

Drainage Services Department



Contract No. CM 12/2019

Expansion of Sha Tau Kok Sewage Treatment Works

Environmental Team Services for Construction Phase (2020-2021)

Odour Commissioning Test Report for TSTP

[August 2021]

	Name	Signature
Prepared & Checked:	Lemon Lam	
Reviewed, Approved & Certified:	Y W Fung	

Version:2	Date: 13 August 2021
-----------	----------------------

Disclaimer
 This Odour Commissioning Test Report is prepared for Drainage Services Department and is given for its sole benefit in relation to and pursuant to Contract No. CM 12/2019 and may not be disclosed to, quoted to or relied upon by any person other than Drainage Services Department without our prior written consent. No person (other than Drainage Services Department into whose possession a copy of this report comes may rely on this report without our express written consent and Drainage Services Department may not rely on it for any purpose other than as described above.

AECOM Asia Co. Ltd.
 12/F, Grand Central Plaza, Tower 2, 138 Shatin Rural Committee Road, Shatin, NT, Hong Kong
 Tel: (852) 3922 9000 Fax: (852) 3922 9797 www.aecom.com



Drainage Services Department
42/F, Revenue Tower
5 Gloucester Road
Wan Chai
Hong Kong

Your reference:

Our reference: HKDSD206/50/107489

Date: 18 August 2021

Attention: Mr Alvin Ho

BY EMAIL & POST
(email: acmho@dsd.gov.hk)

Dear Sirs

Agreement No.: CM 14/2018
Independent Environmental Checker Services for
Expansion of Sha Tau Kok Sewage Treatment Works
Odour Commissioning Test Report for TSTP (Version 2)

We refer to email of 13 August 2021 from AECOM Asia Co. Ltd attaching the Odour Commissioning Test Report for TSTP (Version 2).

We have no comment and hereby verify the captioned Proposal in accordance with Clause 2.15 of the Environmental Permit no. EP-517/2017/A.

Should you have any queries, please do not hesitate to contact the undersigned or our Ms Karen Po at 2618 2831.

Yours faithfully
ANewR CONSULTING LIMITED

James Choi
Independent Environmental Checker

CPSJ/LCCR/PKWK/lsm

cc DSD – Mr Alex Leung (email: alexleung_dsd@dc1803.com.hk)
Binnies – Mr Kendrick Wong (email: re_em2@dc1803.com.hk)
Binnies – Mr Alaster Chan (email: are_em2@dc1803.com.hk)
AECOM – Mr YW Fung (email: yw.fung@aecom.com)
AECOM – Ms Lemon Lam (email: lemon.lam@aecom.com)

TABLE OF CONTENTS

	Page
1 INTRODUCTION	2
1.1 Background	2
1.2 Scope of Report	2
2 ODOUR MONITORING	2
2.1 Odour Commissioning Test Monitoring (Operation Phase for TSTP)	2
2.2 H ₂ S Monitoring Methodology	3
2.3 Monitoring Equipment	4
2.4 Monitoring Locations	4
2.5 Results and Observation	5
3 RECOMMENDATIONS	5

List of Tables

Table 2.1	Design Parameter of Exhaust Stack and Odour Emission Rate of TSTP
Table 2.2	Approved Alternative Odour Monitoring Methodology
Table 2.3	Details of H ₂ S Measurement
Table 2.4	Details of H ₂ S Analyzer Equipment
Table 2.5	Summary of H ₂ S Monitoring Results

