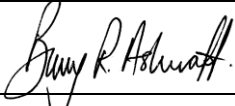


Schedule to CERTIFICATE OF ACCREDITATION																							
Laboratory	Metrology Calibration Services Limited																						
Address	PO Box 10024, Te Rapa, Hamilton, 3241 30 Northway Street, Te Rapa, Hamilton, 3200																						
Telephone	07 849-6296																						
Fax	07 849-2928																						
URL	www.metrologygroup.co.nz																						
Authorised Representative	Mr Lyndon Kapoor Laboratory/Technical Manager																						
Client No.	3916																						
Programme	Metrology & Calibration Laboratory																						
Accreditation Number	618																						
Initial Accreditation Date	1 August 1996																						
Conformance Standard	NZS ISO/IEC 17025:2005 General requirements for the competence of testing and calibration laboratories																						
Testing Services Summary	<table border="0"> <tr> <td>5.01</td> <td>Engineers' Limit Gauges</td> </tr> <tr> <td>5.02</td> <td>Jigs, Fixtures, Cutting Tools and Components</td> </tr> <tr> <td>5.03</td> <td>Engineers' Measuring Tools and Instruments</td> </tr> <tr> <td>5.04</td> <td>Machine Tools</td> </tr> <tr> <td>5.05</td> <td>Geometric Form</td> </tr> <tr> <td>5.11</td> <td>Working Standards of Length and Angle</td> </tr> <tr> <td>5.12</td> <td>Precision Measuring Instruments</td> </tr> <tr> <td>5.51</td> <td>Force Measuring Devices</td> </tr> <tr> <td>5.53</td> <td>Testing Machines</td> </tr> <tr> <td>5.55</td> <td>Speed Measuring Devices</td> </tr> <tr> <td>5.91</td> <td>Frequency Measurement and Time Measurement</td> </tr> </table>	5.01	Engineers' Limit Gauges	5.02	Jigs, Fixtures, Cutting Tools and Components	5.03	Engineers' Measuring Tools and Instruments	5.04	Machine Tools	5.05	Geometric Form	5.11	Working Standards of Length and Angle	5.12	Precision Measuring Instruments	5.51	Force Measuring Devices	5.53	Testing Machines	5.55	Speed Measuring Devices	5.91	Frequency Measurement and Time Measurement
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5.51	Force Measuring Devices																						
5.53	Testing Machines																						
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Signatories	<table border="0"> <tr> <td>Mr Jack Brown</td> <td>5.01, 5.02, 5.03, 5.05, 5.11, 5.12, 5.51, 5.55, 5.91</td> </tr> <tr> <td>Mr Lyndon Kapoor</td> <td>5.01, 5.02, 5.03, 5.04, 5.05, 5.11, 5.12, 5.51, 5.53, 5.55, 5.91</td> </tr> </table>	Mr Jack Brown	5.01, 5.02, 5.03, 5.05, 5.11, 5.12, 5.51, 5.55, 5.91	Mr Lyndon Kapoor	5.01, 5.02, 5.03, 5.04, 5.05, 5.11, 5.12, 5.51, 5.53, 5.55, 5.91																		
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Mr Lyndon Kapoor	5.01, 5.02, 5.03, 5.04, 5.05, 5.11, 5.12, 5.51, 5.53, 5.55, 5.91																						

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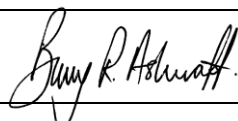
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Calibration temperature 20 °C ± 1 °C.
 All measurement uncertainties are based on a level of confidence of at least 95 %.
 Unless stated elsewhere in this schedule, calibrations are performed at the premises of the accredited laboratory.
 L is length in metres unless otherwise stated

