

Certificate of Calibration

Calibration Certification Information			
Cal. Date: October 21, 2019	Rootsmeter S/N: 438320	Ta: 295	°K
Operator: Jim Tisch		Pa: 744.2	mm Hg
Calibration Model #: TE-5025A	Calibrator S/N: 2456		

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.4200	3.2	2.00
2	3	4	1	1.0180	6.3	4.00
3	5	6	1	0.9030	7.9	5.00
4	7	8	1	0.8620	8.8	5.50
5	9	10	1	0.7120	12.6	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)	
0.9849	0.6936	1.4066	0.9957	0.7012	0.8904	
0.9808	0.9635	1.9892	0.9915	0.9740	1.2592	
0.9787	1.0838	2.2240	0.9894	1.0957	1.4078	
0.9775	1.1340	2.3325	0.9882	1.1464	1.4765	
0.9724	1.3658	2.8131	0.9831	1.3807	1.7808	
QSTD	m=	2.08799	QA	m=	1.30746	
	b=	-0.03545		b=	-0.02244	
	r=	0.99989		r=	0.99989	

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

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TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Project : Environmental Monitoring Works For Contract No. KLN/2015/07			Date of Calibration: 15-May-20		
Location : KER1b			Next Calibration Date: 14-Aug-20		
Brand:	Tisch		Technician: Tony Wan		
Model:	TE-5170	S/N:	3477		

CONDITIONS					
Sea Level Pressure (hPa):	1008.3	Corrected Pressure (mm Hg):	756		
Temperature (°C):	28.5	Temperature (K):	302		

CALIBRATION ORIFICE					
Make:	Tisch	Qstd Slope:	2.08799		
Model:	TE-5025A	Qstd Intercept:	-0.03545		
Calibration Date:	21-Oct-19	Expiry Date:	21-Oct-20		
S/N:	2456				

CALIBRATION							
Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qstd (m ³ /min)	I (chart)	IC (corrected)	LINEAR REGRESSION
18	6.00	-7.20	13.200	1.743	50.00	49.59	Slope = 39.9042 Intercept = -19.4311 Corr. coeff.: 0.9934
13	4.50	-6.50	11.000	1.592	46.00	45.62	
10	3.00	-5.40	8.400	1.394	36.00	35.70	
7	2.50	-4.20	6.700	1.246	29.00	28.76	
5	1.50	-3.30	4.800	1.058	24.00	23.80	

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:

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

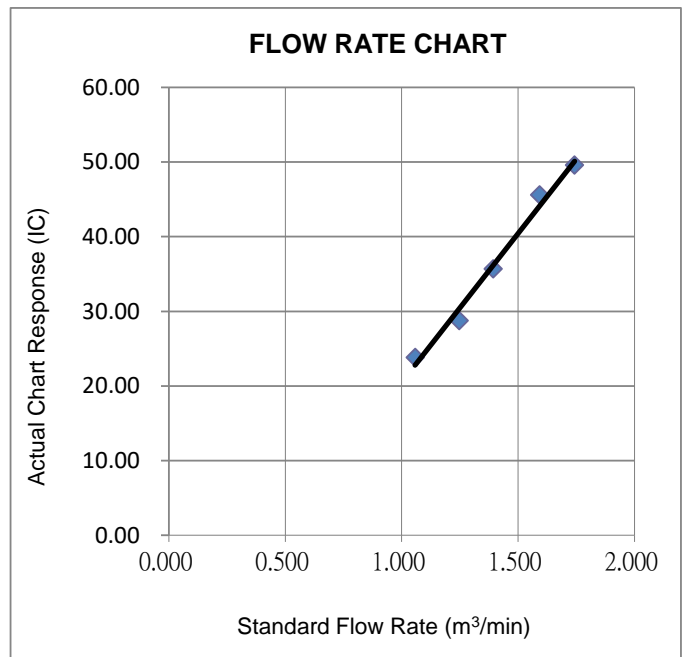
m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure



Wan Ka Ho

Wan Ka Ho
Project Consultant

Report Date: 19/5/2020

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TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Project : Environmental Monitoring Works For Contract No. KLN/2015/07			Date of Calibration: 9-Apr-20
Location : KTD1a			Next Calibration Date: 8-Jul-20
Brand:	Tisch		Technician: Mike Kan
Model:	TE-5170	S/N: 4037	

