Noise

MAXLAB

CALIBRATION CERTIFICATE

Certificate Information

Date of Issue	11-Feb-2022	**Certificate Number**	MLCN220284S

Customer Information

Company Name	Acuity Sustainability Consulting Limited
Address	Unit E, 12/F., Ford Glory Plaza, Nos. 37-39 Wing Hong Street, Cheung Sha Wan, Kowloon, HK

Equipment-under-Test (EUT)

Description	Sound Level Calibrator
Manufacturer	Rion
Model Number	NC-74
Serial Number	34504770
Equipment Number	--

Calibration Particular

Date of Calibration	11-Feb-2022		
Calibration Equipment	4231(MLTE008) / AV200063 / 23-Jun-23 1357(MLTE190) / MLEC21/05/02 / 26-May-22		
Calibration Procedure	MLCG00, MLCG15		
Calibration Conditions	Laboratory	Temperature	23 °C ± 5 °C
		Relative Humidity	55% ± 25%
	EUT	Stabilizing Time	Over 3 hours
		Warm-up Time	Not applicable
		Power Supply	Internal battery
Calibration Results	Calibration data were detailed in the continuation pages. Calibration result was within EUT specification.		

Approved By & Date

K.O. Lo 11-Feb-2022

Statements

* Calibration equipment used for this calibration are traceable to national / international standards.
* The results on this Calibration Certificate only relate to the values measured at the time of the calibration and the uncertainties quoted will not include allowance for the EUT long term drift, variation with environmental changes, vibration and shock during transportation, overloading, mishandling, misuse, and the capacity of any other laboratory to repeat the measurement.
* MaxLab Calibration Centre Limited shall not be liable for any loss or damage resulting from the use of the EUT.
* The copy of this Certificate is owned by MaxLab Calibration Centre Limited. No part of this Certificate may be reproduced without the prior written approval of MaxLab Calibration Centre Limited.

萬儀校正中心有限公司
MaxLab Calibration Centre Limited
香港新界葵涌華星街16-18號保盈工業大廈9樓B室
Unit B, 9/F., Boldwin Industrial Bldg., 16-18 Wah Sing Street, Kwai Chung, N.T., Hong Kong Tel: (852) 2116 1380 Fax: (852) 2264 6480 Email: info@maxlab.com.hk

MAXLAB

Certificate No. MLCN220284S

Calibration Data

EUT Setting	Standard Reading	EUT Error from Setting	Calibration Uncertainty	EUT Specification
94 dB	94.0 dB	0.0 dB	0.20 dB	± 0.3 dB

- END -

Calibrated By : Dan
Date : 11-Feb-22

Checked By : K.O. Lo
Date : 11-Feb-22

萬儀校正中心有限公司
MaxLab Calibration Centre Limited
香港新界葵涌華星街 16-18 號保盈工業大廈 9 樓 B 室
Unit B, 9/F., Boldwin Industrial Bldg., 16-18 Wah Sing Street, Kwai Chung, N.T., Hong Kong Tel: (852) 2116 1380 Fax: (852) 2264 6480 Email: info@maxlab.com.hk

Certificate of Calibration

for

Description:	*Sound Level Meter*
Manufacturer:	*NTi Audio*
Type No.:	*XL2 (Serial No.: A2A-09696-E0)*
Microphone:	*ACO 7052 (Serial No.:68840)*
Preamplifier:	*NTi Audio M2211 MA220 (Serial No.:5287)*

Submitted by:

Customer:	*Acumen Environmental Engineering and Technologies Co. Ltd.*
Address:	*Unit D, 12/F, Ford Glory Plaza, Nos. 37-39 Wing Hong Street, Cheung Sha Wan, Kowloon, Hong Kong*

Upon receipt for calibration, the instrument was found to be:

☑ **Within**
☐ **Outside**

the allowable tolerance.

The test equipment used for calibration are traceable to National Standards via:
- The Government of The Hong Kong Special Administrative Region Standard & Calibration Laboratory

Date of receipt: 24 March 2022

Date of calibration: 26 March 2022

Calibrated by: _____
Calibration Technician

Certified by: _____
Mr. Ng Yan Wa
Laboratory Manager

Date of issue: 26 March 2022

ACOUSTICS AND AIR TESTING LABORATORY CO LTD. (A+A) *L

Room 422,Leader Industrial Centre,57-59 Au Pui Wan Street ,Fo Tan, Shatin,N.T.,Hong Kong
Tel: (852) 2668 3423 Fax:(852) 2668 6946
Homepage: http://www.aa-lab.com E-mail : inquiry@aa-lab.com

1. *Calibration Precaution:*

- The unit-under-test (UUT) was allowed to stabilize in the laboratory for over 24 hours, and switched on to warm up for over 10 minutes before the commencement of the test.

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

2. *Calibration Conditions:*

Air Temperature:	22.6 °C
Air Pressure:	1006 hPa
Relative Humidity:	74.5 %

3. *Calibration Equipment:*

	Type	Serial No.	Calibration Report Number	Traceable to
Multifunction Calibrator	B&K 4226	2288467	AV200041	HOKLAS

4. *Calibration Results*

Sound Pressure Level

Reference Sound Pressure Level

Setting of Unit-under-test (UUT)			Applied value		UUT Reading, dB	IEC 61672 Class 1 Specification, dB
Range, dB	Freq. Weighting	Time Weighting	Level, dB	Frequency, Hz		
30-130	dBA SPL	Fast	94	1000	94.1	±0.4

Linearity

Setting of Unit-under-test (UUT)			Applied value		UUT Reading, dB	IEC 61672 Class 1 Specification, dB
Range, dB	Freq. Weighting	Time Weighting	Level, dB	Frequency, Hz		
30-130	dBA SPL	Fast	94	1000	94.1	Ref
			104		104.1	±0.3
			114		114.1	±0.3

Time Weighting

Setting of Unit-under-test (UUT)			Applied value		UUT Reading, dB	IEC 61672 Class 1 Specification, dB
Range, dB	Freq. Weighting	Time Weighting	Level, dB	Frequency, Hz		
30-130	dBA SPL	Fast	94	1000	94.1	Ref
		Slow			94.1	±0.3

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Homepage: http://www.aa-lab.com E-mail : inquiry@aa-lab.com

Frequency Response

Linear Response

Setting of Unit-under-test (UUT)			Applied value		UUT Reading, dB	IEC 61672 Class 1 Specification, dB
Range, dB	Freq. Weighting	Time Weighting	Level, dB	Frequency, Hz		
30-130	dB SPL	Fast	94	31.5	94.0	±2.0
				63	94.1	±1.5
				125	94.1	±1.5
				250	94.0	±1.4
				500	94.1	±1.4
				1000	94.1	Ref
				2000	94.3	±1.6
				4000	94.9	±1.6
				8000	93.6	+2.1; -3.1

A-weighting

Setting of Unit-under-test (UUT)			Applied value		UUT Reading, dB	IEC 61672 Class 1 Specification, dB
Range, dB	Freq. Weighting	Time Weighting	Level, dB	Frequency, Hz		
30-130	dBA SPL	Fast	94	31.5	54.7	-39.4 ±2.0
				63	67.9	-26.2 ±1.5
				125	78.0	-16.1 ±1.5
				250	85.4	-8.6 ±1.4
				500	90.9	-3.2 ±1.4
				1000	94.1	Ref
				2000	95.5	+1.2 ±1.6
				4000	95.9	+1.0 ±1.6
				8000	92.5	-1.1+2.1; -3.1

C-weighting

Setting of Unit-under-test (UUT)			Applied value		UUT Reading, dB	IEC 61672 Class 1 Specification, dB
Range, dB	Freq. Weighting	Time Weighting	Level, dB	Frequency, Hz		
30-130	dBC SPL	Fast	94	31.5	91.0	-3.0 ±2.0
				63	93.2	-0.8 ±1.5
				125	93.9	-0.2 ±1.5
				250	94.0	-0.0 ±1.4
				500	94.1	-0.0 ±1.4
				1000	94.1	Ref
				2000	94.1	-0.2 ±1.6
				4000	94.1	-0.8 ±1.6
				8000	90.6	–3.0 +2.1: –3.1

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5. *Calibration Results Applied*

The results apply to the particular unit-under-test only. All calibration points are within manufacture's specification as IEC 61672 Class 1.

Uncertainties of Applied Value:

94 dB	31.5 Hz	± 0.05
	63 Hz	± 0.05
	125 Hz	± 0.05
	250 Hz	± 0.05
	500 Hz	± 0.05
	1000 Hz	± 0.05
	2000 Hz	± 0.05
	4000 Hz	± 0.05
	8000 Hz	± 0.10
104 dB	1000 Hz	± 0.05
114 dB	1000 Hz	± 0.05

The uncertainties are evaluated for a 95% confidence level.

Note:
The values given in this certification only related to the values measured at the time of the calibration and any uncertainties quoted will not allow for the equipment long-term drift, variations with environmental changes, vibration and shock during transportation, overloading, mis-handling, or the capability of any other laboratory to repeat the calibration. (A+A)*L shall not be liable for any loss or damage resulting from the use of the equipment.

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輝創工程有限公司
Sun Creation Engineering Limited
Calibration & Testing Laboratory

Certificate of Calibration
校正證書

Certificate No. : C216243
證書編號

ITEM TESTED / 送檢項目 (Job No. / 序引編號 : IC21-2101) Date of Receipt / 收件日期 : 12 October 2021

Description / 儀器名稱 : Mini Anemometer
Manufacturer / 製造商 : RS PRO
Model No. / 型號 : RS-90
Serial No. / 編號 : 210722168
Supplied By / 委託者 : Acuity Sustainability Consulting Limited
Room C 11/F, Ford Glory Plaza, No. 37-39 Wing Hong Street,
Cheung Sha Wan, Kowloon

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 : 25 October 2021

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
- Agilent Technologies / Keysight Technologies
- Testo Industrial Services GmbH, Germany
- Rohde & Schwarz Laboratory, Germany
- Fluke Everett Service Center, USA

Tested By 測試 : CKLo
C K Lo
Assistant Engineer

Certified By 核證 : H C Chan
Engineer

Date of Issue 簽發日期 : 26 October 2021

Sun Creation Engineering Limited – Calibration & Testing Laboratory
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輝創工程有限公司 - 校正及檢測實驗所
c/o 香港新界屯門興安里一號四樓
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輝創工程有限公司
Sun Creation Engineering Limited
Calibration & Testing Laboratory

Certificate of Calibration
校正證書

Certificate No. : C216243
證書編號

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

2. Test equipment :

Equipment ID	Description	Certificate No.
CL018	Portable Calibrator	C204749
CL041 & CL041B	Digital Thermometer	C212654
CL042 & CL042B	Digital Thermometer	C212655
CL292	Recorder	C214057
CL330	Environmental Chamber	C205909
CL386	Multi-function Measuring Instrument	S16494

3. Test procedure : MA006 & MA130N.

4. 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
2.01	1.70	+0.31	0.15	2.0
4.00	3.75	+0.25	0.20	2.0
6.01	5.81	+0.20	0.25	2.0
8.00	7.74	+0.26	0.29	2.0
10.01	9.84	+0.17	0.34	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.

Remarks : - 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.

Sun Creation Engineering Limited – Calibration & Testing Laboratory
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South America
RS Componentes Limitada
Av. Pdte. Eduardo Frei M. 6001-71
Centro Empresas El Cortijo
Conchali, Santiago, Chile
www.rs-components.com

Instruction Manual

RS-90

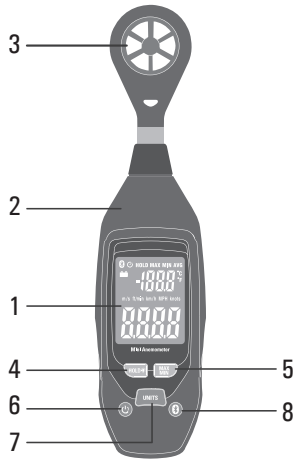
Stock No: 155-8899

Mini Anemometer

EN

1.Introduction

The Thermo-Anemometer measures Air velocity and temperature. Careful use of this meter will provide years of reliable service.



2.Meter Description

1. LCD Display
2. Body of meter
3. Fan
4. HOLD/ ☀ button
5. MAX/ MIN button
6. Power on/ off button
7. UNITS button
8. Bluetooth button

3.Button Description

Power on/ off, Auto-power off:

Power on: Short press button "⏻" to power on, system default auto power off. Long press to power on and disable auto power off function.Long press the button again to enable the auto power off function.

Power off: Short press button "⏻" to power off

Auto-power off: Auto-power off signal "⏲" displays in the left coner of LCD and the instrument will auto-power off in 10 minutes of no button operations.
If press the power on/off button for over 1 minute. It will be recognized as faulty operation and the instrument will auto power off.

UNITS button: Short press to switch air velocity unit; Long press to switch temperature unit.

button: Long press to activate or deactivate Bluetooth.

HOLD/ ☼ button: Short press to hold the current data; Long press to activate or deactivate backlight.
MAX/ MIN button: Short press to record Maximum, Minimum and Average readings of temperature and Air velocity.

Note: MAX/ MIN button is deactivated when hold the current readings.

4.Display Layout

: Bluetooth symbol
: Low battery indicator
: Timing power off symbol
MAX: Maximum reading of temperature air velocity
MIN: Minimum reading of temperature air velocity
AVG: Average reading of temperature air velocity
HOLD: Hold the displayed temperature/ air velocity readings.
°C/ °F: Temperature measurement unit
m/s, ft/min, km/h, MPH, knots: Air velocity measurement unit.
Larger LCD digits at botton of display is Air Velocity readings
Smaller LCD digits at top, right of display is Temperature readings

• Data Hold
Short press hold button to freeze the temperature and velocity readings, meanwhile, hold symbol displayed on LCD when measures. Press hold button again to return normal measurement.

