



Certificate of Calibration

Calibration Certification Information

Cal. Date: October 17, 2018 Rootsmeter S/N: 438320 Ta: 294 °K
 Operator: Jim Tisch Pa: 755.7 mm Hg
 Calibration Model #: TE-5025A Calibrator S/N: **2154**

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.4590	3.2	2.00
2	3	4	1	1.0410	6.4	4.00
3	5	6	1	0.9310	7.9	5.00
4	7	8	1	0.8840	8.8	5.50
5	9	10	1	0.7320	12.7	8.00

Data Tabulation

Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)}$ (y-axis)	Va	Qa (x-axis)	$\sqrt{\Delta H \left(\frac{Ta}{Pa} \right)}$ (y-axis)
1.0035	0.6878	1.4197	0.9958	0.6825	0.8821
0.9993	0.9599	2.0078	0.9915	0.9525	1.2475
0.9973	1.0712	2.2448	0.9895	1.0629	1.3948
0.9961	1.1268	2.3543	0.9884	1.1180	1.4628
0.9909	1.3536	2.8394	0.9832	1.3432	1.7642
QSTD	m=	2.13015	QA	m=	1.33386
	b=	-0.04186		b=	-0.02601
	r=	0.99996		r=	0.99996

Calculations

Vstd=	$\Delta Vol((Pa-\Delta P)/Pstd)(Tstd/Ta)$	Va=	$\Delta Vol((Pa-\Delta P)/Pa)$
Qstd=	Vstd/ΔTime	Qa=	Va/ΔTime
For subsequent flow rate calculations:			
Qstd= $1/m \left(\left(\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)} \right) - b \right)$		Qa= $1/m \left(\left(\sqrt{\Delta H \left(\frac{Ta}{Pa} \right)} \right) - b \right)$	

Standard Conditions

Tstd: 298.15 °K

Pstd: 760 mm Hg

Key

ΔH: calibrator manometer reading (in H2O)

ΔP: rootsmeter manometer reading (mm Hg)

Ta: actual absolute temperature (°K)

Pa: actual barometric pressure (mm Hg)

b: intercept

m: slope

RECALIBRATION

US EPA recommends annual recalibration per 1998 40 Code of Federal Regulations Part 50 to 51, Appendix B to Part 50, Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere, 9.2.17, page 30

FUGRO TECHNICAL SERVICES LIMITED

Fugro Development Centre,
5 Lok Yi Street, Tai Lam,
Tuen Mun, N.T.,
Hong Kong.

Tel : +852 2450 8233
Fax : +852 2450 6138
E-mail : matlab@fugro.com
Website : www.fugro.com

**TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET**

Project : Environmental Monitoring Works For Contract No. KLN/2015/07
Location : KTD1a
Brand: Tisch
Model: TE-5170
S/N: 4037
Date of Calibration: 24-Mar-19
Next Calibration Date: 23-Jun-19
Technician: Mike Kan

CONDITIONS

Sea Level Pressure (hPa): 1018.0
Temperature (°C): 17.5
Corrected Pressure (mm Hg): 764
Temperature (K): 291

CALIBRATION ORIFICE

Make: Tisch
Model: TE-5025A
Calibration Date: 17-Oct-18
S/N: 2154
Qstd Slope: 2.13015
Qstd Intercept: -0.04186
Expiry Date: 17-Oct-19

CALIBRATIONS

Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qstd (m ³ /min)	I (chart)	IC (corrected)	LINEAR REGRESSION
18	6.80	-6.00	12.800	1.725	42.00	42.64	Slope = 30.2225 Intercept = -9.7073 Corr. coeff.: 0.9954
13	4.20	-5.60	9.800	1.512	36.00	36.55	
10	3.60	-3.40	7.000	1.281	28.00	28.43	
7	2.40	-2.20	4.600	1.042	20.00	20.30	
5	1.20	-1.60	2.800	0.817	16.00	16.24	

