
3.3	A			120	120	140	480	120	170		
10.9	A					140		140	230		
20	A			110	90	100		120	500		

Hewlett Packard 3458A Multimeter Reference Instrument (RMS sinusoidal current given)

2.4 μ A to 120 μ A	10 Hz to 20 Hz	0.4 % + 30 nA
	20 Hz to 45 Hz	0.10 % + 30 nA
	45 Hz to 100 Hz	30 nA
	100 Hz to 1 kHz	30 nA
0.06 mA to 1.2 mA	10 Hz to 20 Hz	0.4 % + 200 nA
	20 Hz to 45 Hz	0.10 % + 200 nA
	45 Hz to 100 Hz	200 nA
	100 Hz to 1 kHz	200 nA
	1 kHz to 5 kHz	200 nA
	5 kHz to 20 kHz	200 nA
	20 kHz to 50 kHz	0.4 % + 400 nA
	50 kHz to 100 kHz	0.55 % + 1.5 μ A
0.6 mA to 12 mA	10 Hz to 20 Hz	0.4 % + 2 μ A
	20 Hz to 45 Hz	0.10 % + 2 μ A
	45 Hz to 100 Hz	2 μ A
	100 Hz to 1 kHz	2 μ A
	1 kHz to 5 kHz	2 μ A
	5 kHz to 20 kHz	2 μ A
	20 kHz to 50 kHz	0.4 % + 4 μ A
	50 kHz to 100 kHz	0.55 % + 15 μ A
6 mA to 120 mA	10 Hz to 20 Hz	0.4 % + 20 μ A
	20 Hz to 45 Hz	0.10 % + 20 μ A
	45 Hz to 100 Hz	20 μ A
	100 Hz to 1 kHz	20 μ A
	1 kHz to 5 kHz	20 μ A
	5 kHz to 20 kHz	20 μ A
	20 kHz to 50 kHz	0.4 % + 40 μ A
	50 kHz to 100 kHz	0.55 % + 150 μ A

Operations Manager
Authorisation:

[Signature]

Issue 72

Date:13/05/26

Page 14 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

52.5 mA to 1.05 A	10 Hz to 20 Hz	0.4 % + 200 μ A
	20 Hz to 45 Hz	0.16 % + 200 μ A
	45 Hz to 100 Hz	0.08 % + 200 μ A
	100 Hz to 1 kHz	0.1 % + 200 μ A
	1 kHz to 5 kHz	0.1 % + 200 μ A
	5 kHz to 20 kHz	0.1 % + 200 μ A
	20 kHz to 50 kHz	1 % + 400 μ A

Fluke 8846A Multimeter Reference Instrument (RMS sinusoidal current given)

>5 μ A to 100 μ A	3 Hz to 5 Hz	1.1 % + 0.06 μ A
	5 Hz to 10 Hz	0.35 % + 0.06 μ A
	10 Hz to 20 Hz	0.32 % + 0.06 μ A
	20 Hz to 40 Hz	0.14 % + 0.06 μ A
	40 Hz to 100 Hz	0.13 % + 0.06 μ A
	100 Hz to 200 Hz	0.12 % + 0.06 μ A
	200 Hz to 1 kHz	0.11 % + 0.06 μ A
	1 kHz to 5 kHz	0.06 % + 0.06 μ A
	5 kHz to 10 kHz	0.7 μ A

>0.05 mA to 1 mA	3 Hz to 5 Hz	1 % + 0.4 μ A
	5 Hz to 10 Hz	0.3 % + 0.4 μ A
	10 Hz to 20 Hz	0.3 % + 0.4 μ A
	20 Hz to 40 Hz	0.11 % + 0.4 μ A
	40 Hz to 100 Hz	0.1 % + 0.4 μ A
	100 Hz to 200 Hz	0.09 % + 0.4 μ A
	200 Hz to 1 kHz	0.09 % + 0.4 μ A
	1 kHz to 5 kHz	0.1 % + 0.4 μ A
	5 kHz to 10 kHz	2.5 μ A

>0.5 mA to 10 mA	3 Hz to 5 Hz	1.1 % + 6 μ A
	5 Hz to 10 Hz	0.35 % + 6 μ A
	10 Hz to 20 Hz	0.15 % + 6 μ A
	20 Hz to 40 Hz	0.07 % + 6 μ A
	40 Hz to 100 Hz	0.06 % + 6 μ A
	100 Hz to 200 Hz	0.06 % + 6 μ A
	200 Hz to 1 kHz	0.05 % + 6 μ A
	1 kHz to 5 kHz	6 μ A
	5 kHz to 10 kHz	70 μ A

>5 mA to 100 mA	3 Hz to 5 Hz	1 % + 40 μ A
	5 Hz to 10 Hz	0.3 % + 40 μ A
	10 Hz to 20 Hz	0.2 % + 40 μ A
	20 Hz to 40 Hz	0.07 % + 40 μ A
	40 Hz to 100 Hz	0.07 % + 40 μ A
	100 Hz to 200 Hz	0.07 % + 40 μ A

Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page 15 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

	200 Hz to 1 kHz	0.07 % + 40 μ A
	1 kHz to 5 kHz	0.1 % + 40 μ A
	5 kHz to 10 kHz	250 μ A
>20 mA to 329 mA	3 Hz to 5 Hz	1 % + 320 μ A
	5 Hz to 10 Hz	0.3 % + 320 μ A
	10 Hz to 20 Hz	0.2 % + 320 μ A
	20 Hz to 40 Hz	0.07 % + 320 μ A
	40 Hz to 100 Hz	0.07 % + 320 μ A
	100 Hz to 200 Hz	0.06 % + 320 μ A
	200 Hz to 1 kHz	0.05 % + 320 μ A
	1 kHz to 5 kHz	320 μ A
	5 kHz to 10 kHz	2.30 mA
>0.05 A to 1 A	3 Hz to 5 Hz	1 % + 400 μ A
	5 Hz to 10 Hz	0.3 % + 400 μ A
	10 Hz to 20 Hz	0.35 % + 400 μ A
	20 Hz to 40 Hz	0.12 % + 400 μ A
	40 Hz to 100 Hz	400 μ A
	100 Hz to 200 Hz	400 μ A
	200 Hz to 1 kHz	400 μ A
	1 kHz to 5 kHz	400 μ A
	5 kHz to 10 kHz	7 mA
>0.15 A to 3 A	3 Hz to 5 Hz	1.1 % + 1.8 mA
	5 Hz to 10 Hz	0.35 % + 1.8 mA
	10 Hz to 20 Hz	0.4 % + 1.8 mA
	20 Hz to 40 Hz	0.17 % + 1.8 mA
	40 Hz to 100 Hz	1.8 mA
	100 Hz to 200 Hz	1.8 mA
	200 Hz to 1 kHz	1.8 mA
	1 kHz to 5 kHz	1.8 mA
	5 kHz to 10 kHz	3.7 % + 21 mA
>0.5 A to 10 A	3 Hz to 5 Hz	1.1 % + 6 mA
	5 Hz to 10 Hz	0.35 % + 6 mA
	10 Hz to 20 Hz	0.4 % + 6 mA
	20 Hz to 40 Hz	0.17 % + 6 mA
	40 Hz to 100 Hz	6 mA
	100 Hz to 200 Hz	0.01 % + 6 mA
	200 Hz to 1 kHz	0.02 % + 6 mA
	1 kHz to 5 kHz	0.08 % + 6 mA
	5 kHz to 10 kHz	0.35 % + 70 mA

