

ภาคผนวก จ

ใบรับรองการสอบเทียบเครื่องมือ

บริษัท ยูไนเต็ด แอนนาลิสต์ แอนด์
เอ็นจิเนียริง คอนซัลแตนท์ จำกัด

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E02NI85E15AC0GC
Cylinder Number: EB0062269
Laboratory: 124 - Riverton (SAP) - NJ
PGVP Number: B52018
Gas Code: O2,BALN

Customer PO Number: 5218002858
Reference Number: 82-401241461-1
Cylinder Volume: 145.7 CF
Cylinder Pressure: 2015 PSIG
Valve Outlet: 590
Certification Date: Jul 17, 2018

Expiration Date: Jul 17, 2026

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
OXYGEN	15.00 %	15.04 %	G1	+/- 0.6% NIST Traceable	07/17/2018
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	09061420	CC273671	22.53 % OXYGEN/NITROGEN	+/- 0.4%	Mar 08, 2019

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Horiba MPA 510-Q2-7TWMJ041	Paramagnetic	Jul 12, 2018

Triad Data Available Upon Request

NOTES:

NET QTY: 4878.4g
GROSS QTY: 27722.4g
PO# 5218002858

This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol, Document EPA-600/R-12/531. All testing processes and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2008 and relate only to items identified on this certificate. All values are certified to be NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.



TESTING CERT No. 3082.05

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E05NI83E15A000C
Cylinder Number: CC457499
Laboratory: 124 - Riverton (SAP) - NJ
PGVP Number: B52018
Gas Code: CO,CO2,NO,NOX,SO2,BALN

Reference Number: 82-401241460-1
Cylinder Volume: 153.9 CF
Cylinder Pressure: 2015 PSIG
Valve Outlet: 660
Certification Date: Jul 13, 2018

Expiration Date: Jul 13, 2026

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	400.0 PPM	400.6 PPM	G1	+/- 0.7% NIST Traceable	07/06/2018, 07/13/2018
NITRIC OXIDE	400.0 PPM	400.6 PPM	G1	+/- 0.6% NIST Traceable	07/06/2018, 07/13/2018
SULFUR DIOXIDE	400.0 PPM	411.4 PPM	G1	+/- 0.9% NIST Traceable	07/06/2018, 07/13/2018
CARBON MONOXIDE	800.0 PPM	783.1 PPM	G1	+/- 0.9% NIST Traceable	07/06/2018
CARBON DIOXIDE	16.00 %	16.09 %	G1	+/- 0.7% NIST Traceable	07/06/2018
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	15060430	CC450508	496.8 PPM NITRIC OXIDE/NITROGEN	+/- 0.5%	May 04, 2021
PRM	12368	5604119	29.86 PPM NITROGEN DIOXIDE/AIR	+/- 1.5%	Jun 02, 2017
GMIS	7042010104	CC503941	5.101 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Jun 01, 2020
NTRM	16060125	CC437415	515.2 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Nov 16, 2021
NTRM	14060142	CC436630	990.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Nov 18, 2018
NTRM	12061519	CC354776	19.87 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	Jan 11, 2024

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 AHR0801933 CO2	FTIR	Jun 21, 2018
Siemens Ultramat 6 J3-599 COLOW	NDIR	Jun 28, 2018
Nicolet 6700 AHR0801933 NO	FTIR	Jul 12, 2018
Nicolet 6700 AHR0801933 NO2	FTIR	Jul 12, 2018
Nicolet 6700 AHR0801933 SO2	FTIR	Jul 05, 2018

Triad Data Available Upon Request

NOTES: PO# 5218002858

Net weight: 12.1 lbs
Gross weight: 62.1 lbs

This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol, Document EPA-600/R-12/531. All testing processes and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2008 and relate only to items identified on this certificate. All values are certified to be NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.



TESTING CERT No. 3082.05

Envi Equipment Service Co., Ltd.

110/254 Moo 3, Tumbon Bang Rak Phatthana, Amphur Bang Bua Thong, Nonthaburi 11110

Tel. 098 362 9152, 089 478 7885

E-mail: sales@envi-ees.com

Certificate No. : E22-08034

Page : 1 of 6

CERTIFICATE OF CALIBRATION

Customer : United Analyst and Engineering Consultant Co., Ltd.

Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260

Description of Equipment : Console meter

Manufacturer : Apex Instrument

Model Number : XC-572-V

Serial Number : 1701018

ID./Control No. : -

Environment Conditions : Temperature (25 ± 2) °C
Humidity (50 ± 15) % RH

Cal. Date : 17/08/2022

Issue Date : 17/08/2022

Calibration Method or Calibration Procedure Used

US EPA Method (United State Environmental Protection Agency)

This certificate is traceable to national standard, which realize the units of measurement according to the International System of Units (IS).

Result of Calibration

This certificate may not be reproduced other than in full except with prior Written approval of the Technical Manager, Envi Equipment Service Company Limited.

These reported uncertainties of measurement are expanded by a coverage factor of k=2, providing a 95% confidence level

Calibrated by : Mr. Sanya Sangnil

Approved by : (Mr. Mana Fuekhud)
Technical Manager

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Certificate No. : E22-08034

Page : 2 of 6

METHOD 5 CONSOLE CALIBRATION USING REFERENCE WET GAS METER W-NK-2.5-B-Z No.547425 5-POINT METRIC UNIT

Meter Console Information		Calibration Conditions				Factors/Conversions		
Console Model Number	XC-572-V	Date	Time	17/08/2022	10:20 AM	Std Temp	293	K
Console Serial Number	1701018	Calibration Reference No.	E22-08034			Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure	755.99	mm Hg		K ₁	0.386	
DGM Serial Number	00002030	Calibration Meter Gamma	0.999			Console Leak Check	PASS	

Calibration Data									
Run Time	Metering Console					Calibration Meter			
	DGM Orifice	Volume	Volume	Outlet Temp Initial	Outlet Temp Final	Volume	Volume	Outlet Temp Initial	Outlet Temp Final
Elapsed	DH	Initial	Final			Initial	Final		
(Q)	(P _m)	(V _{mi})	(V _{mf})	(t _{mi})	(t _{mf})	(V _{wi})	(V _{wf})	(t _{wi})	(t _{wf})
min	mm H ₂ O	m ³	m ³	°C	°C	m ³	m ³	°C	°C
12.50	13.0	1910.8900	1911.0300	27	27	85.69988	85.84334	27	27
12.55	13.0	1911.0300	1911.1700	27	27	85.84334	85.98642	27	27
8.80	26.0	1911.1810	1911.3210	27	27	85.99774	86.14128	26	26
8.80	26.0	1911.3210	1911.4610	28	28	86.14128	86.28450	26	26
14.62	40.0	1911.4740	1911.7540	28	28	86.29780	86.58438	26	26
14.60	40.0	1911.7540	1912.0340	28	28	86.58438	86.86982	26	26
10.83	70.0	1912.0450	1912.3250	28	28	86.88092	87.16578	25	25
10.83	70.0	1912.3250	1912.6050	29	29	87.16578	87.45004	25	25
9.47	90.0	1912.6190	1912.8990	29	29	87.46412	87.74662	25	25
9.47	90.0	1912.8990	1913.1790	29	29	87.74662	88.02862	25	25



เอกสารไม่ควบคุม

Meter Console Information	
Console Model Number	XC-572-V
Console Serial Number	1701018
DGM Model Number	SK25EX
DGM Serial Number	00002030

Calibration Conditions			
Date	Time	17/08/2022	10:20 AM
Calibration Reference No.	E22-08034		
Barometric Pressure	755.99	mm Hg	
Calibration Meter Gamma	0.999		

Factors/Conversions		
Std Temp	293	K
Std Press	760	mm Hg
K ₁	0.386	
Console Leak Check	PASS	

Calibration Data								
Results								
Standardized Data				Dry Gas Meter				
Dry Gas Meter		Calibration Meter		Calibration Factor		Flowrate		Variation
(V _{m(Std)})	(Q _{m(Std)})	(V _{W(Std)})	(Q _{W(Std)})	Value	Variation	Std & Corr	.0212 m ³ /min	
m ³	m ³ /min	m ³	m ³ /min	(Y)	(ΔY)	(Q _{m(Std)(Corr)})	(ΔH _g)	(ΔH _g)
						m ³ /min	mm H ₂ O	
0.136	0.011	0.139	0.011	1.022	0.009	0.011	46.016	-1.144
0.136	0.011	0.139	0.011	1.020	0.007	0.011	46.632	-0.528
0.137	0.016	0.140	0.016	1.022	0.009	0.016	45.525	-1.635
0.137	0.016	0.139	0.016	1.019	0.006	0.016	45.728	-1.431
0.274	0.019	0.279	0.019	1.019	0.006	0.019	48.607	1.447
0.274	0.019	0.278	0.019	1.014	0.002	0.019	48.884	1.725
0.276	0.025	0.278	0.026	1.009	-0.003	0.026	47.409	0.249
0.276	0.025	0.278	0.026	1.007	-0.006	0.026	47.609	0.449
0.276	0.029	0.276	0.029	0.999	-0.014	0.029	47.509	0.349
0.276	0.029	0.276	0.029	0.997	-0.016	0.029	47.678	0.518
				1.013	Y Average		47.160	ΔH _g Average

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is ± 0.02 .
For ΔH_g , orifice pressure differential that equates to 0.75 cfm (0.0212 m³/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ± 0.2 inches (5.1mm) H₂O.