Calculations:

$$Qstd = 1/m[\text{Sqrt}(H2O(Pa/Pstd)(Tstd/Ta))-b]$$

$$IC = I[\text{Sqrt}(Pa/Pstd)(Tstd/Ta)]$$

Qstd = standard flow rate

IC = corrected chart response

I = actual chart response

m = calibrator Qstd slope

b = calibrator Qstd intercept

Ta = actual temperature during calibration (deg K)

Pa = actual pressure during calibration (mm Hg)

Tstd = 298 deg K

Pstd = 760 mm Hg

For subsequent calculation of sampler flow:

$$1/m((I[\text{Sqrt}(298/Tav)(Pav/760)]-b)$$

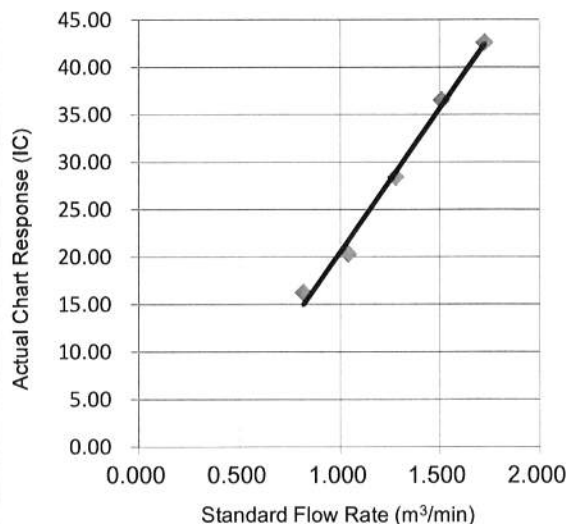
m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure

FLOW RATE CHART

Report Date: 25 Mar 2019

WAN KA HO
Project Consultant

FUGRO TECHNICAL SERVICES LIMITED

Fugro Development Centre,
5 Lok Yi Street, Tai Lam,
Tuen Mun, N.T.,
Hong Kong.

Tel : +852 2450 8233
Fax : +852 2450 6138
E-mail : matlab@fugro.com
Website : www.fugro.com

**TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET**

Project : Environmental Monitoring Works For Contract No. KLN/2015/07

Date of Calibration: 24-Mar-19

Location : KTD2b

Next Calibration Date: 23-Jun-19

Brand: Tisch

Technician: Mike Kan

Model: TE-5170

S/N: 3838

CONDITIONS

Sea Level Pressure (hPa): 1018.0 Corrected Pressure (mm Hg): 764

Temperature (°C): 17.5 Temperature (K): 291

CALIBRATION ORIFICE

Make: Tisch Qstd Slope: 2.13015

Model: TE-5025A Qstd Intercept: -0.04186

Calibration Date: 17-Oct-18 Expiry Date: 17-Oct-19

S/N: 2154

CALIBRATIONS

Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qstd (m ³ /min)	I (chart)	IC (corrected)	LINEAR REGRESSION
18	7.00	-6.40	13.400	1.764	54.00	54.82	Slope = 28.9732
13	5.20	-4.80	10.000	1.527	46.00	46.70	Intercept = 3.7516
10	3.80	-3.20	7.000	1.281	42.00	42.64	Corr. coeff.: 0.9935
7	2.60	-2.00	4.600	1.042	34.00	34.52	
5	1.40	-1.40	2.800	0.817	26.00	26.40	

Calculations: $Qstd = 1/m[\text{Sqrt}(H2O(Pa/Pstd)(Tstd/Ta))-b]$ $IC = I[\text{Sqrt}(Pa/Pstd)(Tstd/Ta)]$

Qstd = standard flow rate

IC = corrected chart response

I = actual chart response

m = calibrator Qstd slope

b = calibrator Qstd intercept

Ta = actual temperature during calibration (deg K)