• Temperature and Air velocity measurement
1. Turn on the instrument by pressing power on/off button.
2. Press UNITS button to select unit of measurement. Note: After power on, the meter will display the presetb unit before last power off.
3. Put the instrument in environment that is to be measured.
4. Observe readings on the LCD display, The larger digits displayed on main LCD is Air Velocity reading.
   The smaller digits displayed on upper right LCD is temperature reading.

• MAX/MIN/AVG reading
1. Press MAX/MIN button for the first time, the instrument will enter Max tracking mode. The tracked max reading will display on the LCD.

2. Press MAX/MIN button for the second time, the instrument will enter Min tracking mode. The tracked min reading will display on the LCD.
3. Press MAX/MIN button for the third time, the instrument will enter Avg tracking mode. The tracked average reading will display on the LCD.
4. Press MAX/MIN button for the fourth time, the current reading will display on the LCD.

Note: Avg mode will automatically stop in 2 hours and the instrument will auto power off

• Bluetooth communication
Long press Bluetooth button to activate bluetooth function. The instrument can transmit measured datas and instrument status to software and the software can control the instrument.

The instrument will automatically turn off in order to lengthen the battery working life. When symbol appears on the LCD, please replace the old battery with new ones.

1. Open the battery compartment with a suitable screwdriver.
2. Replace 9 V battery.
3. Mount the battery compartment again.

4. Specifications

Air velocity	Range	Resolution	Accuracy
m/s	1.10 – 25.00 m/s	0.01 m/s	±(3%+0.30 m/s)
km/h	4.0 – 90.0 km/h	0.1 km/h	±(3%+1.0 km/h)
ft./min	220 – 4920 ft./min	1 ft./min	±(3%+40 ft./min)
MPH	2.5 – 56.0 MPH	0.1 MPH	±(3%+0.4 MPH)
knots	2.2 – 48.0 knots	0.1 knots	±(3%+0.4 knots)
Air temperature	-10 – 60°C (14 ~ 140°F)	0.1°C/°F	2.0°C (4.0°F)

Air Quality

ACUITY
SUSTAINABILITY
CONSULTING LIMITED

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Sibata LD-5R K-Factor Verification Test by Total Suspended Particulates HVS Test Report

Verification Test Date: 3-Dec-22 to 4-Dec-22
Next Verification Test Date: 2-Dec-23
Unit-under-Test- Model No. Sibata LD-5R
Unit-under-Test Serial No. 0Z4545
Our Report Refrence No. RPT-22-HVS-0026
Calibration Location: AM2, Located near the Leachate Treatment Works within the NENT Landfill

Standard Equipment Information			
Verification Equipment Type		Tisch TSP HVS	Tisch HVS Calibrator
Standard Equipment Model No.		TE-5170X	TE-5025A
Equipment serial no.	MFC	1106	3465
Last Calibration Date		1-Dec-22	28-Jun-22
Next Calibration Date		31-Jan-23	27-Jun-23

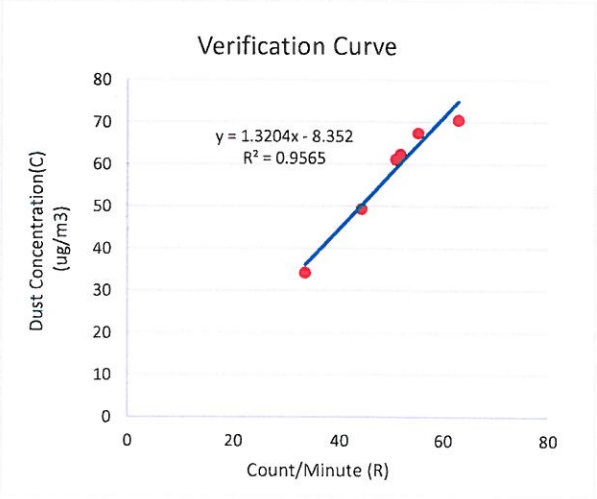
Verification Test No.	Date	Time			K-Factor	Counts/ Minute (R)	Total Counts (TC)	TSP Sample ID No.	Dust Concentration (ug/m3), (C)
		Start-time	End-time	Elapsed Time (in min)	K-Factor (K=C/R)	x-axis			y axis
1	3/12/2022	194.73	198.08	201.00	0.00120	51	10251	R222043/1	61
2	3/12/2022	198.08	201.27	191.40	0.00102	34	6444	R222043/2	34
3	3/12/2022	201.27	204.35	184.80	0.00111	44	8193	R222043/3	49
4	4/12/2022	252.37	255.36	179.40	0.00122	55	9927	R222044/1	67
5	4/12/2022	255.38	258.38	180.00	0.00120	52	9360	R222044/2	62
6	4/12/2022	258.38	261.38	180.00	0.00112	63	11340	R222044/3	70
					0.00114				

K-Factor to be inputted in LD-5R (corrected 1 decimal point): 1.1

By Linear Regression of y on x:

slope, mh= 1.3204
intercept,ch= -8.3520
*Correlation Coefficient,R= 0.9780
Verification Test Result: Strong Correlation, Results were accepted.

* If the Correlation Coefficient, R is <0.5. Checking and Re-verification are required.



Verified By: _____ Date: 05-12-2022
Technical Manager

ACUITY SUSTAINABILITY CONSULTING LIMITED

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Unit E, 12/F, Ford Glory Plaza
Nos 37-39 Wing Hong Street,
Cheung Sha Wan, Kowloon.
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Sibata LD-5R K-Factor Verification Test by Total Suspended Particulates HVS Test Report

Verification Test Date: 3-Dec-22 to 4-Dec-22
Next Verification Test Date: 2-Dec-23
Unit-under-Test- Model No.: Sibata LD-5R
Unit-under-Test Serial No.: 882106
Our Report Refrence No.: RPT-22-HVS-0027
Calibration Location: AM2, Located near the Leachate Treatment Works within the NENT Landfill

Standard Equipment Information			
Verification Equipment Type		Tisch TSP HVS	Tisch HVS Calibrator
Standard Equipment Model No.		TE-5170X	TE-5025A
Equipment serial no.	MFC	1106	3465
Last Calibration Date		1-Dec-22	28-Jun-22
Next Calibration Date		31-Jan-23	27-Jun-23

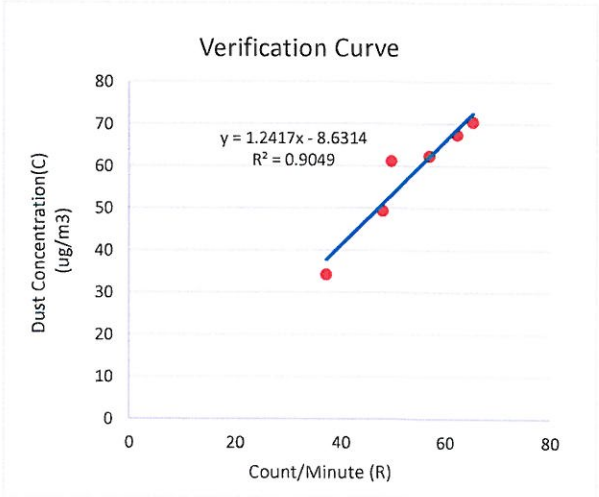
Verification Test No.	Date	Time			K-Factor	Counts/ Minute (R)	Total Counts (TC)	TSP Sample ID No.	Dust Concentration (ug/m3), (C)
		Start-time	End-time	Elapsed Time (in min)	K-Factor (K=C/R)	x-axis			y axis
1	3/12/2022	194.73	198.08	201.00	0.00123	50	9983	R222043/1	61
2	3/12/2022	198.08	201.27	191.40	0.00092	37	7146	R222043/2	34
3	3/12/2022	201.27	204.35	184.80	0.00103	48	8870	R222043/3	49
4	4/12/2022	252.37	255.36	179.40	0.00108	62	11183	R222044/1	67
5	4/12/2022	255.38	258.38	180.00	0.00110	57	10260	R222044/2	62
6	4/12/2022	258.38	261.38	180.00	0.00108	65	11760	R222044/3	70
					0.00107				

K-Factor to be inputted in LD-5R (corrected 1 decimal point): 1.1

By Linear Regression of y on x:

slope, mh= 1.2417
intercept,ch= -8.6314
*Correlation Coefficient,R= 0.9513
Verification Test Result: Strong Correlation, Results were accepted.

* If the Correlation Coefficient, R is <0.5. Checking and Re-verification are required.



Verified By: _____ Date: 05-12-2022
Technical Manager

ACUITY
SUSTAINABILITY
CONSULTING LIMITED

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Nos. 37-39 Wing Hong Street,
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Tel.: (852) 2698 6833
Fax.: (852) 2698 9383

Sibata LD-5R K-Factor Verification Test by Total Suspended Particulates HVS Test Report

Verification Test Date: 3-Dec-22 to 4-Dec-22
Next Verification Test Date: 2-Dec-23
Unit-under-Test- Model No. Sibata LD-5R
Unit-under-Test Serial No. 882110
Our Report Refrence No. RPT-22-HVS-0025
Calibration Location: AM2, Located near the Leachate Treatment Works within the NENT Landfill

Standard Equipment Information			
Verification Equipment Type		Tisch TSP HVS	Tisch HVS Calibrator
Standard Equipment Model No.		TE-5170X	TE-5025A
Equipment serial no.	MFC	1106	3465
Last Calibration Date		1-Dec-22	28-Jun-22
Next Calibration Date		31-Jan-23	27-Jun-23

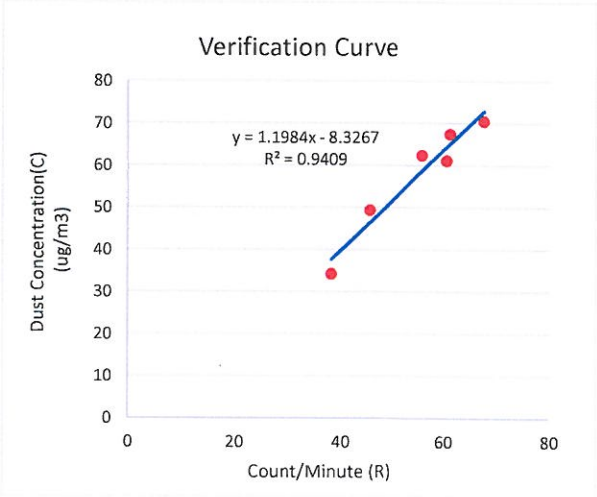
Verification Test No.	Date	Time			K-Factor	Counts/ Minute (R)	Total Counts (TC)	TSP Sample ID No.	Dust Concentration (ug/m3), (C)
		Start-time	End-time	Elapsed Time (in min)	K-Factor (K=C/R)	x-axis			y axis
1	3/12/2022	194.73	198.08	201.00	0.00101	61	12194	R222043/1	61
2	3/12/2022	198.08	201.27	191.40	0.00089	38	7337	R222043/2	34
3	3/12/2022	201.27	204.35	184.80	0.00108	46	8439	R222043/3	49
4	4/12/2022	252.37	255.36	179.40	0.00110	61	11003	R222044/1	67
5	4/12/2022	255.38	258.38	180.00	0.00112	56	10080	R222044/2	62
6	4/12/2022	258.38	261.38	180.00	0.00104	68	12180	R222044/3	70
					0.00104				

K-Factor to be inputted in LD-5R (corrected 1 decimal point): 1.0

By Linear Regression of y on x:

slope, mh= 1.1984
intercept,ch= -8.3267
*Correlation Coefficient,R= 0.9700
Verification Test Result: Strong Correlation, Results were accepted.

* If the Correlation Coefficient, R is <0.5. Checking and Re-verification are required.



Verified By: _____ Date: 05-12-2022
Technical Manager

ACUITY SUSTAINABILITY CONSULTING LIMITED

Website www.acuityhk.com
Unit E, 12/F, Ford Glory Plaza
Nos. 37-39 Wing Hong Street,
Cheung Sha Wan, Kowloon
Tel.: (852) 2698 6833
Fax: (852) 2698 9383

Sibata LD-5R K-Factor Verification Test by Total Suspended Particulates HVS Test Report

Verification Test Date: 3-Dec-22 to 4-Dec-22
Next Verification Test Date: 2-Dec-23
Unit-under-Test- Model No. Sibata LD-5R
Unit-under-Test Serial No. 942532
Our Report Refrence No. RPT-22-HVS-0024
Calibration Location: AM2, Located near the Leachate Treatment Works within the NENT Landfill

Standard Equipment Information			
Verification Equipment Type		Tisch TSP HVS	Tisch HVS Calibrator
Standard Equipment Model No.		TE-5170X	TE-5025A
Equipment serial no.	MFC	1106	3465
Last Calibration Date		1-Dec-22	28-Jun-22
Next Calibration Date		31-Jan-23	27-Jun-23

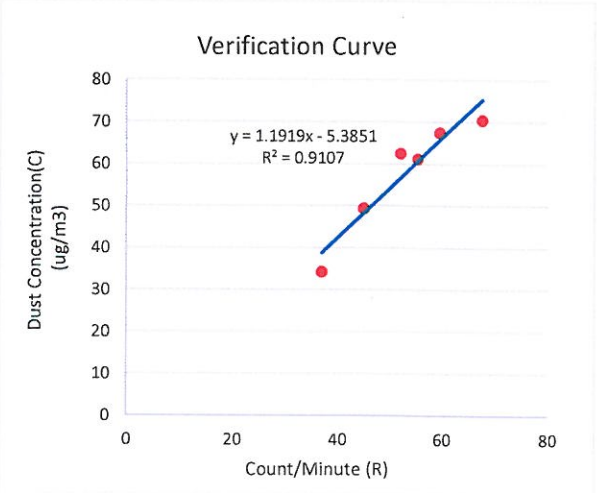
Verification Test No.	Date	Time			K-Factor	Counts/ Minute (R)	Total Counts (TC)	TSP Sample ID No.	Dust Concentration (ug/m3), (C)
		Start-time	End-time	Elapsed Time (in min)	K-Factor (K=C/R)	x-axis			y axis
1	3/12/2022	194.73	198.08	201.00	0.00111	55	11122	R222043/1	61
2	3/12/2022	198.08	201.27	191.40	0.00093	37	7082	R222043/2	34
3	3/12/2022	201.27	204.35	184.80	0.00110	45	8316	R222043/3	49
4	4/12/2022	252.37	255.36	179.40	0.00113	60	10704	R222044/1	67
5	4/12/2022	255.38	258.38	180.00	0.00120	52	9360	R222044/2	62
6	4/12/2022	258.38	261.38	180.00	0.00104	68	12180	R222044/3	70
					0.00108				

K-Factor to be inputted in LD-5R (corrected 1 decimal point): 1.1

By Linear Regression of y on x:

slope, mh= 1.1919
intercept,ch= -5.3851
*Correlation Coefficient,R= 0.9543
Verification Test Result: Strong Correlation, Results were accepted.