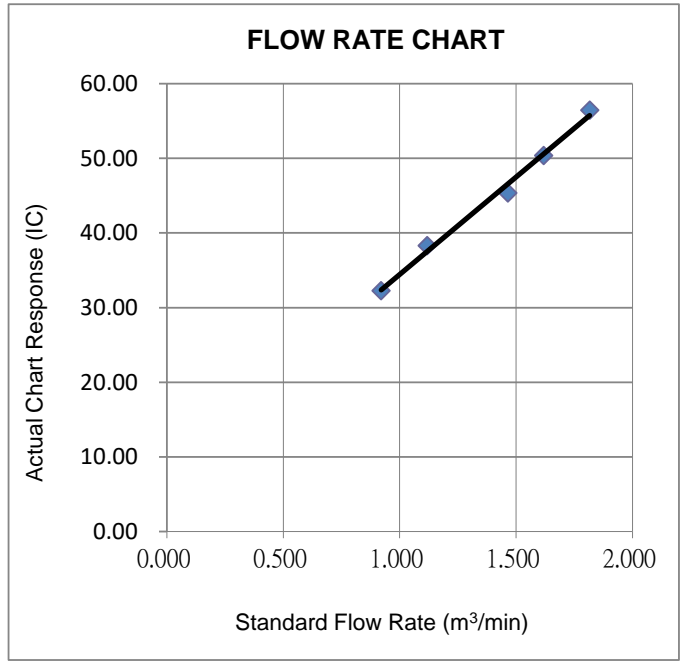
CONDITIONS			
Sea Level Pressure (hPa):	1017.5	Corrected Pressure (mm Hg):	763
Temperature (°C):	21.6	Temperature (K):	295

CALIBRATION ORIFICE			
Make:	Tisch	Qstd Slope:	2.08799
Model:	TE-5025A	Qstd Intercept:	-0.03545
Calibration Date:	21-Oct-19	Expiry Date:	21-Oct-20
S/N:	2456		

CALIBRATION							
Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qstd (m ³ /min)	I (chart)	IC (corrected)	LINEAR REGRESSION
18	10.80	-3.10	13.900	1.817	56.00	56.44	Slope = 26.0899 Intercept = 8.3490 Corr. coeff.: 0.9964
13	9.20	-1.80	11.000	1.618	50.00	50.39	
10	8.40	-0.60	9.000	1.465	45.00	45.35	
7	6.60	1.40	5.200	1.118	38.00	38.30	
5	5.20	1.70	3.500	0.920	32.00	32.25	

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



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Report Date: 14/4/2020

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TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

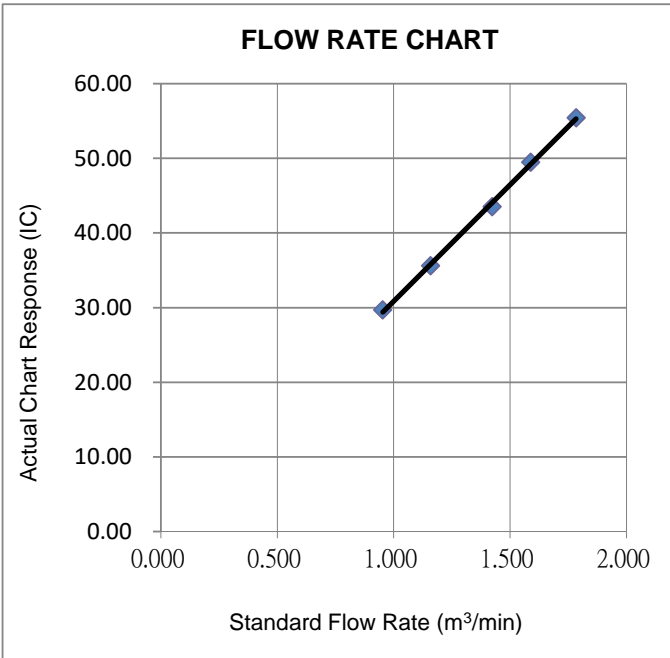
Project : Environmental Monitoring Works For Contract No. KLN/2015/07			Date of Calibration: 7-Jul-20		
Location : KTD1a			Next Calibration Date: 6-Oct-20		
Brand:	Tisch		Technician: Mike Kan		
Model:	TE-5170	S/N:	4037		