เอกสารไม่ควบคุม

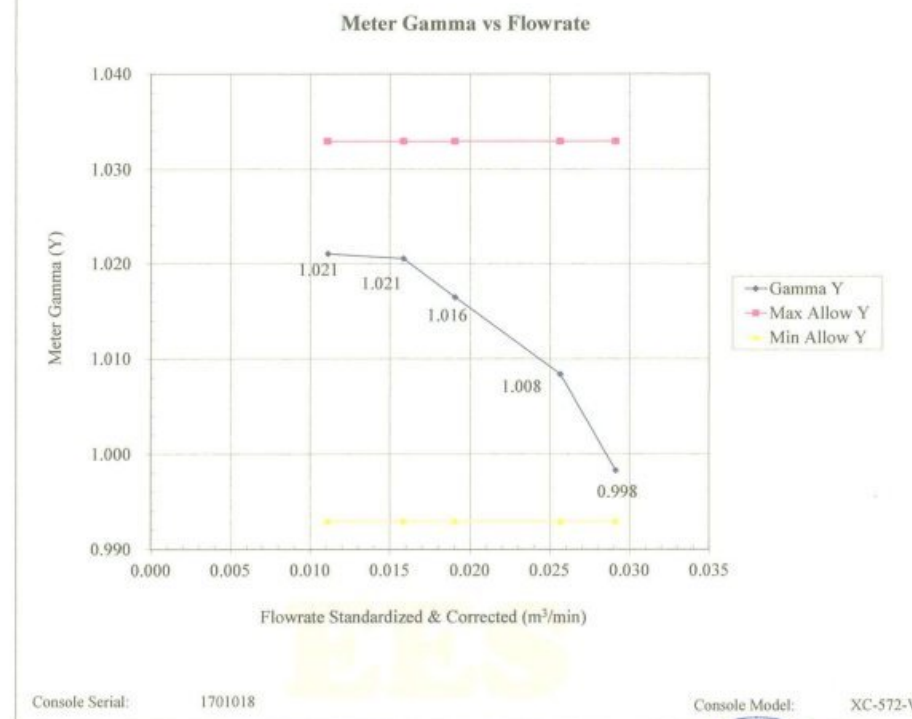
Meter Console Information	
Console Model Number	XC-572-V
Console Serial Number	1701018
DGM Model Number	SK25EX
DGM Serial Number	00002030

Calibration Conditions			
Date	Time	17/08/2022	10:20 AM
Calibration Reference No.	E22-08034		
Barometric Pressure	755.99	mm Hg	
Calibration Meter Gamma	0.999		

Factors/Conversions		
Std Temp	293	K
Std Press	760	mm Hg
K ₁	0.386	
Console Leak Check	PASS	

Calibration Date: 17-8-2022

Calibration Reference No: E22-08034



เอกสารไม่ควบคุม

Meter Console Information	
Console Model Number	XC-572-V
Console Serial Number	1701018
DGM Model Number	SK25EX
DGM Serial Number	00002030

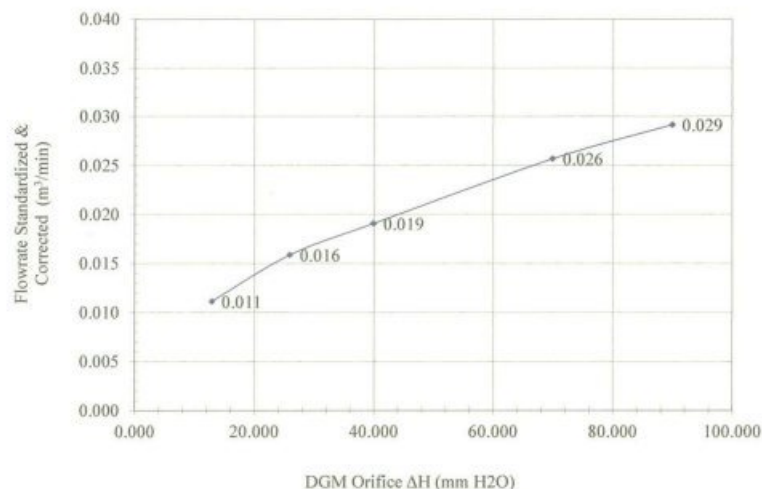
Calibration Conditions			
Date	Time	17/08/2022	10:20 AM
Calibration Reference No.	E22-08034		
Barometric Pressure	755.99	mm Hg	
Calibration Meter Gamma	0.999		

Factors/Conversions		
Std Temp	293	K
Std Press	760	mm Hg
K ₁	0.386	
Console Leak Check	PASS	

Calibration Date: 17-8-2022

Calibration Reference No: E22-08034

Meter Pressure vs Flowrate



Console Serial: 1701018

Console Model: XC-572-V



เอกสารไม่ควบคุม

THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information	
Console Model Number	XC-572-V
Console Serial Number	1701018
DGM Model Number	SK25EX
DGM Serial Number	00002030
Meter Box Model Number	JENCO 765 KF
Meter Box Serial Number	JC 16103

Calibration Conditions			
Date	Time	17/08/2022	12:40 PM
Calibration Reference No.	E22-08034		
Reference Thermometer	DIGICON		
Serial Number	183169105		

Results

Console Thermocouple Simulator											
Channel and test point	Meter Box Channel Temperature Reading (°C)										
	-18.0	25.0	38.0	93.0	149.0	260.0	371.0	482.0	593.0	816.0	1038.0
Stack	-17.0	23.0	36.0	92.0	148.0	257.0	370.0	480.0	591.0	813.0	1035.0
Aux	-17.0	23.0	36.0	92.0	148.0						
Probe	-17.0	23.0	36.0	92.0	148.0						
Filter	-16.0	23.0	36.0	92.0	148.0						
Oven	-17.0	23.0	36.0	92.0	148.0						
Exit	-16.0	23.0	36.0								

Tolerance Range

Stack	± 1.50%	Absolute	Meter	± 3.0 °C
Probe	± 3.0 °C		Exit	± 2.0 °C
Filter	± 3.0 °C			



Envir Equipment Service Co., Ltd.



เอกสารไม่ควบคุม

Envi Equipment Service Co., Ltd.

110/254 Moo 3, Tumbon Bang Rak Phatthana, Amphur Bang Bua Thong, Nonthaburi 11110

Tel. 098 362 9152, 089 478 7885

E-mail: sales@envi-ees.com

Certificate No. : E22-08034

Page : 1 of 6

CERTIFICATE OF CALIBRATION

Customer : United Analyst and Engineering Consultant Co., Ltd.

Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260

Description of Equipment : Console meter

Manufacturer : Apex Instrument

Model Number : XC-572-V

Serial Number : 1701018

ID./Control No. : -

Environment Conditions : Temperature (25 ± 2) °C
Humidity (50 ± 15) % RH

Cal. Date : 17/08/2022

Issue Date : 17/08/2022

Calibration Method or Calibration Procedure Used

US EPA Method (United State Environmental Protection Agency)

This certificate is traceable to national standard, which realize the units of measurement according to the International System of Units (IS).

Result of Calibration

This certificate may not be reproduced other than in full except with prior Written approval of the Technical Manager, Envi Equipment Service Company Limited.

These reported uncertainties of measurement are expanded by a coverage factor of k=2, providing a 95% confidence level

Calibrated by : Mr. Sanya Sangnil

Certificate No. : E22-08034

Page : 2 of 6

METHOD 5 CONSOLE CALIBRATION USING REFERENCE WET GAS METER W-NK-2.5-B-Z No.547425 5-POINT METRIC UNIT

Meter Console Information		Calibration Conditions				Factors/Conversions		
Console Model Number	XC-572-V	Date	Time	17/08/2022	10:20 AM	Std Temp	293	K
Console Serial Number	1701018	Calibration Reference No.	E22-08034			Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure	755.99	mm Hg		K ₁	0.386	
DGM Serial Number	00002030	Calibration Meter Gamma	0.999			Console Leak Check	PASS	

Calibration Data									
Run Time	Metering Console					Calibration Meter			
	DGM Orifice	Volume	Volume	Outlet Temp Initial	Outlet Temp Final	Volume	Volume	Outlet Temp Initial	Outlet Temp Final
Elapsed	DH	Initial	Final			Initial	Final		
(Q)	(P _m)	(V _m)	(V _m)	(t _m)	(t _m)	(V _w)	(V _w)	(t _w)	(t _w)
min	mm H ₂ O	m ³	m ³	°C	°C	m ³	m ³	°C	°C
12.50	13.0	1910.8900	1911.0300	27	27	85.69988	85.84334	27	27
12.55	13.0	1911.0300	1911.1700	27	27	85.84334	85.98642	27	27
8.80	26.0	1911.1810	1911.3210	27	27	85.99774	86.14128	26	26
8.80	26.0	1911.3210	1911.4610	28	28	86.14128	86.28450	26	26
14.62	40.0	1911.4740	1911.7540	28	28	86.29780	86.58438	26	26
14.60	40.0	1911.7540	1912.0340	28	28	86.58438	86.86982	26	26
10.83	70.0	1912.0450	1912.3250	28	28	86.88092	87.16578	25	25
10.83	70.0	1912.3250	1912.6050	29	29	87.16578	87.45004	25	25
9.47	90.0	1912.6190	1912.8990	29	29	87.46412	87.74662	25	25
9.47	90.0	1912.8990	1913.1790	29	29	87.74662	88.02862	25	25



เอกสารไม่ควบคุม

Meter Console Information	
Console Model Number	XC-572-V
Console Serial Number	1701018
DGM Model Number	SK25EX
DGM Serial Number	00002030

Calibration Conditions			
Date	Time	17/08/2022	10:20 AM
Calibration Reference No.	E22-08034		
Barometric Pressure	755.99	mm Hg	
Calibration Meter Gamma	0.999		

Factors/Conversions		
Std Temp	293	K
Std Press	760	mm Hg
K ₁	0.386	
Console Leak Check	PASS	

Calibration Data								
Results								
Standardized Data				Dry Gas Meter				
Dry Gas Meter		Calibration Meter		Calibration Factor		Flowrate		Variation
(V _{m(Std)})	(Q _{m(Std)})	(V _{W(Std)})	(Q _{W(Std)})	Value	Variation	Std & Corr	.0212 m ³ /min	
m ³	m ³ /min	m ³	m ³ /min	(Y)	(ΔY)	(Q _{m(Std)(Corr)})	(ΔH _g)	(ΔH _g)
						m ³ /min	mm H ₂ O	
0.136	0.011	0.139	0.011	1.022	0.009	0.011	46.016	-1.144
0.136	0.011	0.139	0.011	1.020	0.007	0.011	46.632	-0.528
0.137	0.016	0.140	0.016	1.022	0.009	0.016	45.525	-1.635
0.137	0.016	0.139	0.016	1.019	0.006	0.016	45.728	-1.431
0.274	0.019	0.279	0.019	1.019	0.006	0.019	48.607	1.447
0.274	0.019	0.278	0.019	1.014	0.002	0.019	48.884	1.725
0.276	0.025	0.278	0.026	1.009	-0.003	0.026	47.409	0.249
0.276	0.025	0.278	0.026	1.007	-0.006	0.026	47.609	0.449
0.276	0.029	0.276	0.029	0.999	-0.014	0.029	47.509	0.349
0.276	0.029	0.276	0.029	0.997	-0.016	0.029	47.678	0.518
				1.013	Y Average			ΔH _g Average
								47.160

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is ± 0.02 .
For ΔH_g , orifice pressure differential that equates to 0.75 cfm (0.0212 m³/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ± 0.2 inches (5.1mm) H₂O.



