

ภาคผนวก จ

ใบรับรองการสอบเทียบเครื่องมือ

บริษัท ยูไนเต็ด แอนนาลิสต์ แอนด์
เอ็นจิเนียริง คอนซัลแตนท์ จำกัด

List of Instruments Certification for Air & Noise Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Stack									
1	Pre-Test Console	Total Suspended Particulate (TSP)	Apex Instruments, USA.	XC-572-V 1701019	Environmental Solution Integrator Co.,Ltd.	E23-04044	25 Apr 23	23 Apr 24	-
2	Flue gas Analyzer	Sulphur Dioxide Oxide of Nitrogen as Nitrogen Dioxide Oxygen Carbon Monoxide	Testo	Testo 350 NEW 60899456	Entech Associate Co.td	G 660139	8 Mar 23	6 Mar 24	-
3	Standard Gas	CO, CO ₂ , NO, NO _x , SO ₂ , BALN 400-800 ppm	Airgas	CC457499	Airgas	E05NI83E15A000C	13 Jul 18	13 Jul 26	-
4	Standard Gas	CO, CO ₂ , NO, NO _x , SO ₂ , BALN 400-800 ppm	Airgas	CC155784	Airgas	E05NI83E15A000C	1 Nov 18	1 Nov 26	-
5	Standard Gas	SO ₂ , BALN 50 ppm	Airgas	CC728570	Airgas	E02NI99E15AC5X1	15 Aug 19	15 Aug 27	-
6	Standard Gas	SO ₂ , BALN 100 ppm	Airgas	EB0129049	Airgas	E02NI99E15A0032	14 Aug 19	14 Aug 27	-
7	Standard Gas	CO, CO ₂ , NO, NO _x , SO ₂ , BALN 100-200 ppm	Airgas	CC452945	Airgas	E04NI99E15A01ZC	21 Aug 19	21 Aug 27	-
8	Standard Gas	CO, CO ₂ , NO, NO _x , SO ₂ , BALN 200-400 ppm	Airgas	CC715530	Airgas	E05NI91E150012	27 Feb 19	27 Feb 27	-
9	Standard Gas	CO, CO ₂ , NO, NO _x , SO ₂ , BALN 400-800-900 ppm	Airgas	CC715540	Airgas	E05NI83E15A0004	27 Feb 19	27 Feb 27	-
10	Standard Gas	O ₂ , BALN 7%	Airgas	EB0125052	Airgas	E02NI93E15A159A	20 Feb 19	20 Feb 27	-
11	Standard Gas	O ₂ , BALN 15%	Airgas	CC719418	Airgas	E02NI85E15A3432	15 Oct 18	15 Oct 26	-
12	Standard Gas	O ₂ , BALN 15%	Airgas	EB0062269	Airgas	E02NI85E15AC0GC	17 Jul 18	17 Jul 26	-

List of Instruments Certification for Water Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Water									
1	DO Meter	DO Meter	Horiba	LAQUA-DO210 HE9M0048	Technology Promotion Association (Thailand-Japan)	23TW107	2 May 23	30 Apr 24	-

CERTIFICATE OF CALIBRATION

Customer : United Analyst and Engineering Consultant Co., Ltd.
Address : 81 Soi Udomrak 41, Sukhumvit Road, Bangkok, Phrakhanong, Bangkok 10260
Description of Equipment : Console meter
Manufacturer : Apex Instrument
Model Number : KC-872-V
Serial Number : 1701019
ID/Control No. :
Environment Conditions : Temperature (25 ± 2) °C
Humidity (50 ± 15) % RH
Cal. Date : 25/04/2023
Issue Date : 25/04/2023

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 (SI).

Result of Calibration

This certificate may not be reproduced other than in full except with prior Written approval of the Technical Manager, Envir 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 :

Approved by :

(Mr. Piana Pichkrai)

Technical Manager

เอกสารไม่ควบคุม

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			Factory Conversions		
Console Model Number	KC-872-V	Date	Time	25/04/2023	10:00 AM	Std Temp	293 K
Console Serial Number	1701019	Calibration Reference No.	SER23-04016			Std Press	760 mm Hg
DGM Model Number	SK25EX	Barometric Pressure	757.49 mmHg			K ₁	0.386
DGM Serial Number	00002028	Calibration Meter Gamma	0.999			Console Leak Check	PASS

Calibration Data Results							
Standardized Data				Dry Gas Meter			
Dry Gas Meter		Calibration Meter		Calibration Factor		Flowrate	
(V _{actual})	(Q _{actual})	(V _{cal})	(Q _{cal})	Value	Variation	Std & Corr	Variation
(m ³)	(m ³ /min)	(m ³)	(m ³ /min)	(V)	(ΔV)	(Q _{actual})	(ΔH ₂)
0.135	0.011	0.136	0.011	1.004	0.019	0.011	45.580
0.135	0.011	0.135	0.011	0.997	0.012	0.011	46.068
0.136	0.016	0.136	0.016	1.000	0.015	0.016	44.700
0.136	0.016	0.135	0.016	0.993	0.009	0.016	44.924
0.272	0.020	0.268	0.019	0.986	0.001	0.019	46.600
0.272	0.020	0.266	0.019	0.978	-0.007	0.019	46.777
0.274	0.027	0.265	0.026	0.970	-0.015	0.026	46.906
0.274	0.027	0.265	0.026	0.969	-0.016	0.026	46.870
0.274	0.030	0.268	0.030	0.977	-0.007	0.030	45.230
0.275	0.031	0.268	0.030	0.973	-0.012	0.030	45.332
				0.985	Y Average	45.899	
						ΔH ₂ Average	

Notes: 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 ΔH₂, orifice pressure differential that equates to 0.75 cm (0.0212 m³/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ±0.2 inches (5.1 mm) H₂O.



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

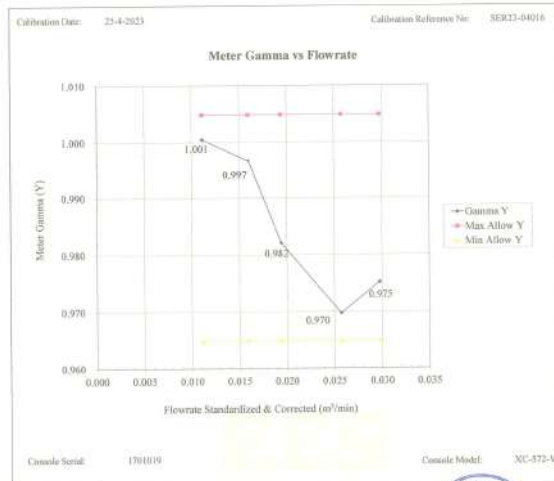
Meter Console Information		Calibration Conditions			Factory Conversions		
Console Model Number	KC-872-V	Date	Time	25/04/2023	10:00 AM	Std Temp	293 K
Console Serial Number	1701019	Calibration Reference No.	SER23-04016			Std Press	760 mm Hg
DGM Model Number	SK25EX	Barometric Pressure	757.49 mmHg			K ₁	0.386
DGM Serial Number	00002028	Calibration Meter Gamma	0.999			Console Leak Check	PASS

Calibration Data									
Metering Console					Calibration Meter				
Run Time	DGM Orifice DH	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final
Elapsed (Q)	(P ₅)	(V _{in})	(V _{out})	(t _{in})	(t _{out})	(V _{in})	(V _{out})	(t _{in})	(t _{out})
min	mm H ₂ O	m ³	m ³	°C	°C	m ³	m ³	°C	°C
12.17	13.0	2094.611	2094.751	34	34	136.89522	137.03608	30	30
12.15	13.0	2094.751	2094.891	34	34	137.03608	137.17600	30	30
8.50	26.0	2094.897	2095.037	35	35	137.18408	137.32456	29	29
8.47	26.0	2095.037	2095.177	35	35	137.32456	137.46414	29	29
13.80	40.0	2095.183	2095.463	36	36	137.47002	137.74746	29	29
13.72	40.0	2095.463	2095.743	36	36	137.74746	138.02270	29	29
10.32	70.0	2095.752	2096.032	36	36	138.03154	138.30536	28	28
10.30	70.0	2096.032	2096.312	37	37	138.30536	138.57984	28	28
9.00	90.0	2096.324	2096.604	37	37	138.58928	138.86564	28	28
8.98	90.0	2096.604	2096.884	37	37	138.86564	139.14072	27	27



เอกสารไม่ควบคุม

Meter Console Information		Calibration Conditions			Factory Conversions		
Console Model Number	KC-872-V	Date	Time	25/04/2023	10:00 AM	Std Temp	293 K
Console Serial Number	1701019	Calibration Reference No.	SER23-04016			Std Press	760 mm Hg
DGM Model Number	SK25EX	Barometric Pressure	757.49 mmHg			K ₁	0.386
DGM Serial Number	00002028	Calibration Meter Gamma	0.999			Console Leak Check	PASS

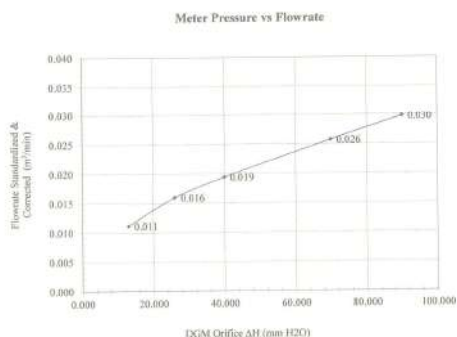


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Meter Console Information		Calibration Conditions				Factors/Conversions	
Console Model Number	XC-872-V	Date	Time	25/04/2023	10:00 AM	Std Temp	293 K
Console Serial Number	1701019	Calibration Reference No.	SER23-04016			Std Press	760 mm Hg
DGM Model Number	SK25EX	Barometric Pressure	757.49 mmHg			K1	0.386
DGM Serial Number	00002028	Calibration Meter Gamma	0.999			Console Leak Check	PASS

