



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

MATERIALAB CONSULTANTS LIMITED

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**TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET**

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

Date of Calibration: 22-Jun-19

Location : KTD1a

Next Calibration Date: 21-Sep-19

Brand: Tisch

Technician: Francis Xie

Model: TE-5170

S/N: 4037

CONDITIONS

Sea Level Pressure (hPa): 1004.7 Corrected Pressure (mm Hg): 754
Temperature (°C): 30.7 Temperature (K): 304

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	4.50	-3.00	7.500	1.288	50.00	49.32	Slope = 37.5204 Intercept = -0.0105 Corr. coeff.: 0.9923
13	4.00	-2.50	6.500	1.200	46.00	45.37	
10	3.50	-2.00	5.500	1.106	40.00	39.46	
7	2.50	-1.00	3.500	0.886	34.00	33.54	
5	1.50	-0.50	2.000	0.675	26.00	25.65	

Calculations:

$$Qstd = 1/m[\sqrt{(H_2O(Pa/Pstd)(Tstd/Ta))}] - b]$$

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

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:

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

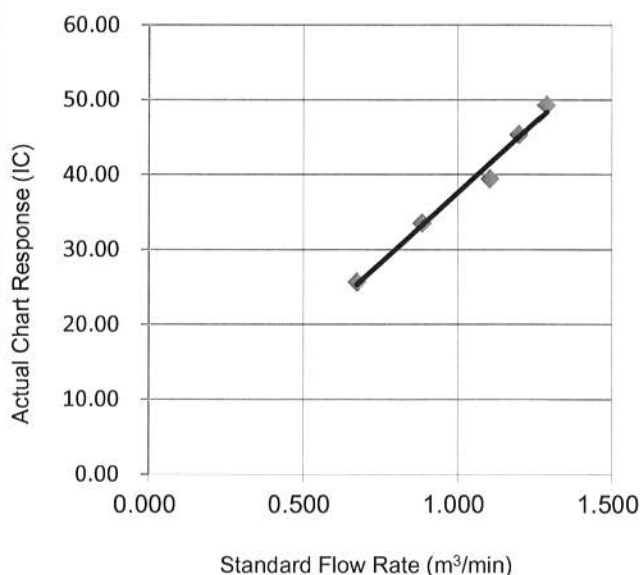
m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure

FLOW RATE CHART

Wan Ka Ho
Project Consultant

Report Date: 23 Jun 2019

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**TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET**

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

Date of Calibration: 22-Jun-19

Location : KER1b

Next Calibration Date: 21-Sep-19

Brand: Tisch

Technician: Francis Xie

Model: TE-5170

S/N: 3482

CONDITIONS

Sea Level Pressure (hPa): 1004.7 Corrected Pressure (mm Hg): 754
Temperature (°C): 30.7 Temperature (K): 304

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	6.00	-4.50	10.500	1.520	50.00	49.32	Slope = 32.8473 Intercept = 0.0200 Corr. coeff.: 0.9929
13	4.50	-4.00	8.500	1.370	46.00	45.37	
10	3.00	-2.00	5.000	1.055	37.00	36.50	
7	2.50	-1.50	4.000	0.946	30.00	29.59	
5	1.50	-1.00	2.500	0.752	25.00	24.66	

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

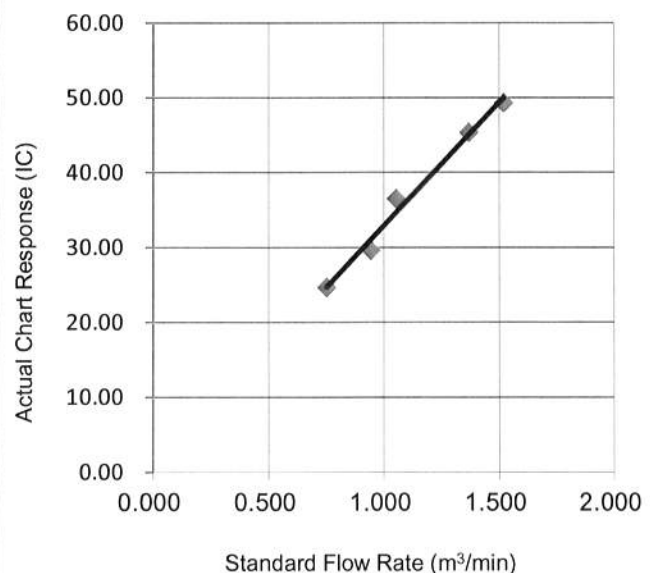
m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure

FLOW RATE CHART

Wan Ka Ho
Project Consultant

Report Date: 23 Jun 2019

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**TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET**

Project : Environmental Monitoring Works For Contract No. KLN/2015/07
Location : KTDb
Brand: Tisch
Model: TE-5170
S/N: 3838
Date of Calibration: 22-Jun-19
Next Calibration Date: 21-Sep-19
Technician: Francis Xie