เอกสารไม่ควบคุม

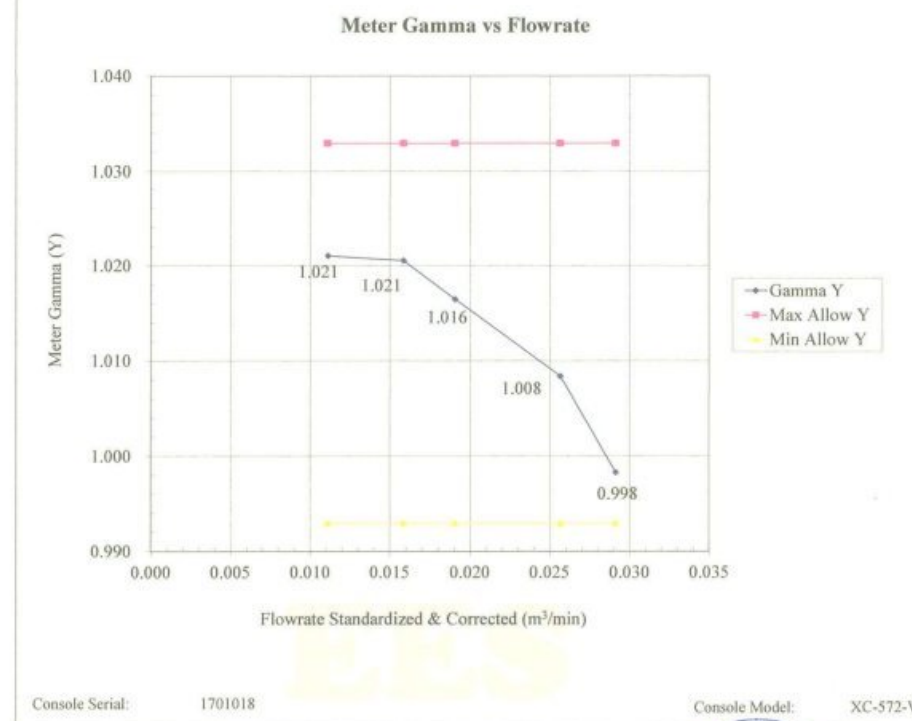
Meter Console Information	
Console Model Number	XC-572-V
Console Serial Number	1701018
DGM Model Number	SK25EX
DGM Serial Number	00002030

Calibration Conditions			
Date	Time	17/08/2022	10:20 AM
Calibration Reference No.	E22-08034		
Barometric Pressure	755.99	mm Hg	
Calibration Meter Gamma	0.999		

Factors/Conversions		
Std Temp	293	K
Std Press	760	mm Hg
K ₁	0.386	
Console Leak Check	PASS	

Calibration Date: 17-8-2022

Calibration Reference No: E22-08034



เอกสารไม่ควบคุม

Meter Console Information	
Console Model Number	XC-572-V
Console Serial Number	1701018
DGM Model Number	SK25EX
DGM Serial Number	00002030

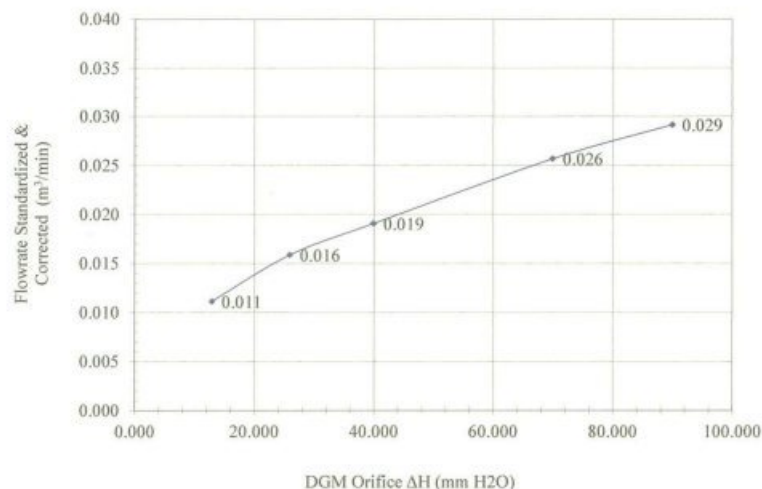
Calibration Conditions			
Date	Time	17/08/2022	10:20 AM
Calibration Reference No.	E22-08034		
Barometric Pressure	755.99	mm Hg	
Calibration Meter Gamma	0.999		

Factors/Conversions		
Std Temp	293	K
Std Press	760	mm Hg
K ₁	0.386	
Console Leak Check	PASS	

Calibration Date: 17-8-2022

Calibration Reference No: E22-08034

Meter Pressure vs Flowrate



Console Serial: 1701018

Console Model: XC-572-V



เอกสารไม่ควบคุม

THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information	
Console Model Number	XC-572-V
Console Serial Number	1701018
DGM Model Number	SK25EX
DGM Serial Number	00002030
Meter Box Model Number	JENCO 765 KF
Meter Box Serial Number	JC 16103

Calibration Conditions			
Date	Time	17/08/2022	12:40 PM
Calibration Reference No.	E22-08034		
Reference Thermometer	DIGICON		
Serial Number	183169105		

Results

Console Thermocouple Simulator											
Channel and test point	Meter Box Channel Temperature Reading (°C)										
	-18.0	25.0	38.0	93.0	149.0	260.0	371.0	482.0	593.0	816.0	1038.0
Stack	-17.0	23.0	36.0	92.0	148.0	257.0	370.0	480.0	591.0	813.0	1035.0
Aux	-17.0	23.0	36.0	92.0	148.0						
Probe	-17.0	23.0	36.0	92.0	148.0						
Filter	-16.0	23.0	36.0	92.0	148.0						
Oven	-17.0	23.0	36.0	92.0	148.0						
Exit	-16.0	23.0	36.0								

Tolerance Range

Stack	± 1.50%	Absolute	Meter	± 3.0 °C
Probe	± 3.0 °C		Exit	± 2.0 °C
Filter	± 3.0 °C			



Envir Equipment Service Co., Ltd.



เอกสารไม่ควบคุม

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Customer: PO# 5218004553
Part Number: E05NI83E15A000C
Cylinder Number: CC155784
Laboratory: 124 - Riverton (SAP) - NJ
PGVP Number: B52018
Gas Code: CO,CO2,NO,NOX,SO2,BALN

Reference Number: 82-401312964-1
Cylinder Volume: 153.9 Cubic Feet
Cylinder Pressure: 2015 PSIG
Valve Outlet: 660
Certification Date: Nov 01, 2018

Expiration Date: Nov 01, 2026

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	400.0 PPM	400.9 PPM	G1	+/- 0.6% NIST Traceable	10/17/2018, 11/01/2018
NITRIC OXIDE	400.0 PPM	400.9 PPM	G1	+/- 0.6% NIST Traceable	10/17/2018, 11/01/2018
SULFUR DIOXIDE	400.0 PPM	403.8 PPM	G1	+/- 0.7% NIST Traceable	10/17/2018, 11/01/2018
CARBON MONOXIDE	800.0 PPM	788.9 PPM	G1	+/- 1.0% NIST Traceable	10/29/2018
CARBON DIOXIDE	16.00 %	16.07 %	G1	+/- 0.7% NIST Traceable	10/29/2018
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	15010127	KAL004357	494.6 PPM NITRIC OXIDE/NITROGEN	+/- 0.5%	Sep 01, 2021
PRM	12368	5604119	28.86 PPM NITROGEN DIOXIDE/AIR	+/- 1.5%	Jun 02, 2017
GMIS	7042010104	CC503941	5.101 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Jun 01, 2020
NTRM	16060125	CC437415	515.2 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Nov 16, 2021
NTRM	11010354	KAL004922	968.8 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	May 30, 2023
NTRM	14060142	CC436630	990.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.8%	Nov 18, 2018
NTRM	12061545	CC354843	19.87 % CARBON DIOXIDE/NITROGEN	+/- 0.8%	Jan 11, 2024

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Horiba VIA 510-CO2-19GYC XEG	NDIR	Oct 05, 2018
Siemens Ultramat 6 J3-599 COHIGH	NDIR	Oct 19, 2018
Nicolet 6700 AHR0801933 NO	FTIR	Oct 04, 2018
Nicolet 6700 AHR0801933 NO2	FTIR	Oct 04, 2018
Nicolet 6700 AHR0801933 SO2	FTIR	Oct 26, 2018

Triad Data Available Upon Request

NOTES:

Gross Weight: 62.12lbs

Net Weight: 12.14lbs

This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol, Document EPA-600/R-12/531. All testing processes and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2008 and relate only to items identified on this certificate. All values are certified to be NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.



CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E02NI99E15AC5X1
Cylinder Number: CC728570
Laboratory: 124 - Plumsteadville - PA
PGVP Number: A12019
Gas Code: SO2,BALN

Reference Number: 160-401554748-1
Cylinder Volume: 144.4 CF
Cylinder Pressure: 2015 PSIG
Valve Outlet: 660
Certification Date: Aug 15, 2019

Expiration Date: Aug 15, 2027

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
SULFUR DIOXIDE	50.00 PPM	50.14 PPM	G1	+/- 1.0% NIST Traceable	08/08/2019, 08/15/2019
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	04170911	KAL003197	49.67 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Jun 20, 2022

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
MKS FTIR - SO2 - 000928781	FTIR	Aug 08, 2019

Triad Data Available Upon Request

NOTES: Gross Weight: 28.9 Kg, Net Weight: 4.7 Kg.