Calibration Date: 25-4-2023

Calibration Reference No: SER23-04016



Console Serial: 1701019

Console Model: XC-872-V



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Instrument description	Flue gas Analyzer
Instrument model	Tusto 350 New
Instrument serial no.	60899456
ID no. or control no.	UAE EPM.005/2588
Manufacturer	Tusto SE & Co. KGaA
Probe description	-
Probe model	-
Probe serial	-
Customer name	UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Customer address	81 SOI UDOMSUK41, SUKHUMVIT ROAD, BANGCHAK PRAMONG BANGKOK 10260

Total pages of certificate	3 Pages
Receiving no.	L-230460
Receiving date	07-Mar-23
Parameter of calibration	Gas Calibration (Oxygen 2.498, 10.04, 21.02 %vol, Carbon Monoxide 80.14, 309.3, 1003 ppm, Nitrogen Dioxide 30.34, 80.96, 202.2 ppm, Nitric Oxide 30.08, 130.8, 320.6 ppm, Sulphur Dioxide 50.04, 100.8, 601.1 ppm)

Condition of UUC	Used
Ambient condition	All of the Measurement were carried out the stabilized laboratory
Temperature	23 ± 0.5 °C
Humidity	55 ± 15 %RH

Calibration place : 17/121 Soi Ngamwongwan 47 Yae 46, Tronngsrong, Latki, Bangkok 10210

Calibration procedure no.: This instrument was calibrated by comparison with Standard gas mixture according to calibration work instruction no. WI-CL-28-C

The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%.
This certificate is applied only to items under test environmental condition.
This Calibration Certificate may not be reproduced other than in full except with the permission of the issuing laboratory.
Calibration certificates without signature and seal are not valid and the results relate only to the items tested/calibrated.
This calibration certificate documents are traceability to national standards, which realize measurement according to the International System of Units (SI).

Date of calibration : 09-Mar-23



Technical Manager

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Issued Date 26/02/16

Entech Industrial Solution Co., Ltd.

17/121 Soi Ngamwongwan 47 Yae 46, Tronngsrong, Latki, Bangkok 10210 THAILAND Tel: 0-2779-8888 Calibration@entech.co.th
Tax ID: 0-105536035591 www.entech.co.th

เอกสารไม่ควบคุม

THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information		Calibration Conditions			
Console Model Number	XC-872-V	Date	Time	25/04/2023	12:00 PM
Console Serial Number	1701019	Calibration Reference No.	SER23-04016		
DGM Model Number	SK25EX	Reference Thermometer	DIGICON		
DGM Serial Number	00002028	Serial Number	183169105		
Meter Box Model Number	JENCO 765 KF				
Meter Box Serial Number	JC 19031				

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	1038.0
Stack	-19.0	23.0	36.0	92.0	149.0	259.0	373.0	484.0	596.0	1044.0
Aux	-19.0	23.0	36.0	92.0	149.0					
Probe	-19.0	23.0	36.0	92.0	149.0					
Filter	-18.0	23.0	36.0	93.0	149.0					
Oven	-19.0	23.0	36.0	93.0	149.0					
Exit	-18.0	23.0	36.0							

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

Tolerance Range



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Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O ₂) 2.498 % Vol	4218/21	Uncle	30-Sep-25
Oxygen (O ₂) 10.04 % Vol	CG-0153-21	Nimt	18-Nov-26
Oxygen (O ₂) 21.02 % Vol	CG-0041-22	Nimt	10-Feb-27
Carbon monoxide (CO) 80.14 ppm	CG-0040-22	Nimt	14-Feb-27
Carbon monoxide (CO) 309.3 ppm	2803/21	Uncle	22-Jun-23
Carbon monoxide (CO) 1003 ppm	45513	Uncle	09-Aug-24
Nitrogen Dioxide (NO ₂) 30.34 ppm	2703/22	Nimt	22-Aug-24
Nitrogen Dioxide (NO ₂) 80.96 ppm	1240/21	Uncle	26-Jun-24
Nitrogen Dioxide (NO ₂) 202.2 ppm	3238/21	Uncle	20-Jul-23
Nitric Oxide (NO) 30.08 ppm	CG-6889-22	Nimt	13-Jun-24
Nitric Oxide (NO) 150.9 ppm	2857/21	Uncle	27-Jun-23
Nitric Oxide (NO) 320.6 ppm	2944/21	Uncle	02-Jul-23
Sulphur Dioxide (SO ₂) 50.04 ppm	1205/21	Uncle	25-Jul-23
Sulphur Dioxide (SO ₂) 100.8 ppm	1587/22	Uncle	09-Nov-24
Sulphur Dioxide (SO ₂) 601.1 ppm	3204/21	Uncle	29-Jul-23

Measured room conditions : Temperature : 23.7 °C Humidity : 59.1 %RH Pressure : 1012.3 mbar

Calibration conditions : Gas Temperature : 23 °C Flow rate : 1,100 mL/min Gas pressure : 1021.3 mbar

Calibration Results Before Adjustment (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty
O ₂ (%Vol)	2.498	2.55	0.052	0.30
O ₂ (%Vol)	10.04	10.12	0.08	0.40
O ₂ (%Vol)	21.02	21.09	0.07	0.80
CO (ppm)	80.14	82	1.86	3.0
CO (ppm)	309.3	315	5.1	6.0
CO (ppm)	1003	1019	16	12
NO (ppm)	30.34	26.8	-3.54	8.0
NO (ppm)	80.96	68.5	-12.46	8.0
NO (ppm)	202.2	178.4	-23.8	12
NO (ppm)	36.08	29	-7.08	8.0
NO (ppm)	150.9	152	1.1	8.0
NO (ppm)	320.6	316	-4.6	12
SO ₂ (ppm)	50.04	50	-0.04	6.0
SO ₂ (ppm)	100.8	101	0.2	6.0
SO ₂ (ppm)	601.1	604	2.9	13

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Issued Date 26/02/16

Entech Industrial Solution Co., Ltd.

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Tax ID: 0-105536035591 www.entech.co.th

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Calibration Results After Adjustment (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (%)
O ₂ (%Vol)	2.498	2.55	0.052	0.20
O ₂ (%Vol)	13.04	13.12	0.08	0.40
O ₂ (%Vol)	21.02	21.09	0.07	0.80
CO (ppm)	80.14	81	0.86	3.0
CO (ppm)	399.9	399	-0.9	6.0
CO (ppm)	1003	1001	-2	12
NO ₂ (ppm)	38.34	38.3	-1.04	8.0
NO ₂ (ppm)	80.96	80.5	-0.46	8.0
NO ₂ (ppm)	292.2	294.1	1.9	12
NO (ppm)	30.08	29	-1.08	6.0
NO (ppm)	150.9	152	1.1	8.0
NO (ppm)	329.6	316	-4.6	12
SO ₂ (ppm)	59.04	59	-0.04	6.0
SO ₂ (ppm)	100.8	101	0.2	6.0
SO ₂ (ppm)	601.3	604	2.8	13

Remark: 1 cm³/mol = 1 %vol, 1 ppm/mol = 1 ppm.

End of Report

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Customer: PCW 5218004553
Part Number: E05N83E15A000C
Cylinder Number: CC155784
Laboratory: 124 - Riverton (SAP) - NJ
PGVP Number: B52018
Gas Code: CO, CO₂, NO, NO₂, SO₂, BALN
Reference Number: 82-401312964-1
Cylinder Volume: 153.9 Cubic Feet
Cylinder Pressure: 2315 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-12/051, 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 volumetric basis unless otherwise noted.

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

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	400.0 PPM	400.3 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				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	15010127	KAL004357	494.8 PPM NITRIC OXIDE/NITROGEN	+/- 0.5%	Sep 01, 2021
PRM	12368	5804119	29.86 PPM NITROGEN DIOXIDE/AIR	+/- 1.5%	Jun 02, 2017
GMS	7842010104	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	+/- 0.6%	May 30, 2023
NTRM	14090142	CC436630	890.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Nov 18, 2018
NTRM	12061919	CC354843	19.87 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	Jan 11, 2024

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

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Horiba VIA 515-CO2-19GT-CO2	NDIR	Oct 05, 2018
Siemens Ultramat 6 J-559 CO/H2	NDIR	Oct 16, 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: 62.12 lbs
Net Weight: 12.14 lbs

This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol document EPA-600/R-12/051. 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: E05N83E15A000C
Cylinder Number: CC457409
Laboratory: 124 - Riverton (SAP) - NJ
PGVP Number: B52018
Gas Code: CO, CO₂, NO, NO₂, 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-12/051, 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 volumetric basis unless otherwise noted.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	400.0 PPM	400.8 PPM	G1	+/- 0.7% NIST Traceable	07/05/2018, 07/13/2018
NITRIC OXIDE	400.0 PPM	400.6 PPM	G1	+/- 0.6% NIST Traceable	07/05/2018, 07/13/2018
SULFUR DIOXIDE	400.0 PPM	411.4 PPM	G1	+/- 0.9% NIST Traceable	07/05/2018, 07/13/2018
CARBON MONOXIDE	800.0 PPM	783.1 PPM	G1	+/- 0.9% NIST Traceable	07/05/2018
CARBON DIOXIDE	16.00 %	16.09 %	G1	+/- 0.7% NIST Traceable	07/05/2018
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	15060430	CC460508	496.8 PPM NITRIC OXIDE/NITROGEN	+/- 0.5%	May 04, 2021
PRM	12368	5804119	29.86 PPM NITROGEN DIOXIDE/AIR	+/- 1.5%	Jun 02, 2017
GMS	7842010104	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	14090142	CC436630	890.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Nov 18, 2018
NTRM	12061919	CC354776	19.87 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	Jan 11, 2024

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

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 AHR0801933 CO2	FTIR	Jun 21, 2018
Siemens Ultramat 6 J-559 CO/LOW	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:PCW 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-12/051. 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: E02N99E15AC5X1
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-12/051, 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 volumetric basis unless otherwise noted.