(e) Resistance

Calibrator range

Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page 16 of 41

CERTIFICATE OF ACCREDITATION



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

0 Ω	18 $\mu\Omega$
1.9 Ω	21 $\mu\Omega/\Omega + 18 \mu\Omega$
10.9 Ω	15 $\mu\Omega/\Omega$
11.9 Ω	10 $\mu\Omega/\Omega$
19 Ω	10 $\mu\Omega/\Omega$
30 Ω	6.4 $\mu\Omega/\Omega$
33 Ω	6.2 $\mu\Omega/\Omega$
109 Ω	7.8 $\mu\Omega/\Omega$
119 Ω	8.6 $\mu\Omega/\Omega$
190 Ω	8.4 $\mu\Omega/\Omega$
300 Ω	6.1 $\mu\Omega/\Omega$
330 Ω	6.3 $\mu\Omega/\Omega$
1.09 k Ω	6.9 $\mu\Omega/\Omega$
1.19 k Ω	7.4 $\mu\Omega/\Omega$
1.9 k Ω	6.7 $\mu\Omega/\Omega$
3 k Ω	6.2 $\mu\Omega/\Omega$
3.3 k Ω	5.7 $\mu\Omega/\Omega$
10.9 k Ω	7.8 $\mu\Omega/\Omega$
11.9 k Ω	5.6 $\mu\Omega/\Omega$
19 k Ω	5.6 $\mu\Omega/\Omega$
30 k Ω	6.8 $\mu\Omega/\Omega$
33 k Ω	5.7 $\mu\Omega/\Omega$
109 k Ω	8.7 $\mu\Omega/\Omega$
119 k Ω	8.7 $\mu\Omega/\Omega$
190 k Ω	8.7 $\mu\Omega/\Omega$
300 k Ω	14 $\mu\Omega/\Omega$
330 k Ω	14 $\mu\Omega/\Omega$
1.09 M Ω	16 $\mu\Omega/\Omega$
1.19 M Ω	17 $\mu\Omega/\Omega$
1.9 M Ω	16 $\mu\Omega/\Omega$
3 M Ω	14 $\mu\Omega/\Omega$
3.3 M Ω	14 $\mu\Omega/\Omega$
10.9 M Ω	24 $\mu\Omega/\Omega$
11.9 M Ω	84 $\mu\Omega/\Omega$
19 M Ω	24 $\mu\Omega/\Omega$
30 M Ω	150 $\mu\Omega/\Omega$
33 M Ω	160 $\mu\Omega/\Omega$
109 M Ω	140 $\mu\Omega/\Omega$
119 M Ω	260 $\mu\Omega/\Omega$
400 M Ω	840 $\mu\Omega/\Omega$
640 M Ω	930 $\mu\Omega/\Omega$
1090 M Ω	940 $\mu\Omega/\Omega$

Hewlett Packard 3458A Multimeter Reference Instrument

0 Ω to 12 Ω	24 $\mu\Omega/\Omega + 50 \mu\Omega$
0 Ω to 120 Ω	12 $\mu\Omega/\Omega + 500 \mu\Omega$

Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page 17 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

0 Ω to 1.2 k Ω	10 $\mu\Omega/\Omega$ + 500 $\mu\Omega$
0 Ω to 12 k Ω	10 $\mu\Omega/\Omega$ + 5 m Ω
0 Ω to 120 k Ω	11 $\mu\Omega/\Omega$ + 50 m Ω
0 Ω to 1.2 M Ω	15 $\mu\Omega/\Omega$ + 2 Ω
0 Ω to 12 M Ω	50 $\mu\Omega/\Omega$ + 100 Ω
0 Ω to 120 M Ω	500 $\mu\Omega/\Omega$ + 1 k Ω
0 Ω to 1.2 G Ω	5000 $\mu\Omega/\Omega$ + 10 k Ω

Fluke 8846A Multimeter Reference Instrument

0 Ω to 10 Ω	0.05 % + 3 m Ω
0 Ω to 100 Ω	0.02 % + 4 m Ω
0 Ω to 1 k Ω	0.02 % + 10 m Ω
0 Ω to 10 k Ω	0.02 % + 100 m Ω
0 Ω to 100 k Ω	0.01 % + 1 Ω
0 Ω to 1 M Ω	0.01 % + 10 Ω
0 Ω to 10 M Ω	0.04 % + 100 Ω
0 Ω to 100 M Ω	0.4 % + 10 k Ω
0 Ω to 1 G Ω	2 % + 100 k Ω

(i) Other

Phase angle

0° to 360°

V & V

Amplitude

35 mV to 50 V

Frequency

60 Hz to 10 kHz

0.075°

V & I

Amplitude (V)

35 mV to 33 V

Amplitude (I)

300 mA to 20 A

Frequency

10 Hz to 1 kHz

0.075°

Electrical simulation of temperature signal for calibration of resistance temperature device calibrators

-200 °C to 0 °C	0.0041 °C
0 °C to 100 °C	0.0048 °C
100 °C to 300 °C	0.0054 °C
300 °C to 600 °C	0.0082 °C
600 °C to 850 °C	0.012 °C

Electrical simulation of temperature signal for calibration of thermocouple calibrators

-200 °C to 0 °C	0.021 °C
0 °C to 100 °C	0.012 °C
100 °C to 300 °C	0.020 °C
300 °C to 600 °C	0.021 °C

Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page 18 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

600 °C to 1200 °C

0.022 °C

5.89 Indicating Instruments and Recording Instruments

In accordance with in-house methods based on manufacturer's recommendations, in the Auckland and Christchurch laboratories

(a) DC voltmeters

220 mV range

0 mV

0.39 μ V

219 mV

6.3 μ V/V + 0.39 μ V

2.2 V range

0.22 V

4.6 μ V/V

2.19 V

5.0 μ V/V

11 V range

2.2 V

4.2 μ V/V

10.9 V

3.3 μ V/V

22 V range

11 V

3.4 μ V/V

21.9 V

3.3 μ V/V

220 V range

22 V

6.3 μ V/V

219.9 V

4.8 μ V/V

1000 V range

220 V

7.9 μ V/V

1000 V

6.5 μ V/V

(b) AC voltmeters

All values in μ V/V

		10 Hz	20 Hz	40 Hz	50 Hz	1 kHz	20 kHz	30 kHz	50 kHz	100 kHz	300 kHz	500 kHz	1 MHz
2	mV	2100	2100	1900				2000		2700	5500	10000	12000
2.2	mV	1900	1900	1800				1900		2500	2500	9900	11000
22	mV	400		260	240			360	660	1400	2200	4200	
220	mV	290	280	110	81			140	380	920	2100	7500	
2.2	V	260	240	91	58			87	130	920	2400	8800	
22	V	250	240	91	66			190	320	800	1800	1500	
220	V	240	240	91	52			83	150				