PO#5219003302



CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E02NI99E15A0032 Reference Number: 160-401554617-1
Cylinder Number: EB0129049 Cylinder Volume: 144.4 CF
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2015 PSIG
PGVP Number: A12019 Valve Outlet: 660
Gas Code: SO2,BALN Certification Date: Aug 14, 2019

Expiration Date: Aug 14, 2027

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
SULFUR DIOXIDE	100.0 PPM	98.88 PPM	G1	+/- 0.8% NIST Traceable	08/07/2019, 08/14/2019
NITROGEN	Balance				
CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	16010235	KAL004419	97.69 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Dec 23, 2021
ANALYTICAL EQUIPMENT					
Instrument/Make/Model		Analytical Principle		Last Multipoint Calibration	
MKS FTIR - SO2 - 000928781		FTIR		Aug 08, 2019	

Triad Data Available Upon Request

NOTES: Gross Weight: 28.9 Kg, Net Weight: 4.7 Kg, PO# 5219003302.



CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04NI99E15A012C Reference Number: 160-401560382-1
Cylinder Number: CC452945 Cylinder Volume: 144.4 Cubic Feet
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2015 PSIG
PGVP Number: A12019 Valve Outlet: 660
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Aug 21, 2019

Expiration Date: Aug 21, 2027

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	100.0 PPM	99.99 PPM	G1	+/- 0.5% NIST Traceable	08/14/2019, 08/21/2019
NITRIC OXIDE	100.0 PPM	99.99 PPM	G1	+/- 0.5% NIST Traceable	08/14/2019, 08/21/2019
CARBON MONOXIDE	200.0 PPM	200.7 PPM	G1	+/- 0.3% NIST Traceable	08/14/2019
SULFUR DIOXIDE	200.0 PPM	199.8 PPM	G1	+/- 0.8% NIST Traceable	08/14/2019, 08/21/2019
NITROGEN	Balance				
CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	18060121	KAL004215	249.9 PPM NITRIC OXIDE/NITROGEN	+/- 0.4%	Nov 08, 2023
NTRM	18060121	KAL004215	250.0 PPM NOx/NITROGEN	+/- 0.4%	Nov 08, 2023
NTRM	04060315	CC432079	252.5 PPM CARBON MONOXIDE/NITROGEN	+/- 0.3%	Feb 21, 2020
NTRM	10010228	AAL072956	255.3 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Apr 25, 2022
ANALYTICAL EQUIPMENT					
Instrument/Make/Model		Analytical Principle		Last Multipoint Calibration	
MKS FTIR - CO - 000928781		FTIR		Aug 02, 2019	
MKS FTIR - NO - 000928781		FTIR		Aug 22, 2019	
MKS FTIR - NOx - 000928781		FTIR		Aug 22, 2019	
MKS FTIR - SO2 - 000928781		FTIR		Aug 08, 2019	

Triad Data Available Upon Request

NOTES: Gross Weight: 28.9 Kg, Net Weight: 4.7 Kg, PO# 5219003302.



CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E05NI91E15A0012 Reference Number: 82-401427551-1
Cylinder Number: CC715530 Cylinder Volume: 148.7 CF
Laboratory: 124 - Riverton (SAP) - NJ Cylinder Pressure: 2015 PSIG
PGVP Number: B52019 Valve Outlet: 660
Gas Code: CO₂, CO, NO, NO_x, SO₂, BALN Certification Date: Feb 27, 2019

Expiration Date: Feb 27, 2027

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NO _x	200.0 PPM	200.9 PPM	G1	+/- 0.6% NIST Traceable	02/19/2019, 02/27/2019
NITRIC OXIDE	200.0 PPM	200.9 PPM	G1	+/- 0.6% NIST Traceable	02/19/2019, 02/27/2019
CARBON MONOXIDE	400.0 PPM	398.8 PPM	G1	+/- 0.7% NIST Traceable	02/21/2019
SULFUR DIOXIDE	400.0 PPM	407.2 PPM	G1	+/- 0.9% NIST Traceable	02/19/2019, 02/27/2019
CARBON DIOXIDE	8.000 %	8.047 %	G1	+/- 1.0% NIST Traceable	02/19/2019
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	18060127	KAL004259	249.9 PPM NITRIC OXIDE/NITROGEN	+/- 0.4%	Nov 08, 2023
PRM	12367	APEX1099237	9.82 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Jun 02, 2017
GMIS	1114201601	CC506710	4.971 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Nov 14, 2019
NTRM	15060538	CC453507	491.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jan 08, 2021
NTRM	15060620	CC450449	248.1 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.6%	Dec 17, 2020
NTRM	07120707	CC214655	6.986 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	Mar 30, 2023

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 AHR0801933 CO ₂	FTIR	Feb 07, 2019
Siemens Ultramat 6 J3-599 COLOW	NDIR	Feb 19, 2019
Nicolet 6700 AHR0801933 NO	FTIR	Feb 01, 2019
Nicolet 6700 AHR0801933 NO ₂	FTIR	Feb 01, 2019
Nicolet 6700 AHR0801933 SO ₂	FTIR	Feb 14, 2019

Triad Data Available Upon Request

NOTES:

Gross Weight: 27854.4 grams

Net Weight: 5100.2 grams

PO# 5219000697

This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol, Document EPA-600/R-12/531. All testing processes and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2008 and relate only to items identified on this certificate. All values are certified to be NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.



TESTING CERT No. 3082.05

เอกสารไม่ควบคุม

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E05NI83E15A0004 Reference Number: 82-401427550-1
Cylinder Number: CC715540 Cylinder Volume: 154.0 CF
Laboratory: 124 - Riverton (SAP) - NJ Cylinder Pressure: 2015 PSIG
PGVP Number: B52019 Valve Outlet: 660
Gas Code: CO₂, CO, NO, NO_x, SO₂, BALN Certification Date: Feb 27, 2019

Expiration Date: Feb 27, 2027

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NO _x	400.0 PPM	405.0 PPM	G1	+/- 0.7% NIST Traceable	02/19/2019, 02/27/2019
NITRIC OXIDE	400.0 PPM	405.0 PPM	G1	+/- 0.7% NIST Traceable	02/19/2019, 02/27/2019
CARBON MONOXIDE	800.0 PPM	794.4 PPM	G1	+/- 0.7% NIST Traceable	02/21/2019
SULFUR DIOXIDE	900.0 PPM	913.4 PPM	G1	+/- 0.7% NIST Traceable	02/19/2019, 02/27/2019
CARBON DIOXIDE	16.00 %	16.09 %	G1	+/- 0.8% NIST Traceable	02/19/2019
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	15010127	KAL004357	494.6 PPM NITRIC OXIDE/NITROGEN	+/- 0.5%	Sep 01, 2021
PRM	12367	APEX1099237	9.82 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Jun 02, 2017
GMIS	1114201601	CC506710	4.971 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Nov 14, 2019
NTRM	14060148	CC436850	990.8 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Nov 18, 2019
NTRM	11010354	KAL004922	968.8 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.6%	May 30, 2023
NTRM	12061504	CC354684	19.87 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	Jan 11, 2024

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 AHR0801933 CO ₂	FTIR	Feb 07, 2019
Siemens Ultramat 6 J3-599 COLOW	NDIR	Feb 19, 2019
Nicolet 6700 AHR0801933 NO	FTIR	Feb 01, 2019
Nicolet 6700 AHR0801933 NO ₂	FTIR	Feb 01, 2019
Nicolet 6700 AHR0801933 SO ₂	FTIR	Feb 14, 2019

Triad Data Available Upon Request

NOTES:

Gross Weight: 28291.4 grams

Net Weight: 5516.6 grams

PO# 5219000697

This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol, Document EPA-600/R-12/531. All testing processes and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2008 and relate only to items identified on this certificate. All values are certified to be NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.



TESTING CERT No. 3082.05

เอกสารไม่ควบคุม

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E02NI85E15A3432 Reference Number: 82-401312965-1
Cylinder Number: CC719418 Cylinder Volume: 145.7 CF
Laboratory: 124 - Riverton (SAP) - NJ Cylinder Pressure: 2015 PSIG
PGVP Number: B52018 Valve Outlet: 590
Gas Code: O2,BALN Certification Date: Oct 15, 2018

Expiration Date: Oct 15, 2026

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
OXYGEN	15.00 %	15.07 %	G1	+/- 0.6% NIST Traceable	10/15/2018
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	09061420	CC273671	22.53 % OXYGEN/NITROGEN	+/- 0.4%	Mar 08, 2019

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Horiba MPA 510-O2-7TWMJ041	Paramagnetic	Oct 05, 2018

Triad Data Available Upon Request

NOTES:

Gross Weight: 60.8 lbs.

Net Weight: 11.3 lbs.

PO#5218004553

This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol, Document EPA-600/R-12/531. All testing processes and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2008 and relate only to items identified on this certificate. All values are certified to be NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.



TESTING CERT No. 3082.05

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E02NI93E15A1594 Reference Number: 82-401427559-1
Cylinder Number: EB0125052 Cylinder Volume: 145.0 CF
Laboratory: 124 - Riverton (SAP) - NJ Cylinder Pressure: 2015 PSIG
PGVP Number: B52019 Valve Outlet: 590
Gas Code: O2,BALN Certification Date: Feb 20, 2019

Expiration Date: Feb 20, 2027

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
OXYGEN	7.000 %	7.028 %	G1	+/- 0.4% NIST Traceable	02/20/2019
NITROGEN	Balance				
CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	09060236	CC263114	9.961 % OXYGEN/NITROGEN	+/- 0.3%	Nov 05, 2024
ANALYTICAL EQUIPMENT					
Instrument/Make/Model	Analytical Principle		Last Multipoint Calibration		
Horiba MPA 510-O2-TTWMJ041	Paramagnetic		Feb 04, 2019		

Triad Data Available Upon Request

NOTES:

Gross Weight: 27864.2 grams

Net Weight: 4802.6 grams

PO# 5219000697

This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol, Document EPA-600/R-12/531. All testing processes and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2008 and relate only to items identified on this certificate. All values are certified to be NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.



TESTING CERT No. 3082.05

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E02NI93E15A1594 Reference Number: 82-401427559-1
Cylinder Number: EB0125062 Cylinder Volume: 145.0 CF
Laboratory: 124 - Riverton (SAP) - NJ Cylinder Pressure: 2015 PSIG
PGVP Number: B52019 Valve Outlet: 590
Gas Code: O2,BALN Certification Date: Feb 20, 2019

Expiration Date: Feb 20, 2027

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
OXYGEN	7.000 %	7.038 %	G1	+/- 0.4% NIST Traceable	02/20/2019
NITROGEN	Balance				
CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	09060236	CC263114	9.961 % OXYGEN/NITROGEN	+/- 0.3%	Nov 05, 2024
ANALYTICAL EQUIPMENT					
Instrument/Make/Model	Analytical Principle		Last Multipoint Calibration		
Horiba MPA 510-O2-TTWMJ041	Paramagnetic		Feb 04, 2019		

Triad Data Available Upon Request

NOTES:

Gross Weight: 27864.2 grams

Net Weight: 4802.6 grams

PO# 5219000697

This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol, Document EPA-600/R-12/531. All testing processes and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2008 and relate only to items identified on this certificate. All values are certified to be NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.




