

Appendix E. Calibration Certificates



ALS Laboratory Group

ANALYTICAL CHEMISTRY & TESTING SERVICES

SUB-CONTRACTING REPORT

CONTACT	: MS VANESSA LI	WORK ORDER	: HK1944863
CLIENT	: MOTT MACDONALD HONG KONG LIMITED		
ADDRESS	: 3/F INTERNATIONAL TRADE TOWER, 348 KWUN TONG ROAD, KWUN TONG, KOWLOON, HONG KONG	SUB-BATCH	: 1
		DATE RECEIVED	: 17-OCT-2019
		DATE OF ISSUE	: 30-OCT-2019
PROJECT	: PERFORMANCE CHECK OF TSP DUST METER	NO. OF SAMPLES	: 1
		CLIENT ORDER	: ---

General Comments

- Sample(s) were received in ambient condition.
- Sample(s) analysed and reported on as received basis.
- Calibration was subcontracted to and analysed by Action United Enviro Services.
- Sample information (Project name, Sample ID, Sampling date/ time) is provided by client.

Signatories

This document has been signed by those names that appear on this report and are the authorised signatories

Signatories

Position

Richard Fung

General Manager

This is the Final Report and supersedes any preliminary report with this batch number.

Results apply to sample(s) as submitted. All pages of this report have been checked and approved for release.

ALS Technichem (HK) Pty Ltd
Part of the **ALS Laboratory Group**

11/F. Chung Shun Knitting Centre 1 - 3 Wing Yip Street Kwai Chung N.T. Hong Kong
Tel. +852 2610 1044 Fax. +852 2610 2021 www.alsglobal.com

WORK ORDER : HK1944863
SUB-BATCH : 1
CLIENT : MOTT MACDONALD HONG KONG LIMITED
PROJECT : PERFORMANCE CHECK OF TSP DUST METER



ALS Lab ID	Client's Sample ID	Sample Type	Sample Date	External Lab Report No.
HK1944863-001	S/N: 296098	Equipments	17-Oct-2019	S/N: 296098

Equipment Verification Report (TSP)

Equipment Calibrated:

Type: Laser Dust monitor
 Manufacturer: Sibata LD-3B
 Serial No. 296098
 Equipment Ref: Nil
 Job Order HK1944863

Standard Equipment:

Standard Equipment: Higher Volume Sampler
 Location & Location ID: AUES office (calibration room)
 Equipment Ref: HVS 018
 Last Calibration Date: 22 August 2019

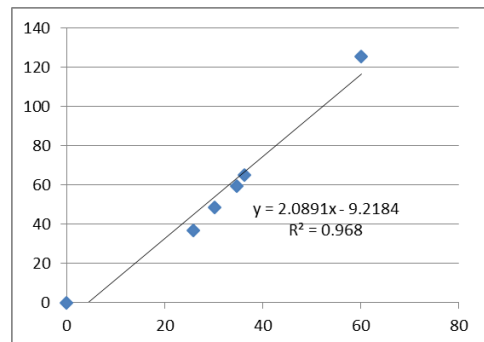
Equipment Verification Results:

Testing Date: 24 & 25 October 2019

Hour	Time	Mean Temp °C	Mean Pressure (hPa)	Concentration in µg/m ³ (Standard Equipment)	Total Count (Calibrated Equipment)	Count/Minute (Total Count/min)
2hr02min	13:21 ~ 15:23	26.2	1014.9	37	3145	25.8
2hr01min	15:26 ~ 17:27	26.2	1014.9	49	3641	30.2
2h11min	09:13 ~ 11:24	25.8	1016.7	65	4764	36.3
2hr	11:27 ~ 13:27	25.8	1016.7	125	7210	60.1
2hr02min	13:31 ~ 15:33	25.8	1016.7	59	4218	34.6

Linear Regression of Y or X

Slope (K-factor): 2.0891 (µg/m³)/CPM
 Correlation Coefficient 0.9839
 Date of Issue 29 October 2019




Remarks:

- Strong** Correlation ($R > 0.8$)
- Factor 2.0891 (µg/m³)/CPM should be applied for TSP monitoring