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

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				

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

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
MKS FTIR - SO2 - 005928T81	FTIR	Aug 08, 2019

Triad Data Available Upon Request

NOTES:Gross Weight: 26.9 Kg, Net Weight: 4.7 Kg.
PO#5219003302





Airgas Specialty Gases
Airgas USA, LLC
6441 Easton Road
Bldg 1
Plumsteadville, PA 19049
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E02N199E15A0032 Reference Number: 160-401554617-1
Cylinder Number: E80129049 Cylinder Volume: 144.4 CF
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2015 PSIG
PGVP Number: A12019 Valve Outlet: 660
Gas Code: SO₂BALN 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 820R-12/031, 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					Assay Dates
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	
SULFUR DIOXIDE	100.0 PPM	98.85 PPM	G1	+/- 0.6% NIST Traceable	08/07/2019, 08/14/2019
NITROGEN	Balance				
CALIBRATION STANDARDS					Assay Dates
Type	Lot ID	Cylinder No	Concentration	Uncertainty	
NTRM	16010235	KAL004419	97.89 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.6%	Dec 23, 2021
ANALYTICAL EQUIPMENT					Assay Dates
Instrument/Make/Model	Analytical Principle				Last Multipoint Calibration
MKS FTR - SO ₂ - 000928781	FTR				Aug 06, 2019

Triad Data Available Upon Request

NOTES: Gross Weight: 28.9 Kg. Net Weight: 4.7 Kg. POW 5219003302.



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Airgas Specialty Gases
Airgas USA, LLC
600 Union Landing Road
Channahon, IL 60817-0000
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E05N191E15A0012 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, NO₂, 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 820R-12/031, 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					Assay Dates
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	
NO ₂	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	02/19/2019, 02/27/2019
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, 02/27/2019
NITROGEN	Balance				

CALIBRATION STANDARDS					Assay Dates
Type	Lot ID	Cylinder No	Concentration	Uncertainty	
NTRM	1006127	KAL004228	248.9 PPM NITRIC OXIDE/NITROGEN	+/- 0.4%	Nov 08, 2023
PRM	12367	APEX1099237	8.82 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Jun 02, 2017
QMS	1114201801	CC050710	4.971 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Nov 14, 2019
NTRM	15060538	CC453307	491.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jan 04, 2021
NTRM	15060620	CC454049	243.1 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.6%	Dec 17, 2020
NTRM	07130707	CC214695	8.986 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	Mar 30, 2023

ANALYTICAL EQUIPMENT					Last Multipoint Calibration
Instrument/Make/Model	Analytical Principle				
Nucleo 6700 AHR0801933 CO ₂	FTR				Feb 07, 2019
Siemens Ultramat 6 JI-598 COLOW	NDIR				Feb 19, 2019
Nucleo 6700 AHR0801933 NO	FTR				Feb 01, 2019
Nucleo 6700 AHR0801933 NO ₂	FTR				Feb 01, 2019
Nucleo 6700 AHR0801933 SO ₂	FTR				Feb 14, 2019

Triad Data Available Upon Request

NOTES:
Gross Weight: 27.854 kg grams
Net Weight: 5100.2 grams
POW 5219000697

This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012) document EPA 820R-12/031, 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.
ISO/IEC 17025 and to Airgas ISO 9001:2008 and relate only to items identified on this certificate. This certificate is valid only for the use of the calibration mixture as stated. This document shall not be reproduced in full without written approval of the issuer.



TESTING CERT No. 3082.05

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Airgas Specialty Gases
Airgas USA, LLC
6441 Easton Road
Bldg 1
Plumsteadville, PA 19049
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N199E15A012C 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, NO₂, SO₂, BALN Certification Date: Aug 21, 2027
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 820R-12/031, 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					Assay Dates
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	
NO ₂	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					Assay Dates
Type	Lot ID	Cylinder No	Concentration	Uncertainty	
NTRM	1006121	KAL004215	248.9 PPM NITRIC OXIDE/NITROGEN	+/- 0.4%	Nov 08, 2023
NTRM	1006121	KAL004215	250.0 PPM NO ₂ /NITROGEN	+/- 0.4%	Nov 08, 2023
NTRM	04060315	CC432670	352.5 PPM CARBON MONOXIDE/NITROGEN	+/- 0.3%	Feb 21, 2020
NTRM	10010228	KAL029096	255.3 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Apr 29, 2022

ANALYTICAL EQUIPMENT					Last Multipoint Calibration
Instrument/Make/Model	Analytical Principle				
MKS FTR - CO - 000928781	FTR				Aug 02, 2019
MKS FTR - NO - 000928781	FTR				Aug 22, 2019
MKS FTR - NO ₂ - 000928781	FTR				Aug 22, 2019
MKS FTR - SO ₂ - 000928781	FTR				Aug 08, 2019

Triad Data Available Upon Request

NOTES: Gross Weight: 28.9 Kg. Net Weight: 4.7 Kg. POW 5219003302.



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Airgas Specialty Gases
Airgas USA, LLC
600 Union Landing Road
Channahon, IL 60817-0000
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E05N191E15A0004 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, NO₂, 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 820R-12/031, 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					Assay Dates
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	
NO ₂	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	02/19/2019, 02/27/2019
SULFUR DIOXIDE	800.0 PPM	813.4 PPM	G1	+/- 0.7% NIST Traceable	02/19/2019, 02/27/2019
CARBON DIOXIDE	16.00 %	16.00 %	G1	+/- 0.8% NIST Traceable	02/19/2019, 02/27/2019
NITROGEN	Balance				

CALIBRATION STANDARDS					Assay Dates
Type	Lot ID	Cylinder No	Concentration	Uncertainty	
NTRM	15010127	KAL004357	494.6 PPM NITRIC OXIDE/NITROGEN	+/- 0.5%	Sep 01, 2021
PRM	12367	APEX1099237	8.82 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Jun 02, 2017
QMS	1114201801	CC050710	4.971 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Nov 14, 2019
NTRM	14080146	CC438650	990.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Nov 19, 2019
NTRM	11010354	KAL004922	968.8 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.6%	May 30, 2023
NTRM	12061004	CC254684	19.87 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	Jan 11, 2024

ANALYTICAL EQUIPMENT					Last Multipoint Calibration
Instrument/Make/Model	Analytical Principle				
Nucleo 6700 AHR0801933 CO ₂	FTR				Feb 07, 2019
Siemens Ultramat 6 JI-598 COLOW	NDIR				Feb 19, 2019
Nucleo 6700 AHR0801933 NO	FTR				Feb 01, 2019
Nucleo 6700 AHR0801933 NO ₂	FTR				Feb 01, 2019
Nucleo 6700 AHR0801933 SO ₂	FTR				Feb 14, 2019

Triad Data Available Upon Request

NOTES:
Gross Weight: 28291.4 grams
Net Weight: 5516.6 grams
POW 5219000697

This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012) document EPA 820R-12/031, 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.
ISO/IEC 17025 and to Airgas ISO 9001:2008 and relate only to items identified on this certificate. This certificate is valid only for the use of the calibration mixture as stated. This document shall not be reproduced in full without written approval of the issuer.



TESTING CERT No. 3082.05

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Cert. No.: 23TW107
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	23CG1172	22 Mar 2025
2) Balance	1126143764	140RC004	22MM50	20 Sep 2023

2. Standard Material :-

Material	Manufacturer	Lot.No.	Assay
Sodium Thiosulfate pentahydrate	Morck	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)
8.16	8.16	0.0055

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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เอกสารไม่ควบคุม



Equipment : DO Meter with Sensor
Condition As-Received : Used Item
Reference : 2304-0776WSC-2

Cert. No.: 23LM90
Page: 2 of 2

Procedure Used :-

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	1502A	A7B843	23J24	04 Jan 2024

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
25.0	80	25.002	25.0	-0.002	0.16	2.00
30.0	80	29.999	30.0	0.001	0.16	2.00
35.0	80	35.002	35.0	-0.002	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 %.

-000-

เอกสารไม่ควบคุม



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 19, SEANLEANG, SUANLEANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9454



Cert. No.: 23LM90
Page: 1 of 2

Certificate of Calibration

Equipment : DO Meter with Sensor
Manufacturer : Horiba
Model : LAQUA-DO210
Serial No. : HE9M0048
ID No. : UAE EFM.118/2563 (ENV.DO.07/63)
Submitted by : United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phra Khanong,
Bangkok 10260
Location : TPA On Site Calibration Laboratory
Received Order : 28 April 2023
Calibrated Date : 02 May 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V

Calibrated by : Kunchit Promrat

Approved by :

() Pornthippa Tameyakul
(✓) Malee Butkruea
() Suwit Imjai

Issue Date : 10 May 2023

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

บริษัท อินทิเกรทเต็ด รีเสิร์ช เซ็นเตอร์ จำกัด



Certificate of Calibration

Certificate Number : MB1-1843-2022

Page 1 of 2 Pages

Equipment : Electronic Balance

Manufacturer : Sartorius

Model : BSA224S-CW

Serial Number : 31591470

ID Number : N/A

Max Capacity : 220 (g)

Resolution : 0.0001 (g)

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor k , providing a level of confidence of approximately 95 %.The uncertainty evaluation has been carried out in accordance with UKAS M3003 requirements. This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI). This Certificate may not be reproduced other than in full except with the prior written approval of Calibration Center, Intro TSC Co.,Ltd.