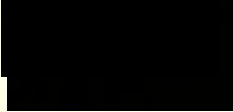
TESTING CERT No. 3082.05



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3 : EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000 FAX. 0-2719-9484

Cert.No.: 22TW120
Page.: 1 of 2

Certificate of Testing

Equipment : DO Meter
Manufacturer : Horiba
Model : LAQUA-DO210
Serial No. : HE9M0048
ID No. : UAE.EFM.18/2563(ENV.DO.07/63)
Received Date : 10 May 2022
Test Date : 24 May 2022
Reference : 2205-0278WSC-2
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong, Bangkok 10260
Laboratory Condition : Temperature (25 ± 5) °C
Humidity (50 ± 20) %
Test Procedure : In - house method : CP-CH9
by Comparison Technique with Azide Modification Method
Tested by : 
Approved by : 
(/) Malee Butkruea
() Saithip Meangmai
() Warakorn Lernagatrakul
Issue Date : 30 May 2022

เอกสารไม่ควบคุม
B 0268920



Cert.No.: 22TW120
Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :

This certification is traceable to the International System of Unit through the reference standards laboratory of Industrial Calibration Center, Technology Promotion Association (Thailand-Japan).

Instruments	Serial No.	ID No.	Certificate No.	Due Date
1) Burette	-	130BU10	21CG1389	25 Mar 2023
2) Balance	1126143764	140RC004	21MM430	21 Sep 2022

2. Standard Material :-

Material	Manufacturer	Lot.No.	Assay
Sodium Thiosulfate pentahydrate	Merck	AM1763316	100.2%

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 9K2B0030

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.12	8.13	0.013

This report was certified only for the instrument we tested. It is allowable to use for study the system efficiency. The environmental impact control and present to organization it may concerned. Intend to use for advertising and referral purpose is prohibited. This report may not be reproduced other in full, without written approval of the laboratory

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 22LM81
Page.: 1 of 2

Certificate of Calibration

Equipment : DO Meter with Sensor
Manufacturer : Horiba
Model : LAQUA-DO210
Serial No. : HE9M0048
ID No. : UAE.EFM.117/2563 (ENV.D0.07/63)
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : TPA On Site Calibration Laboratory
Received Order : 10 May 2022
Calibrated Date : 24 May 2022
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V

Calibrated by :

Approved by :

() Pornthippa Tameyaku
(/) Malee Butkruea
() Suwit Imjai

Issue Date : 26 May 2022

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced other than in full, except with the prior written
Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

เอกสารไม่ควบคุม
A 0053956



Equipment : DO Meter with Sensor
Condition As-Received : Used Item
Reference : 2205-0278WSC-3
Procedure Used :-

Cert. No.: 22LM81
Page.: 2 of 2

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Digital Thermometer	1523	2188080	2111273	22 Nov 2022

2. This certificate is valid only to the item calibrated on date and place of calibration.

3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 9K2B0030

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
25.00	80	24.998	25.0	0.002	0.16	2.00
30.00	80	30.002	30.0	-0.002	0.16	2.00
35.00	80	35.003	35.0	-0.003	0.16	2.00

UUC* : Unit Under Calibration

The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor *k*, providing a level of confidence of approximately 95 %.

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Malee

เอกสารไม่ควบคุม
A 111213

บริษัท อินทิเกรทเต็ด รีเสิร์ช เซ็นเตอร์ จำกัด

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0155

MTC No. EEL. BP. 21/1264

CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited

Address : 122 Moo 2, T.Thatoom, A.Srimahaphote, Prachinburi 25140.

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Integrating Sound Level Meter

Manufacturer : ACO

Model : 6236

Serial No. : 192015

Microphone : Type 7052NR No.73304

Preamplifier : -

Ambient Environment

Temperature : $(23 \pm 3) ^\circ\text{C}$ Relative Humidity : $(50 \pm 15) \%$ Ambient Pressure : $(101.325 \pm 1.5) \text{ kPa}$

Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Pistonphone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 3 Dec. 2021

Date of Calibration : 10-11 Jan. 2022

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FM.BL.MTC.002 Rev.4

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Request No. 21-65/0155

MTC No. EEL. BP. 21/1264

9. Power Amplifier Brüel&Kjær 2706 S/N 1517650.

10. Speaker Tannoy Limited, Great Britain British Patent No. 215300.

11. Digital Multimeter Agilent 34401A S/N MY44005560.

12. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2006). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

This instrument has been calibrated against standards maintained at the Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

The reported expanded uncertainty is based upon a standard uncertainty multiplied by a coverage factor $k=2$, providing a level of confidence of approximately 95%.

Date of Calibration : 10-11 Jan. 2022

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Request No. 21-65/0155

MTC No. EEL. BP. 21/1264

1. Absolute Sensitivity

Reference	Unit Under Test				Tolerance
Acoustic Signal (dB)	Measured Value (dB)		Deviation	Uncertainty	Limit Class 2 (+dB)
	Before adjust	After adjust	(dB)	(+dB)	
113.96	113.0	114.0	0.0	0.30	1.4

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 115.3 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)
16.8	0.10

2.2 The microphone of the sound level meter was replaced by electrical signal input device

Frequency Weighting	Measured Value (dB)	Uncertainty (±dB)
A-Weighting	14.8	0.10
C-Weighting	21.1	0.10
Flat	25.7	0.10

Date of Calibration : 10-11 Jan. 2022

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Request No. 21-65/0155

MTC No. EEL. BP. 21/1264

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
125	0.2	0.1	0.1	0.40	2.0
1 000	-0.8	-0.7	-0.7	0.40	1.4
4 000	-0.1	-0.1	0.3	0.40	3.6

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
63	0.2	0.0	0.0	0.20	2.5
125	0.0	0.1	0.1	0.20	2.0
250	0.0	0.0	0.0	0.20	1.9
500	0.0	0.0	0.0	0.20	1.9
1 000	0.0	0.0	0.0	0.20	1.4
2 000	-0.2	0.0	0.0	0.20	2.6
4 000	-0.5	-0.3	0.0	0.20	3.6
8 000	-0.6	-0.5	-0.1	0.20	5.6

Date of Calibration : 10-11 Jan. 2022

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Request No. 21-65/0155

MTC No. EEL. BP. 21/1264

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (+dB)	Tolerance Limits Class 2 (+dB)
A-weighting	94.0	0.0	0.20	0.4
C-weighting	94.0	0.0	0.20	0.4
Flat	94.1	0.1	0.20	0.4

5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (+dB)	Tolerance Limits Class 2 (+dB)
Fast	94.0	0.0	0.20	0.3
Slow	94.0	0.0	0.20	0.3
Leq	94.0	0.0	0.20	0.3

6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (+dB)	Tolerance Limits Class 2 (+dB)
122	122.1	0.1	0.30	1.4
121	121.1	0.1	0.30	1.4
120	120.0	0.0	0.30	1.4
119	119.0	0.0	0.30	1.4
114	114.0	0.0	0.30	1.4
109	108.9	-0.1	0.30	1.4
104	104.0	0.0	0.30	1.4
99	99.0	0.0	0.30	1.4

Date of Calibration : 10-11 Jan. 2022

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6. Level linearity on the reference level range (cont.)

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (+dB)	Tolerance Limits Class 2 (+dB)
94	94.0	0.0	0.30	1.4
89	89.0	0.0	0.30	1.4
84	83.9	-0.1	0.30	1.4
79	78.9	-0.1	0.30	1.4
74	74.2	0.2	0.30	1.4
69	69.2	0.2	0.30	1.4
64	64.1	0.1	0.30	1.4
59	59.0	0.0	0.30	1.4
54	54.1	0.1	0.30	1.4
49	49.1	0.1	0.30	1.4
44	44.1	0.1	0.30	1.4
39	39.0	0.0	0.30	1.4
34	34.2	0.2	0.30	1.4
33	33.2	0.2	0.30	1.4
32	32.3	0.3	0.30	1.4
31	31.3	0.3	0.30	1.4
30	30.4	0.4	0.30	1.4

Date of Calibration : 10-11 Jan. 2022

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Request No. 21-65/0155

MTC No. EEL. BP. 21/1264

7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (+dB)	Tolerance Limits Class 2 (+dB)
40-130	125	125.1	0.1	0.30	1.4
30-120	115	115.0	0.0	0.30	1.4
20-110	105	105.0	0.0	0.30	1.4
20-100	95	95.0	0.0	0.30	1.4
20-90	85	85.0	0.0	0.30	1.4
20-80	75	75.0	0.0	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (+dB)	Tolerance Limits Class 2 (dB)
Fast	200	115.7	-0.3	0.20	± 1.3
	2	98.8	-0.2	0.20	+1.3; -2.8
	0.25	88.3	-1.7	0.20	+1.8; -5.3
Slow	200	109.4	-0.2	0.20	± 1.3
	2	89.8	-0.2	0.20	+1.3; -5.3
SEL	200	109.9	-0.1	0.20	± 1.3
	2	90.0	0.0	0.20	+1.3; -2.8
	0.25	80.9	-0.1	0.20	+1.8; -5.3

Date of Calibration : 10-11 Jan. 2022

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9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (+dB)	Tolerance limits Class 2 (+dB)
Complete cycle	125.4	125.8	0.4	0.20	2.4
Positive half cycle	124.4	124.3	-0.1	0.20	1.4
Negative half cycle	124.4	124.3	-0.1	0.20	1.4

10. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (+dB)	Tolerance Limits Class 2 (+dB)
Positive one-half cycle	Negative one-half cycle			
133.1	133.1	0.0	0.30	1.8

Calibration

Approval

Date of

Electrical

Indication

Laboratory

Centre

Date of Issue : 12 Jan. 2022

Ref: 2011264120305034012

End of Certificate

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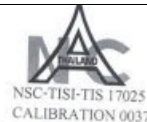
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MTC No. EEL. BP. 17/1264