5.01 Engineers' Limit Gauges

	Range (mm) Unless stated otherwise	Least uncertainty of measurement
(a) Plain plug, ring and gap gauges, Taper plug and ring gauges.		
Plain gap gauges in accordance with BS 969 and CP 139		
Length	10 to 50	0.9 µm
	50 to 100	1 µm
	100 to 200	1.4 µm
Parallelism		0.7 µm
Plain parallel plug gauges in accordance with BS 969 and CP137		
Diameter	up to 10	0.5 µm
	10 to 25	0.6 µm
	25 to 50	0.7 µm
	50 to 75	0.8 µm
	75 to 100	0.9 µm
	100 to 200	1.1 µm
200 to 345	1.5 µm	
Plain tapered plug gauges in accordance with CP138		
Taper up to 1 in 8 on diameter		
Diameter	3 to 50	3 µm
	>50 to 100	4 µm
	>100 to 200	8 µm
Taper above 1 in 8 up to 1 in 3 on diameter		
Diameter	3 to 50	5 µm
	>50 to 100	6 µm
	>100 to 200	12 µm
Plain parallel ring gauges in accordance with CP139 and manufacturers specification for accuracy		
Diameter	10 to 50	0.9 µm
	50 to 100	1.0 µm
	100 to 200	1.4 µm
Parallelism		0.5 µm
Roundness to BS 3730 (MZC)		0.12 µm

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Plain taper ring gauges in accordance with CP140

Taper up to 1 in 8 on diameter

Diameter	3 to 50	6 µm
	>50 to 100	8 µm
	>100 to 200	12 µm

Taper above 1 in 8 up to 1 in 3 on diameter

Diameter	3 to 50	8 µm
	>50 to 100	10 µm
	>100 to 200	14 µm

(b) Parallel screw plug and ring gauges. Adjustable thread calliper gauges for parallel threads.

Parallel screw plug gauges in accordance with BS 3643/2, BS 1580/1 & 2, AS 1722.2 and BS 919/3, BS 919/1 and CP116

Simple effective diameter	up to 300	2.5 µm
Major Diameter	up to 300	2.5 µm
Minor Diameter	up to 300	2.5 µm
Flank Angles		8 minutes of arc
Pitch		2.5 µm

Parallel screw ring gauges in accordance with CP119

Simple effective diameter	10 up to 200	4.0 µm
Major Diameter	10 up to 200	4.0 µm
Minor Diameter	10 up to 200	4.0 µm
Flank Angles		8 minutes of arc
Pitch		2.5 µm

Parallel screw ring gauges in accordance with CP165

Effective diameter (to check plugs)		3 µm
Major diameter	1 to 10	4 µm
Minor diameter	1 to 10	4 µm
Flank angles	1 to 10	8 minutes of arc
Pitch	1 to 10	2.5 µm

(c) Taper screw plug and ring gauges. Adjustable thread calliper gauges (3 roll type) for taper threads.

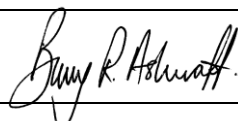
Tapered screw plug gauges in accordance with BS 21, ANSI/ASME B1.20.1 and B1.20.5 and CP117

Simple effective diameter	up to 6 inches	3.5 µm
Major Diameter	up to 6 inches	3.5 µm
Minor Diameter	up to 6 inches	3.5 µm
Flank Angles		8 minutes of arc
Pitch		2.5 µm

Tapered screw ring gauges in accordance with BS 21, ANSI/ASME B1.20.1 and B1.20.5 and CP118

Virtual effective Diameter	NPT/BSPT up to 4 inches	7.0 µm
Minor Diameter		

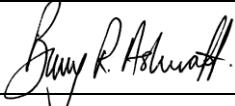
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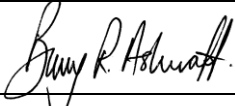


