



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=	$\Delta Vol \left(\frac{Pa - \Delta P}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)$	Va=	$\Delta Vol \left(\frac{Pa - \Delta P}{Pa} \right)$
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			Date of Calibration: 24-Mar-19
Location : KTD1a			Next Calibration Date: 23-Jun-19
Brand:	Tisch		Technician: Mike Kan
Model:	TE-5170	S/N: 4037	

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	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:

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

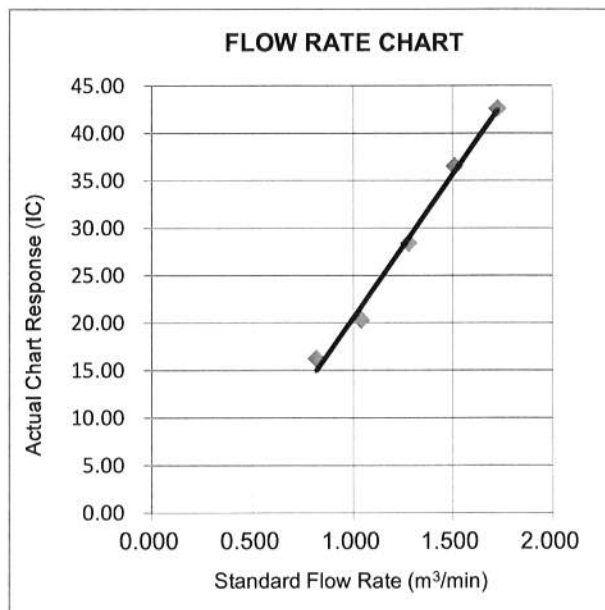
m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure



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 : Environmantal 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			

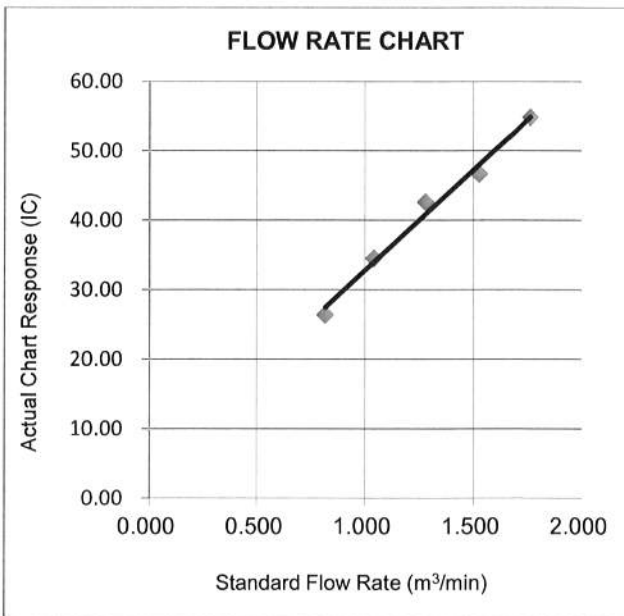
CALIBRATIONS							
Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qstd (m ³ /min)	I (chart)	IC (corrected)	LINEAR REGRESSION
18	7.00	-6.40	13.400	1.764	54.00	54.82	Slope = 28.9732 Intercept = 3.7516 Corr. coeff.: 0.9935
13	5.20	-4.80	10.000	1.527	46.00	46.70	
10	3.80	-3.20	7.000	1.281	42.00	42.64	
7	2.60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



WAN KA HO
 Project Consultant

Report Date: 25 Mar 2019

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 : KER1b		Next Calibration Date: 23-Jun-19	
Brand:	Tisch	Technician: Mike Kan	
Model:	TE-5170	S/N:	3482

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 Intercept = -13.5339 Corr. coeff.: 0.9973
13	5.40	-5.40	10.800	1.586	38.00	38.58	
10	3.20	-3.60	6.800	1.262	26.00	26.40	
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:

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

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

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:

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

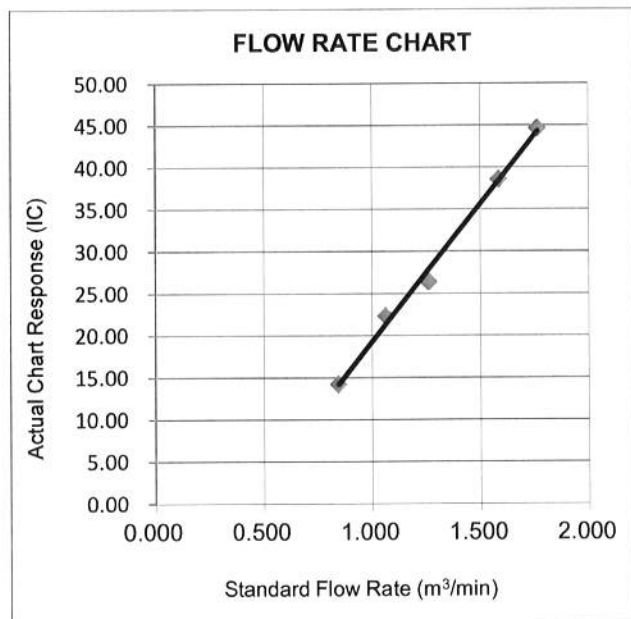
m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure



WAN KA HO
Project Consultant

Report Date: 25 Mar 2019

MATERIALAB CONSULTANTS LIMITED

Room 723 & 725, 7/F, Block B,
Profit Industrial Building,
1-15 Kwai Fung Crescent, Kwai Fong,
Hong Kong.

Tel : +852 2450 8238
Fax : +852 2450 8032
E-mail : mcl@fugro.com
Website : www.fugro.com



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

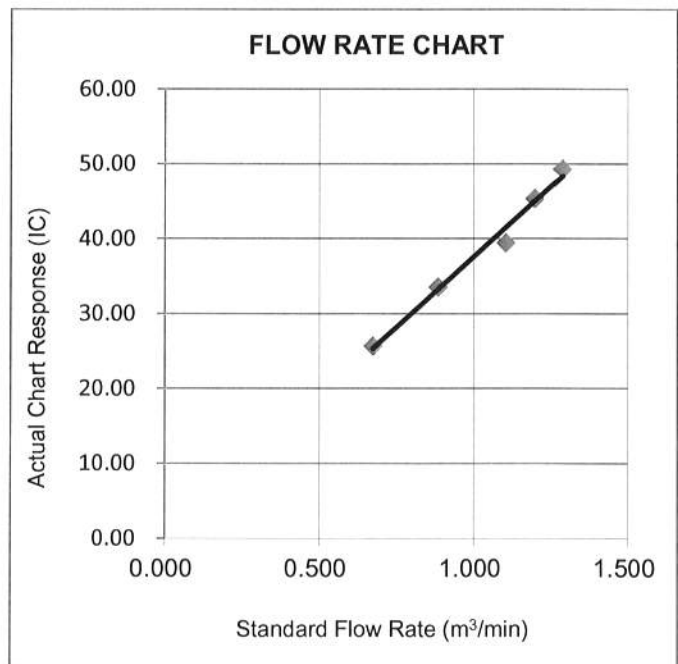
CALIBRATION ORIFICE

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:
 $Q_{std} = 1/m[\sqrt{H_2O(P_a/P_{std})(T_{std}/T_a)}] - b$
 $IC = I[\sqrt{P_a/P_{std}}(T_{std}/T_a)]$
 Qstd = standard flow rate
 IC = corrected chart response
 I = actual chart response
 m = calibrator Qstd slope
 b = calibrator Qstd intercept
 T_a = actual temperature during calibration (deg K)
 P_a = actual pressure during calibration (mm Hg)
 T_{std} = 298 deg K
 P_{std} = 760 mm Hg
For subsequent calculation of sampler flow:
 $1/m((I)[\sqrt{298/T_{av}}(P_{av}/760)] - b)$
 m = sampler slope
 b = sampler intercept
 I = chart response
 T_{av} = daily average temperature
 P_{av} = daily average pressure



Wan Ka Ho
 Project Consultant

Report Date: 23 Jun 2019

MATERIALAB CONSULTANTS LIMITED

Room 723 & 725, 7/F, Block B,
Profit Industrial Building,
1-15 Kwai Fung Crescent, Kwai Fong,
Hong Kong.

Tel : +852 2450 8238
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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:

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

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

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:

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

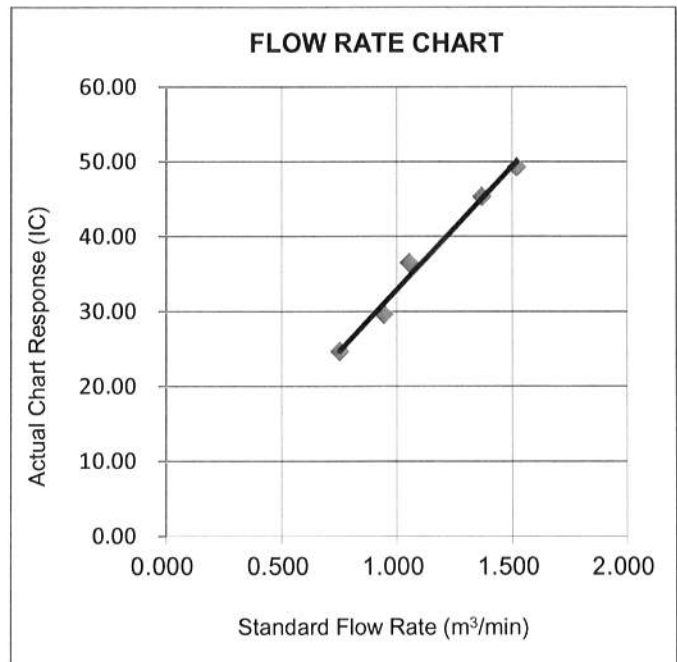
m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure



Wan Ka Ho
Project Consultant

Report Date: 23 Jun 2019

MATERIALAB CONSULTANTS LIMITED

Room 723 & 725, 7/F, Block B,
Profit Industrial Building,
1-15 Kwai Fung Crescent, Kwai Fong,
Hong Kong.

Tel : +852 2450 8238
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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 : KTDb		Next Calibration Date: 21-Sep-19	
Brand:	Tisch	Technician: Francis Xie	
Model:	TE-5170	S/N:	3838

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	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:

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

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

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:

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

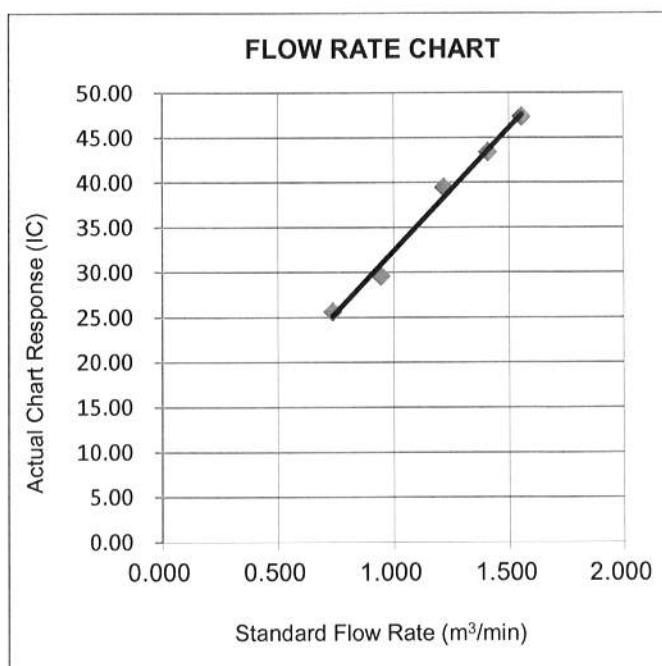
m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure



Wan Ka Ho
Project Consultant

Report Date: 23 Jun 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:-

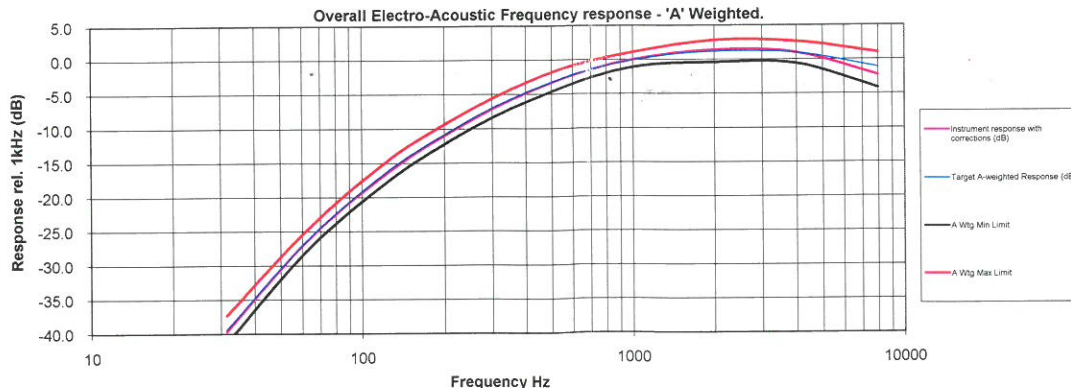
- Self Generated Noise Test
- Electrical Signal Test Of Frequency Weightings
- Frequency & Time Weightings At 1 kHz
- Level Linearity On The Reference Level Range
- Toneburst Response Test
- C-peak Sound Levels
- Overload Indication
- Acoustic Tests