CALIBRATION CERTIFICATE

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Address : 122 Moo 2, T.Thatoom, A.Srimahaphote, Prachinburi 25140

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Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

Instrument Calibrated :

Ambient Environment

Description : Sound Level Meter

Temperature : $(23 \pm 3) ^\circ\text{C}$

Manufacturer : Delta OHM

Relative Humidity : $(50 \pm 15) \%$

Model : HD 2010UC

Ambient Pressure : $(101.325 \pm 1.5) \text{ kPa}$

Serial No. : 11040842479

Microphone : Type UC-52 No.114674

Preamplifier : Delta Type HD2010PNE2 No.11001018

Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Pistonphone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 3 Dec. 2021

Date of Calibration : 17 Jan. 2022

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The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

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1. Absolute Sensitivity

1. Absolute Sensitivity					
Reference	Unit Under Test				Tolerance
Acoustic Signal (dB)	Measured Value (dB)		Deviation (dB)	Uncertainty (±dB)	Limit Class 2 (±dB)
	Before adjust	After adjust			
113.94	113.8	113.9	0.0	0.30	1.4

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 114.0 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)
23.5	0.10

2.2 The microphone of the sound level meter was replaced by electrical signal input device

Frequency Weighting	Measured Value (dB)	Uncertainty (±dB)
A-Weighting	19.5	0.10
C-Weighting	25.2	0.10
Flat	27.3	0.10

Date of Calibration : 17 Jan. 2022

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting	C-weighting	Flat		
	(dB)	(dB)	(dB)		
125	0.3	0.3	0.2	0.40	2.0
1 000	-0.8	-0.8	-0.8	0.40	1.4
4 000	-0.1	0.0	-0.1	0.40	3.6

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting	C-weighting	Flat		
	(dB)	(dB)	(dB)		
63	0.1	-0.1	-0.3	0.20	2.5
125	0.1	0.0	-0.1	0.20	2.0
250	0.1	0.0	-0.1	0.20	1.9
500	0.0	0.0	0.0	0.20	1.9
1 000	0.0	0.0	0.0	0.20	1.4
2 000	-0.1	0.1	-0.1	0.20	2.6
4 000	0.0	0.2	-0.4	0.20	3.6
8 000	0.0	0.1	-0.8	0.20	5.6

Date of Calibration : 17 Jan. 2022

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Request No. 21-65/0155

MTC No. EEL. BP. 17/1264

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
A-weighting	94.0	0.0	0.20	0.4
C-weighting	94.0	0.0	0.20	0.4
Flat	94.0	0.0	0.20	0.4

5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
Fast	94.0	0.0	0.20	0.3
Slow	94.0	0.0	0.20	0.3
Leq	94.0	0.0	0.20	0.3

6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
120	119.9	-0.1	0.30	1.4
119	119.0	0.0	0.30	1.4
114	114.0	0.0	0.30	1.4
109	109.0	0.0	0.30	1.4
104	104.0	0.0	0.30	1.4
99	98.9	-0.1	0.30	1.4
94	94.0	0.0	0.30	1.4
89	88.9	-0.1	0.30	1.4
84	84.0	0.0	0.30	1.4

Date of Calibration : 17 Jan. 2022

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Request No. 21-65/0155

MTC No. EEL. BP. 17/1264

6. Level linearity on the reference level range (cont.)

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
79	79.0	0.0	0.30	1.4
74	73.9	-0.1	0.30	1.4
69	68.9	-0.1	0.30	1.4
64	63.9	-0.1	0.30	1.4
59	58.9	-0.1	0.30	1.4
54	53.9	-0.1	0.30	1.4
49	48.9	-0.1	0.30	1.4
44	43.9	-0.1	0.30	1.4
43	43.0	0.0	0.30	1.4
42	41.9	-0.1	0.30	1.4
41	41.0	0.0	0.30	1.4
40	39.9	-0.1	0.30	1.4
39	38.9	-0.1	0.30	1.4

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7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
60-140	135	135.2	0.2	0.30	1.4
50-130	125	125.1	0.1	0.30	1.4
40-120	115	115.0	0.0	0.30	1.4
30-110	105	105.0	0.0	0.30	1.4
20-100	95	94.9	-0.1	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (dB)
Fast	200	115.9	-0.1	0.20	±1.3
	2	98.8	-0.2	0.20	+1.3; -2.8
	0.25	89.7	-0.3	0.20	+1.8; -5.3
Slow	200	109.4	-0.2	0.20	±1.3
	2	89.6	-0.4	0.20	+1.3; -5.3
SEL	200	110.0	0.0	0.20	±1.3
	2	89.9	-0.1	0.20	+1.3; -2.8
	0.25	80.8	-0.2	0.20	+1.8; -5.3

Date of Calibration : 17 Jan. 2022

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9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (±dB)	Tolerance limits Class 2 (±dB)
Complete cycle	135.4	135.3	-0.1	0.20	2.4
Positive half cycle	134.4	134.2	-0.2	0.20	1.4
Negative half cycle	134.4	134.2	-0.2	0.20	1.4

10. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Positive one-half cycle	Negative one-half cycle			
141.0	141.0	0.0	0.30	1.8

Calibrated by :

Approved by :


(Mr. Pawate Khlaypa)
Acting Director

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Ref : 2011264120305034007

Date of

Date of

Certificate

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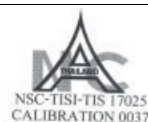
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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0155

MTC No. EEL. BP. 19/1264

CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.

Address : 122 Moo 2 T.Thatoom, A.Srimahaphote, Prachinburi 25140.

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Rion

Model : NL-42

Serial No. : 00646442

Microphone : Type UC-52 No.153069

Preamplifier : Type NH-24 No.46656

Ambient Environment

Temperature : $(23 \pm 3) ^\circ\text{C}$

Relative Humidity : $(50 \pm 15) \%$

Ambient Pressure : $(101.325 \pm 1.5) \text{ kPa}$

Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Pistonphone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 3 Dec. 2021

Date of Calibration : 28-29 Dec. 2021

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9. Power Amplifier Brüel&Kjær 2706 S/N 1517650.

10. Speaker Tannoy Limited, Great Britain British Patent No. 215300.

11. Digital Multimeter Agilent 34401A S/N MY44005560.

12. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2006). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

This instrument has been calibrated against standards maintained at the Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

The reported expanded uncertainty is based upon a standard uncertainty multiplied by a coverage factor $k=2$, providing a level of confidence of approximately 95%.

Date of Calibration : 28-29 Dec. 2021

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Request No. 21-65/0155

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1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Unit Under Test			Tolerance Limit Class 2 (±dB)
	Measured Value (dB)	Deviation (dB)	Uncertainty (±dB)	
113.94	113.9	0.0	0.30	1.4

Note: No adjustment. The internal calibration was display at 124.1 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)
17.6	0.10

2.2 The microphone of the sound level meter was replaced by electrical signal input device

Frequency Weighting	Measured Value (dB)	Uncertainty (±dB)
A-Weighting	12.9	0.10
C-Weighting	18.2	0.10
Flat	23.9	0.10

Date of Calibration : 28-29 Dec. 2021

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
125	0.1	0.2	0.2	0.40	2.0
1 000	-0.4	-0.4	-0.4	0.40	1.4
4 000	-0.5	-0.5	-0.5	0.40	3.6

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
63	0.0	-0.1	-0.1	0.20	2.5
125	-0.1	0.0	0.0	0.20	2.0
250	-0.1	0.0	0.0	0.20	1.9
500	-0.1	0.0	0.0	0.20	1.9
1 000	0.0	0.0	0.0	0.20	1.4
2 000	0.0	0.0	0.0	0.20	2.6
4 000	0.0	0.0	0.0	0.20	3.6
8 000	0.0	0.0	0.0	0.20	5.6

Date of Calibration : 28-29 Dec. 2021

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Request No. 21-65/0155

MTC No. EEL. BP. 19/1264

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
A-weighting	94.0	0.0	0.20	0.4
C-weighting	94.0	0.0	0.20	0.4
Flat	94.0	0.0	0.20	0.4

5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
Fast	94.0	0.0	0.20	0.3
Slow	94.0	0.0	0.20	0.3
Leq	94.0	0.0	0.20	0.3

6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
137	137.0	0.0	0.30	1.4
136	136.0	0.0	0.30	1.4
135	135.0	0.0	0.30	1.4
134	134.0	0.0	0.30	1.4
133	133.0	0.0	0.30	1.4
132	132.0	0.0	0.30	1.4
131	131.0	0.0	0.30	1.4

Date of Calibration : 28-29 Dec. 2021

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6. Level linearity on the reference level range (cont.)

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
130	130.0	0.0	0.30	1.4
129	129.0	0.0	0.30	1.4
124	124.0	0.0	0.30	1.4
119	119.0	0.0	0.30	1.4
114	114.0	0.0	0.30	1.4
109	109.0	0.0	0.30	1.4
104	104.0	0.0	0.30	1.4
99	99.0	0.0	0.30	1.4
94	94.0	0.0	0.30	1.4
89	89.0	0.0	0.30	1.4
84	84.0	0.0	0.30	1.4
79	79.0	0.0	0.30	1.4
74	74.0	0.0	0.30	1.4
69	69.0	0.0	0.30	1.4
64	63.9	-0.1	0.30	1.4
59	58.9	-0.1	0.30	1.4
54	53.9	-0.1	0.30	1.4
49	48.9	-0.1	0.30	1.4
44	43.9	-0.1	0.30	1.4
39	38.9	-0.1	0.30	1.4
34	33.9	-0.1	0.30	1.4
29	28.9	-0.1	0.30	1.4
28	27.9	-0.1	0.30	1.4

Date of Calibration : 28-29 Dec. 2021

6 / 8

The results relate only to the items tested/calibrated or value assigned.