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Flank angles Pitch To check plugs		8 minutes of arc 2.5 µm
Crimp tool plug gauges to manufacturer's specifications and CP179 Insulation, Braid, Barrel, Contact		0.6 µm
5.02 Jigs, Fixtures, Cutting Tools and Components (calibration may be carried out on site)		
Ranges and least uncertainties as specified in class 5.01 and 5.03. Actual uncertainties calculated on a case by case basis.		
Thread Cutting Taps including Odd Flute Taps to CP212		Least uncertainty of measurement
Effective Diameter Major/Minor Diameter Flank angles		5 µm 5 µm 8 minutes of arc
Measurement using Axiom CMM to CP242 Volume performance (400 mm x 500 mm x 600 mm) Bi-directional accuracy		0.005 mm / 300 mm 0.004 mm
5.03 Engineers' Measuring Tools and Instruments (calibration may be carried out on site)		
(a) Examination to nominated national or international standards		
(b) Other tools and instruments.		
Angle plates including box, in accordance with BS 5535 and CP131		
	Range (mm) Unless otherwise stated	Least uncertainty of measurement
Squareness Flatness		(2 + 8L) µm (1.5 + 0.8D) µm where D= diagonal in m
Parallelism	<250 x 200 >250 x 200	1.8 µm 3.0 µm
Callipers, in accordance with ISO 3599:1976, ISO 6906, BS 887, JIS B 7507, DIN 862 and CP101 (may be carried out on site)		
Accuracy of Indication – internal and external up to 3000 mm		
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Engineer's Levels to BS 3509 & BS 958 and CP114		
Mean sensitivity		10 % of nominal minimum 1 seconds of arc
Base flatness		2 µm
Roll error		10 % of nominal
Feeler gauges to BS 959 and CP107 (may be carried out on site)		
Thickness		0.7 µm
Parallelism		0.4 µm
Polymex/foil shims to CP124		
Thickness		0.5 µm
Height gauges Vernier 0.02 mm/0.001 inch to BS 1643, JIS B 7517 and CP108 (may be carried out on site)		
Accuracy of reading	up to 2000 mm	(8 + 5L) µm
Parallelism		2.0 µm
Flatness		2.0 µm
Perpendicularity		(2 + 8L) µm
Setting blocks supplied with height gauge		
Length		0.5 µm
Parallelism		0.5 µm
Height Gauges Digital 0.01 mm/0.0005 inch in accordance with JIS B 7517 and CP127 (may be carried out on site)		
Accuracy of reading	up to 1000 mm	(8 + 5L) µm
Parallelism		2.0 µm
Flatness		2.0 µm
Micrometers – External in accordance with BS 870, DIN 863 + JIS B 7502 and CP109 (may be carried out on site)		
Range of error to traverse of the Micrometer Screw	0 to 25	0.7 µm
	25 to 75	1 µm
	>75	0.8 µm
Parallelism	0 to 75	0.25 µm
	100 to 150	0.6 µm
	>150 to 300	2 µm
	>300	3 µm
Flatness		0.15 µm
Zero setting	0 to 25	1 µm
	25 to 100	1.5 µm
	>100	(1 + 9L) µm
Micrometers – Internal/Stick in accordance with BS 959, + JIS B 7502, + DIN 863/4 and CP110 (may be carried out on site)		
Range of error of traverse of the Micrometer screw		2 µm
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Zero setting at minimum range (Int. Misc)	(2 + 5L) μm
Extension tube lengths up to 300	(0.4 + 3L) μm
>300 to 600	3 μm
>600 to 1000	5 μm
Spacing collar length	0.6 μm
Gap setting gauge length	(0.4 + 3L) μm
Gap setting gauge parallelism	0.4 μm
Flatness	0.2 μm

Micrometers – Depth in accordance with BS 6468 and CP104 (may be carried out on site)

Range of error of traverse of the Micrometer screw	2 μm
Zero setting at minimum range	(2 + 4L) μm
Flatness (optical flat method) 0.2 μm	
(test indicator method)	2 μm
Parallelism of measuring face to datum	1 μm

Micrometer heads type 3 in accordance with BS 1734 and CP112

Error of traverse of measuring face (progressive error)	0.4 μm
(periodic error)	0.3 μm
Repeatability	0.2 μm