Figure

Figure 1	Monitoring Locations of TSTP No.1 and TSTP No.2
----------	---

List of Appendices

Appendix A	Calibration Certificates of Monitoring Equipment
------------	--

1 INTRODUCTION

1.1 Background

- 1.1.1. The Project in Sha Tau Kok mainly comprises of the following items:
- i) Increase the treatment capacity of Sha Tau Kok Sewage Treatment Works (STKSTW) to 5,000 m³/day at Average Dry Weather Flow (ADWF) in Phase 1, with suitable allowance to cater for a further increase of treatment capacity to 10,000 m³/day at ADWF in Phase 2;
 - ii) Construct a Temporary Sewage Treatment Plant (TSTP);
 - iii) Demolish the existing Sha Tau Kok Sewage Pumping Station (STKSPS) and decommission the rising main between STKSPS and STKSTW;
 - iv) Construct a new gravity sewer; and
 - v) Decommission the existing submarine outfall and construct a new one.
- 1.1.2. The Project site will be within the existing STKSTW while the construction of the gravity sewers and demolition of STKSPS will be carried out in Sha Tau Kok Town. The proposed submarine outfall will be constructed by Horizontal Directional Drilling (HDD) method under the seabed of Starling Inlet.
- 1.1.3. The Environmental Impact Assessment (EIA) Report for Expansion of Sha Tau Kok Sewage Treatment Works (Register No: AEIAR-207/2017) was approved on 14 February 2017. A Variation of an Environmental Permit (EP) EP-517/2017/A was issued on 18 October 2019 and it is the current permit for the Project.
- 1.1.4. Since 27 February 2020, AECOM Asia Co. Ltd (AECOM) has been appointed as the ET to undertake the EM&A programme during construction phase (2020 – 2021) of the Project.
- 1.1.5. The EM&A programme of this Project shall be implemented in accordance with the requirements and procedures set out in the EM&A Manual and the EP No. EP-517/2017/A.
- 1.1.6. The construction phase and EM&A programme of the Project commenced on 27 May 2019. The TSTP will be in operation in mid of July 2020 tentatively.
- 1.1.7. A proposal for changes of the environmental monitoring methodology and requirement (Operation Phase of Odour Monitoring) had submitted to EPD on 29 April 2020 and comments from EPD were received on 26 May 2020. A revised proposal was submitted on 28 May 2020 and approved by EPD on 4 June 2020.
- 1.1.8. In accordance with Section 3.3.1 of EM&A Manual, odour commissioning test for the TSTP and STKSTW is recommended to be performed prior to their operation to ascertain the effectiveness of the deodorization systems at the TSTP and STKSTW during the operation phase.
- 1.1.9. According to the Condition 2.15 of EP No. EP-517/2017/A, a Commissioning Test Report shall be submitted to demonstrate compliance with the odour removal efficiency of no less than 99.5% at exhaust of deodorizing facility before the commencement of operation of the TSTP and STKSTW.

1.2 Scope of Report

- 1.2.1 This report presents the odour commissioning test methodology, monitoring results and recommendations in order to ascertain the effectiveness and demonstrate compliance with the odour removal efficiency of no less than 99.5% at the exhaust of deodorization systems at the TSTP.

2 ODOUR MONITORING

2.1 Odour Commissioning Test Monitoring (Operation Phase for TSTP)

- 2.1.1 A commissioning test for the TSTP is recommended to be performed prior to their operation to ascertain the effectiveness of the deodorization systems at the TSTP during the operation

phase. Exhaust air flow rate, temperature of exhaust, odour concentrations at the outlet of the deodorization systems should be monitored during the commissioning test.

2.1.2 The exhaust air flow rate, temperature of exhaust, odour concentrations for the TSTP during the EIA's design stage is presented in **Table 2.1**.

2.1.3 Based on the actual design information of the deodorization systems of TSTP No.1 and TSTP No.2, the design parameters are updated in **Table 2.1**. The approved alternative method for odour monitoring is presented in **Table 2.2**.

Table 2.1 Design Parameter of Exhaust Stack and Odour Emission Rate of TSTP

Design Parameter	Unit	TSTP		TSTP	
		EIA's Design Stage		Actual Design	
Location	-	TSTP No.1	TSTP No.1	TSTP No.1	TSTP No.2
No. of emission points	-	2		2	
Building height	m above ground	14.3	14.3	8	8
Stack height	m above ground	16.3	16.3	12.24	12.24
Equivalent stack radius	m	0.15	0.25	0.3	0.3
Exit temperature	-	ambient	ambient	Ambient ($\pm 10^{\circ}\text{C}$)	Ambient ($\pm 10^{\circ}\text{C}$)
Total flowrate @ exit temp.	m^3hr^{-1}	3,952	9,293	10178	10178
	m^3s^{-1}	1.10	2.58	2.827	2.827
Exit velocity	ms^{-1}	15.53	13.15	<10	<10
Maximum H ₂ S emission concentration at inlet	ppm	10	50	10.5	10.5
% of odour removal	%	99.5	99.8	99.5	99.5
Mitigated H ₂ S emission concentration at exhaust	ppm	0.05	0.1	0.053	0.053
Mitigated odour emission concentration at exhaust	OUm^{-3}	106.4	212.8	112.8	112.8
Mitigated odour emission rate	OUs^{-1}	116.8	549.2	318.9	318.9

Note: the equivalent detection threshold criterion (1 odour unit) is 0.00047 ppm by volume of H₂S.