*If $R < 0.5$, repair or re-verification is required for the equipment

Operator : Fai So Signature :  Date : 29 October 2019

QC Reviewer : Ben Tam Signature :  Date : 29 October 2019

TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Location : Gold King Industrial Building, Kwai Chung Date of Calibration: 22-Aug-19
 Location ID : Calibration Room Next Calibration Date: 22-Nov-19

CONDITIONS

Sea Level Pressure (hPa)	1005.5	Corrected Pressure (mm Hg)	754.125
Temperature (°C)	29.2	Temperature (K)	302

CALIBRATION ORIFICE

Make->	TISCH	Qstd Slope ->	2.0968
Model->	5025A	Qstd Intercept ->	-0.00065
Calibration Date->	5-Feb-19	Expiry Date->	5-Feb-20

CALIBRATION

Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qstd (m3/min)	I (chart)	IC corrected	LINEAR REGRESSION		
							Slope =	Intercept =	Corr. coeff. =
18	6.6	6.6	13.2	1.714	56	55.39	Slope =	37.1811	
13	5.2	5.2	10.4	1.522	50	49.46	Intercept =	-7.4343	
10	4.1	4.1	8.2	1.351	44	43.52	Corr. coeff. =	0.9969	
8	2.6	2.6	5.2	1.076	34	33.63			
5	1.7	1.7	3.4	0.870	24	23.74			

Calculations :

$$Q_{std} = 1/m[\text{Sqrt}(H2O(Pa/P_{std})(T_{std}/T_a))-b]$$

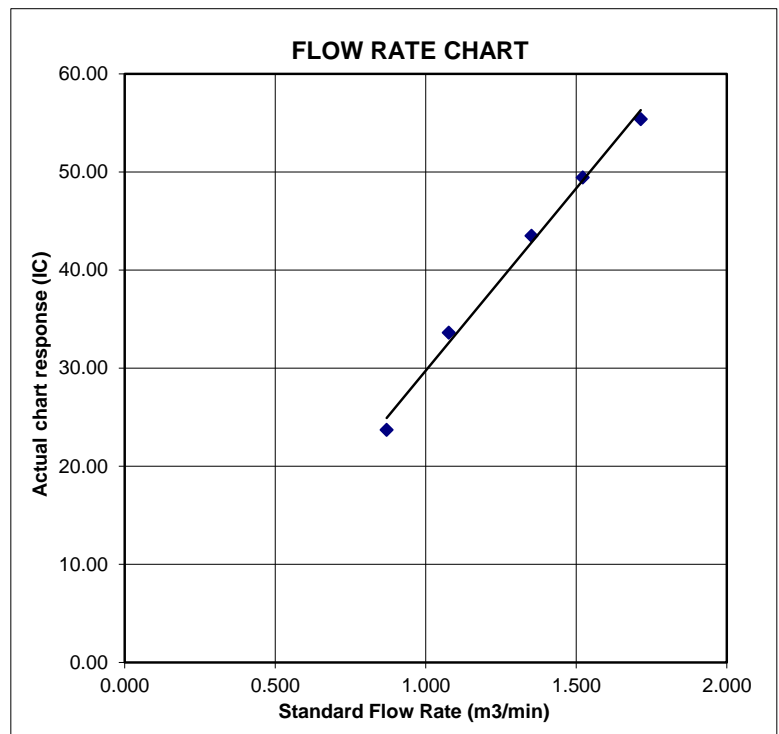
$$IC = I[\text{Sqrt}(Pa/P_{std})(T_{std}/T_a)]$$

Qstd = standard flow rate
 IC = corrected chart responses
 I = actual chart response
 m = calibrator Qstd slope
 b = calibrator Qstd intercept
 Ta = actual temperature during calibration (deg K)
 Pstd = actual pressure during calibration (mm Hg)

For subsequent calculation of sampler flow:

$$1/m((I)[\text{Sqrt}(298/T_{av})(P_{av}/760)]-b)$$

m = sampler slope
 b = sampler intercept
 I = chart response
 Tav = daily average temperature
 Pav = daily average pressure



