

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=	$\Delta Vol((Pa-\Delta P)/Pstd)(Tstd/Ta)$	Va=	$\Delta Vol((Pa-\Delta P)/Pa)$
Qstd=	$Vstd/\Delta Time$	Qa=	$Va/\Delta Time$
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: 18-Feb-20
Location : KER1b Next Calibration Date: 17-May-20
Brand: Tisch Technician: Tony Wan
Model: TE-5170 S/N: 3477

CONDITIONS

Sea Level Pressure (hPa): 1026.4 Corrected Pressure (mm Hg): 770
Temperature (°C): 14.7 Temperature (K): 288

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	4.60	-7.90	12.500	1.751	51.00	52.24	Slope = 24.2236 Intercept = 9.1388 Corr. coeff.: 0.9953
13	3.40	-6.10	9.500	1.529	45.00	46.09	
10	2.40	-5.20	7.600	1.369	40.00	40.97	
7	1.00	-4.10	5.100	1.125	36.00	36.88	
5	0.30	-2.80	3.100	0.881	30.00	30.73	

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:

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

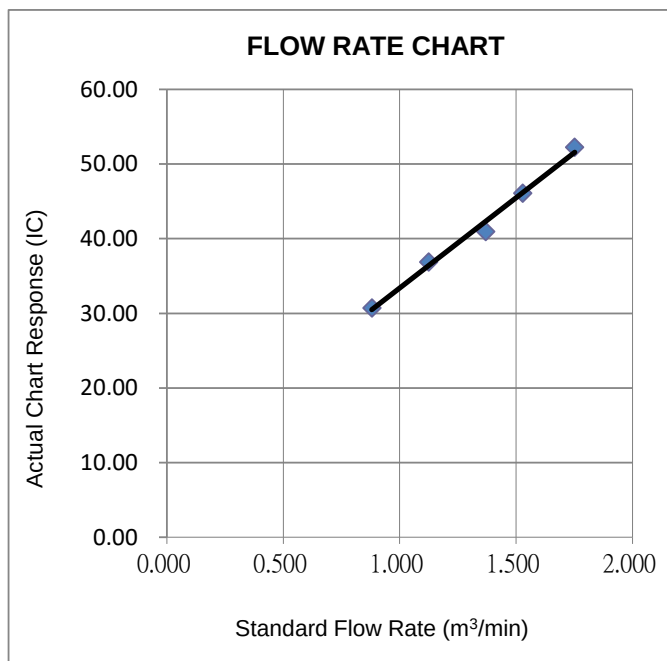
m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure



Wan Ka Ho

Wan Ka Ho
Project Consultant

Report Date: 20/2/2020

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**TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET**

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

CONDITIONS

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

CALIBRATION ORIFICE

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

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:

$Q_{std} = 1/m[\sqrt{H_2O(Pa/P_{std})(T_{std}/Ta)}] - b$

$IC = I[\sqrt{Pa/P_{std}}(T_{std}/Ta)]$

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:

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

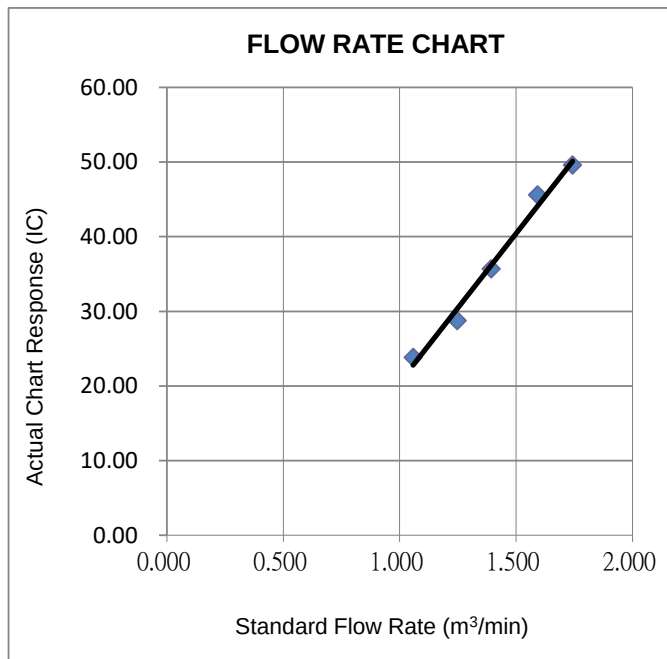
m = sampler slope

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

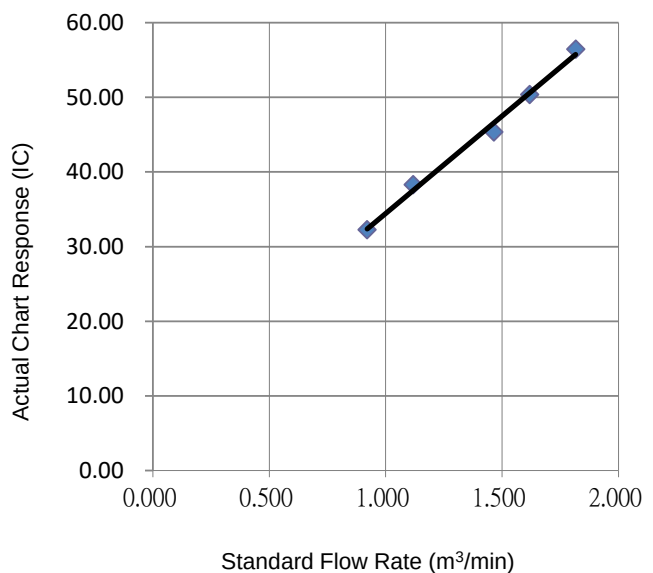
m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure

FLOW RATE CHART
Wan Ka Ho

Project Consultant

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

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

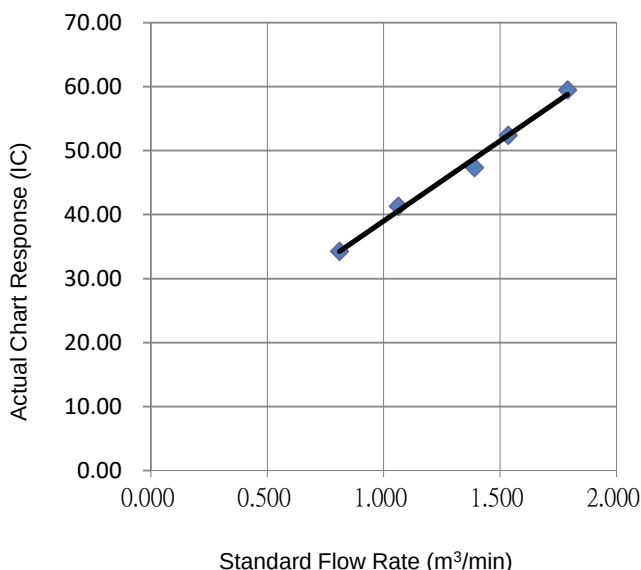
m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure

FLOW RATE CHART

Wan Ka Ho
Project Consultant

Report Date: 14/4/2020



Certificate of Calibration

Calibration Certification Information

Cal. Date: January 17, 2020 Rootsmeter S/N: 438320 Ta: 295 °K
Operator: Jim Tisch Pa: 744.2 mm Hg
Calibration Model #: TE-5025A Calibrator S/N: 3746

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.4340	3.2	2.00
2	3	4	1	1.0180	6.4	4.00
3	5	6	1	0.9080	7.9	5.00
4	7	8	1	0.8700	8.7	5.50
5	9	10	1	0.7150	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	0.6868	1.4066	0.9957	0.6944	0.8904
0.9807	0.9633	1.9892	0.9914	0.9739	1.2592
0.9787	1.0779	2.2240	0.9894	1.0896	1.4078
0.9776	1.1237	2.3325	0.9883	1.1360	1.4765
0.9724	1.3601	2.8131	0.9831	1.3749	1.7808
QSTD	m=	2.09221	QA	m=	1.31010
	b=	-0.02779		b=	-0.01759
	r=	0.99994		r=	0.99994

Calculations

Vstd= $\Delta Vol((Pa-\Delta P)/Pstd)(Tstd/Ta)$	Va= $\Delta Vol((Pa-\Delta P)/Pa)$
Qstd= $Vstd/\Delta Time$	Qa= $Va/\Delta Time$
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

High-Volume TSP Sampler

5-POINT CALIBRATION DATA SHEET



File No. MA20003/18/0002

Project No. CKL 1 - Flat 121 Cha Kwo Ling Village

Date: 8-May-20 Next Due Date: 8-Jul-20 Operator: SK

Equipment No.: A-01-18 Model No.: TE 5170 Serial No. 0723

Ambient Condition			
Temperature, Ta (K)	302.3	Pressure, Pa (mmHg)	756.3

Orifice Transfer Standard Information					
Serial No.	3746	Slope, mc	0.0592	Intercept, bc	-0.0274
Last Calibration Date:	17-Jan-20	$mc \times Qstd + bc = [\Delta H \times (Pa/760) \times (298/Ta)]^{1/2}$			
Next Calibration Date:	17-Jan-21	$Qstd = \{[\Delta H \times (Pa/760) \times (298/Ta)]^{1/2} - bc\} / mc$			

Calibration of TSP Sampler					
Calibration Point	Orifice			HVS	
	ΔH (orifice), in. of water	$[\Delta H \times (Pa/760) \times (298/Ta)]^{1/2}$	Qstd (CFM) X - axis	ΔW (HVS), in. of water	$[\Delta W \times (Pa/760) \times (298/Ta)]^{1/2}$ Y-axis
1	12.7	3.53	60.09	8.6	2.90
2	9.3	3.02	51.48	6.0	2.43
3	7.1	2.64	45.04	4.7	2.15
4	4.6	2.12	36.35	3.1	1.74
5	3.0	1.72	29.44	1.9	1.37

By Linear Regression of Y on X

Slope, mw = 0.0492 Intercept, bw : -0.0725

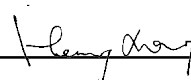
Correlation coefficient* = 0.9991

*If Correlation Coefficient < 0.990, check and recalibrate.