Table 2.2 Approved Alternative Odour Monitoring Methodology

Measurement Locations	Parameter	Equipment
At the Exhaust of TSTP No.1 and TSTP No.2	<ul style="list-style-type: none"> ▪ Exhaust air flow rate ▪ Temperature of exhaust ▪ H₂S Concentration (ppm) 	H ₂ S Analyzer Anemometer

2.2 H₂S Monitoring Methodology

2.2.1 15-minute Hydrogen Sulphide (H₂S) concentration (in parts per million) was measured by portable H₂S analyzer at the exhausts of TSTP No.1 and TSTP No.2. The exhaust air flow rate, ambient temperature, temperature of exhaust, weather condition and wind speed were recorded during the measurement. The details of H₂S measurement is presented in **Table 2.3**.

Table 2.3 Details of H₂S Measurement

Measurement Locations	Measurement Parameters
At the Exhaust of TSTP No.1 and TSTP No.2	<p>15-minute H₂S Measurement (every 5 minutes measure one reading) - Average value of the three 5-minute readings will be used to justify the compliance.</p> <p>Exhaust air flow rate, ambient temperature, temperature of exhaust, weather condition and wind speed will be recorded.</p>

2.3 Monitoring Equipment

- 2.3.1 The details of H₂S analyzer is presented in **Table 2.4**. The calibration certificate of H₂S analyzer is presented in **Appendix A**.
- 2.3.2 Exhaust air flow rate, ambient temperature, temperature of exhaust and wind speed were recorded during the measurement. The calibration certificate of air velocity meter is presented in **Appendix A**.

Table 2.4 Details of H₂S Analyzer Equipment

Equipment	Equipment Model
H ₂ S Analyzer	Jerome 631X (Capable Range of measuring H ₂ S concentration: 3ppb to 50ppm)
Air Velocity Meter	TSI 9555-P

2.4 Monitoring Locations

- 2.4.1 H₂S measurements were undertaken at the exhaust of TSTP No.1 and TSTP No.2. The monitoring locations is shown in **Figure 1**. Photographic records during the measurement was presented in **Photo 1**.

Photo 1



2.5 Results and Observation

- 2.5.1 The H₂S measurement at the exhaust of TSTP No.1 and TSTP No.2 was carried out on 12 June 2020. The weather was sunny during the measurement.
- 2.5.2 15-min H₂S measurement, a total of 3 sets reading of H₂S concentration, were recorded at the exhaust of deodorization systems. Exhaust air flowrate, exhaust temperature, ambient temperature and wind speed were recorded during the measurement.
- 2.5.3 The H₂S measurement results at TSTP No.1 and TSTP No.2 are presented in **Table 2.5**.

Table 2.5 Summary of H₂S Monitoring Results

Location	Date & Weather	Time	Ambient		Exhaust			H ₂ S concentration, ppm		Expressed in Odour Unit (*), OU/m ³		Odour Removal Efficiency, %	
			Temp., °C	Wind speed, m/s	Temp., °C	Air velocity, m/s	Air flow rate, m ³ /s	Inlet	Exhaust	Inlet	Exhaust	Ave.	
Exhaust of TSTP No.1	12 Jun 2020 Sunny	10:35	33.4	0.19	32.7	6.90	1.95	0.65	<0.003	1383.0	6.4	99.5	99.6
		10:40			33.2	6.88	1.95	0.70	<0.003	1489.4	6.4	99.6	
		10:45			33.3	6.85	1.94	0.67	<0.003	1425.5	6.4	99.6	
Exhaust of TSTP No.2	12 Jun 2020 Sunny	11:00	34.5	0.21	32.7	7.06	2.00	0.69	<0.003	1468.1	6.4	99.6	99.6
		11:05			32.2	7.01	1.98	0.67	<0.003	1425.5	6.4	99.6	
		11:10			31.3	7.04	1.99	0.72	<0.003	1531.9	6.4	99.6	