Protractors – Bevel mechanical and optical in accordance with BS 1685 and CP112

Accuracy of indication	1.5 minutes of arc
Straightness	2.5 μm
Parallelism	3 μm
Flatness	2 μm

Rulers – Steel in accordance with BS 4372 and JIS B 7516 and CP133

Accuracy of graduation centreline	
relative to datum end up to 2000 mm	32 μm
Squareness per 10 mm	4 μm
Straightness of the scale edge	30 $\mu\text{m}/\text{m}$

Retractable steel pocket rules and tape measures in accordance with JIS B 7512, BS 4481-1, AS 1290-4, AS 1290-5 and CP167

Accuracy of graduation centreline relative to blade tip inside face	(50 + 12L) μm
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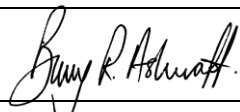
Straightedges up to 6 m in accordance with BS 5204: Part 2:1977 and CP103

Straightness	(1.5 + 0.5L) μm
Parallelism	3 μm

Squares – Engineers incl Cylindrical and Block in accordance with BS 939:1977 and CP102

Try Squares up to 600 mm	(2 + 8L) μm
Cylindrical/Block squares not exceeding 140 mm dia/width	(1 + 4L) μm
Cylindrical/Block squares exceeding 140 dia/width	(2 + 4L) μm
Parallelism	
Try squares blade	2.3 μm

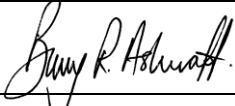
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Plane angle	4 seconds of arc
Squareness	(0.7 + 0.007L) µm
Parallelism	1 µm
Wet Film Thickness Gauges – wheel type in accordance with manufacturer’s specification and CP191	
Accuracy of indication	0.8 µm
Thread Micrometers in accordance with DIN 863 part 3 and CP201	
Range of error of traverse of the micrometer screw	2 µm
Zero setting	1 µm
Cone/vee semi angles	6 minutes of arc
Linear Counting Wheels in accordance with CP194	(30 + 0.2L) mm
Inclinometers in accordance with manufacturer’s specification and CP210	
Digital 0.1° resolution	4 minutes of arc
Pendulum type 1 minute of arc resolution	30 seconds of arc
Flatness of Base	2 µm
Parallelism	1 µm
Electronic levels (1 arc second resolution)	2 seconds of arc
5.04 Machine Tools (carried out on site, in accordance with CP156)	
(a) Geometric testing	Least uncertainty of measurement
Flatness of beds and tables	(1.5 + 0.8D) µm where D = diagonal in m
Straightness of guide ways	(1.5 + 0.5L) µm
Squareness/Parallelism	(1.5 + 0.01L) µm
(b) Practical tests	
Digital machine scales 0.01 mm	(10 + 0.01L) µm
5.05 Geometric Form (calibration may be carried out on site and is in accordance with CP214)	
	Least uncertainty of measurement
(a) Surface texture	0.05 µm + 2 % of nominal
(b) Roundness @ x 10,000	0.12 µm
(c) Straightness	(1.5 + 0.5L) µm
(d) Flatness	(1.5 + 0.8L) µm
(e) Eccentricity	0.3 µm
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- (f) Squareness (0.7 + 0.007L) μm
- (g) Angle 3 second of arc

5.11 Working Standards of Length and Angle

- (a) Gauge blocks and accessories

Gauge Block verification, central length and variation in length in accordance with BS4311 and ISO 3650 used as a guide. Verification by comparison, using a TESA 0.01 μm dual probe differential probing system. Measurement uncertainty expanded to reflect in-house method.