Certificate of Calibration

Calibration Certification Information			
Cal. Date: February 5, 2019	Rootsmeter S/N: 438320	Ta: 293	°K
Operator: Jim Tisch		Pa: 753.1	mm Hg
Calibration Model #: TE-5025A	Calibrator S/N: 1941		

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.4830	3.2	2.00
2	3	4	1	1.0430	6.4	4.00
3	5	6	1	0.9300	7.9	5.00
4	7	8	1	0.8870	8.7	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)
1.0036	0.6767	1.4197	0.9958	0.6714	0.8821
0.9993	0.9581	2.0078	0.9915	0.9506	1.2475
0.9973	1.0723	2.2448	0.9895	1.0640	1.3947
0.9962	1.1231	2.3544	0.9884	1.1144	1.4628
0.9908	1.3536	2.8395	0.9831	1.3431	1.7642
QSTD	m=	2.09680	QA	m=	1.31298
	b=	-0.00065		b=	-0.00040
	r=	0.99999		r=	0.99999

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



專業化驗有限公司
QUALITY PRO TEST-CONSULT LIMITED

Unit 10, 14/F, Wah Wai Centre, 38-40 Au Pui Wan St., Fotan, Hong Kong
Email: info@qualityprotest.com; Website: www.qualityprotest.com
Tel: (852) 3956 8717; Fax: (852) 3956 3928

REPORT OF EQUIPMENT PERFORMANCE CHECK/ CALIBRATION

Report No. : AI100182
Date of Issue : 30 October 2019
Page No. : 1 of 2

PART A – CUSTOMER INFORMATION

Enovative Environmental Service Ltd.
Flat 2207, Yu Fun House,
Yu Chui Court, Shatin
New Territories, Hong Kong
Attn: Mr. Thomas WONG

PART B – DESCRIPTION

Name of Equipment : YSI 6920V2 (Multi-Parameters)
Manufacturer : YSI (a xylem brand)
Serial Number : 0001C6A7
Date of Received : Oct 28, 2019
Date of Calibration : Oct 28, 2019
Date of Next Calibration^(a) : Jan 27, 2020

PART C – REFERENCE METHODS/ DOCUMENTS FOR THE CALIBRATION

<u>Parameter</u>	<u>Reference Method</u>
pH at 25°C	APHA 21e 4500-H ⁺ B
Dissolved Oxygen	APHA 21e 4500-O G
Conductivity at 25°C	APHA 21e 2510 B
Salinity	APHA 21e 2520 B
Turbidity	APHA 21e 2130 B
Temperature	Section 6 of international Accreditation New Zealand Technical Guide no. 3 Second edition March 2008: Working Thermometer Calibration Procedure.

PART D – CALIBRATION RESULTS^(b,c)

(1) pH at 25°C

Target (pH unit)	Displayed Reading ^(d) (pH Unit)	Tolerance ^(e) (pH Unit)	Results
4.00	4.07	0.07	Satisfactory
7.42	7.49	0.07	Satisfactory
10.01	10.05	0.04	Satisfactory

Tolerance of pH should be less than ± 0.20 (pH unit)

(2) Temperature


Reading of Ref. thermometer (°C)	Displayed Reading (°C)	Tolerance (°C)	Results
15.0	15.1	0.1	Satisfactory
25.0	25.0	0.0	Satisfactory
35.0	35.0	0.0	Satisfactory

Tolerance limit of temperature should be less than ± 2.0 (°C)

~ CONTINUED ON NEXT PAGE ~

Remark(s): -

- ^(a) The "Date of Next Calibration" is recommended according to best practice principals as practiced by QPT or quoted from relevant international standards.
^(b) The results relate only to the calibrated equipment as received
^(c) The performance of the equipment stated in this report is checked with independent reference material and results compared against a calibrated secondary source.
^(d) "Displayed Reading" denotes the figure shown on item under calibration/ checking regardless of equipment precision or significant figures.
^(e) The "Tolerance Limit" mentioned is referenced to YSI product specifications.