Operations Manager
Authorisation:

Issue 72

Date: 13/05/26

Page 19 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

250	V		330		460	470	1800			
750	V		467							
1050	V		68	130	460					

In the Christchurch laboratory

All values in $\mu\text{V/V}$

		0.01 Hz	10 Hz	20 Hz	45 Hz	1 kHz	5 kHz	10 kHz	20 kHz	30 kHz	50 kHz	100 kHz	500 kHz
1	mV	45000	380	380	180	180	180	180	280	330	960	1900	1900
33	mV	5000	320	320	71	120	51	64	120	120	300	580	580
330	mV	5000	320	320	33	120	42	48	120	150	440	780	780
3.3	V	5000	320	320	30	120	100	98	120	98	150		
33	V				320	120	64	120	220	110	550		
330	V				320	120	64	180					
1020	V				320	120	64	180					

(c) DC ammeters

220 μA range

0 μA

220 μA

5.3 nA

38 $\mu\text{A/A}$ + 5.3 nA

2.2 mA range

0.22 mA

2.19 mA

59 $\mu\text{A/A}$

34 $\mu\text{A/A}$

22 mA range

2.2 mA

21.9 mA

48 $\mu\text{A/A}$

32 $\mu\text{A/A}$

220 mA range

22 mA

219.9 mA

66 $\mu\text{A/A}$

48 $\mu\text{A/A}$

2.2 A range

0.22 A

2.2 A

120 $\mu\text{A/A}$

110 $\mu\text{A/A}$

11 A range

2.2 A

11 A

440 $\mu\text{A/A}$

300 $\mu\text{A/A}$

20 A range

Operations Manager
Authorisation:

Issue 72

Date: 13/05/26

Page 20 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

11 A	810 μ A/A
19.9 A	790 μ A/A

Clamp meters using current coil (nominal ranges)

4 mA	0.47 %
12 mA	0.31 %
20 mA	0.21 %
100 mA	0.19 %
3 A	2.20 %
10 A	0.69 %
20 A	0.68 %
100 A	0.67 %
150 A	0.63 %
550 A	0.58 %
600 A	0.58 %
900 A	0.55 %

In the Christchurch laboratory

Fluke 5522A Calibrator Reference Instrument

0 μ A to 330 μ A	81 μ A/A
0 mA to 3.3 mA	26 μ A/A
0 mA to 33 mA	36 μ A/A
0 mA to 330 mA	41 μ A/A
0 mA to 1.1 A	98 μ A/A
1.1 A to 3 A	110 μ A/A
0 A to 11 A	120 μ A/A
11 A to 20.5 A	1000 μ A/A

Fluke 52120A Transconductance Amplifier Reference Instrument (using Fluke 5522A Calibrator)

CMC uncertainty for DC Current is calculated as the root sum of squares of the uncertainties for the appropriate Fluke 5522A voltage or current output values and the Fluke 52120A Range. Example uncertainties are given below (truncated to two significant figures). Output values are at 10 % and 100 % of each range.

Fluke 52120A, Fluke 5522A Reference Instruments current

Range	Output	
0.2 A to 2 A	0.2 A	0.49 mA/A
	2 A	0.13 mA/A
	2 A to 20 A	2 A
10 A to 100 A	20 A	0.091 mA/A
	10 A	0.44 mA/A
	100 A	0.082 mA/A

Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page 21 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

Fluke 52120A Transconductance Amplifier and Fluke 52120A/COIL 3KA (using Fluke 5522A Calibrator)
Reference Instruments

CMC uncertainty for equivalent DC Current using the Fluke 52120A and 52120A/COIL 3KA is calculated as the root sum of squares of the uncertainties for the appropriate Fluke 5522A voltage or current output values, the Fluke 52120A Range and the Fluke 52120A/COIL 3KA Range. Example uncertainties are given below (rounded to two significant figures).

Fluke 52120A, Fluke 5522A Reference Instruments current

5 A to 50 A	5 A	9.8 mA/A
	50 A	7.3 mA/A
50 A to 500 A	50 A	9.8 mA/A
	500 A	7.3 mA/A
250 A to 2500 A	250 A	3.2 mA/A
	2500 A	0.65 mA/A

Fluke 52120A Transconductance Amplifier and Fluke 52120A/COIL 6KA (using Fluke 5522A Calibrator)
Reference Instruments

CMC uncertainty for equivalent DC Current using the Fluke 52120A and 52120A/COIL 6KA is calculated as the root sum of squares of the uncertainties for the appropriate Fluke 5522A voltage or current output values, the Fluke 52120A Range and the Fluke 52120A/COIL 6KA Range. Example uncertainties are given below (rounded to two significant figures).

Fluke 52120A, Fluke 5522A Reference Instruments current

10 A to 100 A	10 A	8.4 mA/A
	100 A	7.1 mA/A
100 A to 1000 A	100 A	8.4 mA/A
	1000 A	7.1 mA/A
500 A to 5000 A	500 A	5.5 mA/A
	5000 A	4.3 mA/A

(d) AC ammeters

All values in $\mu\text{A/A}$

		10 Hz	20 Hz	40 Hz	45 Hz	100 Hz	1 kHz	5 kHz	10 kHz	30 kHz
9	μA	1900	1900	1100			930	1500	7700	
220	μA	570	580	540			130	320	1200	
330	μA									13000
2.2	mA	280	240	160			100	220	1200	
3.3	mA	430	240							
22	mA									

Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page 22 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

33	mA			160					3100
220	mA	280	240			100	190	1000	3500
330	mA		380	360	360	460	1000	8100	
2.2	A					360	820	3200	
11	A								
20	A				1100	1100	1300	23000	

Clamp meters using current coil (nominal ranges)

3 mA	50 Hz	0.22 %
30 mA	50 Hz	0.63 %
300 mA	50 Hz	0.36 %
3 A	50 Hz	0.28 %
10 A	50 Hz	0.61 %
100 A	50 Hz	0.80 %
550 A	50 Hz	0.20 %
600 A	50 Hz	0.71 %
900 A	50 Hz	0.66 %
20 A	400 Hz	1.8 %
50 A	400 Hz	1.3 %
100 A	400 Hz	1.2 %
120 A	400 Hz	1.1 %
250 A	400 Hz	1.2 %
400 A	400 Hz	1.1 %

Toroidal-Type Clamps

20 A to 150 A	40 to 60 Hz	0.44 %
150 A to 1000 A	40 to 60 Hz	0.38 %

In the Christchurch laboratory

Fluke 5522A Calibrator Reference Instrument

All values in $\mu\text{A/A}$

		10 Hz	20 Hz	40 Hz	45 Hz	100 Hz	1 kHz	5 kHz	10 kHz	30 kHz
29	μA	600	470	300	440	1300	1200	1600	3200	3200
330	μA	550	350	250	240	150	260	1100	2200	2200
3.3	mA	460	260	160	160	160	260	1100	2100	2100
33	mA	560	290	160	160	160	250	300	1600	1600
330	mA	690	620	190	190	190	910	4500		
1.1	A	630	700	330	330	330	730	12000		

Operations Manager
Authorisation:

Issue 72

Date: 13/05/26

Page 23 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

3	A			280	350	380	13000			
11	A			1200	1300	540	8800			
20.5	A			1200	1300	540	8800			

Fluke 52120A Transconductance Amplifier (using Fluke 5500A Calibrator) Reference Instruments

CMC uncertainty for AC Current is calculated as the root sum of squares of the uncertainties for the appropriate Fluke 5500A voltage or current output values and the Fluke 52120A range.