Note: * equivalent detection threshold criterion: 1OU= 0.00047ppm of H₂S

- 2.5.4 As shown in the **Table 2.5**, the measured temperature of exhaust and exhaust air flow rate were kept maintained with the requirement as stated in **Table 2.1** of actual design.
- 2.5.5 The H₂S monitoring results shown that, the averaged H₂S concentrations measured of <0.003ppm at TSTP No.1 and TSTP No.2 were well below the mitigated H₂S emission concentration at exhausts (i.e. 0.053ppm) as stated in **Table 2.1** of actual design.
- 2.5.6 The calculated odour removal efficiency at TSTP No.1 and TSTP No.2 were not less than 99.5%.
- 2.5.7 It is concluded that the effectiveness of the two deodorization systems at the TSTP were attained and complied with requirement of no less than 99.5% of odour removal efficiency at exhausts.

3 RECOMMENDATIONS

- 3.1.1 The recommended mitigation measures as stated in the EM&A Manual and EP should be implemented:
- No concurrent operation of the TSTP and the expanded STKSTW.
 - To minimize odour problem, the sludge tankers for disposal of sludge and all process equipment of the TSTP shall be fully enclosed.
 - Deodourizing facility using activated carbon filters and/or bio-trickling filters shall be equipped for TSTP, to attain the required odour removal efficiency at exhaust. Regular monitoring of odour emission will be conducted to check the compliance of the deodorization system for TSTP.
 - The deodorization system would undergo maintenance annually or when the average odour removal efficiency of deodorization facility is smaller than the required odour removal efficiency.
 - Regular maintenance of deodorization unit does not require stoppage of deodorization unit. When replacement of carbon for deodorization unit is required, each unit will take minimum 4 days to complete the replacement work, during which a stand-by unit will operate. Odour

patrol is proposed during the period of both deodourisation units are under maintenance or cleaning of the deodorization system for TSTP at the same time.

- Ventilation system shall also be provided inside the TSTP to ensure adequate air exchange within the plants.
- The sludge produced should be removed off-site regularly to avoid accumulation of odorous materials on site. Trucks transporting sludge shall be fully enclosed to minimise any potential odour impact during the transportation process.