Set Point Calculation	
From the TSP Field Calibration Curve, take Qstd = 43 CFM	
From the Regression Equation, the "Y" value according to	
$mw \times Qstd + bw = [\Delta W \times (Pa/760) \times (298/Ta)]^{1/2}$	
Therefore, Set Point; W = $(mw \times Qstd + bw)^2 \times (760 / Pa) \times (Ta / 298) =$ <u>4.26</u>	

Remarks: _____

Conducted by: SK Wong Signature:  Date: 8 May 2020

Checked by: Henry Leung Signature:  Date: 8 May 2020

High-Volume TSP Sampler

5-POINT CALIBRATION DATA SHEET



File No. MA20003/55/0002

Project No. CKL 2 - Flat 103 Cha Kwo Ling Village

Date: 8-May-20 Next Due Date: 8-Jul-20 Operator: SK

Equipment No.: A-01-55 Model No.: TE 5170 Serial No. 1956

Ambient Condition			
Temperature, Ta (K)	302.3	Pressure, Pa (mmHg)	756.3

Orifice Transfer Standard Information					
Serial No.	3746	Slope, mc	0.0592	Intercept, bc	-0.0274
Last Calibration Date:	17-Jan-20	$mc \times Qstd + bc = [\Delta H \times (Pa/760) \times (298/Ta)]^{1/2}$			
Next Calibration Date:	17-Jan-21	$Qstd = \{[\Delta H \times (Pa/760) \times (298/Ta)]^{1/2} - bc\} / mc$			

Calibration of TSP Sampler					
Calibration Point	Orifice			HVS	
	ΔH (orifice), in. of water	$[\Delta H \times (Pa/760) \times (298/Ta)]^{1/2}$	Qstd (CFM) X - axis	ΔW (HVS), in. of water	$[\Delta W \times (Pa/760) \times (298/Ta)]^{1/2}$ Y-axis
1	12.7	3.53	60.09	7.3	2.68
2	9.9	3.12	53.10	6.0	2.43
3	7.2	2.66	45.36	4.4	2.08
4	4.3	2.05	35.16	3.3	1.80
5	2.6	1.60	27.44	2.3	1.50

By Linear Regression of Y on X

Slope, mw = 0.0356 Intercept, bw : 0.5214

Correlation coefficient* = 0.9974

*If Correlation Coefficient < 0.990, check and recalibrate.

Set Point Calculation

From the TSP Field Calibration Curve, take Qstd = 43 CFM

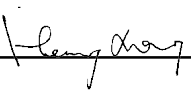
From the Regression Equation, the "Y" value according to

$$mw \times Qstd + bw = [\Delta W \times (Pa/760) \times (298/Ta)]^{1/2}$$

Therefore, Set Point; W = $(mw \times Qstd + bw)^2 \times (760 / Pa) \times (Ta / 298) =$ 4.29

Remarks: _____

Conducted by: SK Wong Signature:  Date: 8 May 2020

Checked by: Henry Leung Signature:  Date: 8 May 2020

Certificate of Calibration - Wind Monitoring Station

Description: Yau Lai Estate, Bik Lai House
Manufacturer: Davis Instruments
Model No.: Davis7440
Serial No.: MC01010A44
Equipment No.: SA-03-04
Date of Calibration 21-Feb-2020
Next Due Date 21-Aug-2020

1. Performance check of Wind Speed

Wind Speed, m/s		Difference D (m/s)
Wind Speed Reading (V1)	Anemometer Value (V1)	$D = V1 - V2$
0.0	0.0	0.0
1.2	1.3	-0.1
2.0	2.1	-0.1
3.0	3.2	-0.2

2. Performance check of Wind Direction

Wind Direction (°)		Difference D (°)
Wind Direction Reading (V1)	Marine Compass Value (V1)	$D = W1 - W2$
0	0	0.0
90	90	0.0
180	180	0.0
270	270	0.0

Test Specification:

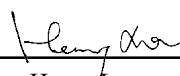
1. Performance Wind Speed Test - The wind meter was on-site calibrated against the anemometer

2. Performance Wind Direction Test - The wind meter was on-site calibrated against the marine compass at four direction

Calibrated by:


Wong Shing Kwai

Approved by:


Henry Leung