Example uncertainties are given below (rounded to two significant figures).

Available frequency range 10 Hz to 10 kHz. Output values are at 10 % and 100 % of each range

Uncertainty values in mA/A

Range	Output	50 Hz	400 Hz	10 kHz
0.2 A to 2 A	0.2 A	5.4	5.4	310
	2 A	0.56	0.56	31
2 A to 20 A	2 A	4.7	4.7	47
	20 A	0.49	0.49	4.7
12 A to 120 A	12 A	1.6	7.8	88
	120 A	0.23	0.80	35

Fluke 52120A Transconductance Amplifier and Fluke 52120A/COIL 3KA (using 5522A Calibrator) Reference Instruments

CMC uncertainty for equivalent AC Current using the Fluke 52120A and 52120A/COIL 3KA is calculated as the root sum of squares of the uncertainties for the appropriate Fluke 5522A voltage or current output values, the Fluke 52120A Range and the Fluke 52120A/COIL 3KA Range.

Example uncertainties are given below (rounded to two significant figures).

Available frequency range is 50 Hz to 400 Hz.

Uncertainty values in mA/A

Range	Output	50 Hz	400 Hz
5 A to 50 A	5A	11	11
	50 A	7.3	7.3
50 A to 500 A	50 A	11	11
	500 A	7.3	7.3
300 A to 3000 A	300 A	3.4	8.4
	3000 A	0.56	1.0

Fluke 52120A Transconductance Amplifier and Fluke 52120A/COIL 6KA (using 5522A Calibrator) Reference Instruments

Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page 24 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

CMC uncertainty for equivalent AC Current using the Fluke 52120A and 52120A/COIL 6KA is calculated as the root sum of squares of the uncertainties for the appropriate Fluke 5500A voltage or current output values, the Fluke 52120A Range and the Fluke 52120A/COIL 6KA Range.

Example uncertainties are given below (rounded to two significant figures).

Available frequency range is 50 Hz to 400 Hz.

Uncertainty values in mA/A

Range	Output	50 Hz	400 Hz
10 A to 100 A	10 A	10	10
	100 A	7.2	7.2
100 A to 1000 A	100 A	9.6	9.6
	1000 A	7.2	7.2
600 A to 6000 A	600 A	5.8	9.3
	6000 A	4.3	3.9

(e) Wattmeters

CMC 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: 1 mVac to 1020 Vac, or 0 V to 1020 Vdc. Current limitations: 29 μ Aac to 20.5 Aac, or 0 A to 20.5 Adc. Auxiliary voltage limitations: 10 mVac to 5 Vac, or 0 V to 7 Vdc.

The range of direct output is from 29 nWac through to 20.91 kWac (at unity power factor), or 0 Wdc through to 20.91 kWdc (or equivalent in VA).

Power can be simulated over greater ranges for equipment incorporating current clamps or current transformers. (Maximum output available for the voltage input is 1020 V, and maximum output available for the "current" input is 20.5 A or 5 V).

(f) Varmeters

CMC 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 5.89 (e)

(g) Phase angle indicators

Refer to 5.88 (i)

In the Christchurch laboratory

0° to 179.98°	10 Hz to 65 Hz	0.10°
	65 Hz to 500 Hz	0.25°
	500 Hz to 1 kHz	0.50°

Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page 25 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

1 kHz to 5 kHz	2.5°
5 kHz to 10 kHz	5.0°
10 kHz to 30 kHz	10°

(h) Power factor meters

CMC uncertainty for power factor may be calculated from the least uncertainty given above for Phase angle indicators. (For example: Least uncertainty for power factor of 0.500 at 50 Hz is $\text{ACos}(0.500) \pm 0.10^\circ$, which is $0.500 (+0.001511, -0.001512)$ or 0.500 ± 0.002).

Voltage and current limitations apply as for 5.89 (e)

(i) Ohmmeters

0 Ω	38 $\mu\Omega$
1 Ω	46 $\mu\Omega/\Omega + 38 \mu\Omega$
1.9 Ω	84 $\mu\Omega/\Omega$
10 Ω	21 $\mu\Omega/\Omega$
19 Ω	21 $\mu\Omega/\Omega$
100 Ω	9.2 $\mu\Omega/\Omega$
190 Ω	9.5 $\mu\Omega/\Omega$
1 k Ω	6.2 $\mu\Omega/\Omega$
1.9 k Ω	6.5 $\mu\Omega/\Omega$
10 k Ω	6.2 $\mu\Omega/\Omega$
19 k Ω	6.1 $\mu\Omega/\Omega$
100 k Ω	7.7 $\mu\Omega/\Omega$
190 k Ω	9.2 $\mu\Omega/\Omega$
1 M Ω	12 $\mu\Omega/\Omega$
1.9 M Ω	16 $\mu\Omega/\Omega$
10 M Ω	36 $\mu\Omega/\Omega$
19 M Ω	42 $\mu\Omega/\Omega$
100 M Ω	93 $\mu\Omega/\Omega$
1 G Ω	220 $\mu\Omega/\Omega$

In the Christchurch laboratory using a Fluke 5522A Calibrator Reference Instrument

0 Ω to 11 Ω	91 $\mu\Omega/\Omega$
11 Ω to 33 Ω	45 $\mu\Omega/\Omega$
33 Ω to 110 Ω	20 $\mu\Omega/\Omega$
110 Ω to 330 Ω	12 $\mu\Omega/\Omega$
330 Ω to 1.1 k Ω	16 $\mu\Omega/\Omega$
1.1 k Ω to 3.3 k Ω	11 $\mu\Omega/\Omega$
3.3 k Ω to 11 k Ω	9.2 $\mu\Omega/\Omega$
11 k Ω to 33 k Ω	22 $\mu\Omega/\Omega$
33 k Ω to 110 k Ω	19 $\mu\Omega/\Omega$
110 k Ω to 330 k Ω	26 $\mu\Omega/\Omega$
330 k Ω to 1.1 M Ω	22 $\mu\Omega/\Omega$

Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page 26 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory

Accreditation Number 271

SCOPE OF ACCREDITATION

1.1 MΩ to 3.3 MΩ	49 μΩ/Ω
3.3 MΩ to 11 MΩ	85 μΩ/Ω
11 MΩ to 33 MΩ	76 μΩ/Ω
33 MΩ to 110 MΩ	130 μΩ/Ω
110 MΩ to 330 MΩ	300 μΩ/Ω
330 MΩ to 1100 MΩ	1500 μΩ/Ω