CONDITIONS					
Sea Level Pressure (hPa):	1009.2	Corrected Pressure (mm Hg):	757		
Temperature (°C):	30.1	Temperature (K):	303		

CALIBRATION ORIFICE					
Make:	Tisch	Qstd Slope:	2.08799		
Model:	TE-5025A	Qstd Intercept:	-0.03545		
Calibration Date:	21-Oct-19	Expiry Date:	21-Oct-20		
S/N:	2456				

CALIBRATION							
Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qstd (m ³ /min)	I (chart)	IC (corrected)	LINEAR REGRESSION
18	7.80	-6.10	13.900	1.784	56.00	55.42	Slope = 31.1581 Intercept = -0.2921 Corr. coeff.: 0.9995
13	6.60	-4.40	11.000	1.589	50.00	49.48	
10	5.40	-3.40	8.800	1.423	44.00	43.54	
7	4.20	-1.60	5.800	1.158	36.00	35.62	
5	3.00	-0.90	3.900	0.953	30.00	29.69	

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



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Report Date: 14/4/2020

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TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Project : Environmental Monitoring Works For Contract No. KLN/2015/07			Date of Calibration: 9-Apr-20		
Location : KTD2c			Next Calibration Date: 8-Jul-20		
Brand:	Tisch		Technician: Mike Kan		
Model:	TE-5170	S/N:	3838		

CONDITIONS					
Sea Level Pressure (hPa):	1017.5	Corrected Pressure (mm Hg):	763		
Temperature (°C):	21.6	Temperature (K):	295		

CALIBRATION ORIFICE					
Make:	Tisch	Qstd Slope:	2.08799		
Model:	TE-5025A	Qstd Intercept:	-0.03545		
Calibration Date:	21-Oct-19	Expiry Date:	21-Oct-20		
S/N:	2456				

CALIBRATION							
Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qstd (m ³ /min)	I (chart)	IC (corrected)	LINEAR REGRESSION
18	8.30	-5.20	13.500	1.791	59.00	59.46	Slope = 25.0637 Intercept = 13.9296 Corr. coeff.: 0.9960
13	6.80	-3.10	9.900	1.536	52.00	52.41	
10	5.90	-2.20	8.100	1.391	47.00	47.37	
7	4.30	-0.40	4.700	1.063	41.00	41.32	
5	3.40	0.70	2.700	0.810	34.00	34.27	

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:

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

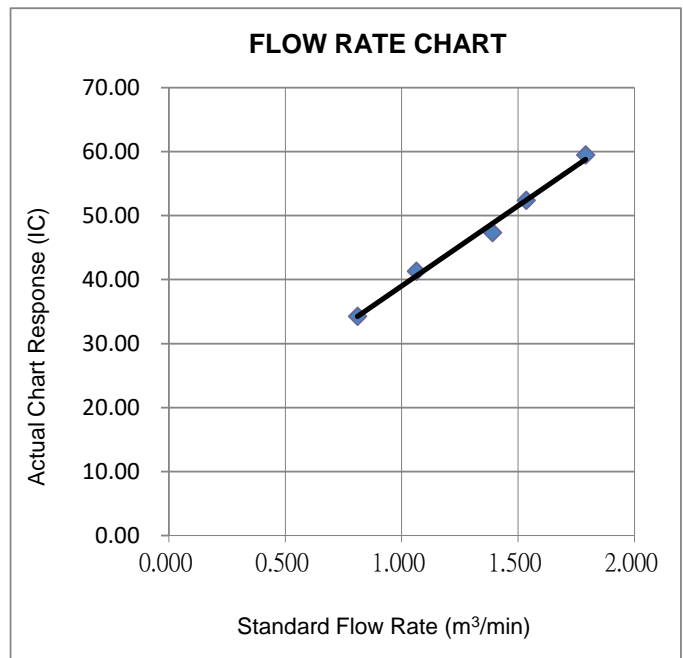
m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure



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Report Date: **14/4/2020**

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TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Project : Environmental Monitoring Works For Contract No. KLN/2015/07			Date of Calibration: 7-Jul-20		
Location : KTD2c			Next Calibration Date: 6-Oct-20		
Brand:	Tisch		Technician: Mike Kan		
Model:	TE-5170	S/N:	3838		