Pa = actual pressure during calibration (mm Hg)

Tstd = 298 deg K

Pstd = 760 mm Hg

For subsequent calculation of sampler flow: $1/m((I[\text{Sqrt}(298/Tav)(Pav/760)]-b)$

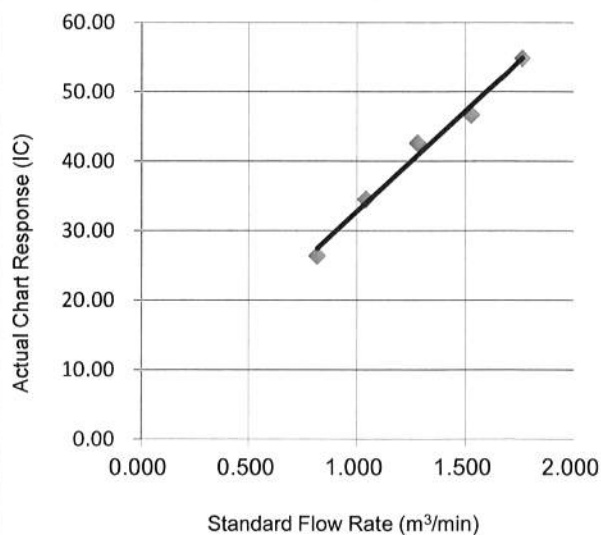
m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure

FLOW RATE CHART

Report Date: 25 Mar 2019

WAN KA HO

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FUGRO TECHNICAL SERVICES LIMITED

Fugro Development Centre,
5 Lok Yi Street, Tai Lam,
Tuen Mun, N.T.,
Hong Kong.

Tel : +852 2450 8233
Fax : +852 2450 6138
E-mail : matlab@fugro.com
Website : www.fugro.com



TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Project : Environmental Monitoring Works For Contract No. KLN/2015/07
Location : KER1b
Brand: Tisch
Model: TE-5170 S/N: 3482
Date of Calibration: 24-Mar-19
Next Calibration Date: 23-Jun-19
Technician: Mike Kan

CONDITIONS

Sea Level Pressure (hPa): 1018.0 Corrected Pressure (mm Hg): 764
Temperature (°C): 17.5 Temperature (K): 291

CALIBRATION ORIFICE

Make: Tisch Qstd Slope: 2.13015
Model: TE-5025A Qstd Intercept: -0.04186
Calibration Date: 17-Oct-18 Expiry Date: 17-Oct-19
S/N: 2154

43755

Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qstd (m ³ /min)	I (chart)	IC (corrected)	LINEAR REGRESSION
18	7.20	-6.20	13.400	1.764	44.00	44.67	Slope = 32.7929
13	5.40	-5.40	10.800	1.586	38.00	38.58	Intercept = -13.5339
10	3.20	-3.60	6.800	1.262	26.00	26.40	Corr. coeff.: 0.9973
7	2.60	-2.20	4.800	1.064	22.00	22.33	
5	1.20	-1.80	3.000	0.845	14.00	14.21	

Calculations:

$$Qstd = 1/m[\sqrt{(H2O(Pa/Pstd)(Tstd/Ta))}-b]$$

$$IC = I[\sqrt{(Pa/Pstd)(Tstd/Ta)}]$$

Qstd = standard flow rate

IC = corrected chart response

I = actual chart response

m = calibrator Qstd slope

b = calibrator Qstd intercept

Ta = actual temperature during calibration (deg K)

Pa = actual pressure during calibration (mm Hg)