(j) LCR meters

Capacitance

Frequency

0.22 nF	5 kHz	1800 μF/F
0.39 nF	1 kHz	2900 μF/F
0.48 nF	1 kHz	1300 μF/F
0.6 nF	1 kHz	830 μF/F
1 nF	1 kHz	540 μF/F
2 nF	1 kHz	460 μF/F
7 nF	1 kHz	390 μF/F
10.9 nF	1 kHz	190 μF/F
20 nF	1 kHz	190 μF/F
70 nF	1 kHz	240 μF/F
109 nF	1 kHz	270 μF/F
200 nF	1 kHz	480 μF/F
300 nF	1 kHz	690 μF/F
0.7 μF	100 Hz	780 μF/F
1.09 μF	100 Hz	780 μF/F
2 μF	100 Hz	790 μF/F
3 μF	100 Hz	780 μF/F
7 μF	100 Hz	790 μF/F
10 μF	100 Hz	830 μF/F
20 μF	100 Hz	910 μF/F
30 μF	100 Hz	1000 μF/F
70 μF	50 Hz	630 μF/F
109 μF	50 Hz	780 μF/F
200 μF	dc	290 μF/F
300 μF	dc	250 μF/F
0.33 mF	dc	240 μF/F
0.7 mF	dc	280 μF/F
1.09 mF	dc	240 μF/F
1.1 mF	dc	230 μF/F
2 mF	dc	250 μF/F
3 mF	dc	230 μF/F
3.3 mF	dc	250 μF/F
10.9 mF	dc	240 μF/F
20 mF	dc	230 μF/F
30 mF	dc	230 μF/F
33 mF	dc	230 μF/F

Operations Manager
Authorisation:

Issue 72

Date: 13/05/26

Page 27 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

110 mF

dc

240 μ F/F

In the Christchurch laboratory using a Fluke 5522A Calibrator Reference Instrument

0.22 nF to 0.4 nF	25000 μ F/F
0.4 nF to 1.1 nF	9100 μ F/F
1.1 nF to 3.3 nF	3000 μ F/F
3.3 nF to 11 nF	1900 μ F/F
11 nF to 33 nF	3000 μ F/F
33 nF to 110 nF	910 μ F/F
110 nF to 330 nF	910 μ F/F
0.33 μ F to 1.1 μ F	1900 μ F/F
1.1 μ F to 3.3 μ F	1900 μ F/F
3.3 μ F to 11 μ F	1300 μ F/F
11 μ F to 33 μ F	1600 μ F/F
33 μ F to 110 μ F	970 μ F/F
110 μ F to 330 μ F	1700 μ F/F
0.33 mF to 1.1 mF	2100 μ F/F
1.1 mF to 3.3 mF	1500 μ F/F
3.3 mF to 11 mF	1500 μ F/F
11 mF to 33 mF	1500 μ F/F
33 mF to 110 mF	1300 μ F/F

(n) Digital storage recorders

This section gives CMC uncertainties for oscilloscope calibrations using the Wavetek 9500 Calibrator Reference Instrument

DC Voltage into 1 M Ω	-222.4 V to -99.999 V	0.014 % + 25 μ V
	-99.999 V to -9.9999V	0.012 % + 25 μ V
	-9.9999 V to -999.99 mV	0.019 % + 25 μ V
	-999.99 mV to -99.999 mV	50 μ V/V + 25 μ V
	-99.999 mV to -9.9999 mV	25 μ V
	-9.9999 mV to -999.99 μ V	25 μ V
	-999.99 μ V to -888 μ V	0.025 % + 25 μ V
	0 V	15 μ V
	888 μ V to 1 mV	0.025 % + 25 μ V
	1 mV to 10 mV	25 μ V
	10 mV to 100 mV	25 μ V
	100 mV to 1V	30 μ V/V + 25 μ V
	1 V to 10 V	0.016 % + 25 μ V
	10 V to 100 V	0.015 % + 25 μ V
	100 V to 222.4 V	0.012 % + 25 μ V
DC Voltage into 50 Ω	-5.56 V to -888 μ V	0.025 % + 25 μ V
	0 V	15 μ V
	888 μ V to 5.56 V	0.025 % + 25 μ V

Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page 28 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

Square Voltage into 1 MΩ (negative, positive, or symmetric)	35.52 μVpp to 999.99 μVpp	1 % + 10 μV
	1 mVpp to 21 mVpp	0.1 % + 15 μV
	21.001 mVpp to 556 mVpp	0.1 % + 1 μV
	556.01 mVpp to 210 Vpp	0.05 % + 1 μV
	0 V	15 μV

Output Frequency	10 Hz to 100 kHz	0.25 μHz/Hz
------------------	------------------	-------------

Square Voltage into 50 Ω (negative, positive or symmetric)	35.52 μVpp to 999.99 μVpp	1.0 % + 10 μV
	1 mVpp to 21 mVpp	0.1 % + 15 μV
	21.001 mVpp to 556 mVpp	0.1 % + 1 μV
	556.01 mVpp to 5.56 Vpp	0.05 % + 1 μV
	0 V	15 μV

Output Frequency	10 Hz to 100 kHz	0.25 μHz/Hz
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Levelled Sine

Reference level 50 kHz to 10 MHz	4.4 mVpp to 5.56 Vpp	1.5 %
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Flatness relative to reference level 100 mHz to 100 MHz	4.44 mVpp to 1 Vpp	0.7 %
	1 Vpp to 3.337 Vpp	0.7 %
	3.337 Vpp to 5.56 Vpp	1.5 %

100 MHz to 550 MHz	4.44 mVpp to 1 Vpp	2 %
	1 Vpp to 3.337 Vpp	2 %
	3.337 Vpp to 5.56 Vpp	3 %

550 MHz to 1.1 GHz	4.44 mVpp to 1 Vpp	2 %
	1 Vpp to 3.3369 Vpp	2 %

Low Edge
into 50 Ω and 1 MΩ

Output Voltage	4.4 mVpp to 3.1 Vpp	3 %
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Rise/Fall Time (10 % to 90 %)	4.44 mVpp to 3.1 Vpp	500 ps nominal
----------------------------------	----------------------	----------------

Output Period	500 ns to 100 ms	0.25 μs/s
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High Edge into 50 Ω

Output Voltage	888 mVpp to 5.56 Vpp	3 %
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Rise/Fall Time (10 % to 90 %)	888 mVpp to 5.56 Vpp	100 ns nominal
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Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page 29 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