Customer Reference : L087

Customer : INTEGRATED RESEARCH CENTER CO.,LTD.

CSRS No.: CSRS19851022

122 Moo 2, T. Thatoom,

Date of Receipt : 28-Oct-22

A. Srimahaphote, Prachinburi 25140

Date of Calibration : 31-Oct-22

Location : WATER LAP IP-1

Condition of this result of calibration

1. Reference Standard instruments :

Instruments	Model	Serial No.	Certificate No.	Due Date
Weight set (1 mg to 200 g)	Class E2	K-1871/20	10468/3149/20	22-Nov-22

2. This Certification is traceable to the International System of Unit maintained at : -

- National Institute of Metrology (Thailand)

3. This result of calibration was found accurate as shown on date and place of calibration only.

Method : Measurement In-house Method Calibration Procedure No. CP-CL-43 base on UKAS Publication Ref : Lab 14 : 2019

Environmental Conditions :

Temperature : (30 \pm 10) °C

Humidity : (50 \pm 20) %

Air Pressure : (1010 \pm 10) mbar

Calibrated By :

Date of Issued :

Approved Signatory :



INTRO TSC Company Limited

Calibration Center Measuring and Testing Instrument

46/155 Nualchan Rd., Nualchan, Bungkum, Bangkok 10230, Thailand

Tel : +66-2363-4417-21 Fax : +66-2363-4427 E-mail : info@intro.co.th

Certificate Number : MB1-1843-2022

Page 2 of 2 Pages

Calibration Result (Weight) : Without Adjustment

1. Repeatability of Reading

Nominal Value (g)	Standard Deviation (g)	Maximum diff. Between successive (g)
200	0.00000	0.0000

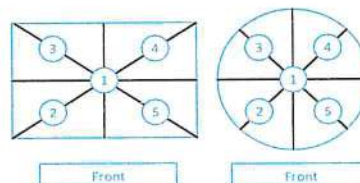
2. Error of indication from nominal value

Nominal Value (g)	Balance Reading (g)	Correction Value (g)	Uncertainty (\pm) (g)	factor k	Balance Reading Before Adjust (g)
Unload	0.0000	0.0000	0.000084	2.00	-
20	20.0000	0.0000	0.00010	2.00	-
40	40.0000	0.0000	0.00013	2.00	-
60	60.0000	0.0000	0.00021	2.00	-
80	80.0000	0.0000	0.00021	2.00	-
100	100.0000	0.0000	0.00022	2.00	-
120	120.0000	0.0000	0.00040	2.00	-
140	140.0000	0.0000	0.00040	2.00	-
160	160.0000	0.0000	0.00040	2.00	-
180	180.0000	0.0000	0.00040	2.00	-
200	200.0000	0.0000	0.00040	2.00	-

3. Eccentric or off-center loading

Nominal Value (g)	Reference Position				
	Position 1 (g)	Position 2 (g)	Position 3 (g)	Position 4 (g)	Position 5 (g)
100	100.0000	100.0000	100.0000	100.0000	100.0000

Eccentric Error = 0.0000 (g)



End of report

Nath



Certificate of Calibration

Certificate Number : MB1-1844-2022

Page 1 of 2 Pages

Equipment : Electronic Balance

Manufacturer : Sartorius

Model : ME36S

Serial Number : 27206085

ID Number : N/A

Max Capacity : 31000 (mg)

Resolution : 0.001 (mg)

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor k , providing a level of confidence of approximately 95 %. The uncertainty evaluation has been carried out in accordance with UKAS M3003 requirements. This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI). This Certificate may not be reproduced other than in full except with the prior written approval of Calibration Center, Intro TSC Co., Ltd.

Customer Reference : L087

Customer : INTEGRATED RESEARCH CENTER CO.,LTD.

CSRS No.: CSRS19851022

122 Moo 2, T. Thatoom,

Date of Receipt : 28-Oct-22

A. Srimahaphote, Prachinburi 25140

Date of Calibration : 31-Oct-22

Location : WATER LAB IP-1

Condition of this result of calibration

1. Reference Standard instruments :

Instruments	Model	Serial No.	Certificate No.	Due Date
Weight set (1 mg to 200 g)	Class E2	K-1871/20	10468/3149/20	22-Nov-22

2. This Certification is traceable to the International System of Unit maintained at : -

- National Institute of Metrology (Thailand)

3. This result of calibration was found accurate as shown on date and place of calibration only.

Method : Measurement In-house Method Calibration Procedure No. CP-CL-43 base on UKAS Publication Ref : Lab 14 : 2019

Environmental Conditions :

Temperature : (30 ± 10) °C

Humidity : (50 ± 20) %

Air Pressure : (1010 ± 10) mbar

Calibrated By :

Approved Signatory :

Date of Issued :

Ms.



INTRO TSC Company Limited

Calibration Center Measuring and Testing Instrument

46/155 Nualchan Rd., Nualchan, Bungkum, Bangkok 10230, Thailand
Tel : +66-2363-4417-21 Fax : +66-2363-4427 E-mail : info@intro.co.th

Certificate Number : MB1-1844-2022

Page 2 of 2 Pages

Calibration Result (Weight) : Without Adjustment

1. Repeatability of Reading

Nominal Value (mg)	Standard Deviation (mg)	Maximum diff. Between successive (mg)
30000	0.0008	0.002

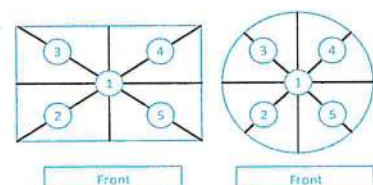
2. Error of indication from nominal value

Nominal Value (mg)	Balance Reading (mg)	Correction Value (mg)	Uncertainty (\pm) (mg)	factor k	Balance Reading Before Adjust (mg)
Unload	0.000	0.000	0.00084	2.00	-
3000	3000.003	-0.003	0.028	2.00	-
6000	6000.007	-0.007	0.040	2.00	-
9000	9000.016	-0.016	0.043	2.00	-
12000	11999.984	0.016	0.10	2.00	-
15000	14999.976	0.024	0.10	2.00	-
18000	17999.967	0.033	0.10	2.00	-
21000	20999.953	0.047	0.13	2.00	-
24000	23999.943	0.057	0.13	2.00	-
27000	26999.938	0.062	0.13	2.00	-
30000	29999.922	0.078	0.13	2.00	-

3. Eccentric or off-center loading

Nominal Value (mg)	Reference Position				
	Position 1 (mg)	Position 2 (mg)	Position 3 (mg)	Position 4 (mg)	Position 5 (mg)
10000	9999.997	9999.998	9999.988	9999.983	9999.988

Eccentric Error = 0.014 (mg)



End of report



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

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

Request No.23-66/0173

MTC.No.23-66/0173

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 : 13 January 2023

Condition of measured item : Normal

Calibration date : 19 January 2023

Standard :

Standard	Certificate No.	Date due	Traceability
RTD Thermometer	PSL-T 643/65	1-Jun-24	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

Calibrated by : ..

Approved by : ..

Director

Mechanical Engineering Standards Laboratory

Ref. 2013266011300154001

Issued Date 19 January 2023

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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.23-66/0173

2/2

MTC.No.23-66/0173

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 (%)
0.05655	0.055399	24.624	1006.36	+2.08	1.00
0.51386	0.50293	24.659	1006.60	+2.17	0.99
1.0232	1.0974	24.616	1006.84	-6.76	0.86
1.5371	1.5037	24.608	1007.10	+2.22	0.86
2.0531	2.0096	24.591	1007.36	+2.17	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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Request No. 22-66 / 0256

MTC No. PSL-H 0112 / 66

Certificate of Calibration

Customer : Integrated Research Center Company Limited
122, T.Thatoon, A.Srimahaphote, Prachinburi, 25140

Item : Thermo-Hygrometer (Thermal Environment Monitor)

Model /Type : HD32.2

Serial Number : 10027484

Manufacturer : Delta OHM

Date of Request : 24 January 2023

Date of Calibration : 6 February 2023

The certifies the above equipment was calibrated in accordance with the recognised International Standard ISO/IEC 17025:2017 and the operation according to procedure no. WI.CP.18.

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2$, which for a normal distribution corresponds to a coverage probability of approximately 95 %.

Calibrated by :

Approved by

Photometry and Temperature Standards Laboratory

Ref. No : 2012266012400292002

Issued Date : 13 February 2023

Page 1 of 4

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Request No. 22-66 / 0256

MTC No. PSL-H 0112 / 66

Description of Unit Under Calibration :

Customer : Integrated Research Center Company Limited
Address : 122, T.Thatoom, A.Srimahaphote, Prachinburi, 25140
Item : Thermo-Hygrometer (Thermal Environment Monitor)
Serial Number : 10027484
Calibration Required : Temperature at (20, 30, 40) °C
Ambient Condition : Ambient temperature (23 ± 3) °C
Relative humidity (55 ± 20) %
Laboratory Address : Photometry and Temperature Standards Laboratory
Soi 1, Bangpoo Industrial Estate, Sukhumvit Rd., Samutprakan

Reference Standard :

Digital Thermometer with Sensor, Model : F250H, S/N : 9345 008 2331, Sensor RTD Probe No. RTD-01 and RTD-02 which was calibrated by Industrial Metrology and Testing Service Centre, Certificate No. PSL-T 0786/65.

The temperature scale in use of this laboratory is the International Temperature Scale of 1990.

Calibration Procedure :

The certifies the above equipment was calibrated according to procedure no. WI.CP.18.