* If the Correlation Coefficient, R is <0.5. Checking and Re-verification are required.



Verified By: _____ Date: 05-12-2022
Technical Manager

ACUITY sustainability
Member of the Aurecon Group

aurecon

HIVOL SAMPLER CALIBRATION DATA SHEET (TSP)

Site Information

Location:	NENTX	Site ID:	AM1	Date:	01-Dec-2022
Serial No:	1105	Model:	TE-5170X	Operator:	Andy Li

Ambient Condition

Corrected Pressure (mm Hg):	759.7	Temperature (deg K):	302.1

Calibration Orifice

Model:	TE-5025A	Slope:	1.28946
Serial No.:	3465	Intercept:	-0.01207
Calibration Due Date:	28-Jun-23	Corr. Coeff	0.99998

Calibration Data

Plate or Test #	In,H2O (in)	Qa, X-Axis (m3/min)	I, CFM (chart)	IC, Y-Axis (corrected)
1	0.60	0.388	45.0	28.37
2	1.10	0.522	51.0	32.16
3	1.50	0.608	54.0	34.05
4	1.90	0.683	57.0	35.94
5	2.40	0.767	60.0	37.83

Sampler Calibtation Relationship (Qa on x-axis, IC on y-axis)

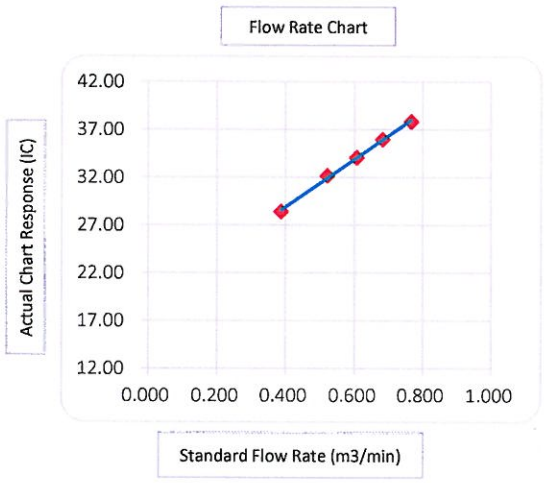
m= 24.8397 b= 18.9217 Corr. Coeff= 0.9988

Sampler set point(SSP) 49 CFM

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:
(1.21*m+b)/[Sqrt(298/Tav)(Pav/760)]
m = sampler slope
b = sampler intercept
I = chart response
Tav = average temperature
Pav = average pressure



Checked by: _____ Date: 01-Dec-2022

ACUITY sustainability
Member of the Aurecon Group

aurecon

HIVOL SAMPLER CALIBRATION DATA SHEET (TSP)

Site Information

Location:	NENTX	Site ID:	AM2	Date:	01-Dec-2022
Serial No:	1106	Model:	TE-5170X	Operator:	Andy Li

Ambient Condition

Corrected Pressure (mm Hg):	759.7	Temperature (deg K):	302.1

Calibration Orifice

Model:	TE-5025A	Slope:	1.28946
Serial No.:	3465	Intercept:	-0.01207
Calibration Due Date:	28-Jun-23	Corr. Coeff	0.99998

Calibration Data

Plate or Test #	In,H2O (in)	Qa, X-Axis (m3/min)	I, CFM (chart)	IC, Y-Axis (corrected)
1	0.30	0.277	41.0	25.85
2	1.00	0.498	48.0	30.27
3	1.80	0.665	52.0	32.79
4	2.30	0.751	57.0	35.94
5	2.90	0.842	62.0	39.09

Sampler Calibtation Relationship (Qa on x-axis, IC on y-axis)

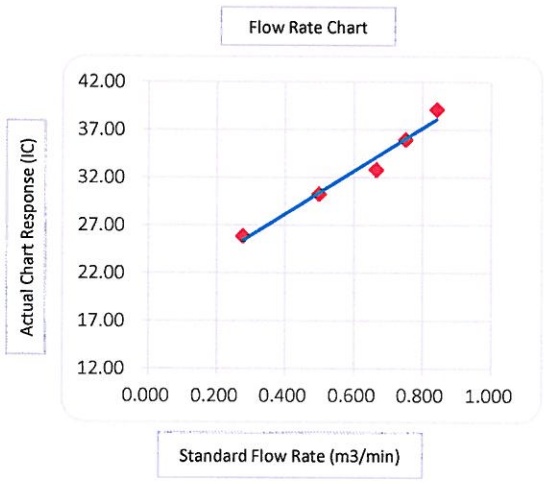
m= 22.4910 b= 19.1407 Corr. Coeff= 0.9855

Sampler set point(SSP) 47 CFM

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:
(1.21*m+b)/[Sqrt(298/Tav)(Pav/760)]
m = sampler slope
b = sampler intercept
I = chart response
Tav = average temperature
Pav = average pressure



Checked by: _____ Date: 01-Dec-2022

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HIVOL SAMPLER CALIBRATION DATA SHEET (TSP)

Site Information

Location:	NENTX	Site ID:	AM3	Date:	01-Dec-2022
Serial No:	1856	Model:	TE-5170X	Operator:	Andy Li

Ambient Condition

Corrected Pressure (mm Hg):	759.7	Temperature (deg K):	302.1

Calibration Orifice

Model:	TE-5025A	Slope:	1.28946
Serial No.:	3465	Intercept:	-0.01207
Calibration Due Date:	28-Jun-23	Corr. Coeff	0.99998

Calibration Data

Plate or Test #	In,H2O (in)	Qa, X-Axis (m3/min)	I, CFM (chart)	IC, Y-Axis (corrected)
1	0.40	0.319	42.0	26.48
2	0.90	0.473	46.0	29.01
3	1.20	0.545	51.0	32.16
4	1.90	0.683	56.0	35.31
5	2.20	0.735	58.0	36.57

Sampler Calibtation Relationship (Qa on x-axis, IC on y-axis)

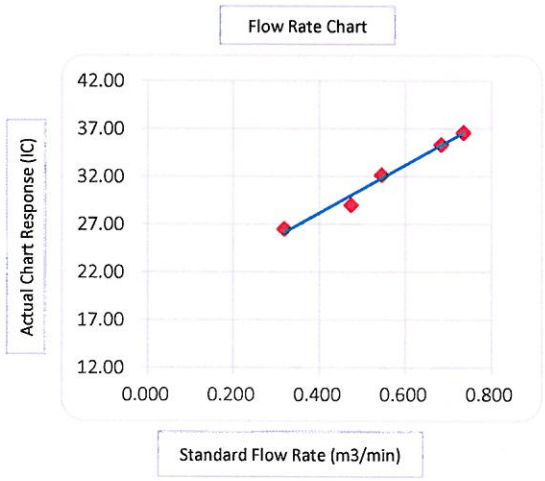
m= 25.0757 b= 18.0890 Corr. Coeff= 0.9913

Sampler set point(SSP) 49 CFM

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:
(1.21*m+b)/[Sqrt(298/Tav)(Pav/760)]
m = sampler slope
b = sampler intercept
I = chart response
Tav = average temperature
Pav = average pressure



Checked by: _____ Date: 01-Dec-2022

TISCH Environmental

RECALIBRATION DUE DATE:
June 28, 2023

Certificate of Calibration

Calibration Certification Information					
Cal. Date:	June 28, 2022	**Rootsmeter S/N:** 438320	**Ta:** 296	°K	
Operator:	Jim Tisch		**Pa:** 755.1	mm Hg	
Calibration Model #:	TE-5025A	**Calibrator S/N:** **3465**			

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.4290	3.2	2.00
2	3	4	1	1.0130	6.4	4.00
3	5	6	1	0.9050	7.9	5.00
4	7	8	1	0.8590	8.8	5.50
5	9	10	1	0.7110	12.8	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)	$\sqrt{\Delta H\left(Ta/Pa\right)}$ (y-axis)
0.9961	0.6970	1.4144	0.9958	0.6968	0.8854
0.9918	0.9791	2.0003	0.9915	0.9788	1.2522
0.9899	1.0938	2.2364	0.9895	1.0934	1.4000
0.9887	1.1509	2.3456	0.9883	1.1506	1.4683
0.9834	1.3831	2.8289	0.9830	1.3826	1.7708
QSTD	**m=**	**2.05924**	**QA**	**m=**	**1.28946**
	b=	**-0.01929**		**b=**	**-0.01207**
	r=	**0.99998**		**r=**	**0.99998**

Calculations

Vstd=	ΔVol((Pa-ΔP)/Pstd)(Tstd/Ta)	**Va=**	ΔVol((Pa-ΔP)/Pa)
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= $1/m\left(\left(\sqrt{\Delta H\left(Ta/Pa\right)}\right)-b\right)$

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

Tisch Environmental, Inc.
145 South Miami Avenue
Village of Cleves, OH 45002

www.tisch-env.com
TOLL FREE: (877)263-7610
FAX: (513)467-9009

PROMAT (HK) LTD
寶時(香港)有限公司
901 New Trend Centre, 704 Prince Edward Road East, San Po Kong, Kowloon, Hong Kong
Tel: (852)2661 2392 Fax: (852)2661 2086 Email: info@promat.hk http://www.promat.hk

PROMAT
Your Solution To Testing Instrument

Calibration Certificate

Customer Name	**Paul Y Construction Co. Ltd**
Model	**PS200**
Serial	**373075**
Tested On	**16 November, 2022**
Cal Expires	**16 November, 2023**
Audible Alarm	**PASS**
Visual Alarm	**PASS**
Calibrated For	**METHANE**
100% LEL Equivalent	**4.4% by VOL**
Overall Results	**PASS**

Calibration Result

Gas Applied	Range	Reading	Calibrated	Result
Zero Air	% LEL	0	0	PASS
Zero Air	% O2	20.9	20.9	PASS
Zero Air	PPM CO	0	0	PASS
Zero Air	PPM H2S	0	0	PASS

Gas Applied	Range	Reading	Calibrated	Result
50% LEL Methane	% LEL	61	50	PASS
18% VOL Oxygen	% O2	17.8	N/A	PASS
100 PPM Carbon Monoxide	PPM CO	71	100	PASS
25 PPM Hydrogen Sulphide	PPM H2S	22	25	PASS

Calibrated By Ivan Lo : _____

PROMAT (HK) LTD

Water Quality

YSF Corporation Ltd.
5A, Blk1 Kin Ho Ind. Bldg., 20-24 Au Pui Wan St., Fo Tan, Shatin, N.T., HK.
Tel: (852) 8109 8368 Fax: (852) 3007 4857 E-mail: sales@ysftool.com
www.sokkia.com.hk www.ysf.com.hk
Supply, Repair, Rental, Scanning and Calibration Service of Surveying Instruments and Accessories

CERTIFICATE OF CALIBRATION

Certificate No.	: CS-CC- 220859	Customer	: Paul Y Engineering Group
Manufacturer	: Yamayo	Address	: 11/F., Paul Y. Centre,
Equipment	: Water Level Measure		51 Hung To Road,
Model	: RWL100		Kwun Tong, Kowloon, HK
Serial No.	: 11801	Calibration Interval	: 12 months
Calibration Date	: 4th August, 2022	Reference Document	: CS/ME/ 1(HKST)
Expire Date	: 3rd August, 2023	Report No.	: CS-CR- 220859

The instrument has been checked and calibrated according to document procedures and using standards and instruments which are traceable to international accepted standards. The standards and instruments used in the calibration are calibrated on a schedule which is adjusted to maintain traceability at the required accuracy level, or have been derived from the ratio type of self-calibration techniques. This is established by our Quality Management System, audited to ISO9001 :2015 by an independent national accredited body.

The specified calibration interval is a recommendation. Depending on the type of use ambient conditions or accuracy requirements, other calibration intervals may be applicable. The user shall be responsible that calibration is carried out at adequate intervals.

YSF Corporation Ltd. hereby certifies this instrument meets or exceeds all published specifications of the manufacturer at present inforce. This calibration certificate may only be distruibuted in a complete and unchanged form. Unsigned calibration certificates are invalid.

Calibrated by

Wayne

Wayne Ng, Service Engineer
4th August, 2022

Checked by

Wallace Yu, Service Manager
4th August, 2022

CKL/CSL/220859

YSF Corporation Ltd.