Tstd = 298 deg K

Pstd = 760 mm Hg

For subsequent calculation of sampler flow:

$$1/m((I)[\sqrt{(298/Tav)(Pav/760)}]-b)$$

m = sampler slope

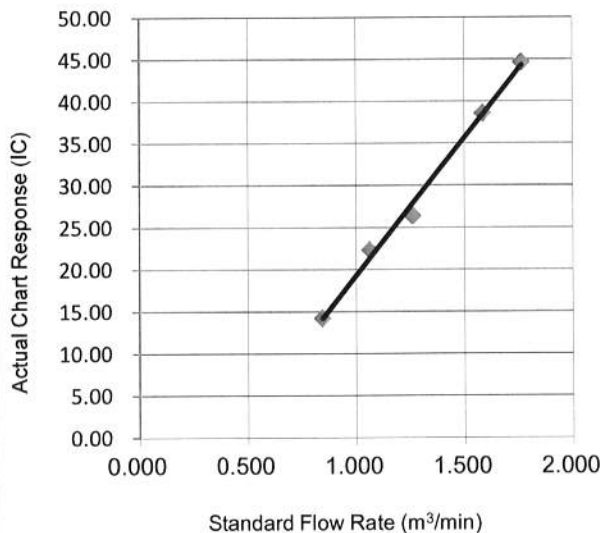
b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure

FLOW RATE CHART



WAN KA HO

Project Consultant

Report Date: 25 Mar 2019

Certificate of Conformity and Calibration

Instrument Model:- CEL-633A

Serial Number 1488270
Firmware revision V006-03

Microphone Type:- CEL-251

Serial Number 2772

Preamplifier Type:- CEL-495

Serial Number 004014

Instrument Class/Type:- 1

Applicable standards:-

IEC 61672: 2002 / EN 60651 (Electroacoustics - Sound Level Meters)
IEC 60651 1979 (Sound Level Meters), ANSI S1.4: 1983 (Specifications For Sound Level Meters)

Note:- The test sequences performed in this report are in accordance with the current Sound level meter Standard - IEC61672. The combination of tests performed are considered to confirm the products electro-acoustic performance to all applicable standards including superceeded Sound Level Meter Standards - IEC60651 and IEC60804.

Test Conditions:- 30 °C
58 %RH
1003 mBar

Test Engineer:- Chris Taylor
Date of Issue:- September 7, 2018


Declaration of conformity:-

This test certificate confirms that the instrument specified above has been successfully tested to comply with the manufacturer's published specifications. Tests are performed using equipment traceable to national standards in accordance with Casella's ISO 9001:2008 quality procedures. This product is certified as being compliant to the requirements of the CE Directive.

Test Summary:-

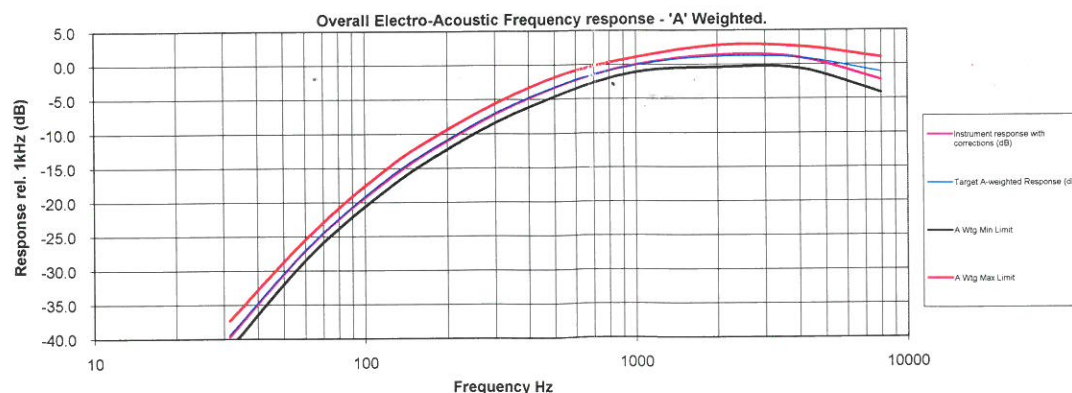
Self Generated Noise Test
Electrical Signal Test Of Frequency Weightings
Frequency & Time Weightings At 1 kHz
Level Linearity On The Reference Level Range
Toneburst Response Test
C-peak Sound Levels
Overload Indication
Acoustic Tests