CONDITIONS					
Sea Level Pressure (hPa):	1009.2	Corrected Pressure (mm Hg):	757		
Temperature (°C):	30.1	Temperature (K):	303		

CALIBRATION ORIFICE					
Make:	Tisch	Qstd Slope:	2.08799		
Model:	TE-5025A	Qstd Intercept:	-0.03545		
Calibration Date:	21-Oct-19	Expiry Date:	21-Oct-20		
S/N:	2456				

CALIBRATION							
Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qstd (m ³ /min)	I (chart)	IC (corrected)	LINEAR REGRESSION
18	7.60	-5.80	13.400	1.752	60.00	59.37	Slope = 35.9358 Intercept = -4.0249 Corr. coeff.: 0.9984
13	6.40	-4.00	10.400	1.545	52.00	51.46	
10	5.80	-2.80	8.600	1.407	46.00	45.52	
7	4.40	-1.20	5.600	1.139	38.00	37.60	
5	3.00	-0.80	3.800	0.941	30.00	29.69	

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:

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

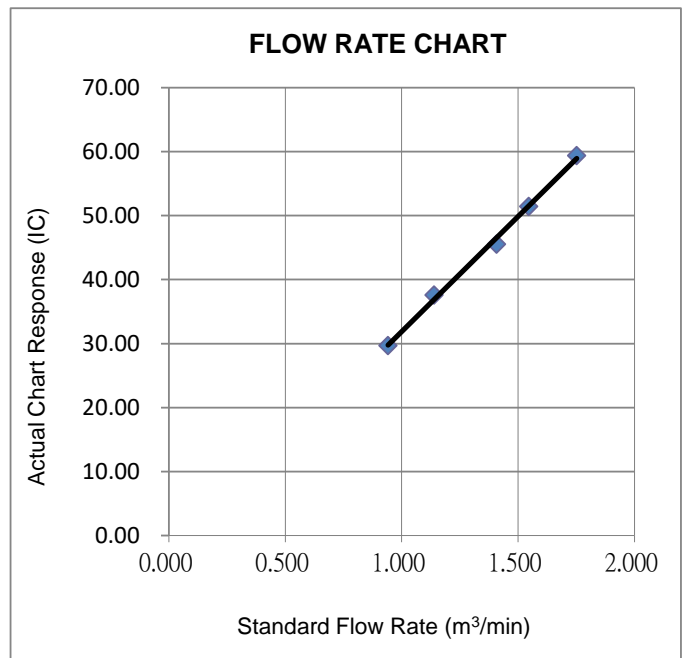
m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure



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Project Consultant

Report Date: **14/4/2020**

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Report no.: 183057CA196305(2)

Page 1 of 1

CALIBRATION CERTIFICATE OF SOUND LEVEL METER

Client Supplied Information

Client : Fugro Technical Services Ltd.

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 Level Meter
Manufacturer : Casella
Model No. :
Serial No. :
Next Calibration Date : 16-Oct-2020
Specification Limit : EN 61672: 2003 Type 1

	Meter	Microphone	Preamplifier
Model No.	CEL-63X	CE-251	CEL-495
Serial No.	1367959	03395	002712

Laboratory Information

Details of Reference Equipment -

Description : B & K Acoustic Multifunction Calibrator 4226 (Traditional free field setting)
Equipment ID. : R-108-1

Date of Calibration : 17-Oct-2019 Ambient Temperature : 22 °C

Calibration Location : Calibration Laboratory of FTS

Method Used : By direct comparison

Calibration Results :

Parameters		Mean Value (dB)	Specification Limit(dB)
A-weighting frequency response	4000Hz	1.4	2.6 to -0.6
	2000Hz	1.3	2.8 to -0.4
	1000Hz	0.0	1.1 to -1.1
	500Hz	-3.4	-1.8 to -4.6
	250Hz	-8.8	-7.2 to -10.0
	125Hz	-16.2	-14.6 to -17.6
	63Hz	-26.3	-24.7 to -27.7
	31.5Hz	-39.2	-37.4 to -41.4
Differential level linearity	94dB-104dB	0.0	± 0.6
	104dB-114dB	0.0	± 0.6