Calibration Report

Certificate No. : CS-CC-220859 Certificate Report No. : CS-CR-220859

Client : Paul Y Engineering Group

Address : 11/F., Paul Y. Centre, 51 Hung To Road, Kwun Tong, Kowloon, HK

Item Calibrated **:Name/Description:** Water Level Measure

Manufacturer: Yamayo

Model: RWL100 **Serial No:** 11801

Reference Standard : 784049
Calibration check according to customer's requirement.

Calibration Method **:** Procedure CS01

Calibration Conditions

Temperature : (26 ± 3℃)

Relative Humidity : 90% RH

Date of Test : 4th August, 2022

Test Results **: PASS (**All calibration points were within the tolerances as shown in the attached calibration results.)

Calibrated by : Wayne
Wayne Ng, Service Engineer
Date: 4th August, 2022

HKCS Approved Signatory: _____
Wallace Yu, Service Manager
Date: 4th August, 2022

Notes: 1, The test equipment used for calibration are traceable to national standards/international system of units(SI)
2, The values given in this calibration certificate only to the values measured at the time of test & any uncertainties quoted will not include allowance for the equipment long term drift, variations with environmental changes,vibration and shock during transportation, overloading, mis-handling, or the capability of any other laboratory to repeat the measurement. YSF Corporation Ltd. shall not be liable for any loss/damage resulting from the use of the equipment.
3, The test results apply to the above Unit-Under-Test only.
4, This certificate shall not be reproduced, except on full, without approval of YSF Corporation Ltd.

YSF Corporation Ltd.
5A, Blk1 Kin Ho Ind. Bldg., 20-24 Au Pui Wan St., Fo Tan, Shatin, N.T., HK.
Tel: (852) 8109 8368 Fax: (852) 3007 4857 E-mail: sales@ysftool.com
www.sokkia.com.hk www.ysf.com.hk
Supply, Repair, Rental, Scanning and Calibration Service of Surveying Instruments and Accessories

CERTIFICATE OF CALIBRATION

Certificate No.	: CS-CC- 220858	Customer	: Paul Y Engineering Group
Manufacturer	: Yamayo	Address	: 11/F., Paul Y. Centre,
Equipment	: Water Level Measure		51 Hung To Road,
Model	: RWL50		Kwun Tong, Kowloon, HK
Serial No.	: 12711	Calibration Interval	: 12 months
Calibration Date	: 4th August, 2022	Reference Document	: CS/ME/ 1(HKST)
Expire Date	: 3rd August, 2023	Report No.	: CS-CR- 220858

The instrument has been checked and calibrated according to document procedures and using standards and instruments which are traceable to international accepted standards. The standards and instruments used in the calibration are calibrated on a schedule which is adjusted to maintain traceability at the required accuracy level, or have been derived from the ratio type of self-calibration techniques. This is established by our Quality Management System, audited to ISO9001 :2015 by an independent national accredited body.

The specified calibration interval is a recommendation. Depending on the type of use ambient conditions or accuracy requirements, other calibration intervals may be applicable. The user shall be responsible that calibration is carried out at adequate intervals.

YSF Corporation Ltd. hereby certifies this instrument meets or exceeds all published specifications of the manufacturer at present inforce. This calibration certificate may only be distruibuted in a complete and unchanged form. Unsigned calibration certificates are invalid.

Calibrated by

Wayne

Wayne Ng, Service Engineer
4th August, 2022

Checked by

Wallace Yu, Service Manager
4th August, 2022

CKL/CSL/220858

YSF Corporation Ltd.

Calibration Report

Certificate No. : CS-CC-220858 Certificate Report No. : CS-CR-220858

Client : Paul Y Engineering Group

Address : 11/F., Paul Y. Centre, 51 Hung To Road, Kwun Tong, Kowloon, HK

Item Calibrated **:Name/Description:** Water Level Measure

Manufacturer: Yamayo

Model: RWL50 **Serial No.:** 12711

Reference Standard : 784049
Calibration check according to customer's requirement.

Calibration Method **:** Procedure CS01

Calibration Conditions

Temperature : (26 ± 3℃)

Relative Humidity : 90% RH

Date of Test : 4th August, 2022

Test Results **: PASS** (All calibration points were within the tolerances as shown in the attached calibration results.)

Calibrated by : Wayne
Wayne Ng, Service Engineer
Date: 4th August, 2022

HKCS Approved Signatory:
Wallace Yu, Service Manager
Date: 4th August, 2022

Notes: 1, The test equipment used for calibration are traceable to national standards/international system of units(SI)
2, The values given in this calibration certificate only to the values measured at the time of test & any uncertainties quoted will not include allowance for the equipment long term drift, variations with environmental changes,vibration and shock during transportation, overloading, mis-handling, or the capability of any other laboratory to repeat the measurement. YSF Corporation Ltd. shall not be liable for any loss/damage resulting from the use of the equipment.
3, The test results apply to the above Unit-Under-Test only.
4, This certificate shall not be reproduced, except on full, without approval of YSF Corporation Ltd.

Hong Kong Calibration Ltd.
香 港 校 正 有限公司

Calibration Certificate

Certificate No. **210252** Page 1 of 2 Pages

Customer : Acuity Sustainability Consulting Limited

Address : Unit E, 12/F, Ford Glory Plaza, No. 37-39 Wing Hong Street, Cheung Sha Wan, Kowloon, H.K.

Order No. : Q24081 **Date of receipt :** 31-Oct-22

Item Tested

Description : Flow Probe
Manufacturer : Global Water
Model : FP111
I.D. : --
Serial No. : 22K100859

Test Conditions

Date of Test : 7-Nov-22
Ambient Temperature : 23°C
Supply Voltage : --
Relative Humidity : 78%

Test Specifications

Calibration check.
Ref. Document/Procedure : V12

Test Results

All results were within the manufacturer's specification.
The results are shown in the attached page(s).

Main Test equipment used:

Equipment No.	Description	Cert. No.	Traceable to
S179	Std. Tape	201868	NIM-PRC
S136A	Stop Watch	201878	SCL-HKSAR

The values given in this Calibration 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 environmental changes, vibration and shock during transportation, overloading, mis-handling, or the capability of any other laboratory to repeat the measurement. Hong Kong Calibration Ltd. shall not be liable for any loss or damage resulting from the use of the equipment.

The test equipment used for calibration are traceable to International System of Units (SI), or by reference to a natural constant.
The test results apply to the above Unit-Under-Test only

Calibrated by : Kin Wong

Approved by : Alan Chu

Date: 7-Nov-22

This Certificate is issued by:
Hong Kong Calibration Ltd.
Unit 8B, 24/F., Well Fung Industrial Centre, No. 58-76, Ta Chuen Ping Street,Kwai Chung, NT,Hong Kong.
Tel: 2425 8801 Fax: 2425 8646

Calibration Certificate

Certificate No. 210252

Results :

Applied Value (m/s)	UUT Reading (m/s)	Mfr's Spec.
0.96	1.0	± 0.1 m/s

Remarks : 1. UUT : Unit-Under-Test
2. Uncertainty : ± 1 %, for a confidence probability of not less than 95%.

---------- END ----------

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

Test Report No. : R-BB100037
Date of Issue : 12 October 2022

PART A - CUSTOMER INFORMATION

Acuity Sustainability Consulting Limited
Unit E, 12/F, Ford Glory Plaza 37-39 Wing Hong Street, Cheung Sha Wan
Kowloon (HK) Hong Kong

PART B - SAMPLE INFORMATION

Name of Equipment :	HORIBA U-53
Manufacturer :	HORIBA
Serial Number :	PORBNFNT
Date of Received :	10 October 2022
Date of Calibration :	12 October 2022
Date of Next Calibration :	11 January 2023
Request No. :	D-BB100037

PART C - REFERENCE METHODS/ DOCUMENTS FOR THE CALIBRATION

Test Parameter	Reference Method
pH value	APHA 21e 4500 H^+
Temperature	Section 6 of international Accreditation New Zealand Technical Guide no. 3 Second edition March 2008: Working Thermometer Calibration Procedure
Salinity	APHA 21e 2520 B
Dissolved oxygen	APHA 21e 4500 O
Turbidity	APHA 21e 2130 B

PART D - CALIBRATION RESULT

(1) pH value

Target (pH unit)	Display Reading (pH unit)	Tolerance	Result
4.00	4.12	0.12	Satisfactory
7.42	7.61	0.19	Satisfactory
10.01	10.19	0.18	Satisfactory

Tolerance of pH value should be less than ± 0.2 (pH unit)

(2) Temperature

Reading of Ref. thermometer (°C)	Display Reading (°C)	Tolerance	Result
12	12.20	0.20	Satisfactory
26	25.36	-0.64	Satisfactory
37	35.44	-1.56	Satisfactory

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

(3) Salinity

Expected Reading (g/L)	Display Reading (g/L)	Tolerance (%)	Result
10	9.98	-0.20	Satisfactory
20	20.23	1.15	Satisfactory
30	31.20	4.00	Satisfactory

Tolerance of Salinity should be less than ± 10.0 (%)

--- CONTINUED ON NEXT PAGE ---

AUTHORIZED SIGNATORY:

LEE Chun-ning
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REPORT OF EQUIPMENT PERFORMANCE CHECK/ CALIBRATION

Test Report No. : R-BB100037
Date of Issue : 12 October 2022

(4) Dissolved oxygen

Expected Reading (mg/L)	Display Reading (mg/L)	Tolerance	Result
7.87	7.45	-0.42	Satisfactory
4.09	4.05	-0.04	Satisfactory
1.26	1.00	-0.26	Satisfactory
0.01	0.06	0.05	Satisfactory

Tolerance of Dissolved oxygen should be less than ± 0.5 (mg/L)

(5) Turbidity

Expected Reading (NTU)	Display Reading (NTU)	Tolerance (%)	Result
0	0.00	--	Satisfactory
10	9.34	-6.6	Satisfactory
20	19.3	-3.5	Satisfactory
100	101	1.0	Satisfactory
800	780	-2.5	Satisfactory

Tolerance of Turbidity should be less than ± 10.0 (%)

Remark(s)

·The "Date of Next Calibration" is recommended according to best practice principals as practiced by QPT or quoted form relevant international standards.

·The results relate only to the calibrated equipment as received

·The performance of the equipment stated in this report is checked with independent reference material and results compared against a calibrated secondary source.

·"Displayed Reading" denotes the figure shown on item under calibration/ checking regardless of equipment precision or significant figures.

·The "Tolerance Limit" mentioned is the acceptance criteria applicable for similar equipment used by Quality Pro Test-Consult Ltd. or quoted form relevant international standards.

--- END OF REPORT ---

acumen laboratory
Member of the Aurecon Group

Standard Operation Procedure

For Digital Dust Indicator

Rev. A, R1

Contents

1 Introduction

1.1 The EIA has considered the potential dust impacts during the construction phase of projects. Construction dust arising from various construction activities would be the concern of different air sensitive receivers. A digital dust indicator would be used to measure the construction dust during the construction phase.

1.2 In this Standard Operation Procedure, Sibata LD-5R Digital Dust Indicator would be introduced.

2.0 Sampler Set-Up

2.1 Dust Monitoring Parameter

2.1.1 According to the EM&A manual, the sampling frequency of at least 3 times in every 6 days should be undertaken when the highest dust impact occurs**.**

2.2 Monitoring Location

2.2.1 Direction of the digital dust indicator shall be pointed to the construction site for measuring the dust emitted from the site. Example of set-up is shown as Figure 2.1

Figure 2.1 Digital dust indicator is pointed to construction site

3.0 Sampler Operations

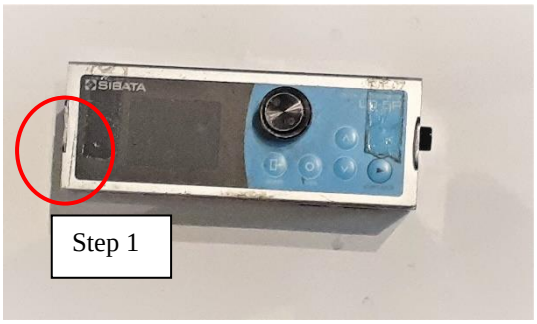
3.1 Sibata LD-5R Digital Dust Indicator

3.1.1 Sibata LD-5R digital dust indicator is a compact handheld dust indicator, which perform real time measurement of suspended particle matter in indoor spaces, public space. Component of Sibata LD-5R digital dust indicator us shown in Figure 3.1 and Figure 3.2

Figure 3.1 Top view of Sibata LD-5R digital dust indicator

Figure 3.2 Side view of Sibata LD-5R digital dust indicator

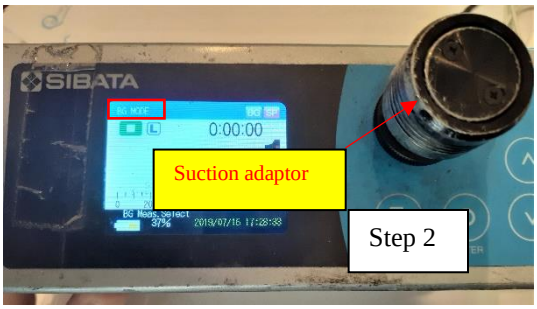
3.1.2 Operation of Sibata LD-5R digital dust indicator



Procedure of starting monitoring

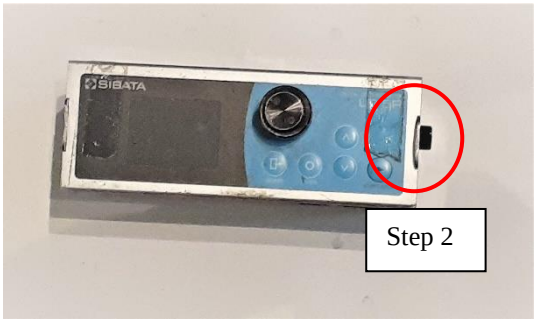
1. Turn on the “On/Off” button at the side of instrument

Program will be changed to “BG” mode and leave it for 1 minute.