Support Equipment :

Temperature & Humidity Controlled Chamber, Model : 9141-5110, S/N : 1205101

Adjustments : NONE

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Request No. 22-66 / 0256

MTC No. PSL-H 0112 / 66

Results of Calibration :- (/) Without Adjustment () After Adjustment

Table : Temperature Measurement @ Wet Bulb (T_n)

Average Measured Temperature (°C)	Average Displayed of UUC (°C)	Correction Measured of UUC (°C)	Expanded Uncertainty of Measurement (± °C)
20.1	20.1	0.0	0.50
30.0	29.8	0.2	0.50
39.9	39.7	0.2	0.50

Table : Temperature Measurement @ Dry Bulb (T)

Average Measured Temperature (°C)	Average Displayed of UUC (°C)	Correction Measured of UUC (°C)	Expanded Uncertainty of Measurement (± °C)
20.1	20.2	-0.1	0.50
30.0	29.7	0.3	0.50
39.9	39.5	0.4	0.50

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Request No. 22-66 / 0256

MTC No. PSL-H 0112 / 66

Results of Calibration :-

Table : Temperature Measurement @ Globe Bulb (Tg)

Average Measured Temperature (°C)	Average Displayed of UUC (°C)	Correction Measured of UUC (°C)	Expanded Uncertainty of Measurement (± °C)
20.1	20.5	-0.4	0.50
30.0	30.0	0.0	0.50
39.9	39.8	0.1	0.50

- Note :**
1. This calibration was done without removing reservoir cover, white plates and blackened copper sphere of the instrument.
 2. The calibration data for instrument in this report is reported within the condition existing at the time of measurement only.

...end of certificate...

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Request No. 22-66 / 0256

MTC No. PSL-H 0111 / 66

Certificate of Calibration

Customer : Integrated Research Center Company Limited
122, T.Thatoom, A.Srimahaphote, Prachinburi, 25140

Item : Thermo-Hygrometer (Thermal Environment Monitor)

Model /Type : HD32.2

Serial Number : 10027485

Manufacturer : Delta OHM

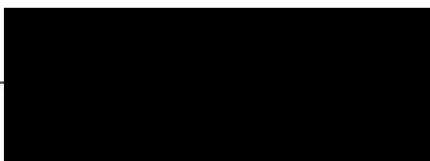
Date of Request : 24 January 2023

Date of Calibration : 6 February 2023

The certifies the above equipment was calibrated in accordance with the recognised International Standard ISO/IEC 17025:2017 and the operation according to procedure no. WI.CP.18.

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2$, which for a normal distribution corresponds to a coverage probability of approximately 95 %.

Calibrated by :



Approved by :



Photometry and Temperature Standards Laboratory

Ref. No : 2012266012400292001

Issued Date : 13 February 2023

Page 1 of 4

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Request No. 22-66 / 0256

MTC No. PSL-H 0111 / 66

Description of Unit Under Calibration :

Customer : Integrated Research Center Company Limited
Address : 122, T.Thatoon, A.Srimahaphote, Prachinburi, 25140
Item : Thermo-Hygrometer (Thermal Environment Monitor)
Serial Number : 10027485
Calibration Required : Temperature at (20, 30, 40) °C
Ambient Condition : Ambient temperature (23 ± 3) °C
Relative humidity (55 ± 20) %
Laboratory Address : Photometry and Temperature Standards Laboratory
Soi 1, Bangpoo Industrial Estate, Sukhumvit Rd., Samutprakan

Reference Standard :

Digital Thermometer with Sensor, Model : F250H, S/N : 9345 008 2331, Sensor RTD Probe No. RTD-01 and RTD-02 which was calibrated by Industrial Metrology and Testing Service Centre, Certificate No. PSL-T 0786/65.

The temperature scale in use of this laboratory is the International Temperature Scale of 1990.

Calibration Procedure :

The certifies the above equipment was calibrated according to procedure no. WI.CP.18.

Support Equipment :

Temperature & Humidity Controlled Chamber, Model : 9141-5110, S/N : 1205101

Adjustments : NONE

Head Office

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Request No. 22-66 / 0256

MTC No. PSL-H 0111 / 66

Results of Calibration :- (/) Without Adjustment () After Adjustment

Table : Temperature Measurement @ Wet Bulb (T_n)

Average Measured Temperature (°C)	Average Displayed of UUC (°C)	Correction Measured of UUC (°C)	Expanded Uncertainty of Measurement (± °C)
20.1	20.1	0.0	0.50
30.0	29.7	0.3	0.50
39.9	39.6	0.3	0.50

Table : Temperature Measurement @ Dry Bulb (T)

Average Measured Temperature (°C)	Average Displayed of UUC (°C)	Correction Measured of UUC (°C)	Expanded Uncertainty of Measurement (± °C)
20.1	20.1	0.0	0.50
30.0	29.5	0.5	0.50
39.9	39.4	0.5	0.50

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Request No. 22-66 / 0256

MTC No. PSL-H 0111 / 66

Results of Calibration :-

Table : Temperature Measurement @ Globe Bulb (Tg)

Average Measured Temperature (°C)	Average Displayed of UUC (°C)	Correction Measured of UUC (°C)	Expanded Uncertainty of Measurement (± °C)
20.1	20.3	-0.2	0.50
30.0	29.8	0.2	0.50
39.9	39.6	0.3	0.50

- Note :**
1. This calibration was done without removing reservoir cover, white plates and blackened copper sphere of the instrument.
 2. The calibration data for instrument in this report is reported within the condition existing at the time of measurement only.

...end of certificate...

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Request No. 22-66 / 0256

MTC No. PSL-H 0113 / 66

Certificate of Calibration

Customer : Integrated Research Center Company Limited
122, T.Thatoon, A.Srimahaphote, Prachinburi, 25140

Item : Thermo-Hygrometer (Thermal Environment Monitor)

Model /Type : HD32.2

Serial Number : 10027486

Manufacturer : Delta OHM

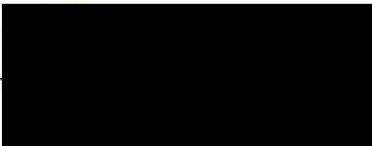
Date of Request : 24 January 2023

Date of Calibration : 6 February 2023

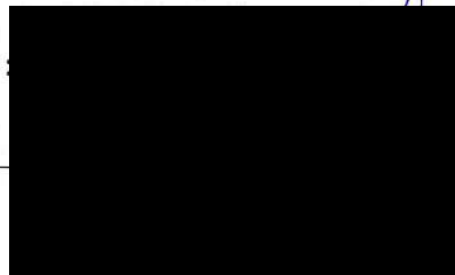
The certifies the above equipment was calibrated in accordance with the recognised International Standard ISO/IEC 17025:2017 and the operation according to procedure no. WI.CP.18.

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2$, which for a normal distribution corresponds to a coverage probability of approximately 95 %.

Calibrated by :



Approved by :



Photometry and Temperature Standards Laboratory

Ref. No : 2012266012400292003

Issued Date : 13 February 2023

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Request No. 22-66 / 0256

MTC No. PSL-H 0113 / 66

Description of Unit Under Calibration :

Customer : Integrated Research Center Company Limited
Address : 122, T.Thatoom, A.Srimahaphote, Prachinburi, 25140
Item : Thermo-Hygrometer (Thermal Environment Monitor)
Serial Number : 10027486
Calibration Required : Temperature at (20, 30, 40) °C
Ambient Condition : Ambient temperature $(23 \pm 3) ^\circ\text{C}$
Relative humidity $(55 \pm 20) \%$
Laboratory Address : Photometry and Temperature Standards Laboratory
Soi 1, Bangpoo Industrial Estate, Sukhumvit Rd., Samutprakan

Reference Standard :

Digital Thermometer with Sensor, Model : F250H, S/N : 9345 008 2331, Sensor RTD Probe No. RTD-01 and RTD-02 which was calibrated by Industrial Metrology and Testing Service Centre, Certificate No. PSL-T 0786/65.

The temperature scale in use of this laboratory is the International Temperature Scale of 1990.

Calibration Procedure :

The certifies the above equipment was calibrated according to procedure no. WI.CP.18.

Support Equipment :

Temperature & Humidity Controlled Chamber, Model : 9141-5110, S/N : 1205101

Adjustments : NONE

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Request No. 22-66 / 0256

MTC No. PSL-H 0113 / 66

Results of Calibration :- (/) Without Adjustment () After Adjustment

Table : Temperature Measurement @ Wet Bulb (T_w)

Average Measured Temperature (°C)	Average Displayed of UUC (°C)	Correction Measured of UUC (°C)	Expanded Uncertainty of Measurement (± °C)
20.1	20.0	0.1	0.50
30.0	29.8	0.2	0.50
39.9	39.7	0.2	0.50

Table : Temperature Measurement @ Dry Bulb (T)

Average Measured Temperature (°C)	Average Displayed of UUC (°C)	Correction Measured of UUC (°C)	Expanded Uncertainty of Measurement (± °C)
20.1	20.1	0.0	0.50
30.0	29.9	0.1	0.50
39.9	39.8	0.1	0.50

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Request No. 22-66 / 0256

MTC No. PSL-H 0113 / 66

Results of Calibration :-

Table : Temperature Measurement @ Globe Bulb (Tg)

Average Measured Temperature (°C)	Average Displayed of UUC (°C)	Correction Measured of UUC (°C)	Expanded Uncertainty of Measurement (± °C)
20.1	20.2	-0.1	0.50
30.0	29.8	0.2	0.50
39.9	39.6	0.3	0.50

- Note :**
1. This calibration was done without removing reservoir cover, white plates and blackened copper sphere of the instrument.
 2. The calibration data for instrument in this report is reported within the condition existing at the time of measurement only.

...end of certificate...

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63/14-15, 67/35-36
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Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TISI-TIS 17025
CALIBRATION 0367

Flow measurement laboratory
Calibration services department.