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



<p>Casella UK</p> <p>Regent House, Wolveley Road, Kempston, Bedford MK42 7JY United Kingdom</p> <p>Tel: +44 (0) 1234 844100 Fax: +44(0) 1234 841490 E-mail: info@casellasolutions.com</p>	<p>Casella USA</p> <p>415 Lawrence Bell Drive, Unit 4 Buffalo, NY 14221, USA</p> <p>Toll Free (800) 366-2966 Tel: +1 (716) 276 3040 E-mail: info@casellausa.com</p>	<p>Casella India</p> <p>Ideal Industries India Pvt.Ltd. 229-230, Spazeedge, Tower-B Sohna Road, Sector-47, Gurgaon-122001, Haryana, India.</p> <p>Tel: +91 124 4495100 E-mail: casella.sales@ideal-industries.in</p>	<p>Casella China</p> <p>Ideal Industries China Room 305, Building 1, No.1279, Chuanqiao Rd, Pudong New District, Shanghai, China</p> <p>Tel: +86-21-31263188 Fax: +86-21-61605906 Email: info@casellasolutions.cn</p>	<p>Casella Australia</p> <p>Ideal Industries (Aust) PTY. LTD Unit 17, 35 Dunlop Rd, Mulgrave, Vic. 3170, Australia.</p> <p>Email: australia@casellasolutions.com</p>
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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 superceeded Sound Level Meter Standards - IEC60651 and IEC60804.

Test Conditions:- 31 °C
 51 %RH
 1000 mBar

Test Engineer:- Chris Taylor
Date of Issue:- 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:-

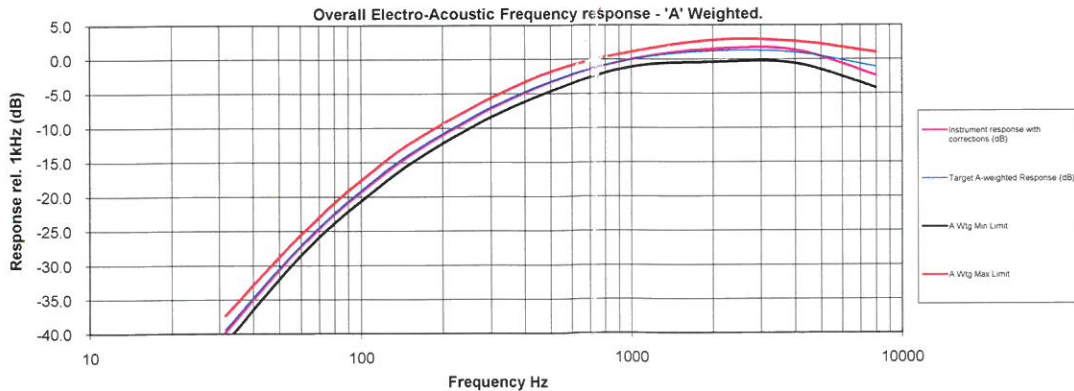
- Self Generated Noise Test
- Electrical Signal Test Of Frequency Weightings
- Frequency & Time Weightings At 1 kHz
- Level Linearity On The Reference Level Range
- Toneburst Response Test
- C-peak Sound Levels
- Overload Indication
- Acoustic Tests

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 1kHz.



<p>Casella UK Regent House, Wolsley Road, Kempston, Bedford MK42 7JY United Kingdom</p> <p>Tel: +44 (0) 1234 844100 Fax: +44(0) 1234 841490 E-mail: info@casellasolutions.com</p>	<p>Casella USA 415 Lawrence Bell Drive, Unit 4 Buffalo, NY 14221, USA</p> <p>Toll Free (800) 366-2966 Tel: +1 (716) 276 3040 E-mail: info@casellausa.com</p>	<p>Casella India Ideal Industries India Pvt Ltd. 229-230, Spazedge, Tower -B Sindhya Road, Sector-47, Gurgaon-122001, Haryana, India.</p> <p>Tel: +91 124 4495100 E-mail: casella.sales@ideal-industries.in</p>	<p>Casella China Ideal Industries China Room 305, Building 1, No.1279, Chuanqiao Rd, Pudong New District, Shanghai, China</p> <p>Tel: +86-21-31263188 Fax: +86-21-61605906 Email: info@casellasolutions.cn</p>	<p>Casella Australia Ideal Industries (Aust) PTY. LTD Unit 17, 35 Dunlop Rd, Mulgrave, Vic. 3170, Australia.</p> <p>Email: australia@casellasolutions.com</p>
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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

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Report no.: 183057CA195161(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

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)

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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 : mallab@fugro.com
Website : www.fugro.com

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Report No. : 183057CA195782

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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 : Kit Leung Date : 24-6-2019
CA-R-297 (22/07/2009) Leung Kwok Tai (Assistant Manager)

** End of Report **