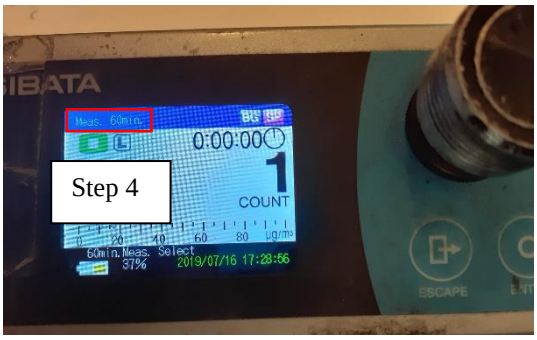


2. Pull out the Suction adaptor and turn the button at the side.

Cover with hand at the suction adaptor measure the background for 10 seconds.



3. Press “ UP” and “ DOWN” for choosing “SPAM Mode” for SPAM Measurement.



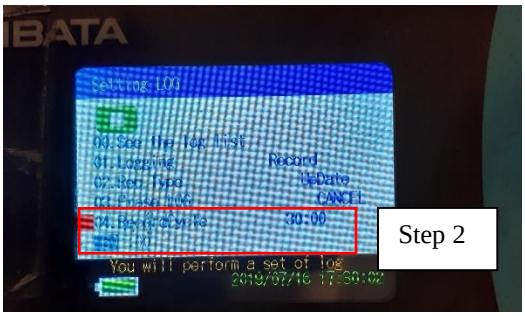
4. Press “Up” and “Down” to select “Measurement Mode” with 60 minutes interval and unit in ug/m^3.
5. Press “Start/Stop” to start monitoring.

Reference:

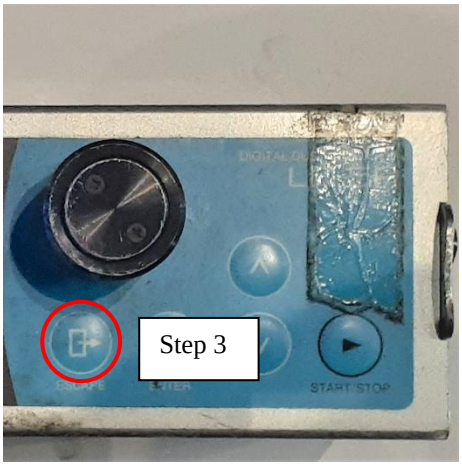
SIBATA Scientific Technology Ltd.. (2017, June 18). Digital Dust indicatores, model LD-5R - SIBATA Scientific Technology Ltd.. YouTube. Retrieved February 10, 2023, from https://www.youtube.com/watch?v=cuU4ptJlSZM

Procedure of setting measurement timer

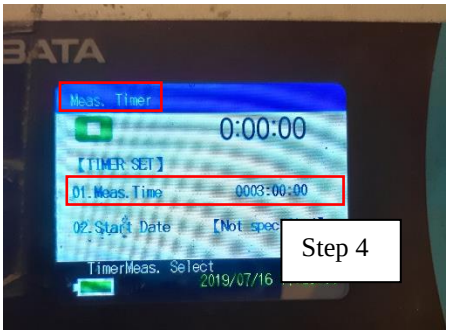
1. Press “Up” or “Down” to find “Setting LOG”.



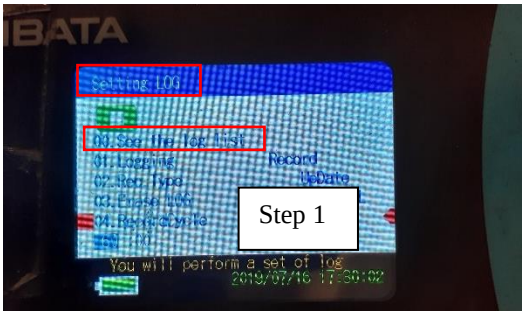
2. Select “Record Cycle” and change the record time subject to different project requirement. For example, setting the record cycle as 60 minutes for normal operation.



3. Press “ESCAPS” back to the main page.

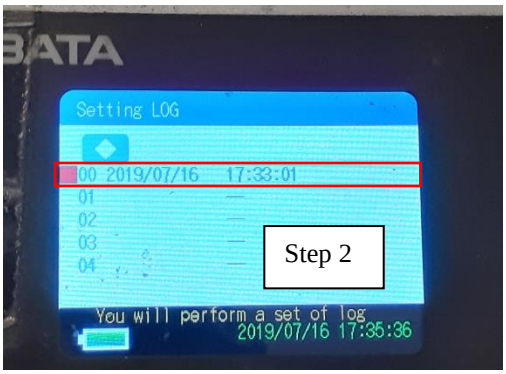


4. Press “Up” or “Down” to access “Measurement Timer” and select “Measurement time” to change the time to 3 hours.



Procedure of accessing the data

1.Press “Up” or “Down” to “Setting LOG” page and select “See the log list”

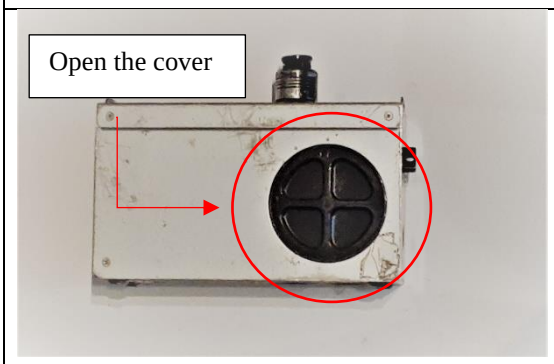


2. Select the file to access the data respectively.

4.0 Regular Instrument Checks

4.1 As there would be constant use of instrument, regular checking would be recommended to check the condition. Items to be checked are stated in Table 4.1.

Table 4.1 Checklist for instrument checking

Example	Description	Y/N	Remarks
	Is there any damage for the digital dust indicator? Could the digital dust indicator be powered?		
	Is the suction adaptor sensitive?		
	Is the battery compartment well maintained? Any damage to the battery compartment?		

5.0 Calibration Procedures

5.1 Direct reading dust meters will be verified against calibrated high volume samples (HVSs) annually. A 2-day, three 3-hour measurement results per day from direct reading dust meter will be taken to compare with the sampling results from the HVS. The correlation between the direct reading dust meter and the HVS will then be concluded. By accounting for the correlation factor, the direct reading dust meter will be considered to achieve comparable results as that of the HVS.

6.0 Audit Schedule

6.1 Checklist of regular checking for digital dust meter which shown in Table 4.1 will be conducted bi-weekly by environmental technician to ensure the all digital dust meter are in good condition and submitted to supervisors. All checklists will be kept by supervisors.

6.2 Log book is provided to environmental technician record the transferal of equipment to other colleagues, reporting to supervisors is required.

6.3 All digital dust indicator will be calibrated annually in HOKLAS accredited laboratory. Calibration certificate will be provided after calibration.

OPERATIONS MANUAL

TE-5170 Total Suspended Particulate
Mass Flow Controlled
High Volume Air Sampler

Tisch Environmental, Inc.
145 South Miami Avenue
Village of Cleves, Ohio 45002

Toll Free: (877) 263 -7610 (TSP AND-PM10)
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sales@tisch-env.com
www.tisch-env.com

TE-5170 Mass Flow Controlled
Total Suspended Particulate High Volume Air Sampler

Welcome

We are the experts in high volume air sampling, lead sampling, lead samplers, particulate monitoring, particulate emissions, pesticide monitoring, pesticide sampling, total suspended particles, particulate sampler, Federal Reference Method PM-10, Federal Reference Method PM2.5, EPA Method TO-4A, EPA Method TO-9A, EPA Method TO-13A. TEI is a family business located in the Village of Cleves, Ohio. TEI employs skilled personnel who average over 20 years of experience each in the design, manufacture, and support of air pollution monitoring equipment. Our modern well-equipped factory, quality philosophy and experience have made TEI the supplier of choice for air pollution monitoring equipment. Now working on the fourth generation, TEI has state-of-the-art manufacturing capability and is looking into the future needs of today's environmental professionals.

Assistance

If you encounter problems or require detailed explanations, do not hesitate to contact Tisch Environmental offices by e-mail or phone.

Toll Free: (877) 263 -7610 (TSP AND-PM10)
Direct: (513) 467-9000
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www.tisch-env.com

Table of Contents

Introduction

EPA Standards

The following manual will instruct you in the unpacking, assembly, operation, calibration, and use of this product. For information on air sampling principles, procedures and requirements and to ensure compliance with government regulations, refer to Title 40 of the Code of Federal Regulations **Appendix B to Part 50**, **Reference Method for Determination of Suspended Particulate Matter in the Atmosphere (High Volume Method)** or **Appendix G to Part 50**, **Reference Method for the Determination of Lead in Suspended Particulate Matter Collected from Ambient Air**. For additional information, contact the local Environmental Protection Agency office serving your area.

Safety Precautions

Before using Tisch Environmental products, always review the corresponding operations manuals and take all necessary safety precautions, especially when working with electricity.

Important Safety Instructions

Read and understand all instructions. Do not dispose of these instructions. Failure to follow all instruction listed in this manual may result in electric shock, fire, and/or personal injury. When using an electrical device, basic precautions must always be followed, including the precautions listed in the safety section of this manual. Never operate this unit in the presence of flammable materials or vapors are present as electrical devices may produce arcs or sparks that can cause fire or explosions. Always disconnect power supply before attempting to service or remove any components. Never immerse electrical parts in water or any other liquid. Always avoid body contact with grounded surfaces when plugging or unplugging this device is wet or dangerous conditions.

Electrical Installation

Installation must be carried out by specialized personal only, and must adhere to all local safety rules. This unit can be used for different power supply versions; before connecting this unit to the power line, always check if the voltage shown on the serial number tag corresponds to the one on your power supply. This product does use grounded plugs and wires. Grounding provides the path of least resistance for electrical currents, thereby reducing the risk of electric shock to users. This system is equipped with electrical cords with internal ground wires and a grounding plug. The plug must be plugged into a matching outlet that is properly installed and grounded in accordance with all local codes and ordinances. Do not modify the plug provided. If plug will not fit outlet, have the proper corresponding outlet installed by a professional, qualified electrician.

Do Not Abuse Cords

In the event that any electrical component of this system needs to be transported, **DO NOT** carry the unit by its power cord or unplug the unit by yanking the cord from the outlet. **Pull the plugs, not the cords**, to reduce risk of damage to unit. Keep all cords away from heat, oil, sharp objects, and moving parts.

Extension Cords

It is always advisable to use the shortest extension cord possible. Grounded units require a three-wire extension cord. As the distance from the supply outlet increases, you must use a heavier gauge extension cord. Using extension cords with inadequately sized wires results in serious changes in voltage, resulting in a loss of power and possible damage to equipment. It is recommended to only use 10-gauge extension cords for this product. Never use cords that exceed one hundred feet. Outdoor extension cords must be marked with the suffix “W-A” (or “W” in Canada)to indicate that it is suitable for outdoor usage. Always ensure that extension cords are properly wired and in good electrical condition. Always replace damaged extension cords immediately, or seek repair from qualified electricians before further use. Remember to protect extension cords from sharp objects, excessive heat, and damp or wet conditions.

Product Description

Introduction

The High Volume Air Sampler (also known as a **lead sampler**) is the recommended instrument for sampling large volumes of air for the collection of TSP (Total Suspended Particulate). The TE-5170 TSP MFC sampler consists of a TE-5001 Anodized Aluminum Shelter, TE-5005 Aluminum Blower Motor Assembly, TE-5004 8”x10” Stainless Steel Filter Holder with probe hole, TE-5009 Continuous flow/pressure recorder, TE-300-310 Mass Flow Controller, TE-5007 Mechanical Timer, and TE-5012 Elapsed Time Indicator.

Applications

- Ambient air monitoring to determine mass concentration of suspended particulate levels relative to air quality standards. This result is reported in micrograms per cubic meter.

- Impact of a specific source on ambient levels of suspended particulates by incorporating a "wind-direction-activation" modification which permits the sampler to operate only when conditions are such that a source-receptor relationship exists.

Calibration Requirements

TE-5170 TSP MFC High Volume Air Sampler should be calibrated:

- Upon installation.
- After routine maintenance or exchange of vacuum motor or motor brushes.
- Once every quarter (three months).
- After 360 sampling hours.

Calibration Kit

The TE-5028 is the preferred product used to calibrate the TE-5170 MFC TSP High Volume Air Sampler. It simulates change in the resistance by rotating the knob on the top of the calibrator. The infinite resolution lets the technician select the desired flow resistance. The TE-5028 calibration kit includes: carrying case, 30" slack tube water manometer, adapter plate, tubing, and TE-5028A orifice with flow calibration certificate. Optional electronic manometer is available by ordering TE-5028E.

Each TE-5028A Orifice Transfer Standard is individually calibrated on a primary standard positive displacement device which is directly traceable to NIST.