		Least uncertainty of measurement
Central Length	≤ 10	0.12 μm
	> 10 to 25	0.12 μm
	> 25 to 50	0.14 μm
	> 50 to 75	0.18 μm
	> 75 to 100	0.24 μm
Variation		0.07 μm

Gauge Block Accessory Sets in accordance with BS 4311 part 2 and CP126

Type A Jaws flatness	0.15 μm
length	0.3 μm
Type B Jaws flatness	0.15 μm
Centre Point flatness	0.15 μm
Deviation of centre point from plane of wringing face	3 μm
Scriber Point flatness	0.15 μm
Base flatness	0.15 μm
Platform flatness	0.15 μm
parallelism	3 μm
height	0.4 μm

- (b) Length bars and accessories

Thread Micrometer Setting Standards in accordance with CP201

Effective diameter	5 μm
Cone/vee flank angles	5 minutes of arc

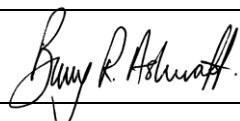
Micrometer settings rods (spherical ended) in accordance with BS870 (Section 3), JIS B 7502 and CP129

up to 1000 mm	(0.6 + 3L) μm
up to 40 inch	(26 + 2L) pinch

Micrometer setting rods (flat parallel ended) in accordance with BS870 (Section 3), JIS B 7502 and CP129

Length	(0.5 + 3L) μm
	(20 + 3L) pinch where L is length in inches

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Parallelism (0.4 + 0.5L) μ m
(15 + 0.5L) μ inch where L is
length in inches

(c) Cylindrical standards, internal and external

Cylindrical setting standards in accordance with MOY/SCM161M issue 3 and CP136

	Range (mm) Unless otherwise stated	Least uncertainty of measurement
Diameter	up to 25	0.6 μ m
	>25 to 50	0.7 μ m
	>50 to 75	0.8 μ m
	>75 to 100	0.9 μ m
	>100 to 200	1.1 μ m
	>200 to 345	1.5 μ m
Roundness (MZC)		0.12 μ m
Concentricity		0.3 μ m

Plain parallel setting ring gauges in accordance with BS 4064, DIN 2250, CP139

Diameter	10 to 50	0.9 μ m
	50 to 100	1.0 μ m
	100 to 200	1.4 μ m
Parallelism		0.5 μ m
Roundness to BS 3730 (MZC)		0.12 μ m

Plain Parallel Setting Ring Gauges in accordance with CP211

0.6 to 11	2 μ m
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Orifice Plates in accordance with BS/EN/ISO 5167-2, ANSI/API MPMS 14.3.2 and CP205

Surface finish (Ra)	0.02 μ m Ra + 2 % of reading
Flatness	6 μ m
Orifice Diameter	2 μ m
Plate thickness (E)	5 μ m
Bevel Angle	8 minutes of arc

(h) Precision graticules in accordance with CP130

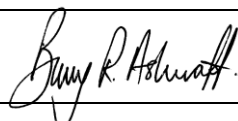
Using gauge blocks < 50	1.3 μ m
Using computerised height gauge < 300	(2 + 0.007L) μ m

(i) Surveying tapes and petroleum dip tapes

Pi tapes in accordance with manufacturer's specification and CP187

On diameter	inch	0.001 inch
On diameter	millimetre	0.03 mm

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Dip Tapes in accordance with JIS B 7512 and CP199
 Graduation centreline position relative to cardinal point (50 + 12L) μm

(m) Reference standards for surface finish, in accordance with BS 1134 part 1 & 2 and CP214(a)

0.3 μm or 12 μinch	0.025 $\mu\text{m Ra}$
0.7 μm or 28 μinch	0.045 $\mu\text{m Ra}$
6 μm or 240 μinch	0.25 $\mu\text{m Ra}$

5.12 Precision Measuring Instruments
 (calibration may be carried out on site)

(d) Precision projection apparatus, in accordance with manufacturer's specification and CP144

	Least uncertainty of measurement
Linear scales	2 μm
Degrees scale	1.5 minutes of arc
Squareness	(1 + 0.01L) μm
Parallelism	(1 + 0.01L) μm
Performance @ 10 x mag'n	0.1 %
Measured @ 20 x mag'n	0.04 %
@ 50 x mag'n	0.01 %
@ 100 x mag'n	0.005 %