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FM.BL.MTC.002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0155

MTC No. EEL. BP. 19/1264

6. Level linearity on the reference level range (cont.)

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
27	26.9	-0.1	0.30	1.4
26	25.9	-0.1	0.30	1.4
25	24.9	-0.1	0.30	1.4

7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
20-130	125	125.0	0.0	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (dB)
Fast	200	126.0	0.0	0.20	± 1.3
	2	108.9	-0.1	0.20	+1.3; -2.8
	0.25	99.9	-0.1	0.20	+1.8; -5.3
Slow	200	119.5	-0.1	0.20	± 1.3
	2	99.9	-0.1	0.20	+1.3; -5.3
SEL	200	120.0	0.0	0.20	± 1.3
	2	100.0	0.0	0.20	+1.3; -2.8
	0.25	90.8	-0.2	0.20	+1.8; -5.3

Date of Calibration : 28-29 Dec. 2021

7/8

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Request No. 21-65/0155

MTC No. EEL. BP. 19/1264

9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (\pm dB)	Tolerance limits Class 2 (\pm dB)
Complete cycle	125.4	125.3	-0.1	0.20	2.4
Positive half cycle	124.4	124.1	-0.3	0.20	1.4
Negative half cycle	124.4	124.1	-0.3	0.20	1.4

10. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
Positive one-half cycle	Negative one-half cycle			
136.5	136.5	0.0	0.30	1.8

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8/8

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0155 MTC No. EEL. BP. 10/1264

CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.
Address : 122 Moo 2 T.Thatoom A.Srimahaphote Prachinburi 25140.
Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.
 : Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., Muang, Samutprakan 10280.

Instrument Calibrated :
 Description : Sound Calibrator
 Manufacturer : ACO
 Model : 2127
 Serial No. : 100012

Ambient Environment
 Temperature : $(23 \pm 3) ^\circ\text{C}$
 Relative Humidity : $(50 \pm 15) \%$
 Ambient Pressure : $(101.325 \pm 1.500) \text{ kPa}$

- Standards used :**
1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
 2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.
 3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.
 4. Digital Multimeter Agilent 34401A S/N MY44005560.
 5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.
 6. Audio Analyzer Keithley 2015-P S/N 4106495.
 7. Condenser Microphone Bruel&Kjaer 4180 S/N 2889871.

Calibration Procedure: CP-102-04 based on IEC 60942-2003; The sound pressure level generated by sound calibrator under test shall be measured by standard microphone using an insert voltage technique.

This instrument has been calibrated against standards maintained at Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

Date of Receipt : 3 Dec. 2021

Date of Calibration : 15 Dec. 2021

1 / 2

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0155 MTC No. EEL. BP. 10/1264

The reported expanded uncertainty is based upon a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%.

Nominal Output of Unit Under Test = 94 dB re 20 μ Pa at 1000 Hz

Acoustic Output in dB re 20 μ Pa, Corrected to Reference Conditions: 101.325 kPa, 23.0 $^\circ\text{C}$ and 50 %RH.

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	93.92	-0.08	± 0.10	$\pm 0.40 \text{ dB}$

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	1008.4	8.4	± 1.5	$\pm 1.0\%$

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	1.70	± 0.50	$\pm 3.0\%$

Notes: 1. No adjustment

Calibra

Date of

Date of Issue

20 Dec. 2021

Ref : 2011264120305034001

End of Certificate

2 / 2

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0155

MTC No. EEL. BP. 11/1264

CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.

Address : 122 Moo 2 T.Thatoom A.Srimahaphote Prachinburi 25140.

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.
: Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Sound Calibrator

Manufacturer : Rion

Model : NC-74

Serial No. : 35046798

Ambient Environment

Temperature : (23 + 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.500) kPa

- Standards used :
1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
 2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.
 3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.
 4. Digital Multimeter Agilent 34401A S/N MY44005560.
 5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.
 6. Audio Analyzer Keithley 2015-P S/N 4106495.
 7. Condenser Microphone Bruel&Kjaer 4180 S/N 2889871.

Calibration Procedure: CP-102-04 based on IEC 60942-2003; The sound pressure level generated by sound calibrator under test shall be measured by standard microphone using an insert voltage technique.

This instrument has been calibrated against standards maintained at Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

Date of Receipt : 3 Dec. 2021

Date of Calibration : 16 Dec. 2021

1/2

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0155

MTC No. EEL. BP. 11/1264

The reported expanded uncertainty is based upon a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95%.

Nominal Output of Unit Under Test = 94 dB re 20μPa at 1000 Hz

Acoustic Output in dB re 20μPa, Corrected to Reference Conditions: 101.325 kPa, 23.0 °C and 50 %RH.

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	93.94	-0.06	± 0.10	±0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	1001.5	1.5	± 1.5	±1.0%

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	0.95	± 0.50	±3.0%

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3.

Calibrated by :

Date of Calibration

Date of Issue

End of Certificate

2 / 2

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**RECALIBRATION
DUE DATE:**
May 25, 2023

Certificate of Calibration

Calibration Certification Information

Cal. Date: May 25, 2022 Rootsmeter S/N: 438320 Ta: 296 °K
Operator: Jim Tisch Pa: 751.08 mm Hg
Calibration Model #: TE-5028A Calibrator S/N: 1836

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.2210	4.5	1.50
2	3	4	1	0.9550	7.3	2.50
3	5	6	1	0.8660	8.8	3.00
4	7	8	1	0.7980	10.3	3.50
5	9	10	1	0.6080	17.5	6.00

Data Tabulation

Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)}$ (y-axis)	Va	Qa (x-axis)	$\sqrt{\Delta H \left(\frac{Ta}{Pa} \right)}$ (y-axis)
0.9890	0.8100	1.2216	0.9940	0.8141	0.7689
0.9853	1.0317	1.5771	0.9903	1.0369	0.9926
0.9833	1.1354	1.7277	0.9883	1.1412	1.0873
0.9813	1.2297	1.8661	0.9863	1.2359	1.1745
0.9718	1.5983	2.4433	0.9767	1.6064	1.5377
QSTD	m=	1.54378	QA	m=	0.96669
	b=	-0.02519		b=	-0.01585
	r=	0.99990		r=	0.99990

Calculations

Vstd=	$\Delta Vol((Pa-\Delta P)/Pstd)(Tstd/Ta)$	Va=	$\Delta Vol((Pa-\Delta P)/Pa)$
Qstd=	Vstd/ΔTime	Qa=	Va/ΔTime
For subsequent flow rate calculations:			
Qstd=	$1/m \left(\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)} - b \right)$	Qa=	$1/m \left(\sqrt{\Delta H \left(\frac{Ta}{Pa} \right)} - b \right)$

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

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Mechanical Engineering Standards Laboratory Soi 1, Bangpoo Industrial Estate, Muang, Samutprakan 10280, Thailand.

Request No.23-65/0131

MTC.No.23-65/0131

Number of page(s) 2

CALIBRATION CERTIFICATE

Nomenclature : DRYCAL FLOWMETER

Manufacturer : Bios International Corporation, USA

Serial No.: 120879

Model : Defender 510 M

Scale range : 50 ml/min to 5000 ml/min

Subdivision : (0.00001, 0.0001, 0.001) l/min

Submitted by : INTEGRATED RESEARCH CENTER COMPANY LIMITED.

122 T.Thatoom A.Srimahaphote,
Prachinburi 25140, Thailand.

Received date : 3 December 2021 Condition of measured item : Normal

Calibration date : 14 December 2021

Standard	Certificate No.	Date due	Traceability
RTD Thermometer	PSL-T 336/63	6-Apr-22	TISTR
Molbox/PressureTransducer/UpStream	MP-0013-21	25-Jan-23	NIMT
Primary Flow Calibrator S/N 117982	MW-0011-21	8-Apr-23	NIMT
Primary Flow Calibrator S/N 119521	MW-0012-21	31-Mar-23	NIMT

Cal

Ref. 2013264120305043001

Issued Date 14 December 2021

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Mechanical Engineering Standards Laboratory Soi 1, Bangpoo Industrial Estate, Muang, Samutprakan 10280, Thailand.

Request No.23-65/0131

2/2

MTC.No.23-65/0131

Calibration point : (0.05, 0.5, 1, 1.5, 2) l/min

Ambient condition : Temperature (23 ± 3) °C , Relative humidity (55 ± 15) %

Atmospheric pressure (1010 ± 13) hPa

Calibration method : The flowmeter (UUC) was calibrated by comparison method with standard flowmeter according to CP-370.01.

The reported value is the value that converted to value at reference condition within pressure and temperature of the actual gas entering the UUC

Measurement data :

UUC Value (l/min)	Standard Value (l/min)	Temperature (°C)	Pressure (hPa)	Deviation (%)	Uncertainty (%)
0.05528	0.055236	22.712	1010.27	+0.08	1.10
0.50726	0.50295	22.564	1010.35	+0.86	0.98
1.0082	0.99739	22.481	1010.59	+1.08	0.85
1.5085	1.4916	22.491	1010.86	+1.13	0.85
2.0231	1.9999	22.518	1011.11	+1.16	0.86

The reported expanded uncertainties are based on standard uncertainties multiplied by a coverage factor $k=2$, which provides a level of confidence of approximately 95%.

The end of calibration certificate.

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FM.BLMTC.002 Rev.4



Certificate of Calibration

Equipment: Balance
Model: BSA224S-CW
Serial No. (or ID.): 31591470
Manufacturer: Sartorius
Condition: In condition

Certificate No.: C01213271
Issued Date: 12 November 2021
Job No.: KSPR2115019
Page: 1 of 2

Customer: Integrated Research Center Co.,Ltd.
122 Moo 2, Tambol Thatoom,
Amphur Srimahaphote, Prachinburi 25140 Thailand

Environment Condition: Temperature 24 °C \pm 0.6 °C
Humidity 62 %RH \pm 2.3 %RH

Calibration Place: Integrated Research Center Co.,Ltd. (ห้องเครื่องชั่ง)
122 Moo 2, Tambol Thatoom,
Amphur Srimahaphote, Prachinburi 25140 Thailand

Calibration By: Mr. Adinan Ninviboon

Calibration Date: 10 November 2021

The Method used: In house method, SPCC-WI-47, base on UKAS Lab 14

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through SPC RT Co., Ltd. Certificate No. C02210714

This certificate is valid for international use.
The measurement results provide a level of confidence of approximately 95%.

These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of SPC RT Co., Ltd.

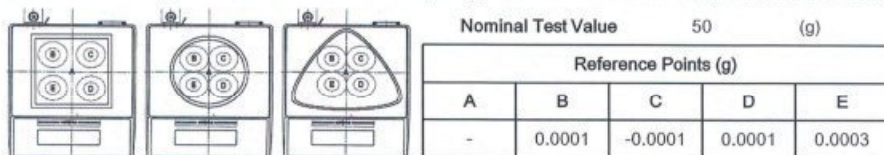
Certificate No.: C01213271

Page: 2 of 2

Calibration Results:

Without Adjustment

Eccentric Error: Weight to be 1/4 or 1/3 of Maximum capacity, taken from the center of the pan as a zero reference.