**** It is recommended by the EPA that each calibrator should be re-calibrated annually. (1998 Code of Federal Regulations Parts 50 to 51, Appendix B to Part 50, Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere, 9.2.5 page 29.)**

Parts

1. Shelter Box - 48" x 20" x 20" 74 lbs

TSP MFC SAMPLER
TE-5170 110volts, 60hz
TE-5170X 220volts, 50hz
TE-5170XZ 220volts, 60hz

8” x 10” TSP Stainless Steel Filter Holder with probe hole
TE-5004

7 Day Mechanical Timer
TE-5007, 110volts, 60hz
TE-5007X, 220volts,50hz
TE-5007XZ, 220volts,60hz

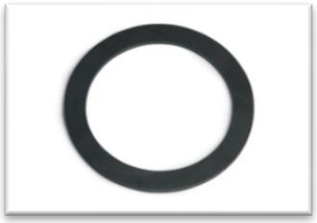
Mass Flow Controller
TE-300-310, 110volts, 60hz
TE-300-310X, 220volts 50/60hz

Elapsed Time Indicator
TE-5012 110volt, 60hz
TE-5012X 220volts, 50hz
TE-5012XZ 220volts, 60hz

Blower Motor Assembly with tubing
TE-5005 110volts, 60hz
TE-5005X, 220volts, 50-60hz

24 Hour Chart Recorder
TE-5009 110volts, 60hz
TE-5009X 220volts,50hz
TE-5009XZ 220volts,60hz

Filter Holder Gasket
TE-5005-9



Envelope box of charts and manual
TE-106

2. Lid Box - 19" x 14" x 14" 9 lbs

Gabled Roof
TE-5001-10

*** Save the shipping containers and packing material for future use.

Assembly

1. Open shelter box and remove Anodized Aluminum Shelter.

2. Enclosed in the 13" x 10" x 9" box on bottom of shelter is the TE-5005 Blower Motor Assembly. Enclosed in the 13” x 10” x 9” box inside of shelter is the TE-5004 Filter Holder with TE-5005-9 gasket. Remove from boxes.

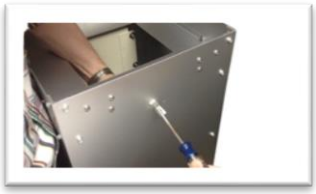
3. Open lid box and remove 5001-10 Roof (for roof assembly see page 13).

4. Screw TE-5004 Filter Holder onto TE-5005 Blower Motor Assembly (tubing, power cord, and hole in filter holder collar to the right) make sure TE-5005-9 gasket is in place.

5. Lower Filter Holder and Blower Motor down through top support pan on shelter. Insert Flow Controller probe into filter holder collar. Before tightening **make sure** probe slot is turned so air coming into filter holder goes through it. Connect tubing from pressure tap of blower motor to TE-5009 Flow Recorder.

Gabled Roof Assembly

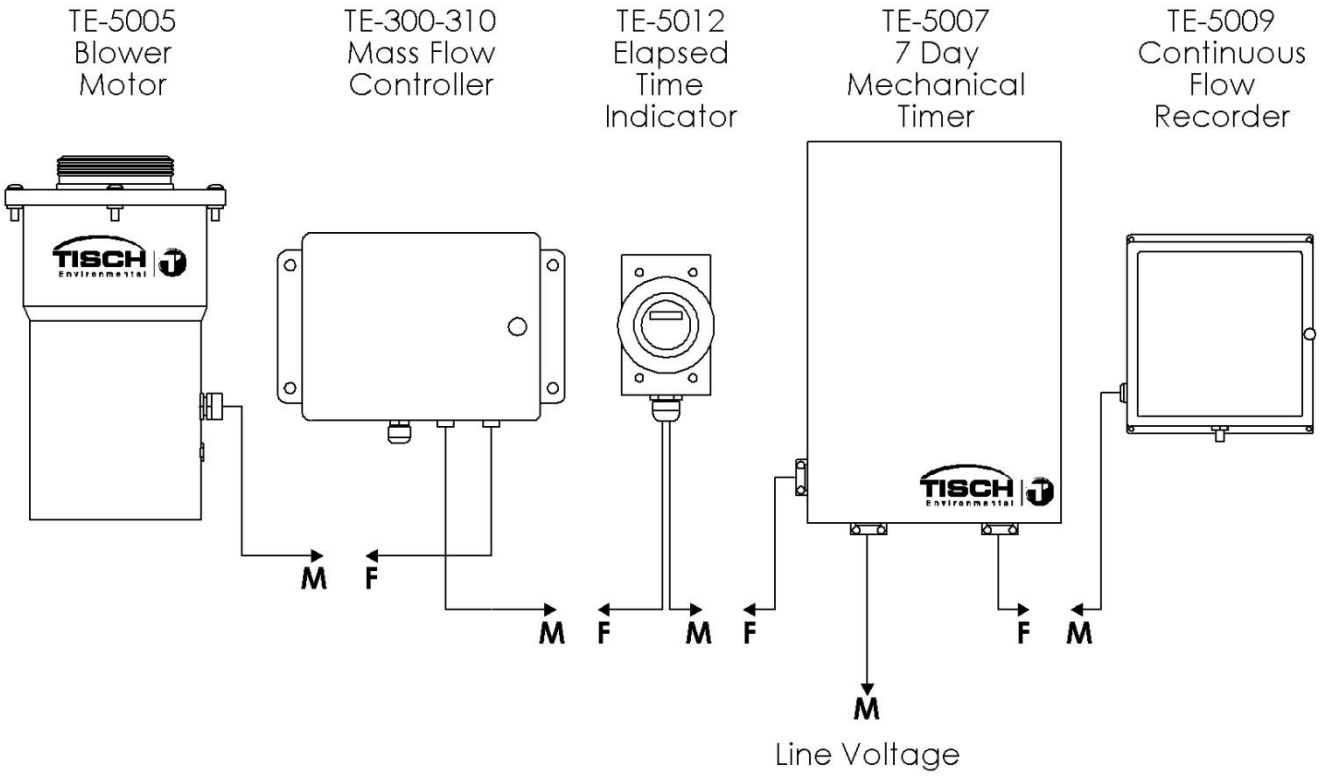
The following steps are accompanied by pictures to aid your understanding of gabled roof assembly. **Please be aware that the pictures are standardized and may not exactly match the equipment that you are using.** The gabled roof is used on several products and the assembly procedure is the same.

Lid Hardware 5 pcs 10-24 x 1/2 pan head screws 5 pcs 10-24 stop nuts 1 pc 6-32 x 3/8 pan head screw 1 pc 6-32 hex nut 1 pc 20" chain with "S" hook 1 pc TE-5001-10-9 roof back catch 1 pc TE-5001-10-10 front catch 1 pc TE-5001-10-11 rear lid hasp	
Step 1 Secure TE-5001-10-10 front catch to the shelter using 2 10-24 pan head screws with stop nuts. **Do not tighten completely, this may need to be adjusted after final assembly**	
Step 2 Secure TE-5001-10-9 roof back catch to the back of shelter using #6-32 pan head screw with stop nut.	
Step 3 Secure TE-5001-10-11 rear lid hasp inside the lid with the slot angled up using (2) #10-24 pan head screws with stop nuts. **Do not tighten completely, this may need to be adjusted after final assembly**	

	Step 4 Remove (4) #10-24 x ½" pan head screws from the rear of the shelter, attach the lid to the shelter by placing the lid hinge plates on the **"OUTSIDE"** of the shelter, line the hinges up with the (4) threaded holes in the back of the shelter. Use the (4) #10-24X ½" pan head screws that were removed preciously to attach the lid hinges to the shelter. **Tighten completely**	
	Step 5 Adjust the front and rears catch to be sure that the lid slots lowers over it when closing. Tighten the roof back hasp and front catch completely.	 
	Step 6 Attach the chain and "S" hook assembly to the side of the shelter with a #6-32 x 3/8" pan head screw.	
	Step 7 The Lid can now be secured in an open or closed position with the "S" hook.	

Electrical Set-Up

TE-5170 Electrical Set-Up



Note: Standard 3-prong plug may require adapter for use in global installations. Please consult your local electrical standards.

1. Connect the TE-5005 Blower Motor plug to the TE-300-310 Mass Flow Controller socket.

2. Connect the Mass Flow Controller plug to the TE-5012 Elapsed Time Indicator socket side.

3. Connect the plug side of the ETI cord set into the TE-5007 7-Day Mechanical Timer timed socket cord on the left side of timer.

4. The other socket cord set on timer (on the right) is hot all the time and is connected to the TE-5009 Continuous Flow Recorder plug.

5. The plug cord set of timer connects to line voltage.

Operations

Visit, www-tisch-env.com/calibration-worksheets, to download calibration worksheets. The calibration worksheets allow the user to input the data and automatically make the calculations. The manual calculation method is described in the following sections for your reference, however, it is highly recommended to download the calibration worksheets.

Calibration Procedure

The following is a step by step process of the calibration of a **TE-5170 Mass Flow Controlled Total Suspended Particulate High Volume Sampling Systems.** Following these steps are example calculations determining the calibration flow rates, and resulting slope and intercept for the sampler. These instructions pertain to the samplers which have air flow controlled by electronic mass flow controllers (MFC) in conjunction with a continuous flow recorder or a manometer. This calibration differs from that of a volumetric flow controlled sampler.

The Total Suspended Particulate samplers (TSP) are also referred to as **lead samplers** as this is another use for these instruments. The instruments are also suitable for capturing large particulate and heavy metal particles. Air monitoring studies that are concerned with smaller respirable particulate will call for the use of PM-10 particulate samplers. The TSP samplers have a wide range of acceptable air flow operating limits, i.e., 1.10 to 1.70 m^3/min (39 to 60 CFM). A mass flow controller will sense a decrease in air flow as particulate is collected in the filer media and increases the voltage to the blower which increases the blower speed in order to maintain the set flow rate.

The attached example calibration worksheets can be used with a **TE-5028 Variable Orifice Calibrator** which uses an adjustable or variable orifice.

One example calibration sheet is attached to this manual. To download the electronic spreadsheet, please visit www.tisch-env.com. **It is highly recommended to download the electronic spreadsheet and use the spreadsheet features to complete calculations, calibration worksheets can be found by visiting www.tisch-env.com.**

Proceed with the following steps to begin the calibration:

1. Disconnect the sampler motor from the mass flow controller and connect the motor to a stable AC power source.

2. Mount the calibrator orifice and top loading adapter plate to the sampler. A sampling filter is generally not used during this procedure. Tighten the top loading adapter hold down nuts securely to ensure that no air leaks are present.

3. Allow the sampler motor to warm up to its normal operating temperature (approximately 10-15 minutes).

4. Conduct a leak test by covering the hole(s) on top of the orifice and pressure tap on the orifice with your hands. Listen for a high-pitched squealing sound made by escaping air. If this sound is heard, a leak is present and the top loading adapter hold-down nuts need to be re-tightened. If the sound is lower, the leak is near one of the other gaskets in the system. **Avoid running the sampler for longer than 30 seconds at a time with the orifice blocked to avoid overheating the motor.** Do not perform this leak test procedure with a manometer connected to the side tap on the calibration orifice or the blower motor. Liquid from the manometer could be drawn into the system and cause motor damage.

5. Connect one side of a water manometer to the pressure tap on the side of the orifice with a rubber vacuum tube. Leave the opposite side of the manometer open to the atmosphere. **Note:** Both valves on the manometer have to be open for the liquid to flow freely. One side of the 'U' tube goes up the other goes down; add together for the "H_2O reading.

6. A manometer must be held vertically to ensure accurate readings. Tapping the backside of the continuous flow recorder will help to center the pen and provide accurate readings. When using a variable orifice (TE-5028A), five flow rates are achieved in this step by adjusting the knob on the variable orifice to five different positions and taking five different readings.

7. Record the ambient air temperature, the ambient barometric pressure, the sampler serial number, the orifice s/n, the orifice slope and intercept with date last certified, todays date, site location and the operators initials on the attached blank calibration sheet.

8. Disconnect the sampler motor from its power source and remove the orifice and top loading adapter plate. Re-connect the sampler motor to the electronic mass flow controller.

An example of a Lead (or TSP) Sampler Calibration Data Sheet has been attached with data filled in from a typical calibration. This includes the transfer standard orifice calibration relationship which was taken from the Orifice Calibration Worksheet that accompanies the calibrator orifice. Since this calibration is for a TSP sampler, the slope and intercept for this orifice uses **standard** flows rather than actual flows and is taken from the Qstandard section of the Orifice Calibration Worksheet. The Qactual flows are only used when calibrating a PM-10 sampler.

The five orifice manometer readings taken during the calibration have been recorded in the column on the data worksheet titled Orifice "H_2O. The five continuous flow recorder readings taken during the calibration have been recorded under the column titled I chart.

The orifice manometer readings need to be converted to the standard air flows they represent using the following equation:

$Qstd = 1/m[Sqrt((H_20)(Pa/760)(298/Ta))-b]$

where:
Qstd = actual flow rate as indicated by the calibrator orifice, m^3/min
H_2O = orifice manometer reading during calibration, "H_2O
Ta = ambient temperature during calibration, K (K = 273 + °C)
298 = standard temperature, a constant that never changes, K
Pa = ambient barometric pressure during calibration, mm Hg
760 = standard barometric pressure, a constant that never changes, mm Hg
m = *Qstandard slope of orifice* calibration relationship
b = *Qstandard intercept of orifice* calibration relationship.

Once these standard flow rates have been determined for each of the five run points, they are recorded in the column titled Qstd, and are represented in cubic meters per minute.

The continuous flow recorder readings taken during the calibration need to be corrected to the current meteorological conditions using the following equation:

$$IC = I[Sqrt((Pa/760)(298/Ta))]$$

where:
IC = continuous flow recorder readings corrected to current Ta and Pa
I = continuous flow recorder readings during calibration
Pa = ambient barometric pressure during calibration, mm Hg.
760 = standard barometric pressure, a constant that never changes, mm Hg
Ta = ambient temperature during calibration, K (K = 273 + °C)
298 = standard temperature, a constant that never changes, K

After each of the continuous flow recorder readings have been corrected, they are recorded in the column titled IC (corrected).