CERTIFICATE OF CALIBRATION

Certificate No. : CL-008-66

Page 1 of 2 Pages

MEASUREMENT ITEM : Top Load Orifice
MANUFACTURER : TISCH
MODEL/TYPE : TE-5028A
SERIAL NUMBER : 2926
ID NUMBER : -
CONDITION AS-RECEIVED : Used item
CUSTOMER : Integrated Research Center Company Limited.
122 Moo 2, Thatoom, Srimahaphote, Prachinburi 25140,
Thailand.

RECEIVED DATE : 20 Mar 2023
MEASUREMENT DATE : 24 Apr 2023
ISSUE DATE : 24 Apr 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature	: 23.0 ± 3.0	°C
Relative Humidity	: 55.0 ± 15.0	%RH
Atmospheric Pressure	: 1010 ± 10	hPa

CALIBRATION CONDITION:

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are 24.4 °C and 51.3%RH.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibration procedure:

The Orifice gas flow device was calibrated against Standard Rotary Displacement Meter (Roots Meter) Model G65/IMC/W2-dp. The WI-CL-004 was used as a calibration guideline.

Traceability:

This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the VSL (National Metrology Institute of Netherlands) via Certificate number: G2211901

Uncertainty of Measurement:

The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor $k=2$, Which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM 'Evaluation of measurement data - Guide to the expression of uncertainty in measurement'

Calibrated by:

- ☐ Mr. Sorawit Thachalad
☒ Miss Jitraporn Lertsomphol



Approved signatory: ...

MEASUREMENT RESULTS:

The Orifice gas flow device was calibrated by direct comparison method with the Standard Rotary Displacement Meter (Roots Meter). The Humid air was used as a medium in the system. The standard conditions are 25°C (298.15 K) and 760 mmHg for standard temperature and standard pressure respectively.

Table 1: The results of Q Standard calibration data

Plate	Flow rate m^3/min	Pressure [Pa] mmHg	Temperature [Ta] °C	Temperature [Tm] °C	Δp_{meter} mmHg	$\Delta p_{Orifice}$ inH ₂ O	γ	Standard Flow [Q_s] m^3/min
1	0.705	758.329	24.44	23.77	50.462	1.122	1.059	0.659
2	1.001	758.356	24.29	23.90	36.610	2.376	1.542	0.954
3	1.117	758.415	24.01	23.47	31.484	3.004	1.734	1.074
4	1.166	758.484	23.86	23.34	29.640	3.290	1.815	1.124
5	1.418	758.544	23.98	23.51	18.777	5.030	2.245	1.387

Slope (m): 1.62707
 Intercept (b): -0.01273
 Correlation coefficient (r): 0.99981
 Uncertainty ($k=2$): 0.015 m^3/min

Table 2: The results of Q actual calibration data

Plate	Flow rate m^3/min	Pressure [Pa] mmHg	Temperature [Ta] °C	Temperature [Tm] °C	Δp_{meter} mmHg	$\Delta p_{Orifice}$ inH ₂ O	γ	Standard Flow [Q_s] m^3/min
1	0.705	758.329	24.44	23.77	50.462	1.122	0.664	0.659
2	1.001	758.356	24.29	23.90	36.610	2.376	0.965	0.954
3	1.117	758.415	24.01	23.47	31.484	3.004	1.085	1.073
4	1.166	758.484	23.86	23.34	29.640	3.290	1.135	1.122
5	1.418	758.544	23.98	23.51	18.777	5.030	1.404	1.385

Slope (m): 1.01912
 Intercept (b): -0.00799
 Correlation coefficient (r): 0.99981
 Uncertainty ($k = 2$): 0.015 m^3/min

End of Certificate of Calibration



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 135/0166

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 of instrument was 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 : 13 Jan. 2023

Date of Calibration : 18 Jan. 2023

1 /

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 135/0166

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°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	± 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	999.9	-0.1	± 1.5	$\pm 1.0\%$

3. Total distortion

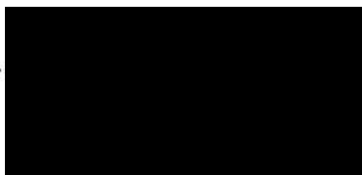
Standard Microphone Type	Measured Total distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	2.15	± 0.50	$\pm 3.0\%$

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :



Approved by :



Director
TISTR

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 18 Jan. 2023

Date of Issue : 19 Jan. 2023

Ref : 2011266011300149001

End of Certificate

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 136/0166

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

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 : 13 Jan. 2023

Date of Calibration : 18 Jan. 2023

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 136/0166

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 °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 Brüel&Kjaer 4180	93.98	-0.02	± 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 Brüel&Kjaer 4180	1001.5	1.5	± 1.5	$\pm 1.0\%$

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjaer 4180	1.00	± 0.50	$\pm 3.0\%$

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was included at level of 0.16 dB from manual.

Calibrated by :



Approved by :



Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 18 Jan. 2023

Date of Issue : 19 Jan. 2023

Ref : 2011266011300149002

End of Certificate

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 144/0166

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 : ACO
Model : 6236
Serial No. : 192014
Microphone : 7052NR No.73303
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 : 13 Jan. 2023

Date of Calibration : 13 Feb. 2023

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 144/0166

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 (2013). 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 : 13 Feb. 2023

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 144/0166

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value(dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
114.00	113.9	114.0	0.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 114.1 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
19.7	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	13.1	0.10	N/A
C-Weight	18.0	0.10	N/A
Flat	21.9	0.10	N/A

Date of Calibration : 13 Feb. 2023

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 144/0166

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve(dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.1	0.1	0.0	1.5	0.45	0.6
1 000	-0.6	-0.6	-0.5	1.0	0.45	0.6
8 000	-2.3	-2.5	-2.1	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve(dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	0.1	0.0	-0.1	2.0	0.20	0.6
125	0.0	0.0	-0.1	1.5	0.20	0.6
250	0.0	0.0	0.0	1.5	0.20	0.6
500	0.0	0.0	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	-0.1	0.0	-0.1	2.0	0.20	0.6
4 000	-0.4	-0.4	-0.1	3.0	0.20	0.6
8 000	-0.6	-0.6	-0.2	5.0	0.20	0.7

Date of Calibration : 13 Feb. 2023

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FM.BL.MTC.002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 144/0166

5. Long-term stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.1	0.1	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

Date of Calibration : 13 Feb. 2023

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 144/0166

7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
120	120.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	113.9	-0.1	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	88.9	-0.1	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3
64	63.9	-0.1	1.1	0.30	0.3
59	58.9	-0.1	1.1	0.30	0.3
54	53.9	-0.1	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	38.9	-0.1	1.1	0.30	0.3

Date of Calibration : 13 Feb. 2023

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Request No. 21-66/0219

MTC No. EEL. BP. 144/0166

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

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
34	34.0	0.0	1.1	0.30	0.3
33	33.0	0.0	1.1	0.30	0.3
32	32.1	0.1	1.1	0.30	0.3
31	31.1	0.1	1.1	0.30	0.3
30	30.2	0.2	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
40-130	94.0	94.0	0.0	1.1	0.30	0.3
30-120	94.0	94.0	0.0	1.1	0.30	0.3
20-110	94.0	94.0	0.0	1.1	0.30	0.3
20-100	94.0	94.0	0.0	1.1	0.30	0.3

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8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	45	45.0	0.0	1.1	0.30	0.3
30-120	35	35.0	0.0	1.1	0.30	0.3
20-110	25	25.3	0.3	1.1	0.30	0.3
20-100	25	25.3	0.3	1.1	0.30	0.3
20-90	25	25.2	0.2	1.1	0.30	0.3
20-80	25	25.0	0.0	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb(ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	116.0	0.0	±1.0	0.20	0.3
	2	98.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	89.2	-0.8	+1.5; -5.0	0.20	0.3
Slow	200	109.5	-0.1	±1.0	0.20	0.3
	2	89.8	-0.2	+1.0; -5.0	0.20	0.3
SEL	200	109.9	-0.1	±1.0	0.20	0.3
	2	90.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

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Request No. 21-66/0219

MTC No. EEL. BP. 144/0166

10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.8	0.4	3.0	0.20	0.35
Positive half cycle	124.4	124.2	-0.2	2.0	0.20	0.35
Negative half cycle	124.4	124.2	-0.2	2.0	0.20	0.35

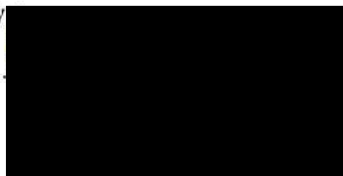
11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
133.0	133.0	0.0	1.5	0.20	0.25

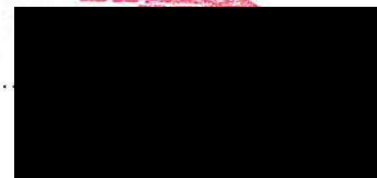
12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by



Approved by :



Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 13 Feb. 2023

Date of Issue : 13 Feb. 2023

Ref : 2011266011300149010

End of Certificate

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 145/0166

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 : ACO
Model : 6236
Serial No. : 192015
Microphone : 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 : 13 Jan. 2023

Date of Calibration : 13 Feb. 2023

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Request No. 21-66/0219

MTC No. EEL. BP. 145/0166

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 (2013). 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 : 13 Feb. 2023

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 145/0166

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value(dB)	Acceptance limit class 2(\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
	Before adjust	After adjust				
114.00	112.0	114.0	0.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 115.8 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
19.8	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
A-Weight	15.6	0.10	N/A
C-Weight	21.2	0.10	N/A
Flat	25.6	0.10	N/A