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. For calibration: Reference SPL are 94, 104 & 114dB, range setting is 20-140dB & time weighting is fast
4. The equipment does comply with EN 61672: 2003 Type 1 sound level meter for the above measurement.
- 5 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 : 23-10-2019 Certified by : K.T. Leung Date : 24-10-2019
CA-R-297 (22/07/2009) Leung Kwok Tai (Assistant Manager)

** End of Report **

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Report no.: 183057CA196174(1)

Page 1 of 1

CALIBRATION CERTIFICATE OF SOUND LEVEL METER

Client Supplied Information

Client : Fugro Technical Services Ltd.

Project : Calibration Services

Details of Unit Under Test, UUT

Description : Sound Level Meter

Manufacturer : Casella

Model No.

Serial No.

Next Calibration Date : 10-Sep-2020

Specification Limit : EN 61672: 2003 Type 1

	Meter	Microphone	Preamplifier
Model No.	CEL-63X	CE-251	CEL-495
Serial No.	1488269	00995	003341

Laboratory Information

Description : B & K Acoustic Multifunction Calibrator 4226 (Traditional free field setting)

Equipment ID. : R-108-1

Date of Calibration : 11-Sep-2019 Ambient Temperature : 22 °C

Calibration Location : Calibration Laboratory of FTS

Method Used : By direct comparison

Calibration Results :

Parameters	Mean Value (dB)	Specification Limit(dB)
A-weighting frequency response	4000Hz	1.0
	2000Hz	1.1
	1000Hz	-0.1
	500Hz	-3.4
	250Hz	-8.7
	125Hz	-16.2
	63Hz	-26.2
	31.5Hz	-39.2
Differential level linearity	94dB-104dB	± 0.6
	104dB-114dB	± 0.6

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. For calibration: Reference SPL are 94, 104 & 114dB, range setting is 20-140dB & time weighting is fast
4. The equipment does comply with EN 61672: 2003 Type 1 sound level meter for the above measurement.
5. The values given in this Calibration Certificate only relate to the unit-under-test and the values measured at the time of the test. Uncertainties will not include allowances for the environmental changes, variation and shock during transportation, or the capability of any other laboratory to repeat the measurement.

Checked by : William Date : 18-9-2019 Certified by : K.T. Young Date : 18-9-2019
CA-R-297 (22/07/2009) Leung Kwok Tai (Assistant Manager)

** End of Report **

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Report no.: 183057CA196275

Page 1 of 1

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. : 2383852
Equipment ID : N/A

Next Calibration Date : 15-Oct-2020

Specification Limit : EN 60942: 2003 Type 1

Laboratory Information

Details of Reference Equipment -

Description : Reference Sound level meter
Equipment ID. : R-119-1

Date of Calibration : 16-Oct-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	0.0 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 : 22-10-2019 Certified by : Leung Kwok Tai Date : 22-10-2019
CA-R-297 (22/07/2009) Leung Kwok Tai (Assistant Manager)

** End of Report **

FUGRO TECHNICAL SERVICES LIMITED

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Page 1 of 1

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. : 2383982
Equipment ID : N/A
Next Calibration Date : 23-Oct-2020
Specification Limit : EN 60942: 2003 Type 1

Laboratory Information

Description : Reference Sound level meter
Equipment ID. : R-119-1
Date of Calibration : 24-Oct-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	-0.1 dB	±0.4dB
114dB	-0.2 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 : 1-11-2019 Certified by : R.T. Leung Date : 1-11-2019
CA-R-297 (22/07/2009) Leung Kwok Tai (Assistant Manager)

** End of Report **

Report No. : 183057CA200894(3)

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-08

Next Calibration Date : 14-Jun-2021

Laboratory Information

Details of Reference Equipment –

Description : Reference Anemometer

Equipment ID : R-101-4

Date of Calibration : 15-Jun-2020 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)
2.02	2.0	0.0
4.15	4.1	-0.1
6.27	6.0	-0.3
8.43	8.0	-0.4
10.75	10.1	-0.7

Remark :

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 : 20-6-2020 Certified by : Leung Kwok Tai Date : 20-6-2020

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

Leung Kwok Tai (Assistant Manager)

** End of Report **