Using Qstd and IC (or FLOW (corrected)) as the x and y axis respectively, a slope, intercept, and correlation coefficient can be calculated using the least squares regression method. The correlation coefficient should never be less than 0.990 after a five point calibration. A coefficient below .990 indicates a calibration that is not linear and the calibration should be performed again. If this occurs, it is most likely the result of an air leak during the calibration or high wind speed during the calibration procedure.

The equations for determining the slope (m) and intercept (b) are as follows:

$$m = \frac{\sum xy - \frac{(\sum x)(\sum y)}{n}}{\sum x^2 - \frac{(\sum x)^2}{n}} \quad ; \quad b = \bar{y} - m\bar{x}$$

The equation for the coefficient of correlation (r) is as follows:

$$r = \frac{\sum xy - \frac{(\sum x)(\sum y)}{n}}{\sqrt{\left[\sum x^2 - \frac{(\sum x)^2}{n}\right]\left[\sum y^2 - \frac{(\sum y)^2}{n}\right]}}$$

where: n = number of observations
$\sum$ = sum of

The acceptable operating flow range of a TSP sampler is 1.1 to 1.7 m^3/min (39 to 60 CFM). Looking at the worksheet column Qstd(see page 38), the flow rates that are within this range can be identified along with the chart reading (I) that represents them. For instance if you wanted to set this sampler at 1.265 m^3/min (44.67 CFM) (Make sure the mass flow controller is plugged in and a filter is in place) you would turn the Flow Adjustment screw until the continuous flow recorder read 37 on the chart. By making sure that the sampler is operating at a chart reading (or manometer reading) that is within the acceptable range, it can be assumed that valid TSP data is being collected.

Example Calculations

The following example problems use data from the attached calibration worksheet.

After all the sampling site information, calibrator information, and meteorological information have been recorded on the worksheet, standard air flows need to be determined from the orifice manometer readings taken during the calibration using the following equation:

1. $Qstd = 1/m[Sqrt((H_20)(Pa/760)(298/Ta))-b]$

where:
Qstd = actual flow rate as indicated by the calibrator orifice, m^3/min
H_2O = orifice manometer reading during calibration, "H_2O
Ta = ambient temperature during calibration, K (K = 273 + °C)
298 = standard temperature, a constant that never changes, K
Pa = ambient barometric pressure during calibration, mm Hg
760 = standard barometric pressure, a constant that never changes, mm Hg
m = *Qstandard slope of orifice* calibration relationship
b = *Qstandard intercept of orifice* calibration relationship.

Note that the ambient temperature is needed in degrees Kelvin to satisfy the Qstd equation. Also, the barometric pressure needs to be reported in millimeters of mercury. In our case the two following conversions may be needed:

2. degrees Kelvin = [5/9 (degrees Fahrenheit - 32)] + 273

3. millimeters of mercury = 25.4(inches of H_2O/13.6)

Inserting the numbers from the calibration worksheet run point number one we get:

4. Qstd = 1/1.47574[Sqrt((7.25)(749/760)(298/293)) - (-.00613)]
5. Qstd = .6776261[Sqrt((7.25)(..9855263)(1.0170648)) + .0.00613]
6. Qstd = .6776261[Sqrt(7.2669947) + .00613]
7. Qstd = .6776261[2.6957363 + .00613]
8. Qstd = .6776261[2.7018663]
9. Qstd = 1.831

Throughout these examples you may find that your results may vary some from those arrived here. This may be due to different calculators carrying numbers to different decimal points. The variations are usually slight and should not be a point of concern.

With the Qstd determined, the corrected chart reading (IC) for this run point needs to be calculated using the following equation:

10. IC = I[Sqrt((Pa/760)(298/Ta))]

where: IC = continuous flow recorder readings corrected to standard
I = continuous flow recorder readings during calibration
Pa = ambient barometric pressure during calibration, mm Hg.
760 = standard barometric pressure, mm Hg
Ta = ambient temperature during calibration, K (K = 273 + °C)
298 = standard temperature, K.

Inserting the data from run point one on the calibration worksheet we get:

11. IC = 52[Sqrt(749/760)(298/293)]
12. IC = 52[Sqrt(1.0023441)]
13. IC = 52[1.0011713]
14. IC = 52.06

This procedure should be completed for all five run points. EPA guidelines state that at least three of the five Qstd flow rates during the calibration be within or nearly within the acceptable operating limits of 1.10 to 1.70 m^3/min (39 to 60 CFM). If this condition is not met, the instrument should be recalibrated. (1998 Code of Federal Regulations Parts 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.)

Using Qstd as our x-axis, and IC as our y-axis, a slope, intercept, and correlation coefficient can be determined using the least squares regression method.

The equations for determining the slope (m) and intercept (b) are as follows:

15.

$$m = \frac{\left[\sum xy - \left(\frac{(\sum x)(\sum y)}{n}\right)\right]}{\sum x^2 - \frac{(\sum x)^2}{n}} \qquad b = \overline{y} - m\overline{x}$$

where: n = number of observations
$\bar{y} = \sum y/n$; $\bar{x} = \sum x/n$
$\sum$ = sum of.

The equation for the coefficient of correlation (r) is as follows:

16. $$r = \frac{\sum xy - \frac{(\sum x)(\sum y)}{n}}{\sqrt{\left[\sum x^2 - \frac{\left(\sum x\right)^2}{n}\right]\left[\sum y^2 - \frac{\left(\sum y\right)^2}{n}\right]}}$$

where: n = number of observations
$\sum$ = sum of.

Before these can be determined, some preliminary algebra is necessary. $\sum x$, $\sum y$, $\sum x^2$, $\sum xy$, $(\sum x)^2$, $(\sum y)^2$, n, $\bar{y}$, and $\bar{x}$ need to be determined.

17. $\Sigma x = 1.831 + 1.631 + 1.452 + 1.265 + 1.119 = 7.298$
18. $\Sigma y = 52.07 + 47.06 + 42.06 + 37.05 + 33.05 = 211.29$
19. $\Sigma x^2 = (1.831)^2 + (1.631)^2 + (1.452)^2 + (1.265)^2 + (1.119)^2 = 10.973412$
20. $\Sigma y^2 = (52.07)^2 + (47.06)^2 + (42.06)^2 + (37.05)^2 + (33.05)^2 = 9159.9771$
21. $\Sigma xy = (1.831)(52.07) + (1.631)(47.06) + (1.452)(42.06) + (1.265)(37.05) + (1.119)(33.05) = 317.01735$
22. $n = 5$
23. $\bar{x} = \Sigma x/n = 1.4596$
24. $\bar{y} = \Sigma y/n = 42.258$
25. $(\Sigma x)^2 = (7.298)^2 = 53.260804$
26. $(\Sigma y)^2 = (211.29)^2 = 44643.464$

Inserting the numbers:

27.
$$slope = \frac{317.01735 - \frac{(7.298)(211.29)}{5}}{10.973412 - \frac{53.260804}{5}}$$

28.

$$slope = \frac{317.01735 - \frac{1541.9944}{5}}{10.973412 - \frac{53.260804}{5}}$$

29.

$$slope = \frac{317.01735 - 308.39888}{10.973412 - 10.65216}$$

30.

$$slope = \frac{8.61847}{0.321252}$$

31. $slope = 26.827755$

32. intercept = 42.258 - (26.827755)(1.4596)
33. intercept = 42.258 – 39.157791
34. intercept = 3.100209

35. correlation coeff. =

$$\frac{317.01735 - \frac{(7.298)(211.29)}{5}}{\sqrt{\left[10.973412 - \frac{53.260804}{5}\right]\left[9159.9771 - \frac{44643.464}{5}\right]}}$$

36. correlation coeff. =

$$\frac{317.01735 - \frac{(1541.9944)}{5}}{\sqrt{[(10.973412 - 10.65216)]\ \ [(9159.977 - 8928.6928)]}}$$

37. correlation coeff. =

$$\frac{(317.01735 - 308.39888)}{\sqrt{[(10.973412 - 10.65216)][(9159.977 - 8928.6928)]}}$$

38. correlation coeff. =

$$\frac{8.61847}{\sqrt{(0.321252)(231.2842)}}$$

39. correlation coeff. = $\dfrac{8.61847}{\sqrt{74.300511}}$

40. correlation coeff. = $\dfrac{8.61847}{8.6197744}$

41. correlation coeff. = .9998

A calibration that has a correlation coefficient of less than .990 is not considered linear and should be re-calibrated. As you can see from both worksheets we have 3 Qstd numbers that are in the TSP range (1.1 - 1.7) and the correlation coefficient. is > .990 , thus a good calibration.

Total Volume

To figure out the total volume of air that flowed through the sampler during your sampling run take a set-up reading (when you set the sampler up manually turn it on and take a continuous flow recorder reading; in our example it should be 38) and a pick-up reading (after the sample has been taken again manually turn sampler on and take a continuous recorder reading; for our example let's say it read 34). Take 38 + 34 = 72 72/2 = 36 so the continuous recorder reading you would use is 36. Put that into the formula (on bottom of worksheet):

1/m((I)[Sqrt(298/Tav)(Pav/760)]- b)

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

Example:

m^3/min = 1/26.8212((36)[Sqrt(298/294)(753/760)]-(+3.1112))
m^3/min = .0372839 ((36)[Sqrt(1.0136054)(0.9907894)] -3.1112)
m^3/min = .0372839 ((36)[Sqrt(1.0042694)] -3.1112)
m^3/min = .0372839 ((36)[1.0021324)] -3.1112)
m^3/min = .0372839 ((36.076766) -3.1112)
m^3/min = .0372839 (32.965566)
m^3/min = 1.2290848
ft^3/min = 1.2290848 x 35.31 = 43.398984
Total ft^3 = ft^3/min x 60 x hours that sampler ran

Let's say our sampler ran 24 hours (end ETI reading - start ETI reading)

** Make sure ETI is in hours otherwise convert to hours **

Total ft^3 = 43.398984 x 60 x 24 = 62,494.536 ft^3
Total m^3 = 1.2290848 x 60 x 24 = 1769.8821 m^3

Sampler Operation

1. After performing calibration procedure, remove filter holder frame by loosening the four wing nuts allowing the brass bolts and washers to swing down out of the way. Shift frame to one side and remove.

2. Carefully center a new filter, rougher side up, on the supporting screen. Properly align the filter on the screen so that when the frame is in position the gasket will form an airtight seal on the outer edges of the filter.

3. Secure the filter with the frame, brass bolts, and washers with sufficient pressure to avoid air leakage at the edges (make sure that the plastic washers are on top of the frame).

4. Wipe any dirt accumulation from around the filter holder with a clean cloth.

5. Close shelter lid carefully and secure with the "S" hook.

6. Make sure all cords are plugged into their appropriate receptacle sockets and the rubber tubing between the blower motor pressure tap and the TE-5009 continuous flow recorder is connected (be careful not to pinch tubing when closing door).

7. Prepare TE-5009 continuous flow recorder as follows:

    a. Clean any excess ink and moisture on the inside of recorder by wiping with a clean cloth.

    b. Depress pen arm lifter to raise pen point and carefully insert a fresh chart.

    c. Carefully align the tab of the chart to the drive hub of the recorder and press gently with thumb to lower chart center onto hub. Make sure chart is placed under the chart guide clip and the time index clip so it will rotate freely without binding. Set time by rotating the drive hub clock-wise until the correct time on chart is aligned with time index pointer.

    d. Make sure the TE-160 pen point rests on the chart with sufficient pressure to make a visible trace.

8. Prepare the Timer as instructed below.

9. Manually trip timer switch on to determine if sampler is operating properly and the recorder is inking correctly.

10. Manually trip timer switch off. If the timer is set correctly you are ready to sample.

11. At the end of the sampling period, remove the frame to expose the filter. Carefully remove the exposed filter from the supporting screen by holding it gently at the ends (not at the corners). Fold the filter lengthwise so that sample touches sample.

12. It is always a good idea to contact the lab you are dealing with to see how they may suggest you collect the filter and any other information that they may need.

Timer Preparation

TE-5007 7-Day Mechanical Timer

1. To set the "START" time, attach a (bright) "ON" tripper to the dial face on the desired "START" time. Tighten tripper screw securely.

2. To set the "STOP" time, attach a (dark) "OFF" tripper to the dial face on the desired "STOP" time. Tighten tripper screw securely.

3. To set current time and day, grasp dial and rotate **clockwise only** until correct time and day appear at time pointer.

Troubleshooting

note: this is a general troubleshooting guide, not all problem may apply to every sampler

Problem	Solution
Brush Motor Won't Turn On	-Check Motor brushes(Change every 500 hours) -Check Motor(Should be replaced after 2 brush changes about 1500 hours) -Check power supply -Ensure that all electrical connections are secure -Make sure timer is on -Make sure flow controller(if applicable) is adjusted properly -Check for loose or damaged wires
Brushless Motor Won't Turn On	-Ensure that all electrical connections are secure -Make sure flow controller(if applicable) is adjusted properly -Check power supply -Make sure timer is on -Check for loose or damaged wires
Mechanical timer not working	-Make sure trippers are set properly -Make sure that trippers are not pressed against switch at start up, the timer need to rotate a few degrees before the trippers hit the switch -Check for loose or damages wires -Check power supply -Check electrical hook up diagram to ensure correct installation -Check Motor
Digital timer not working	-Check timer settings -Make sure current date and time are correct -Make sure power cords are properly connected -Check fuse on main PC board (F3) -Check Power Supply -Check Motor
Mass Flow Controller not working	-Make sure timer is on -Check Motor/Motor brushes -Make sure 8 amp breaker is not popped -Make sure flow probe is installed correctly -Check all electrical connections -Check power supply

Elapsed Time Indicator not working	-Check Power Supply -Check electrical connections
Voltage Variator with ETI not working	-Check Power Supply -Check Electrical Connections -Check Motor
Flow Rate Too Low	-Check for leaks -Check filter media placement -Ensure only one piece of filter paper is installed -Check Flow Controller -Check flow valve(TE-1000PUF samplers only) -Ensure proper voltage is being supplied -Check calibration
Chart Recorder not working	-Replace pen point -Make sure pen point is touching chart -Make sure pen point is on “0” -Make sure tubing from motor is in place -Check Power Supply -Check motor
Air Leaks	-Make sure all gaskets are in place -Make sure all connections are secure -Makes sure connections are not over tightened -Check for damaged components: Filter holder screen, gaskets, motor flanges

Maintenance and Care

A regular maintenance schedule will allow a monitoring network to operate for longer periods of time without system failure. Adjustments in routine maintenance frequency may be necessary due to the operational demands on instruments. It is recommended that the following cleaning and maintenance activities be observed until a stable operating history of the sampler has been established.