Date of Calibration : 13 Feb. 2023

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Request No. 21-66/0219

MTC No. EEL. BP. 145/0166

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve(dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.1	-0.1	-0.2	1.5	0.45	0.6
1 000	0.0	0.0	0.1	1.0	0.45	0.6
8 000	-2.5	-2.1	-1.7	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve(dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	0.1	0.0	-0.1	2.0	0.20	0.6
125	0.1	0.0	0.0	1.5	0.20	0.6
250	0.0	0.0	0.0	1.5	0.20	0.6
500	0.0	0.0	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	0.0	0.0	-0.1	2.0	0.20	0.6
4 000	-0.4	-0.3	-0.1	3.0	0.20	0.6
8 000	-0.6	-0.6	-0.2	5.0	0.20	0.7

Date of Calibration : 13 Feb. 2023

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5. Long-term stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.1	0.1	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
120	120.0	0.0	1.1	0.30	0.3
119	119.1	0.1	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.1	0.1	1.1	0.30	0.3
74	74.2	0.2	1.1	0.30	0.3
69	69.1	0.1	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3
54	54.0	0.0	1.1	0.30	0.3
49	49.1	0.1	1.1	0.30	0.3
44	44.1	0.1	1.1	0.30	0.3
39	39.1	0.1	1.1	0.30	0.3

Date of Calibration : 13 Feb. 2023

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

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
34	34.2	0.2	1.1	0.30	0.3
33	33.2	0.2	1.1	0.30	0.3
32	32.3	0.3	1.1	0.30	0.3
31	31.3	0.3	1.1	0.30	0.3
30	30.4	0.4	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
40-130	94.0	94.0	0.0	1.1	0.30	0.3
30-120	94.0	94.0	0.0	1.1	0.30	0.3
20-110	94.0	94.0	0.0	1.1	0.30	0.3
20-100	94.0	93.9	-0.1	1.1	0.30	0.3

Date of Calibration : 13 Feb. 2023

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Request No. 21-66/0219

MTC No. EEL. BP. 145/0166

8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	45	45.0	0.0	1.1	0.30	0.3
30-120	35	35.0	0.0	1.1	0.30	0.3
20-110	25	25.3	0.3	1.1	0.30	0.3
20-100	25	25.3	0.3	1.1	0.30	0.3
20-90	25	25.3	0.3	1.1	0.30	0.3
20-80	25	25.1	0.1	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb(ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	115.8	-0.2	±1.0	0.20	0.3
	2	98.0	-1.0	+1.0; -2.5	0.20	0.3
	0.25	89.2	-0.8	+1.5; -5.0	0.20	0.3
Slow	200	109.3	-0.3	±1.0	0.20	0.3
	2	89.7	-0.3	+1.0; -5.0	0.20	0.3
SEL	200	109.8	-0.2	±1.0	0.20	0.3
	2	89.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

Date of Calibration : 13 Feb. 2023

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10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.8	0.4	3.0	0.20	0.35
Positive half cycle	124.4	124.3	-0.1	2.0	0.20	0.35
Negative half cycle	124.4	124.3	-0.1	2.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
133.0	133.0	0.0	1.5	0.20	0.25

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by :

.....

Approved by :

.....

Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 13 Feb. 2023

Date of Issue : 13 Feb. 2023

Ref : 2011266011300149011

End of Certificate

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Request No. 21-66/0219

MTC No. EEL. BP. 140/0166

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 : ACO
Model : 6236
Serial No. : 212014
Microphone : 7052NR No.76235
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 : 13 Jan. 2023

Date of Calibration : 10 Feb. 2023

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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 (2013). 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 Feb. 2023

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Request No. 21-66/0219

MTC No. EEL. BP. 140/0166

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value(dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
114.00	114.1	114.0	0.0	1.0	0.30	N/A

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)	Maximum-permitted uncertainty of measurement (±dB)
19.9	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	13.4	0.10	N/A
C-Weight	19.0	0.10	N/A
Flat	23.9	0.10	N/A

Date of Calibration : 10 Feb. 2023

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Request No. 21-66/0219

MTC No. EEL. BP. 140/0166

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve(dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.1	-0.1	-0.1	1.5	0.45	0.6
1 000	-0.5	-0.5	-0.5	1.0	0.45	0.6
8 000	0.6	0.6	1.2	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve(dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	0.3	0.0	0.0	2.0	0.20	0.6
125	0.1	0.0	0.0	1.5	0.20	0.6
250	0.1	0.0	0.0	1.5	0.20	0.6
500	0.1	0.0	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	-0.1	0.0	0.0	2.0	0.20	0.6
4 000	-0.4	-0.3	-0.1	3.0	0.20	0.6
8 000	-0.6	-0.6	-0.2	5.0	0.20	0.7

Date of Calibration : 10 Feb. 2023

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5. Long-term stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.0	0.0	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
120	120.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	83.9	-0.1	1.1	0.30	0.3
79	79.1	0.1	1.1	0.30	0.3
74	74.1	0.1	1.1	0.30	0.3
69	69.1	0.1	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3
54	54.0	0.0	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	39.0	0.0	1.1	0.30	0.3

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

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
34	34.1	0.1	1.1	0.30	0.3
33	33.1	0.1	1.1	0.30	0.3
32	32.2	0.2	1.1	0.30	0.3
31	31.2	0.2	1.1	0.30	0.3
30	30.3	0.3	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
40-130	94.0	94.0	0.0	1.1	0.30	0.3
30-120	94.0	94.0	0.0	1.1	0.30	0.3
20-110	94.0	94.0	0.0	1.1	0.30	0.3
20-100	94.0	93.9	-0.1	1.1	0.30	0.3

Date of Calibration : 10 Feb. 2023

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8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
40-130	45	45.0	0.0	1.1	0.30	0.3
30-120	35	35.0	0.0	1.1	0.30	0.3
20-110	25	25.4	0.4	1.1	0.30	0.3
20-100	25	25.3	0.3	1.1	0.30	0.3
20-90	25	25.3	0.3	1.1	0.30	0.3
20-80	25	25.1	0.1	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb(ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
Fast	200	115.9	-0.1	± 1.0	0.20	0.3
	2	98.3	-0.7	+1.0; -2.5	0.20	0.3
	0.25	89.5	-0.5	+1.5; -5.0	0.20	0.3
Slow	200	109.4	-0.2	± 1.0	0.20	0.3
	2	89.8	-0.2	+1.0; -5.0	0.20	0.3
SEL	200	109.9	-0.1	± 1.0	0.20	0.3
	2	89.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

Date of Calibration : 10 Feb. 2023

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Request No. 21-66/0219

MTC No. EEL. BP. 140/0166

10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.8	0.4	3.0	0.20	0.35
Positive half cycle	124.4	124.3	-0.1	2.0	0.20	0.35
Negative half cycle	124.4	124.3	-0.1	2.0	0.20	0.35

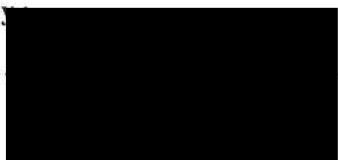
11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
133.0	133.0	0.0	1.5	0.20	0.25

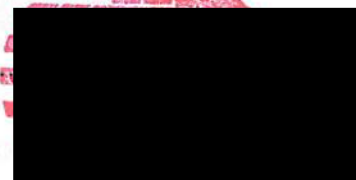
12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by



Approved by :



Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Ref : 2011266011300149006

Date of Calibration : 10 Feb. 2023

Date of Issue : 10 Feb. 2023

End of Certificate

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 138/0166

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 : ACO
Model : 6236
Serial No. : 212015
Microphone : 7052NR No.76236
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 : 13 Jan. 2023

Date of Calibration : 9 Feb. 2023

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Request No. 21-66/0219

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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 (2013). 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 : 9 Feb. 2023

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Request No. 21-66/0219

MTC No. EEL. BP. 138/0166

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value(dB)	Acceptance limit class 2(\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
	Before adjust	After adjust				
114.02	114.4	114.0	0.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 113.8 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
19.8	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
A-Weight	13.2	0.10	N/A
C-Weight	18.6	0.10	N/A
Flat	23.7	0.10	N/A

Date of Calibration : 9 Feb. 2023

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Request No. 21-66/0219

MTC No. EEL. BP. 138/0166

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve(dB)			Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
	A-weight	C-weight	Flat			
125	0.4	0.3	0.3	1.5	0.45	0.6
1 000	-0.8	-0.8	-0.8	1.0	0.45	0.6
8 000	-1.2	-1.2	-0.8	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve(dB)			Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
	A-weight	C-weight	Flat			
63	0.1	0.0	0.0	2.0	0.20	0.6
125	0.0	0.0	0.0	1.5	0.20	0.6
250	0.0	0.0	0.0	1.5	0.20	0.6
500	0.0	0.0	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	-0.1	0.0	0.0	2.0	0.20	0.6
4 000	-0.4	-0.4	0.0	3.0	0.20	0.6
8 000	-0.6	-0.7	-0.2	5.0	0.20	0.7

Date of Calibration : 9 Feb. 2023

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Request No. 21-66/0219

MTC No. EEL. BP. 138/0166

5. Long-term stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.0	0.0	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

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MTC No. EEL. BP. 138/0166

7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
120	120.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	83.9	-0.1	1.1	0.30	0.3
79	79.1	0.1	1.1	0.30	0.3
74	74.2	0.2	1.1	0.30	0.3
69	69.1	0.1	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3
54	54.0	0.0	1.1	0.30	0.3
49	49.1	0.1	1.1	0.30	0.3
44	44.1	0.1	1.1	0.30	0.3
39	39.0	0.0	1.1	0.30	0.3