All Tests Pass
All Tests Pass
All Tests Pass
All Tests Pass
All Tests Pass
All Tests Pass
All Tests Pass

Combined Electro-Acoustic Frequency Response - A Weighted

Combined Electro-Acoustic Frequency Response - A Weighted (IEC 61672-3:2006)

The following A-Weighted frequency response graph shows this instruments overall frequency response based upon the application of multi-frequency pressure field calibrations. The microphones Pressure to Free field correction coefficients are applied to pressure response. Reference level taken at 1kHz.


Casella UK

Regent House, Wolsey Road,
Kempston, Bedford
MK42 7JY
United Kingdom
Tel: +44 (0) 1234 844100
Fax: +44(0) 1234 841490
E-mail: info@casellasolutions.com

Casella USA

415 Lawrence Bell Drive, Unit 4
Buffalo, NY 14221, USA
Toll Free (800) 366-2966
Tel: +1 (716) 276 3040
E-mail: info@casellausa.com

Casella India

Ideal Industries India Pvt Ltd.
229-230, Spazedge, Tower -B Sohna Road,
Sector-47, Gurgaon-122001, Haryana, India.
Tel: +91 124 4495100
E-mail: casella.sales@ideal-industries.in

Casella China

Ideal Industries China
Room 305, Building 1, No.1279, Chuanqiao
Rd, Pudong New District,
Shanghai, China
Tel: +86-21-31263188
Fax: +86-21-61605906
Email: info@casellasolutions.cn

Casella Australia

Ideal Industries (Aust) PTY. LTD
Unit 17, 35 Dunlop Rd, Mulgrave.
Vic. 3170, Australia.
Email: australia@casellasolutions.com

Certificate of Conformity and Calibration

Instrument Model:- CEL-633A

Serial Number 1488289
Firmware revision V006-03

Microphone Type:- CEL-251

Serial Number 2706

Preamplifier Type:- CEL-495

Serial Number 003917

Instrument Class/Type:- 1

Applicable standards:-

IEC 61672: 2002 / EN 60651 (Electroacoustics - Sound Level Meters)
IEC 60651 1979 (Sound Level Meters), ANSI S1.4: 1983 (Specifications For Sound Level Meters)

Note:- The test sequences performed in this report are in accordance with the current Sound level meter Standard - IEC61672. The combination of tests performed are considered to confirm the products electro-acoustic performance to all applicable standards including superseded Sound Level Meter Standards - IEC60651 and IEC60804.

Test Conditions:-

31 °C
51 %RH
1000 mBar

Test Engineer:-
Date of Issue:-

Chris Taylor
September 10, 2018


Declaration of conformity:-

This test certificate confirms that the instrument specified above has been successfully tested to comply with the manufacturer's published specifications. Tests are performed using equipment traceable to national standards in accordance with Casella's ISO 9001:2008 quality procedures. This product is certified as being compliant to the requirements of the CE Directive.