FIGURE

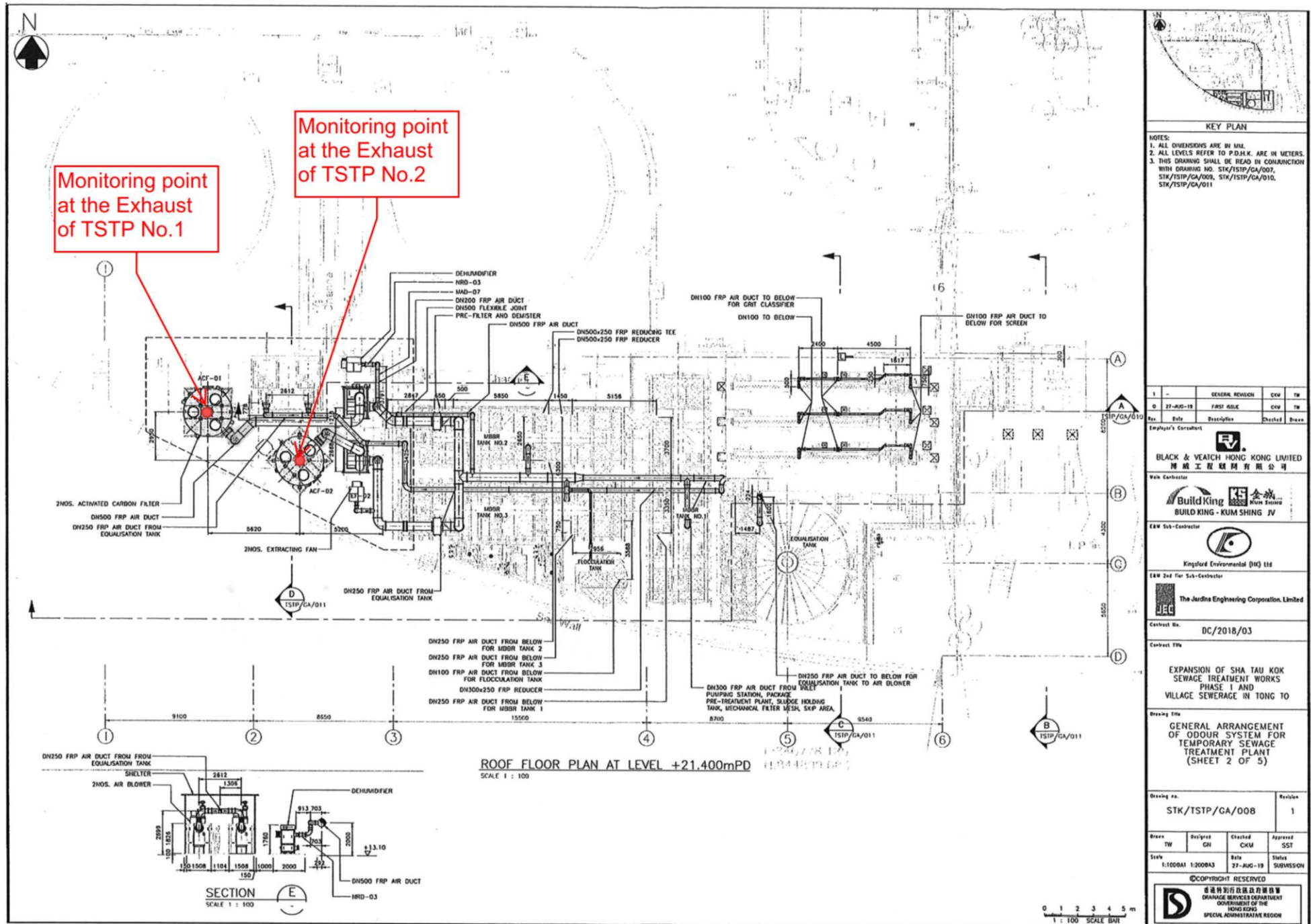


Figure 1 Monitoring Locations of TSTP No.1 and TSTP No.2

APPENDIX A

Calibration Certificates of Monitoring Equipment



Calibration Certificate

Certificate No.: CC0071910

1. Description

Calibration item :	a) Hydrogen Sulfide (H ₂ S)
Equipment description :	Gold Film Hydrogen Sulfide Analyzer
Manufacturer :	ARIZONA INSTRUMENT LLC
Type / Model No. :	Jerome® 631X
Serial No. :	1914
Assigned equipment no. :	N/A
Adjustment :	N/A
Remark :	Received with good condition

2. Customer information

Customer :	AECOM
Address :	8/F, Tower 2, Grand Central Plaza, 138 Shatin Rural Committee Road, Shatin, N.T. HK
Date of receipt :	4 October 2019

3. Date of performance of the calibration

Date of calibration :	10 October 2019
-----------------------	-----------------

Approved Signatory
WM Ling



Company Chop:
Certificate issue date: 11 October 2019

1. The certificate shall not be reproduced except in full, without written approval of CAL LAB LTD
2. The certificate is issued subject to the latest Terms and Conditions, available at our web site

CT-BEG-02
Page 1 of 3
cc0071910



4. Result of Calibration

a) Hydrogen Sulfide (H₂S)

Reference Setting ; ppm	Measured reading ; ppm	Error of indication ; % FS
0	0.000	0.0
0.5	0.46	-0.1
1.0	0.96	-0.1
5.0	4.2	-1.6
10.0	9.1	-1.8

Estimated expanded uncertainty: 2.1 % FS

Technical Requirement: ± 5 ppm

Hydrogen Sulfide (H₂S) - Repeatability

Reference reading ; ppm	RSD ; %
10.0	1.6

Technical Requirement: ± 2 %

Hydrogen Sulfide (H₂S) – Response Time

Reference reading ; ppm	Response time ; second
10.0	13

Technical Requirement:
 ≤ 30 seconds (Pump)