Output Period	10 μ s to 100 ms	0.25 μ s/s
High Edge into 1 M Ω		
Output Voltage	888 mVpp to 100 Vpp	3 %
	100.01 Vpp to 210 Vpp	3 %
Rise/Fall Time (10 % to 90 %)	888 mVpp to 100 Vpp	150 ns nominal
	100.01 Vpp to 210 Vpp	200 ns nominal
Output Period	10 μ s to 100 ms	0.25 μ s/s
Fast Edge into 50 Ω		
Output Voltage	4.44 Vpp to 3.1 Vpp	3 %
Rise/Fall Time (10 % to 90 %)	4.44 Vpp to 3.1 Vpp	150 ps nominal
Output Period	500 ns to 100 ms	0.25 μ s/s
Time Markers into 50 Ω and 1 M Ω		
Square (nom. peak to peak)	9.0091 ns to 55 s	
	100 mV, 250 mV, 500 mV	0.25 μ s/s
	1 V	0.05 μ s/s
	(Rise/Fall Time 1 ns typical)	
Sine (nom. peak to peak)	450.5 ps to 909.1 ps	
	100 mV, 250 mV, 500 mV	0.25 μ s/s
	909.1 ps to 9.0091 μ s	
	100 mV, 250 mV, 500 mV, 1 V	0.25 μ s/s
	(Rise/Fall Time 1 ns typical)	
Pulse (nom. peak to peak)	900.91 ns to 55 s	
	100 mV, 250 mV, 500 mV, 1 V	0.25 μ s/s
	(Rise/Fall Time 1 ns typical)	
Triangle (nom. peak to peak)	900.91 ns to 55 s	
	100 mV, 250 mV, 500 mV, 1 V	0.25 μ s/s
	(Rise/Fall Time 2.5 % period)	
DC Current	88.8 μ A to 111.2 mA	0.25 % + 0.5 μ A
	-111.2 mA to -88.8 μ A	0.25 % + 0.5 μ A

Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page 30 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

Square Current	88.8 μ App to 111.2 mApp	0.25 % + 0.5 μ A
Resistance	10 Ω to 40 Ω	0.5 %
	40 Ω to 90 Ω	0.1 %
	90 Ω to 150 Ω	0.5 %
	50 k Ω to 800 k Ω	0.5 %
	800 k Ω to 1.2 M Ω	0.1 %
	1.2 M Ω to 12 M Ω	0.5 %
Capacitance	1 pF to 35 pF	2 % + 0.25 pF
	35 pF to 95 pF	2 % + 0.25 pF

Composite Video Output

Amplitude 1.0 V peak to peak
Pattern: (Full Raster) White, Grey or Black
Sync Polarity: Positive or Negative
Standards: 625-line 50 Hz, 525-line 60 Hz
Trigger Output: Composite Sync or Odd Field start

LF Linear Ramp

Waveforms: 1 V peak to peak triangle, symmetrical about ground
Ramp Time: 1 ms, 10 ms, 100 ms or 1 s
(Ramp Time wave form is rising/falling/flat over period 3 x s
For example: 1 ms rising, 1 ms falling, 1 ms flat, over 3 ms period)

0.25 % μ s/s

Overload Pulse

Amplitude: 5 V to 20 V into 50 Ω
Polarity: Positive or Negative from ground
Duration: 0.2 s to 100 s (subject to pulse energy limits)
Energy: 1.6 J to 50 J
Power into 50 Ω : 0.5 W to 8 W
Trigger: Manual triggering only, maximum repetition rate 0.3 Hz

Zero Skew

Unadjusted Skew
Skew Temp Coefficient: <0.2 ps/ $^{\circ}$ C
Output Amplitude: 1 Vpp
Frequency Range: 10 Hz to 100 MHz

< 50 ps ch to ch

Input Leakage Function

Open Circuit Output Leakage
Short Circuit Output Offset

< 50 pA
< 15 μ V

Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page **31** of **41**

CERTIFICATE OF ACCREDITATION



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

(q) Other specified devices

Voltage simulation of temperature (Fluke 5522A Calibrator Reference Instrument)

Simulated thermocouple output and thermocouple measurement.

Thermocouple Type

B	600 °C to 800 °C	0.44 °C
	800 °C to 1000 °C	0.34 °C
	1000 °C to 1550 °C	0.30 °C
	1550 °C to 1820 °C	0.33 °C
C	0 °C to 150 °C	0.30 °C
	150 °C to 650 °C	0.26 °C
	650 °C to 1000 °C	0.31 °C
	1000 °C to 1800 °C	0.50 °C
	1800 °C to 2316 °C	0.84 °C
E	-250 °C to -100 °C	0.50 °C
	-100 °C to -25 °C	0.16 °C
	-25 °C to -350 °C	0.14 °C
	350 °C to 650 °C	0.16 °C
	650 °C to 1000 °C	0.21 °C
J	-210 °C to -100 °C	0.27 °C
	-100 °C to -30 °C	0.16 °C
	-30 °C to 150 °C	0.070 °C
	150 °C to 760 °C	0.17 °C
	760 °C to 1200 °C	0.23 °C
K	-200 °C to -100 °C	0.33 °C
	-100 °C to -25 °C	0.18 °C
	-25 °C to 120 °C	0.16 °C
	120 °C to 1000 °C	0.26 °C
	1000 °C to 1372 °C	0.40 °C
L	-200 °C to -100 °C	0.37 °C
	-100 °C to 800 °C	0.26 °C
	800 °C to 900 °C	0.17 °C
N	-200 °C to -100 °C	0.40 °C
	-100 °C to -25 °C	0.22 °C
	-25 °C to 120 °C	0.19 °C
	120 °C to 410 °C	0.18 °C
	410 °C to 1300 °C	0.27 °C

Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page 32 of 41

CERTIFICATE OF ACCREDITATION



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

R	0 °C to 250 °C	0.57 °C
	250 °C to 400 °C	0.35 °C
	400 °C to 1000 °C	0.33 °C
	1000 °C to 1767 °C	0.40 °C
S	0 °C to 250 °C	0.47 °C
	250 °C to 1000 °C	0.36 °C
	1000 °C to 1400 °C	0.37 °C
	1400 °C to 1767 °C	0.46 °C
T	-250 °C to -150 °C	0.63 °C
	-150 °C to 0 °C	0.24 °C
	0 °C to 120 °C	0.16 °C
	120 °C to 400 °C	0.14 °C
U	-200 °C to 0 °C	0.56 °C
	0 °C to 600 °C	0.27 °C

Temperature standard is selectable between ITS-90 or IPTS-68.

Simulated RTD output

RTD Type

Pt 385, 100 Ω	-200 °C to -80 °C	0.05 °C
	-80 °C to 0 °C	0.05 °C
	0 °C to 100 °C	0.07 °C
	100 °C to 300 °C	0.09 °C
	300 °C to 400 °C	0.10 °C
	400 °C to 630 °C	0.12 °C
	630 °C to 800 °C	0.23 °C
Pt 3926, 100 Ω	-200 °C to -80 °C	0.05 °C
	-80 °C to 0 °C	0.05 °C
	0 °C to 100 °C	0.07 °C
	100 °C to 300 °C	0.09 °C
	300 °C to 400 °C	0.10 °C
	400 °C to 630 °C	0.12 °C
Pt 3916, 100 Ω	-200 °C to -190 °C	0.25 °C
	-190 °C to -80 °C	0.04 °C
	80 °C to 0 °C	0.05 °C
	0 °C to 100 °C	0.06 °C
	100 °C to 260 °C	0.07 °C
	260 °C to 300 °C	0.08 °C
	300 °C to 400 °C	0.09 °C

Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page 33 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

	400 °C to 600 °C	0.10 °C
	600 °C to 630 °C	0.23 °C
PtNi 385, 120 Ω	-80 °C to 0 °C	0.08 °C
(NI 120)	0 °C to 100 °C	0.08 °C
	100 °C to 260 °C	0.14 °C

Temperature standard is selectable between ITS-90 or IPTS-68

Thermocouple simulation by special method, reference junction at 0 °C, converting resistance measurements to temperature units using the tables outlined in appendix D of "Traceable Temperatures" second edition.