Test Summary:-

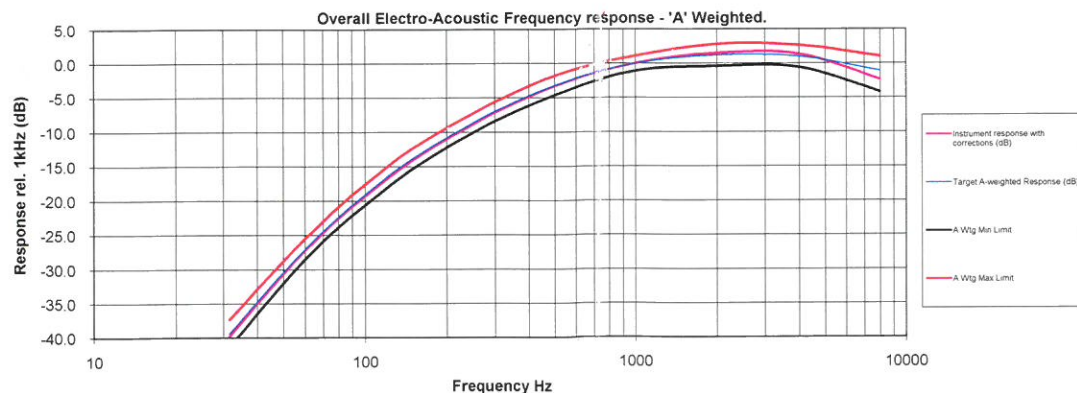
Self Generated Noise Test
Electrical Signal Test Of Frequency Weightings
Frequency & Time Weightings At 1 kHz
Level Linearity On The Reference Level Range
Toneburst Response Test
C-peak Sound Levels
Overload Indication
Acoustic Tests

All Tests Pass
All Tests Pass
All Tests Pass
All Tests Pass
All Tests Pass
All Tests Pass
All Tests Pass
All Tests Pass

Combined Electro-Acoustic Frequency Response - A Weighted

Combined Electro-Acoustic Frequency Response - A Weighted (IEC 61672-3:2006)

The following A-Weighted frequency response graph shows this instrument's overall frequency response based upon the application of multi-frequency pressure field calibrations. The microphones Pressure to Free field correction coefficients are applied to pressure response. Reference level taken at 1 kHz.


Casella UK

Regent House, Wolsley Road,
Kempston, Bedford
MK42 7JY
United Kingdom
Tel: +44 (0) 1234 844100
Fax: +44(0) 1234 841490
E-mail: info@casellasolutions.com

Casella USA

415 Lawrence Bell Drive, Unit 4
Buffalo, NY 14221, USA
Toll Free (800) 366-2966
Tel: +1 (716) 276 3040
E-mail: info@casellausa.com

Casella India

Ideal Industries India Pvt Ltd.
229-230, Spazedge, Tower - B Sindhia Road,
Sector-47, Gurgaon-122001, Haryana, India.
Tel: +91 124 4495100
E-mail: casella.sales@ideal-industries.in

Casella China

Ideal Industries China
Room 305, Building 1, No.1279, Chuanqiao
Rd, Pudong New District,
Shanghai, China
Tel: +86-21-31263188
Fax: +86-21-61605906
Email: info@casellasolutions.cn

Casella Australia

Ideal Industries (Aust) PTY. LTD
Unit 17, 35 Dunlop Rd, Mulgrave,
Vic. 3170, Australia.
Email: australia@casellasolutions.com

FUGRO TECHNICAL SERVICES LIMITED

Fugro Development Centre,
5 Lok Yi Street, Tai Lam,
Tuen Mun, N.T.,
Hong Kong.

Tel : +852 2450 8233
Fax : +852 2450 6138
E-mail : matlab@fugro.com
Website : www.fugro.com

MaterialLab

Report no.: 183057CA185228

Page 1 of 1

CALIBRATION CERTIFICATE OF SOUND CALIBRATOR

Client Supplied Information

Client : MaterialLab Consultants Ltd.

Project : Calibration Services

Details of Unit Under Test, UUT

Description : Sound Calibrator
Manufacturer : Casella (Model CEL-120/1)
Serial No. : 4358289
Equipment ID : N/A
Next Calibration Date : 25-Jun-2019
Specification Limit : EN 60942: 2003 Type 1

Laboratory Information

Description : Reference Sound level meter
Equipment ID. : R-119-1
Date of Calibration : 26-Jun-2018 Ambient Temperature : 22 °C
Calibration Location : Calibration Laboratory of FTS
Method Used : By direct comparison

Calibration Results :

Parameters (Setting of UUT)	Mean Value (error of measurement)	Specification Limit(dB)
94dB	-0.2 dB	±0.4dB
114dB	-0.1 dB	

Remarks :

1. The equipment used in this calibration is traceable to recognized National Standards.
2. The mean value is the average of four measurements.
3. The equipment does comply with the specification limit.