Note: The technical requirement is refer to JJG 695-2003

1. The certificate shall not be reproduced except in full, without written approval of CAL LAB LTD
2. The certificate is issued subject to the latest Terms and Conditions, available at our web site

CT-006-04
Page 2 of 3
cc0071910



5. Reference method for calibration

Hydrogen Sulfide	JJG 695-2003
------------------	--------------

6. Environment condition of calibration

Temperature ; °C	24.5 °C
Relative humidity ; %RH	43 %RH

7. Reference equipment used in the calibration

Item	Model	Serial No.	Expiry date	Traceable to
Hydrogen Sulfide	N/A	L193414080	28 Jan 2020	NIM

- Note1: The estimated expanded uncertainties have been calculated in "Evaluation and expression of uncertainty in measurement" and give an internal estimated to have a level of confidence of 95%. A coverage factor of 2 is assumed unless explicitly stated.
- Note2: The standard (s) and instrument used in the calibration are traceable to national or international recognized standard and are calibrated on a schedule to maintain the accuracy and good condition.
- Note3: The result reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the long term stability of the instrument.
- Note4: The result shows in this calibration certificate relate only to the item calibrated, and the result only applies to the calibration item as received.

Calibrated by: *Yvonne King*
Checked by: *William King*

Date: 10 October 2019

Date: 10 October 2019

*** End of Certificate ***

CT-END-02

1. The certificate shall not be reproduced except in full, without written approval of CAL LAB LTD
2. The certificate is issued subject to the latest Terms and Conditions, available at our web site

Page 3 of 3
cc0071910



輝創工程有限公司

Sun Creation Engineering Limited

Calibration & Testing Laboratory

Certificate of Calibration

校正證書

Certificate No. : C202803
證書編號

ITEM TESTED / 送檢項目 (Job No. / 序引編號: IC20-0967)

Date of Receipt / 收件日期: 7 May 2020

Description / 儀器名稱 : Air Velocity Meter

Manufacturer / 製造商 : TSI

Model No. / 型號 : 9555-P

Serial No. / 編號 : 9555P0836010

Supplied By / 委託者 : Aecom Asia Co., Ltd.

13/F., Tower 2, Grand Central Plaza,

138 Shatin Rural Committee Road, Shatin, N.T.

TEST CONDITIONS / 測試條件

Temperature / 溫度 : (23 ± 2)°C

Relative Humidity / 相對濕度 : (50 ± 25)%

Line Voltage / 電壓 : ---

TEST SPECIFICATIONS / 測試規範

Calibration check

DATE OF TEST / 測試日期 : 20 to 21 May 2020

TEST RESULTS / 測試結果

The results apply to the particular unit-under-test only.

The results are detailed in the subsequent page(s).

The test equipment used for calibration are traceable to National Standards via :

- The Government of The Hong Kong Special Administrative Region Standard & Calibration Laboratory
- South China National Centre of Metrology, China
- Agilent Technologies / Keysight Technologies
- Testo Industrial Services GmbH, Germany
- Fluke Everett Service Center, USA

Tested By
測試

:


T F Lee
Assistant Engineer

Certified By
核證

:


H C Chan
Engineer

Date of Issue
簽發日期

:

22 May 2020

The test equipment used for calibration is traceable to the National Standards as specified in this certificate. This certificate shall not be reproduced except in full, without the prior written approval of this laboratory.

本證書所載校正用之測試器材均可溯源至國際標準。局部複印本證書需先獲本實驗室書面批准。

Sun Creation Engineering Limited - Calibration & Testing Laboratory

c/o 4/F, 1 Hing On Lane, Tuen Mun, New Territories, Hong Kong

輝創工程有限公司 - 校正及檢測實驗室

c/o 香港新界屯門興安里一號四樓

Tel/電話: (852) 2927 2606

Fax/傳真: (852) 2744 8986

E-mail/電郵: callab@suncreation.com

Website/網址: www.suncreation.com



Certificate of Calibration

校正證書

Certificate No. : C202803
證書編號

- The unit-under-test (UUT) was allowed to stabilize in the laboratory for over 12 hours before the commencement of the test.
- Test equipment :