Source

-200.00 °C	0.07 °C
0 °C	0.03 °C
500 °C	0.03 °C
1000 °C	0.03 °C
1370 °C	0.04 °C

Measure

-199.00 °C	0.07 °C
0 °C	0.03 °C
500 °C	0.03 °C
1000 °C	0.05 °C
1370 °C	0.06 °C

Internal reference cold junction check

0.00 °C	0.02 °C
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RTD simulation by special method, converting resistance measurements to temperature units using the tables outlined in appendix C of "Traceable Temperatures" second edition.

Source/Measure

-199.00 °C	0.002 °C
0 °C	0.004 °C
100 °C	0.005 °C
500 °C	0.010 °C
800 °C	0.014 °C

AC Harmonics (Fluke 5522A Calibrator Reference Instrument)

Fundamental frequency	Voltage	Current	Auxiliary Voltage
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Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page 34 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

10 Hz to 45 Hz	33 mV to 33 V	3.3 mA to 3 A	0 mV to 5 V
45 Hz to 65 Hz	33 mV to 1020 V	3.3 mA to 20.5 A	10 mV to 5 V
65 Hz to 500 Hz	33 mV to 1020 V	33 mA to 20.5 A	100 mV to 5 V
500 Hz to 5 kHz	330 mV to 1020 V	33 mA to 20.5 A	100 mV to 5 V
5 kHz to 10 kHz	3.3 V to 1020 V	33 mA to 330 mA	100 mV to 5 V
10 kHz to 30 kHz	3.3 V to 1020 V	33 mA to 330 mA	100 mV to 3.3 V

Maximum frequency of harmonic output: 30 kHz (10 kHz for 3.3 V to 5 V Auxiliary Voltage).

Harmonics available: 2 through 50, limited by maximum frequency of harmonic output.

(For example: a fundamental frequency of 5 kHz limits the maximum harmonic to 6, i.e. 30 kHz. Harmonics through to 50 are available for a fundamental frequency from 10 to 600 Hz {200 Hz for 3.3 to 5 V Auxiliary Voltage}).

CMC uncertainty for amplitude (voltage or current) is as per the uncertainties given in sections (a) DC voltmeters, (b) AC Voltmeters, (c) DC ammeters, and (d) AC ammeters, except that the floor component is doubled. (Note that uncertainties for Auxiliary Voltage are not given).

CMC uncertainty for phase is the greater of that given in (g) Phase angle indicators or 1°.

For example: the CMC uncertainty for phase for a 400 Hz fundamental frequency and 10 kHz harmonic frequency is 10° (from Phase angle least uncertainty for 10 kHz). Another example: the CMC uncertainty for phase for a 50 Hz fundamental frequency and 400 Hz harmonic frequency is 1° (Phase angle CMC uncertainty for 400 Hz is 0.25°, therefore 1° is used).

Electrical test equipment

The CMC uncertainties in this section are applicable to the use of the Fluke 5322A/5/VLC Multifunction Electrical Tester Calibrator and 5322A Resistance Multiplier for the calibration of the following equipment: Insulation testers, PAT testers, RCD testers, Line/Loop testers, Earth testers and equipment employing one or more such functions.

Where the 'Range' specified is not a single point, the lowest CMC uncertainty is given for the range.

Low Resistance (Continuity) – 4-Wire

9.62 mΩ	0.6 %
0.1 Ω to 0.199 Ω	1 %
0.2 Ω to 0.499 Ω	0.8 %
0.5 Ω to 1.999 Ω	0.4 %
2 Ω to 4.999 Ω	0.2 %
5 Ω to 29.99 Ω	0.05 %
30 Ω to 199.9 Ω	0.043 %
0.2 kΩ to 4.99 kΩ	0.05 %
5 kΩ to 10 kΩ	0.05 %

Low Resistance (Continuity) – 2-Wire

Operations Manager
Authorisation:

Issue 72

Date: 13/05/26

Page 35 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory

Accreditation Number 271

SCOPE OF ACCREDITATION

0.1 Ω to 0.199 Ω	5 %
0.2 Ω to 0.499 Ω	2 %
0.5 Ω to 1.999 Ω	0.5 %
2 Ω to 4.999 Ω	0.4 %
5 Ω to 29.99 Ω	0.1 %
30 Ω to 199.9 Ω	0.035 %
0.2 k Ω to 4.99 k Ω	0.05 %
5 k Ω to 10 k Ω	0.05

Low Resistance (Continuity) – Current

For CMCs using multimeters – refer to 5.88 (c) and (d)

High Resistance (Insulation) – Resistance

10 k Ω to 99.99 k Ω	0.03 %
100 k Ω to 999 k Ω	0.03 %
1 M Ω to 9.999 M Ω	0.06 %
10 M Ω to 999.9 M Ω	0.14 %
1 G Ω to 9.999 G Ω	0.5 %
10 G Ω to 100 G Ω	0.6 %
100 G Ω to 199.9 G Ω	0.69 %
200 G Ω to 999.9 G Ω	1.6 %
1000 G Ω to 1999 G Ω	0.79 %
2 T Ω to 10 T Ω	1.7 %

Uncertainty is valid to 3000 V. For test voltages above 3000 V, add 0.1 % for each 1000 V above 3000 V in range 10.00 M Ω to 999 M Ω and 0.3 % in range 1.000 G Ω to 100.0 G Ω

High Resistance (Insulation) – Voltage

For CMCs using multimeters for voltages 0 to 1000 V– refer to 5.88 (a)

Voltages greater than 1000 V

1000 V to 1100 V	0.91 %
1100 V to 1575 V	1.2 %
1575 V to 2500 V	0.79 %
2500 V to 5500 V	0.57 %

High Resistance (Insulation) – Current

For CMCs using multimeters – refer to 5.88 (c)

Ground Bond (Earth Bond) Resistance – DC – 4-Wire

1.023 m Ω	4.3 %
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Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page **36** of **41**

CERTIFICATE OF ACCREDITATION



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

16.4 mΩ	3.6 %
42.56 mΩ	3.7 %
87.1 mΩ	1.9 %
326.6 mΩ	0.98 %
464 mΩ	0.63 %
862.5 mΩ	0.81 %
1.6887 Ω	1 %
4.637 Ω	0.22 %
8.64 Ω	0.13 %
17.001 Ω	0.29 %
47.12 Ω	0.15 %
91.47 Ω	0.13 %
174.51 Ω	0.11 %
467.9 Ω	0.21 %
875.8 Ω	0.1 %
1689.2 Ω	0.11 %

Ground Bond (Earth Bond) Resistance – DC – 2-Wire

28.14 mΩ	4 %
53.82 mΩ	4 %
98.2 mΩ	2.2 %
338.5 mΩ	1.1 %
476.9 mΩ	0.61 %
875.3 mΩ	0.83 %
1.7055 Ω	1 %
4.654 Ω	0.24 %
8.657 Ω	0.16 %
17.019 Ω	0.35 %
47.14 Ω	0.21 %
91.48 Ω	0.12 %
174.54 Ω	0.12 %
468 Ω	0.21 %
875.8 Ω	0.1 %
1689.4 Ω	0.11 %