Checked by : William Date : 28-6-2018 Certified by : Chan Chun Wai Date : 4.7.2018

CA-R-297 (22/07/2009)

Chan Chun Wai (Manager)

**** End of Report ****

FUGRO TECHNICAL SERVICES LIMITED

Fugro Development Centre,
5 Lok Yi Street, Tai Lam,
Tuen Mun, N.T.,
Hong Kong.

Tel : +852 2450 8233
Fax : +852 2450 6138
E-mail : matlab@fugro.com
Website : www.fugro.com

MaterialLab

Report No. : 183057CA185180(1)

Page 1 of 1

CALIBRATION CERTIFICATE OF ANEMOMETER

Client Supplied Information

Client : MaterialLab Consultants Ltd.

Project : Calibration Services

Details of Unit Under Test, UUT

Description : Anemometer

Manufacturer : Benetech

Model No. : GM816

Serial No. : 13372555

Equipment ID. : N/A

Next Calibration Date : 08-Jun-2019

Laboratory Information

Details of Reference Equipment –

Description : Reference Anemometer

Equipment ID. : R-101-4

Date of Calibration : 09-Jun-2018 Ambient Temperature : 22 °C

Calibration Location : Calibration Laboratory of FTS

Method Used : By direct Comparison

Calibration Results :

Reference Reading (m/s)	UUT Reading (m/s)	Error (m/s)
1.96	2.2	0.2
4.04	4.1	0.1
6.05	6.2	0.2
8.02	7.9	-0.1
10.06	9.7	-0.4

Remark :

1. The equipment being used in this calibration is traceable to recognized National Standards.

Checked by : William Date : 12-6-2018 Certified by : Chan Chun Wai Date : 13-6-2018

CA-R-297 (22/07/2009)

Chan Chun Wai (Manager)

**** End of Report ****

FUGRO TECHNICAL SERVICES LIMITED

Fugro Development Centre,
5 Lok Yi Street, Tai Lam,
Tuen Mun, N.T.,
Hong Kong.

Tel : +852 2450 8233
Fax : +852 2450 6138
E-mail : matlab@fugro.com
Website : www.fugro.com

Materialab

Report No. : 182933CA185214(2)

Page 1 of 1

CALIBRATION CERTIFICATE OF ANEMOMETER

Client Supplied Information

Client : Materialab Consultants Ltd.

Address: Room 723 & 725, 7F., Block B Profit Industrial Building, 1-15 Kwai Fung Crescent, Kwai Chung, N.T.

Project : Calibration Services

Details of Unit Under Test, UUT

Description : Comfort Level Probe

Manufacturer : Testo

Model No. :

Serial No. :

Equipment ID :

Meter	Probe
480	409
61003846	03216409

N/A

Next Calibration Due Date : 22-Aug-2019

Laboratory Information

Details of Reference Equipment –

Description : Reference Anemometer

Equipment ID. : R-101-4

Date of Calibration : 23-Aug-2018

Ambient Temperature : 20± 2 °C

Calibration Location : Calibration Laboratory of FTS

Method Used : By direct Comparison

Calibration Results :

Reference Reading (m/s)	UUT Reading (m/s)	Error (m/s)
1.05	1.06	0.01
3.02	3.06	0.04
5.04	5.07	0.03

Remarks :

1. The equipment being used in this calibration is traceable to recognized National Standards.
2. The reported readings in this calibration are an average from 10 trials.

Checked by : William Date : 31-8-2018 Certified by : K. T. Leung Date : 31-8-2018
CA-R-297 (22/07/2009) Leung Kwok Tai (Assistant Manager)

**** End of Report ****