CONDITIONS

Sea Level Pressure (hPa): 1004.7
Temperature (°C): 30.7
Corrected Pressure (mm Hg): 754
Temperature (K): 304

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

43755

Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qstd (m ³ /min)	I (chart)	IC (corrected)	LINEAR REGRESSION
18	5.00	-6.00	11.000	1.555	48.00	47.35	Slope = 27.4013
13	4.50	-4.50	9.000	1.409	44.00	43.40	Intercept = 4.9446
10	3.50	-3.20	6.700	1.218	40.00	39.46	Corr. coeff.: 0.9952
7	2.00	-2.00	4.000	0.946	30.00	29.59	
5	1.00	-1.40	2.400	0.737	26.00	25.65	

Calculations:

$$Qstd = 1/m[\sqrt{(H_2O(Pa/Pstd)(Tstd/Ta))} - b]$$

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

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:

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

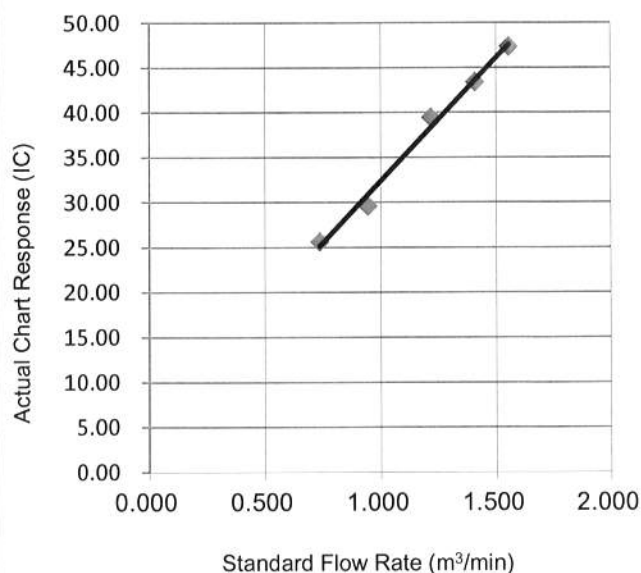
m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure

FLOW RATE CHART

Wan Ka Ho
Project Consultant

Report Date: 23 Jun 2019

Certificate of Conformity and Calibration

Instrument Model:- CEL-633A

Serial Number 1488269
Firmware revision V006-03

Microphone Type:- CEL-251

Serial Number 2869

Preamplifier Type:- CEL-495

Serial Number 004065

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:-

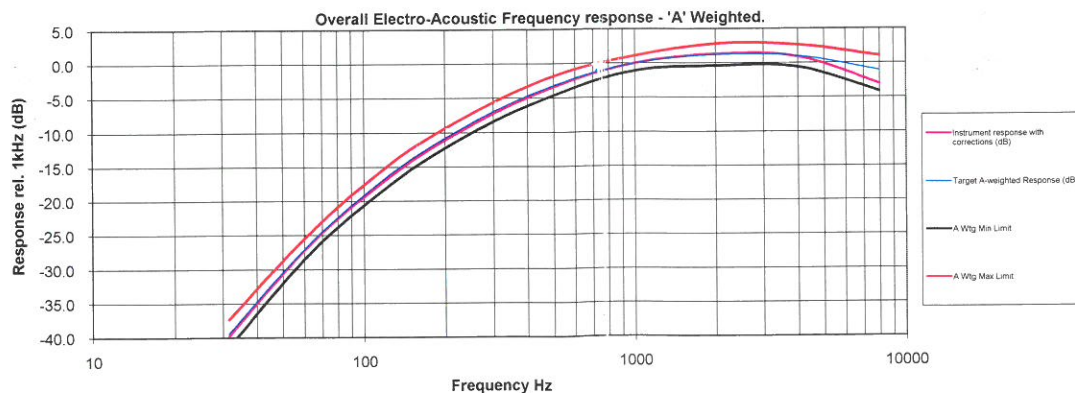
Self Generated Noise Test
Electrical Signal Test Of Frequency Weightings
Frequency & Time Weightings At 1 kHz
Level Linearity On The Reference Level Range
Toneburst Response Test
C-peak Sound Levels
Overload Indication
Acoustic Tests

All Tests Pass
All Tests Pass
All Tests Pass
All Tests Pass
All Tests Pass
All Tests Pass
All Tests Pass
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.