Ground Bond (Earth Bond) Resistance – AC – 4-Wire

1.01 mΩ	6.2 %
16.4 mΩ	6.2 %
42.6 mΩ	6.5 %
87.1 mΩ	3.1 %
326.6 mΩ	1.6 %
464.4 mΩ	1.1 %
862.7 mΩ	0.53 %
1.6887 Ω	1.7 %
4.638 Ω	0.88 %

Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page 37 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

8.642 Ω	0.87 %
17 Ω	0.85 %
47.13 Ω	0.85 %
91.47 Ω	0.86 %
174.51 Ω	0.87 %
467.9 Ω	1.1 %
876 Ω	0.86 %
1690 Ω	0.95 %

Ground Bond (Earth Bond) Resistance – AC – 2-Wire

32.37 m Ω	12 %
57.74 m Ω	9.1 %
101.8 m Ω	4.5 %
342.3 m Ω	2 %
481 m Ω	1.3 %
879 m Ω	1.1 %
1.7059 Ω	1.8 %
4.655 Ω	0.9 %
8.658 Ω	0.87 %
17.022 Ω	0.88 %
47.15 Ω	1.1 %
91.49 Ω	0.87 %
174.53 Ω	0.86 %
468 Ω	1.1 %
876.2 Ω	0.87 %
1690.2 Ω	0.95 %

Ground Bond Resistance – AC & DC – 4-Wire – Low Test Current Measurement

0 A to 0.09 A	10 mA
0.091 A to 0.218 A	5 %
0.219 A to 0.98 A	1.7 %
0.981 A to 3.299 A	1.1 %

Ground Bond Resistance – AC & DC – 4-Wire – High Test Current Measurement

0 A to 0.29 A	100 mA
0.3 A to 1.09 A	10 %
1.1 A to 2.09 A	5.2 %
2.1 A to 3.99 A	3.1 %
4 A to 9.8 A	1.7 %
9.81 A to 15.39 A	1.4 %
15.4 A to 32.99 A	1.1 %

Ground Bond Resistance – AC & DC – 2-Wire – Low Test Current Measurement

Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page 38 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

0 A to 0.029 A	10 mA
0.03 A to 0.099 A	10 %
0.1 A to 0.189 A	5.8 %
0.19 A to 0.469 A	2.8 %
0.47 A to 0.989 A	1.7 %
0.99 A to 3.299 A	1.1 %

Ground Bond Resistance – AC & DC – 2-Wire – High Test Current Measurement

0 A to 0.29 A	100 mA
0.3 A to 1.09 A	5 %
1.1 A to 2.09 A	3.2 %
2.1 A to 3.99 A	2.1 %
4 A to 9.8 A	1.5 %
9.81 A to 15.39 A	1.1 %
15.4 A to 32.99 A	1.1 %

Line/Loop Impedance

32.37 mΩ	12 %
57.74 mΩ	9.1 %
101.8 mΩ	4.5 %
342.3 mΩ	2 %
481 mΩ	1.3 %
0.879 Ω	1.1 %
1.7059 Ω	1.8 %
4.655 Ω	0.9 %
8.658 Ω	0.87 %
17.022 Ω	0.88 %
47.15 Ω	1.1 %
91.49 Ω	0.87 %
174.53 Ω	0.86 %
468 Ω	1.1 %
876.2 Ω	0.87 %
1.6902 kΩ	0.95 %

Leakage Current – Passive, Differential, Substitute (AC)

100 µA to 300.9 µA	0.6 %
0.301 mA to 3 mA	0.18 %
3.001 mA to 30.009 mA	0.31 %

RCD Trip Current

3 mA to 30 mA	0.4 %
30 mA to 300 mA	0.4 %
300 mA to 3000 mA	0.3 %

Operations Manager
Authorisation:

Issue 72

Date:13/05/26

Page 39 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

RCD Trip Time

10 ms to 99.99 ms	0.36 %
100 ms to 999.99 ms	0.044 %
1000 ms to 5000 ms	80 μ s/s

AC Voltage Output

For CMCs using calibrators – refer to 5.89 (b)

AC Voltage Output – Frequency

For CMCs using meters or counters – refer to 5.91 (a) and (c)

DC Voltage Output

For CMCs using calibrators – refer to 5.89 (a)

AC Voltage Multimeter

For CMCs using multimeters for voltages 0 to 1000 V – refer to 5.88 (b)

1000 V to 2996 V	50 Hz to 60 Hz	0.21 %
2996 V to 5500 V	50 Hz to 60 Hz	0.3 %

DC Voltage Multimeter

For CMCs using multimeters for voltages 0 to 1000 V – refer to 5.88 (a)

1000 V to 2998 V	0.18 %
2998 V to 5500 V	0.1 %

5.91 Time and Frequency

In accordance with in-house methods based on manufacturer's recommendations, in the Auckland and Christchurch laboratories

- (a) Frequency meters
- (c) Counters

Nominal range

10 Hz	1.3 μ Hz/Hz
100 Hz	1.3 μ Hz/Hz
120 Hz	1.3 μ Hz/Hz
1000 Hz	1.3 μ Hz/Hz
10 kHz	1.3 μ Hz/Hz

Operations Manager
Authorisation:

Issue 72

Date: 13/05/26

Page 40 of 41



Trescal (New Zealand) Ltd
Metrology & Calibration Laboratory
SCOPE OF ACCREDITATION

Accreditation Number 271

50 kHz	1.3 $\mu\text{Hz/Hz}$
100 kHz	1.3 $\mu\text{Hz/Hz}$
1000 kHz	1.3 $\mu\text{Hz/Hz}$
2000 kHz	1.4 $\mu\text{Hz/Hz}$
10000 kHz	1.3 $\mu\text{Hz/Hz}$

In the Christchurch laboratory

Frequency meters:

Frequency Range		
Levelled sine voltage	0.1 Hz to 12 kHz	3 $\mu\text{Hz/Hz}$
	12 kHz to 1100 MHz	0.25 $\mu\text{Hz/Hz}$
Square voltage	10 Hz to 100 kHz	0.25 $\mu\text{Hz/Hz}$

Period Range		
Time markers	450.5 ps to 55 s	0.25 $\mu\text{s/s}$

Counters:

Frequency Range		
Time markers	0.02 Hz to 2200 MHz	0.25 $\mu\text{Hz/Hz}$

Note 1:

Unless stated otherwise the CMC is based on the performance of the best available device and measurement uncertainties achieved for specific calibrations may be greater than the CMC Uncertainty. A laboratory may not report measurement uncertainties lower than its CMC. However, if the device under calibration has a greater accuracy than the device used to calculate the CMC the laboratory may be able to use the calibration data to lower its CMC Uncertainty. Please contact the laboratory to discuss your specific requirements.

Operations Manager
Authorisation:

Issue 72

Date: 13/05/26

Page 41 of 41