TE-5170 MFC TSP Sampler:

1. Make sure all gaskets (including TE-5005-4 motor cushion) are in good shape and that they seal properly.

2. The power cords should be checked for good connections and for cracks (replace if necessary).

   CAUTION: Do not allow power cord or outlets to be immersed in water!

3. Inspect the filter screen and remove any foreign deposits.

4. Inspect the filter holder frame gasket each sample period and make sure of airtight seal.

5. Check or replace 110v or 220v motor brushes every 400 to 500 running hours.

6. After replacing motor brushes two times, a new motor must be used.

7. Make sure elapsed time indicator is working properly by applying power and observing.

8. Make sure continuous flow recorder pen is still inking each time, tubing has no crimps or cracks, and that the door is sealed completely.

Motor Brush Replacement

110 volt (Brush part #TE-33384)
220 volt (Brush part #TE-33378)

CAUTION: Unplug the unit from any line voltage sources before performing any service on blower motor assembly or any electrical device on this system.

The following steps are accompanied by pictures to aid your understanding of motor brush replacement procedures. ***Please be aware that the pictures are standardized and may not match the equipment that you are using.*** *Motor brush removal and replacement does not change based on motor or brush type, so do not be confused if your equipment differs from what is pictured.*

1. Remove the blower motor from the filter holder. Place on work bench. Remove the flange by removing the four bolts. This will expose the gasket and the motor.

2. Turn assembly on side, loosen the cord retainer and then push cord into housing and at the same time let motor slide out exposing the brushes.

3. Looking down at motor. There are 2 brushes, one on each side. Carefully pry the brass quick disconnect tabs (the tabs are pushed into end of brush) away from the expended brushes and toward the armature. Try to pry the tabs as far as you can without damaging the armature.

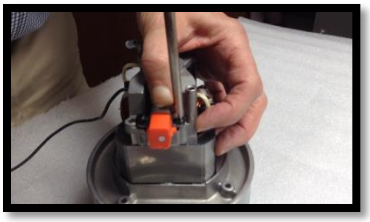
4. With a screwdriver loosen and remove brush holder clamps and release brushes. Carefully, pull quick disconnect tabs from expended brushes.

5. Carefully slide quick disconnect tabs into tab slot of new brush.

6. Push brush carbon against armature until brush housing falls into brush slot on motor.

7. Put brush holder clamps back onto brushes.

8. Make sure quick disconnect tabs are firmly seated into tab slot. Check field wires for good connections.



9. Assemble motor after brush replacement by placing housing over and down on the motor (at same time pull power cord out of housing), being careful not to pinch any motor wires beneath the motor spacer ring.

10. Secure power cord with the cord retainer cap.

11. Replace blower motor flange on top of motor making sure to center gasket. Assemble together with filter holder. Lower filter holder and blower motor down through top support pan on shelter.

****IMPORTANT**** To enhance motor life:

- Change brushes before brush shunt touches armature.
- Seat new brushes by applying 50% voltage for 10 to 15 minutes, the TE-5075 brush break in device allows for the 50% voltage.

TE-116311
110v MFC Motor

TE-33384(green)
110v MFC Motor Brush

TE-116312
220v MFC Motor

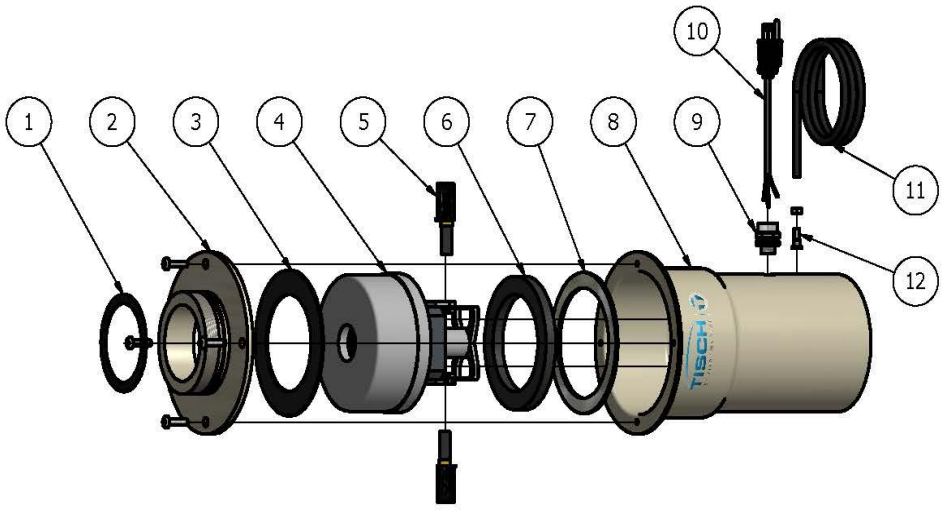
TE-33378(brown)
220v MFC Motor Brush

Warranty

Tisch Environmental, Inc. warrants instruments of its manufacture to be free of defects in material and workmanship for one year from the date of shipment to the purchaser. Its liability is limited to servicing or replacing any defective part of any instrument returned to the factory by the original purchaser. All service traceable to defects in original material or workmanship is considered warranty service and is performed free of charge. The expense of warranty shipping charges to and from our factory will be borne by Tisch Environmental. Service performed to rectify an instrument malfunction caused by abuse, acts of god or neglect, and service performed after the one-year warranty period will be charged to the customer at the current prices for labor, parts, and transportation. Brush-type and brushless type motors will carry a warranty as far as the original manufacture will pass through its warranty to Tisch Environmental, Inc. The right is reserved to make changes in construction, design specifications, and prices without prior notice.

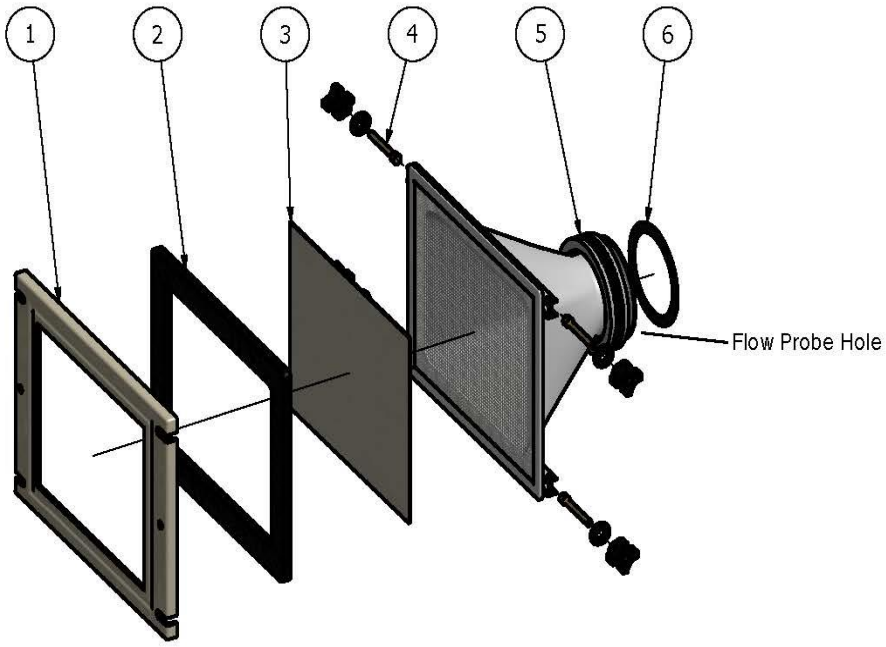
Assembly Drawings

TE-5005 Blower Motor Assembly



TE-5005 Brush Type Aluminum Blower Motor Assembly			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	TE-5005-9	Filter Holder Gasket (between Filter Holder and Blower Motor)
2	1	TE-5005-1	Blower Motor Flange
3	1	TE-5005-2	Flange Gasket
4	1	TE-116311 TE-116312	Motor for 110V MFC Blower Motor for 220V MFC Blower
5	2	TE-33384 TE-33378	Motor Brushes for 110V Motor MFC Motor Brushes for 220V Motor MFC
6	1	TE-5005-4	Motor Cushion
7	1	TE-5005-5	Motor Spacer Ring
8	1	TE-5005-3	Aluminum Blower Motor Housing
9	1	TE-5005-7	Cord Retainer w/ Nut
10	1	TE-5010-4	Power Cord
11	1	TE-5005-6	Tubing 3 ft. Piece
12	1	TE-5005-8	Pressure Tap w/ Nut

TE-5004 Filter Holder Assembly



TE-5004 Filter Holder Assembly			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	TE-3000-2	Hold Down Frame
2	1	TE-5018	8" x 10" Gasket
3	1	N/A	Filter Paper
4	4	TE-5003-9	Plastic Thumb Nut, Brass Bolt, Washer, and Rivet
5	1	TE-5028-9	Aluminum Threaded Ring
6	1	TE-5005-9	Filter Holder Gasket (Between Filter Holder and Blower Motor)

Calibration Worksheet

TE-5170 Calibration Worksheet

Site Information

Location: Cleves, Ohio	Site ID: 145	Date: 31-Oct-14
Sampler: E-5170 MFC	Serial No: 367	Tech: Jim Tisch

Site Conditions

Barometric Pressure (in Hg):	29.50	Corrected Pressure (mm Hg):	749
Temperature (deg F):	68	Temperature (deg K):	293
Average Press. (in Hg):	29.65	Corrected Average (mm Hg):	753
Average Temp. (deg F):	70	Average Temp. (deg K):	294

Calibration Orifice

Make:	Tisch	Qstd Slope:	1.47574
Model:	TE-5028A	Qstd Intercept:	-0.00613
Serial#:	2978	Date Certified:	24-Oct-14

Calibration Information

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	7.25	1.831	52.0	52.07
2	5.75	1.631	47.0	47.06
3	4.55	1.452	42.0	42.06
4	3.45	1.265	37.0	37.05
5	2.70	1.119	33.0	33.05

Linear Regression

Slope:	26.8212
Intercept:	3.1112
Corr. Coeff:	0.9998
# of Observations:	5

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

Average I (chart):	36.0
Average Flow Calculation m3/min	
1.228929308	
Average Flow Calculation in CFM	
43.39349387	
Sample Time (Hrs):	24.0
Total Flow in m3/min	
1769.658204	
Total Flow in CFM	
62486.63118	

NOTE: Ensure calibration orifice has been certified within 12 months of use

Tisch Environmental 145 South Miami Ave, Cleves OH 45002 ● 877.263.7610 ● sales@tisch-env.com ● www.tisch-env.com

Calibrator Certificate

TISCH ENVIRONMENTAL, INC.
145 SOUTH MIAMI AVE
VILLAGE OF CLEVES, OH
45002
513.467.9000
877.263.7610 TOLL FREE
513.467.9009 FAX

TISCH Environmental

ORIFICE TRANSFER STANDARD CERTIFICATION WORKSHEET TE-5028A

Date - Oct 24, 2014 Rootsmeter S/N 9833620 Ta (K) - 296
Operator Tisch Orifice I.D. - 2978 Pa (mm) - 755.65

PLATE OR VDC #	VOLUME START (m3)	VOLUME STOP (m3)	DIFF VOLUME (m3)	DIFF TIME (min)	METER DIFF Hg (mm)	ORFICE DIFF H2O (in.)
1	NA	NA	1.00	1.1880	4.5	1.50
2	NA	NA	1.00	0.9230	7.5	2.50
3	NA	NA	1.00	0.8380	9.0	3.00
4	NA	NA	1.00	0.7790	10.5	3.50
5	NA	NA	1.00	0.5860	18.0	6.00

DATA TABULATION

Vstd	(x axis) Qstd	(y axis)		Va	(x axis) Qa	(y axis)
0.9950	0.8375	1.2254		0.9940	0.8367	0.7665
0.9910	1.0737	1.5819		0.9901	1.0727	0.9896
0.9891	1.1803	1.7329		0.9881	1.1791	1.0840
0.9871	1.2671	1.8718		0.9861	1.2659	1.1709
0.9771	1.6674	2.4507		0.9761	1.6657	1.5331
Qstd slope (m) =		1.47574		Qa slope (m) =		0.92408
intercept (b) =		-0.00613		intercept (b) =		-0.00383
coefficient (r) =		0.99985		coefficient (r) =		0.99985
y axis = SQRT[H2O(Pa/760)(298/Ta)]				y axis = SQRT[H2O(Ta/Pa)]		

CALCULATIONS

Vstd = Diff. Vol[(Pa-Diff. Hg)/760](298/Ta)
Qstd = Vstd/Time

Va = Diff Vol [(Pa-Diff Hg)/Pa]
Qa = Va/Time

For subsequent flow rate calculations:

Qstd = 1/m{[SQRT(H2O(Pa/760)(298/Ta))]- b}
Qa = 1/m{[SQRT H2O(Ta/Pa)]- b}