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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:-

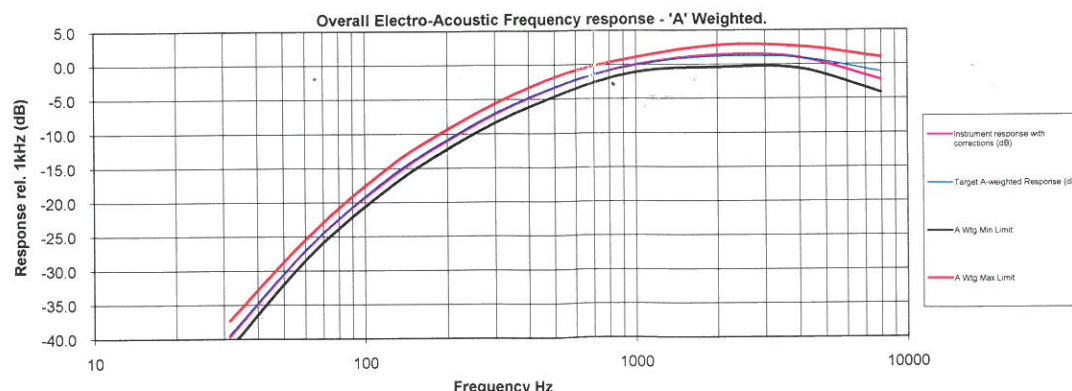
Self Generated Noise Test
Electrical Signal Test Of Frequency Weightings
Frequency & Time Weightings At 1 kHz
Level Linearity On The Reference Level Range
Toneburst Response Test
C-peak Sound Levels
Overload Indication
Acoustic Tests

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.


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MaterialLab

Report no.: 183057CA195161(1)

Page 1 of 1

CALIBRATION CERTIFICATE OF SOUND CALIBRATOR

Client Supplied Information

Client : Fugro Technical Services Limited

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

Project : Calibration Services

Details of Unit Under Test, UUT

Description : Sound Calibrator
Manufacturer : Casella (Model no. CEL-120/1)
Serial No. : 3321858
Next Calibration Date : 06-Mar-2020
Specification Limit : EN 60942: 2003 Type 1

Laboratory Information

Description : Reference Sound level meter
Equipment ID. : R-119-1
Date of Calibration : 07-Mar-2019 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	-0.3 dB	±0.4dB
114dB	-0.3 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 : 12-3-2019 Certified by : R. J. Leung Date : 15-3-2019
CA-R-297 (22/07/2009) Leung Kwok Tai (Assistant Manager)

** End of Report **

FUGRO TECHNICAL SERVICES LIMITED

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MaterialLab

Report no.: 183057CA195873(1)

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CALIBRATION CERTIFICATE OF SOUND CALIBRATOR

Client Supplied Information

Client : Fugro Technical Services Ltd.

Project : Calibration Services

Details of Unit Under Test, UUT

Description : Sound Calibrator
Manufacturer : Casella (Model CEL-120/1)
Serial No. : 4358251
Equipment ID : N-34
Next Calibration Date : 05-Jul-2020
Specification Limit : EN 60942: 2003 Type 1

Laboratory Information

Description : Reference Sound level meter
Equipment ID. : R-119-1
Date of Calibration : 06-Jul-2019 Ambient Temperature : 22 °C
Calibration Location : Calibration Laboratory of MaterialLab
Method Used : By direct comparison

Calibration Results :

Parameters (Setting of UUT)	Mean Value (error of measurement)	Specification Limit(dB)
94dB	-0.1 dB	±0.4dB
114dB	0.0 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.
4. The values given in this Calibration Certificate only relate to the values at the time of the test and any uncertainties will not include allowance for the equipment long term drift, variations with environment changes, vibration and shock during transportation, overloading, mis-handling or the capability of any other laboratory to repeat the measurement.

Checked by : William Date : 26-7-2019 Certified by : P.T. Leung Date : 26-7-2019
CA-R-297 (22/07/2009)

Leung Kwok Tai (Assistant Manager)

** End of Report **

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MaterialLab

Report No. : 183057CA195782

Page 1 of 1

CALIBRATION CERTIFICATE OF ANEMOMETER

Client Supplied Information

Client : Fugro Technical Services Ltd.

Project : Calibration Services

Details of Unit Under Test, UUT

Description : Anemometer

Manufacturer : Benetech

Model No. : GM816

Serial No. : N/A

Equipment ID. : WS-07

Next Calibration Date : 07-Jun-2020

Laboratory Information

Details of Reference Equipment –

Description : Reference Anemometer

Equipment ID. : R-101-4

Date of Calibration : 08-Jun-2019 Ambient Temperature : 22 °C

Calibration Location : Calibration Laboratory of FTS

Method Used : R-C-279

Calibration Results :

Reference Reading (m/s)	UUT Reading (m/s)	Error (m/s)
2.06	1.9	-0.2
4.02	4.4	0.4
6.05	6.5	0.5
8.06	8.6	0.5
10.25	10.1	-0.2

Remark :

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

Checked by : William Date : 20-6-2019 Certified by : K.T. Leung Date : 24-6-2019
CA-R-297 (22/07/2009) Leung Kwok Tai (Assistant Manager)

** End of Report **