LEE Chun-ning, Desmond
Senior Chemist



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PART D – CALIBRATION RESULTS (Cont'd)

(3) Dissolved Oxygen

Expected Reading (mg/L)	Displayed Reading (mg/L)	Tolerance (mg/L)	Results
1.04	0.90	-0.14	Satisfactory
4.10	4.40	0.3	Satisfactory
5.92	6.00	0.08	Satisfactory
7.81	8.10	0.29	Satisfactory

Tolerance limit of dissolved oxygen should be less than ± 0.50 (mg/L)

(4) Conductivity at 25°C

Conc. of KCl (M)	Expected Reading ($\mu\text{S}/\text{cm}$)	Displayed Reading ($\mu\text{S}/\text{cm}$)	Tolerance (%)	Results
0.001	146.9	156	6.19	Satisfactory
0.01	1412	1384	-1.98	Satisfactory
0.1	12890	12810	-0.62	Satisfactory
0.5	58670	57991	-1.16	Satisfactory
1.0	111900	110844	-0.94	Satisfactory

Tolerance limit of conductivity should be less than ± 10.0 (%)

(5) Salinity

Expected Reading (g/L)	Displayed Reading (g/L)	Tolerance (%)	Results
10	10.08	0.80	Satisfactory
20	20.07	0.35	Satisfactory
30	30.1	0.33	Satisfactory

Tolerance limit of salinity should be less than ± 10.0 (%)

(6) Turbidity

Expected Reading (NTU)	Displayed Reading ^(f) (NTU)	Tolerance ^(g) (%)	Results
0	0.50	--	Satisfactory
10	10.02	0.2	Satisfactory
20	20.47	2.3	Satisfactory
100	100.16	0.2	Satisfactory
800	798.93	-0.1	Satisfactory

Tolerance limit of turbidity should be less than ± 10.0 (%)

~ END OF REPORT ~

Remark(s): -

^(f) "Displayed Reading" presents the figures shown on item under calibration/ checking regardless of equipment precision or significant figures.

^(g) The "Tolerance Limit" mentioned is the acceptance criteria applicable for similar equipment used by Quality Pro Test-Consult Ltd. or quoted from relevant international standards.



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(1) pH at 25°C

Target (pH unit)	Displayed Reading ^(d) (pH Unit)	Tolerance ^(e) (pH Unit)	Results
4.00	3.95	-0.05	Satisfactory
7.42	7.36	-0.06	Satisfactory
10.01	9.93	-0.08	Satisfactory

Tolerance of pH should be less than ± 0.20 (pH unit)

(2) Temperature


Reading of Ref. thermometer (°C)	Displayed Reading (°C)	Tolerance (°C)	Results
15.0	15.1	0.1	Satisfactory
25.0	24.9	-0.1	Satisfactory
35.0	34.9	-0.1	Satisfactory

Tolerance limit of temperature should be less than ± 2.0 (°C)

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Senior Chemist



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Conc. of KCl (M)	Expected Reading ($\mu\text{S}/\text{cm}$)	Displayed Reading ($\mu\text{S}/\text{cm}$)	Tolerance (%)	Results
0.001	146.9	140.0	-4.70	Satisfactory
0.01	1412	1394	-1.27	Satisfactory
0.1	12890	12780	-0.85	Satisfactory
0.5	58670	57927	-1.27	Satisfactory
1.0	111900	110880	-0.91	Satisfactory

Tolerance limit of conductivity should be less than ± 10.0 (%)

(5) Salinity

Expected Reading (g/L)	Displayed Reading (g/L)	Tolerance (%)	Results
10	9.90	-1.00	Satisfactory
20	19.88	-0.60	Satisfactory
30	29.89	-0.37	Satisfactory

Tolerance limit of salinity should be less than ± 10.0 (%)

(6) Turbidity

Expected Reading (NTU)	Displayed Reading ^(f) (NTU)	Tolerance ^(g) (%)	Results
0	0.20	--	Satisfactory
10	9.98	-0.2	Satisfactory
20	19.88	-0.6	Satisfactory
100	100.20	0.2	Satisfactory
800	798.82	-0.1	Satisfactory

Tolerance limit of turbidity should be less than ± 10.0 (%)

~ END OF REPORT ~

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