(l) Sine bars and sine tables

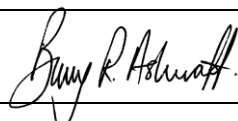
Sine Bars in accordance with BS 3064 and CP113

Flatness - optical interference	0.2 μm
Flatness - test indicator method	(0.5 + 0.006L) μm
Squareness	0.6 μm / 25 mm
Roller Centres	(0.7 + 0.002L) μm
Equality of Roller Diameters	0.6 μm
Roundness	0.12 μm
Parallelism	1 μm
Performance (Plane angle)	4 seconds of arc

Computerised digital height gauges in accordance with manufacturer's specifications and CP120 (calibration may be carried out on site)

0.001 mm or 0.00004 inch	
Accuracy of reading	(1 + 3L) μm
Squareness up to 500 mm	3 μm
Straightness	2 μm
Flatness - gauge block method	2 μm
Flatness - test indication method	2 μm
Parallelism	2 μm

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Computed and calculated results as calculated (see note)

Note: From 10 repeat readings using the height gauge and calibrated ring and plug gauges and 2D artefact.

Mu-Checkers in accordance with CP158

Accuracy of Indication 1 % of range (minimum 0.1 μ m or 4 μ inch)

Repeatability 0.1 μ m

Discrimination 0.1 μ m

Extensometers in accordance with ISO 9513 and CP237

Relative bias error up to 50 mm or 2 inch 0.3 μ m or 12 μ inch

Gauge length 0.025 mm or 0.001 inch

Performance verification of Coordinate Measuring Machines in accordance with ASME B89.4.10360.2 and BS EN/ISO 10360-2

Probe repeatability 1 μ m

Volume accuracy (1.2 + 3.5L) μ m

Uncertainties based on a machine with 1 μ m resolution

Repeatability 0.7 μ m

Point to point probing 0.8 μ m

Bi-directional probing 0.9 μ m

Linear displacement accuracy (0.9 + 3.5L) μ m

Volumetric accuracy 1.7 μ m per 300 mm

5.51 Force Measuring Devices

Spring balances in accordance with CP 180 and manufacturer's specifications

Least uncertainty of measurement

0 kg to 25 kg x 10 g 2 g

0 kg to 25 kg x 50 g 14 g

0 kg to 25 kg x 100 g 23 g

Force gauges in accordance with manufacturer's specifications and CP180

up to 100 kg 0.1 g

5 kg x 0.001 kg 0.001 kg

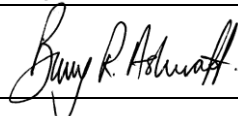
10 kg x 0.002 kg 0.002 kg

25 kg x 0.005 kg (5 + 0.1f)/1000 kg where f is measured force in kg

50 kg x 0.01 kg (10 + 0.1f)/1000 kg where f is measured force in kg

100 kg x 0.01 kg (10 + 0.1f)/1000 kg where f is measured force in kg

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measured force in kg

(The constant 0.1 is to account for the combining of several weights)

5.53 Testing Machines

(j) Rubber hardness meters (durometers)

Scale types A, B, C, D, DO and O in accordance with ASTM D2240, Section 7

	Least uncertainty of measurement
Indentor spring	0.04 N
Indentor shape (diameter)	0.005 mm
Indentor angle	5 minutes of arc
Extension	0.005 mm
Setting Blocks	0.002 mm

5.55 Speed Measuring Devices

(a) Tachometers, in accordance with manufacturer's specification and CP198

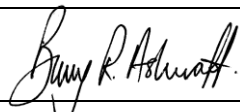
			Least uncertainty of measurement
Non-contact			
Digital	30 rpm to 30000 rpm		1 LSD
Contact			
Digital	30 rpm to 5000 rpm		1 LSD + 1 rpm per 5,000 rpm
Analogue	30 rpm to 5000 rpm		20 % minimum resolution

5.91 Frequency Measurement and Time Measurement

(d) Time interval meters

Time interval error over time specified by customer	0.61 seconds
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Authorised:
General Manager



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Date: 02/05/14

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