Repeatability: Determination of the standard deviation of weighing balance., Readability 0.0001 (g)

Nominal test value (g)	Standard Deviation
20	0.00005
200	0.00006

Departure of indication from nominal value., Readability 0.0001 (g)

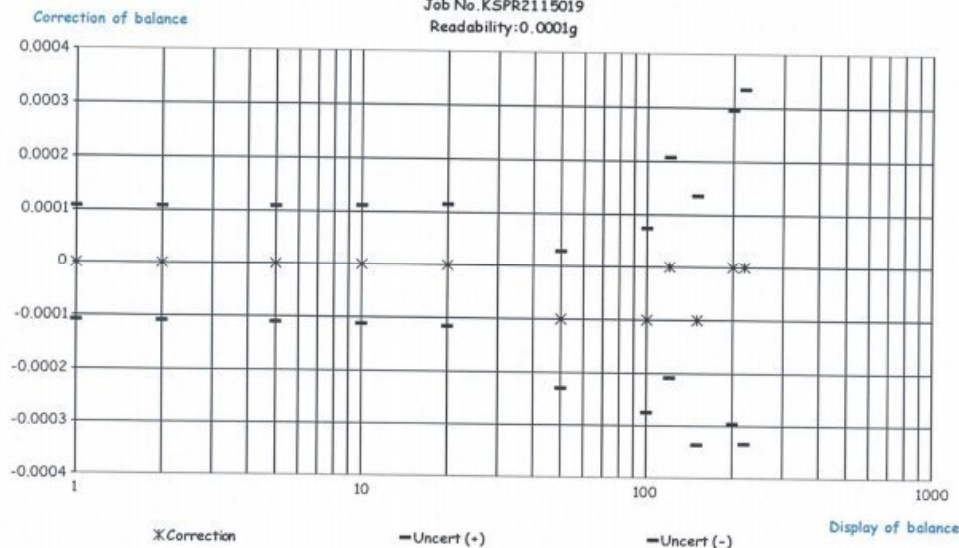
Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Correction of Balance (g)	Uncertainty (g)	k
1	1.00001	1.0000	0.0000	0.00011	2.04
2	1.99999	2.0000	0.0000	0.00011	2.04
5	5.00001	5.0000	0.0000	0.00011	2.04
10	9.99998	10.0000	0.0000	0.00011	2.04
20	20.00001	20.0000	0.0000	0.00012	2.03
50	49.99995	50.0000	-0.0001	0.00013	2.02
100	99.99995	100.0000	-0.0001	0.00017	2.01
120	119.99996	120.0000	0.0000	0.00021	2.00
150	149.99990	150.0000	-0.0001	0.00024	2.00
200	200.00001	200.0000	0.0000	0.00030	2.00
220	220.00002	220.0000	0.0000	0.00033	2.00

The End of Certificate

Without Adjustment

Job No. KSPR2115019

Readability: 0.0001g





Certificate of Calibration

Equipment: Balance
Model: ME36S
Serial No. (or ID.): 27206085
Manufacturer: Sartorius
Condition: In condition

Certificate No.: C01213272
Issued Date: 16 November 2021
Job No.: KSPR2115020
Page: 1 of 3

Customer: Integrated Research Center Co.,Ltd.
122 Moo 2, Tambol Thatoom,
Amphur Srimahaphote, Prachinburi 25140 Thailand

Environment Condition: Temperature 25 °C ± 0.3 °C
Humidity 54 %RH ± 2.4 %RH

Calibration Place: Integrated Research Center Co.,Ltd. (ห้องเครื่องชั่ง)
122 Moo 2, Tambol Thatoom,
Amphur Srimahaphote, Prachinburi 25140 Thailand

Calibration By: Mr. Adinan Ninviboon
Calibration Date: 11 November 2021
The Method used: In house method, SPCC-WI-47, base on UKAS Lab 14
Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIM) Thailand through SPC RT Co., Ltd. Certificate No. C02210500, C02210714

Calibration Results:
Before Adjustment
Eccentric Error: Weight to be 1/4 or 1/3 of Maximum capacity, taken from the center of the pan as a zero reference.

			Nominal Test Value 10000 (mg)	
Reference Points (mg)				
A	B	C	D	E
-	-0.002	0.001	0.000	-0.001

Repeatability: Determination of the standard deviation of weighing balance., Readability 0.001 (mg)

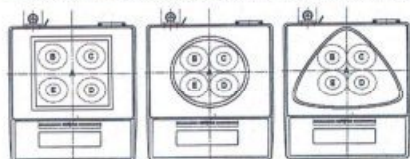
Nominal test value (mg)	Standard Deviation
2000	0.0012
20000	0.0012

Departure of indication from nominal value., Readability 0.001 (mg)

Nominal Value (mg)	Conventional Mass (mg)	Displayed Value (mg)	Correction of Balance (mg)	Uncertainty (mg)	k
1	1.0020	1.002	0.000	0.0035	2.01
5	5.0020	5.002	0.000	0.0035	2.01
10	10.0010	10.001	0.000	0.0049	2.00
50	50.0040	50.003	0.001	0.0063	2.00
100	99.9980	99.997	0.001	0.0082	2.00
500	499.9940	499.995	-0.001	0.013	2.00
1000	1000.0050	1000.002	0.003	0.016	2.00
5000	5000.0050	5000.002	0.003	0.027	2.00
10000	9999.9810	9999.976	0.005	0.033	2.00
20000	20000.0070	19999.981	0.026	0.048	2.00
30000	29999.9880	29999.933	0.055	0.080	2.00

After Adjustment

Eccentric Error: Weight to be 1/4 or 1/3 of Maximum capacity, taken from the center of the pan as a zero reference.



Nominal Test Value 10000 (mg)

Reference Points (mg)				
A	B	C	D	E
-	-0.001	0.000	0.000	-0.001

Repeatability: Determination of the standard deviation of weighing balance., Readability 0.001 (mg)

Nominal test value (mg)	Standard Deviation
2000	0.0011
20000	0.0012

Departure of indication from nominal value., Readability 0.001 (mg)

Nominal Value (mg)	Conventional Mass (mg)	Displayed Value (mg)	Correction of Balance (mg)	Uncertainty (mg)	k
1	1.0020	1.002	0.000	0.0035	2.01
5	5.0020	5.002	0.000	0.0035	2.01
10	10.0010	10.001	0.000	0.0049	2.00
50	50.0040	50.004	0.000	0.0063	2.00
100	99.9980	99.998	0.000	0.0082	2.00
500	499.9940	499.995	-0.001	0.013	2.00
1000	1000.0050	1000.005	0.000	0.016	2.00
5000	5000.0050	5000.003	0.002	0.027	2.00
10000	9999.9810	9999.977	0.004	0.033	2.00
20000	20000.0070	20000.003	0.004	0.048	2.00
30000	29999.9880	29999.986	0.002	0.080	2.00

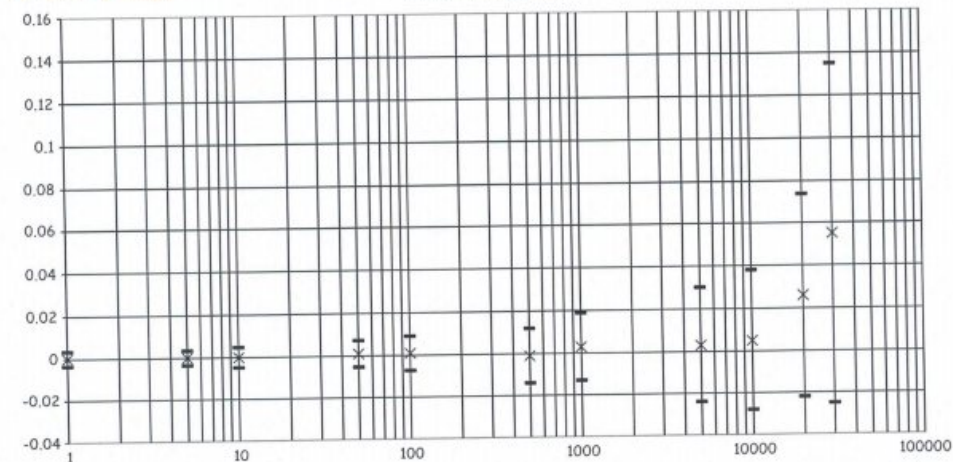
The End of Certificate

Before Adjustment

Job No. KSPR2115020

Readability: 0.001mg

Correction of balance



X Correction

Uncert (+)

Uncert (-)

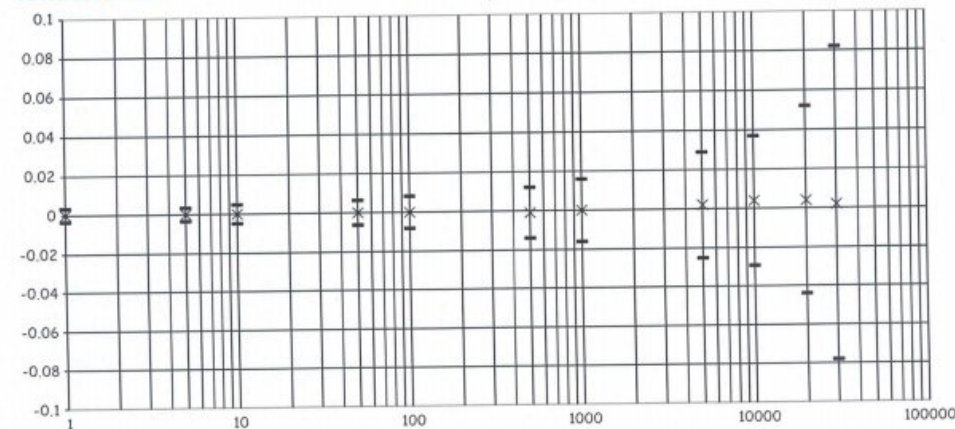
Display of balance

After Adjust

Job No. KSPR2115020

Readability: 0.001mg

Correction of balance



X Correction

Uncert (+)

Uncert (-)

Display of balance