Equipment ID	Description	Certificate No.
CL018	Portable Calibrator	C191834
CL041 & CL041B	Digital Thermometer	C201018
CL042 & CL042B	Digital Thermometer	C201019
CL272 & CL272A	Humidity Control Chamber	C183502 & C183457
CL292	Recorder	C192930
CL316 & CL316A	Precision Multi-function Measuring Instrument	C180363
CL330	Environmental Chamber	C190296
CL360	Portable Air Pressure	RYB201909837
CL410 & CL410D	Multi Functionally Measuring Instrument & Psychrometer	C195787

- Test procedure : MA006, MA103N, MA109N & MA130N.
- Results :

4.1 Air Velocity

Applied Value (m/s)	UUT Reading (m/s)	Measured Correction		
		Value (m/s)	Measurement Uncertainty	
			Expanded Uncertainty (m/s)	Coverage Factor
2.00	2.10	-0.10	0.31	2.0
4.00	4.11	-0.11	0.36	2.0
6.03	6.21	-0.18	0.41	2.0
8.02	8.46	-0.44	0.50	2.0
10.01	10.95	-0.94	0.57	2.0

The results presented are the mean of 10 measurements at each calibration point.

4.2 Temperature

Applied Value (°C)	UUT Reading (°C)	Measured Correction		
		Value (°C)	Measurement Uncertainty	
			Expanded Uncertainty (°C)	Coverage Factor
25.0	24.8	+0.2	0.5	2.0

The results presented are the mean of 3 measurements at each calibration point.

The test equipment used for calibration is traceable to the National Standards as specified in this certificate. This certificate shall not be reproduced except in full, without the prior written approval of this laboratory.

本證書所載校正用之測試器材均可溯源至國際標準。局部複印本證書需先獲本實驗室書面批准。

Sun Creation Engineering Limited – Calibration & Testing Laboratory

c/o 4/F, 1 Hing On Lane, Tuen Mun, New Territories, Hong Kong

輝創工程有限公司 - 校正及檢測實驗室

c/o 香港新界屯門興安里一號四樓

Tel/電話: (852) 2927 2606

Fax/傳真: (852) 2744 8986

E-mail/電郵: callab@suncreation.com

Website/網址: www.suncreation.com



Certificate of Calibration 校正證書

Certificate No. : C202803
證書編號

4.3 Relative Humidity (23°C)

Applied Value (%)	UUT Reading (%)	Measured Correction		
		Value (%)	Measurement Uncertainty	
			Expanded Uncertainty (%)	Coverage Factor
60.0	63.8	-3.8	1.5	2.0

The results presented are the mean of 3 measurements at each calibration point.

4.4 Barometric Pressure

Applied Value (hPa)	UUT Reading (hPa)	Measured Correction		
		Value (hPa)	Measurement Uncertainty	
			Expanded Uncertainty (hPa)	Coverage Factor
1 001.3	995.3	+6.0	2.0	2.0

The results presented are the mean of 3 measurements at each calibration point.

Test Medium : Air

- Remarks :
- UUT Probe Model : 964
S/N : P08350010
 - UUT Setting : ACTUAL/STANDARD : ACTUAL
Temperature Source : Probe
 - The Measured Corrections are defined as :
Value = Applied Value - UUT Reading
 - The expanded uncertainties are for a level of confidence of 95 %.

Note :
Only the original copy or the laboratory's certified true copy is valid.

The values given in this Certificate only relate to the values measured at the time of the test and any uncertainties quoted 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. Sun Creation Engineering Limited shall not be liable for any loss or damage resulting from the use of the equipment.

The test equipment used for calibration is traceable to the National Standards as specified in this certificate. This certificate shall not be reproduced except in full, without the prior written approval of this laboratory.

本證書所載校正用之測試器材均可溯源至國際標準。局部複印本證書需先獲本實驗室書面批准。

Sun Creation Engineering Limited – Calibration & Testing Laboratory

c/o 4/F, 1 Hing On Lane, Tuen Mun, New Territories, Hong Kong

輝創工程有限公司 - 校正及檢測實驗室

c/o 香港新界屯門興安里一號四樓

Tel/電話: (852) 2927 2606

Fax/傳真: (852) 2744 8986

E-mail/電郵: callab@suncreation.com

Website/網址: www.suncreation.com