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

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
34	34.1	0.1	1.1	0.30	0.3
33	33.1	0.1	1.1	0.30	0.3
32	32.1	0.1	1.1	0.30	0.3
31	31.2	0.2	1.1	0.30	0.3
30	30.3	0.3	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
40-130	94.0	93.9	-0.1	1.1	0.30	0.3
30-120	94.0	94.0	0.0	1.1	0.30	0.3
20-110	94.0	93.9	-0.1	1.1	0.30	0.3
20-100	94.0	93.9	-0.1	1.1	0.30	0.3

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8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
40-130	45	45.0	0.0	1.1	0.30	0.3
30-120	35	35.0	0.0	1.1	0.30	0.3
20-110	25	25.4	0.4	1.1	0.30	0.3
20-100	25	25.3	0.3	1.1	0.30	0.3
20-90	25	25.1	0.1	1.1	0.30	0.3
20-80	25	25.0	0.0	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb(ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
Fast	200	115.9	-0.1	± 1.0	0.20	0.3
	2	98.6	-0.4	+1.0; -2.5	0.20	0.3
	0.25	89.2	-0.8	+1.5; -5.0	0.20	0.3
Slow	200	109.5	-0.1	± 1.0	0.20	0.3
	2	89.8	-0.2	+1.0; -5.0	0.20	0.3
SEL	200	109.8	-0.2	± 1.0	0.20	0.3
	2	89.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

Date of Calibration : 9 Feb. 2023

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Request No. 21-66/0219

MTC No. EEL. BP. 138/0166

10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.8	0.4	3.0	0.20	0.35
Positive half cycle	124.4	124.3	-0.1	2.0	0.20	0.35
Negative half cycle	124.4	124.3	-0.1	2.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
133.0	133.0	0.0	1.5	0.20	0.25

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by :

.....

Approved by :

.....

Director

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 9 Feb. 2023

Date of Issue : 10 Feb. 2023

Ref : 2011266011300149004

End of Certificate

9 / 9

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FM.BL.MTC.002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 139/0166

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 : ACO
Model : 6236
Serial No. : 212016
Microphone : 7052NR No.76237
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 : 13 Jan. 2023

Date of Calibration : 10 Feb. 2023

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Request No. 21-66/0219

MTC No. EEL. BP. 139/0166

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 (2013). 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 Feb. 2023

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 139/0166

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value(dB)	Acceptance limit class 2(\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
	Before adjust	After adjust				
114.00	114.5	114.0	0.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 113.6 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
20.1	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
A-Weight	13.9	0.10	N/A
C-Weight	18.7	0.10	N/A
Flat	23.6	0.10	N/A

Date of Calibration : 10 Feb. 2023

3 / 9

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FM.BL.MTC.002 Rev.4

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve(dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.1	0.0	-0.1	1.5	0.45	0.6
1 000	-0.9	-0.9	-0.7	1.0	0.45	0.6
8 000	0.4	0.4	0.7	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve(dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	0.1	0.0	0.0	2.0	0.20	0.6
125	0.1	0.0	0.0	1.5	0.20	0.6
250	0.0	0.0	0.0	1.5	0.20	0.6
500	0.0	0.0	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	-0.1	-0.1	0.0	2.0	0.20	0.6
4 000	-0.4	-0.4	-0.1	3.0	0.20	0.6
8 000	-0.6	-0.6	-0.2	5.0	0.20	0.7

Date of Calibration : 10 Feb. 2023

4 / 9

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5. Long-term stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.1	0.1	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

Date of Calibration : 10 Feb. 2023

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 139/0166

7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
120	120.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	113.9	-0.1	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	103.9	-0.1	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	88.9	-0.1	1.1	0.30	0.3
84	83.9	-0.1	1.1	0.30	0.3
79	79.1	0.1	1.1	0.30	0.3
74	74.1	0.1	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3
64	63.9	-0.1	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3
54	53.9	-0.1	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	39.0	0.0	1.1	0.30	0.3

Date of Calibration : 10 Feb. 2023

6 / 9

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FM.BL.MTC.002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 139/0166

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

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
34	34.0	0.0	1.1	0.30	0.3
33	33.0	0.0	1.1	0.30	0.3
32	32.1	0.1	1.1	0.30	0.3
31	31.1	0.1	1.1	0.30	0.3
30	30.2	0.2	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
40-130	94.0	93.9	-0.1	1.1	0.30	0.3
30-120	94.0	94.0	0.0	1.1	0.30	0.3
20-110	94.0	93.9	-0.1	1.1	0.30	0.3
20-100	94.0	93.9	-0.1	1.1	0.30	0.3

Date of Calibration : 10 Feb. 2023

7 / 9

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 139/0166

8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	45	45.0	0.0	1.1	0.30	0.3
30-120	35	35.0	0.0	1.1	0.30	0.3
20-110	25	25.1	0.1	1.1	0.30	0.3
20-100	25	25.2	0.2	1.1	0.30	0.3
20-90	25	25.2	0.2	1.1	0.30	0.3
20-80	25	25.1	0.1	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb(ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	115.8	-0.2	±1.0	0.20	0.3
	2	98.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	89.8	-0.2	+1.5; -5.0	0.20	0.3
Slow	200	109.5	-0.1	±1.0	0.20	0.3
	2	89.8	-0.2	+1.0; -5.0	0.20	0.3
SEL	200	110.0	0.0	±1.0	0.20	0.3
	2	90.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

Date of Calibration : 10 Feb. 2023

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 139/0166

10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.8	0.4	3.0	0.20	0.35
Positive half cycle	124.4	124.2	-0.2	2.0	0.20	0.35
Negative half cycle	124.4	124.2	-0.2	2.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
133.0	133.0	0.0	1.5	0.20	0.25

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by :

.....

Approved by :

.....

Director
TISTR

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 10 Feb. 2023

Date of Issue : 10 Feb. 2023

Ref : 2011266011300149005

End of Certificate

9 / 9

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 143/0166

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 : UC-52 No.153069
Preamplifier : 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 : 13 Jan. 2023

Date of Calibration : 9 Feb. 2023

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 143/0166

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 (2013). 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 : 9 Feb. 2023

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0219

MTC No. EEL. BP. 143/0166

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value(dB)	Acceptance limit class 2(\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
	Before adjust	After adjust				
113.97	118.0	114.0	0.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 114.3 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
16.7	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
A-Weight	13.6	0.10	N/A
C-Weight	18.8	0.10	N/A
Flat	24.1	0.10	N/A

Date of Calibration : 9 Feb. 2023

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Request No. 21-66/0219

MTC No. EEL. BP. 143/0166

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve(dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.0	0.1	0.1	1.5	0.45	0.6
1 000	0.0	0.0	0.0	1.0	0.45	0.6
8 000	-1.7	-1.7	-1.8	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve(dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	0.0	0.1	0.1	2.0	0.20	0.6
125	0.0	0.1	0.1	1.5	0.20	0.6
250	0.0	0.1	0.1	1.5	0.20	0.6
500	0.0	0.1	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	-0.2	-0.1	-0.1	2.0	0.20	0.6
4 000	-0.3	-0.3	-0.3	3.0	0.20	0.6
8 000	0.0	0.0	0.0	5.0	0.20	0.7

Date of Calibration : 9 Feb. 2023

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Request No. 21-66/0219

MTC No. EEL. BP. 143/0166

5. Long-term stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.0	0.0	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

Date of Calibration : 9 Feb. 2023

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Request No. 21-66/0219

MTC No. EEL. BP. 143/0166

7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
128	127.9	-0.1	1.1	0.30	0.3
127	127.0	0.0	1.1	0.30	0.3
126	125.9	-0.1	1.1	0.30	0.3
125	124.9	-0.1	1.1	0.30	0.3
124	123.9	-0.1	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3
64	63.9	-0.1	1.1	0.30	0.3
59	58.9	-0.1	1.1	0.30	0.3
54	53.9	-0.1	1.1	0.30	0.3
49	48.9	-0.1	1.1	0.30	0.3

Date of Calibration : 9 Feb. 2023

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Request No. 21-66/0219

MTC No. EEL. BP. 143/0166

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

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
44	43.9	-0.1	1.1	0.30	0.3
39	38.9	-0.1	1.1	0.30	0.3
34	33.9	-0.1	1.1	0.30	0.3
29	28.9	-0.1	1.1	0.30	0.3
24	23.9	-0.1	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
80-130	94.0	94.0	0.0	1.1	0.30	0.3
70-120	94.0	94.0	0.0	1.1	0.30	0.3
60-110	94.0	94.0	0.0	1.1	0.30	0.3
50-100	94.0	94.0	0.0	1.1	0.30	0.3

Date of Calibration : 9 Feb. 2023

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8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
80-130	85	85.0	0.0	1.1	0.30	0.3
70-120	75	75.0	0.0	1.1	0.30	0.3
60-110	65	65.0	0.0	1.1	0.30	0.3
50-100	55	54.9	-0.1	1.1	0.30	0.3
40-90	45	44.9	-0.1	1.1	0.30	0.3
30-80	35	35.0	0.0	1.1	0.30	0.3
20-70	25	25.0	0.0	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb(ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	116.0	0.0	±1.0	0.20	0.3
	2	99.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	89.9	-0.1	+1.5; -5.0	0.20	0.3
Slow	200	109.5	-0.1	±1.0	0.20	0.3
	2	89.9	-0.1	+1.0; -5.0	0.20	0.3
SEL	200	110.0	0.0	±1.0	0.20	0.3
	2	90.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

Date of Calibration : 9 Feb. 2023

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Request No. 21-66/0219

MTC No. EEL. BP. 143/0166

10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.3	-0.1	3.0	0.20	0.35
Positive half cycle	124.4	124.1	-0.3	2.0	0.20	0.35
Negative half cycle	124.4	124.1	-0.3	2.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
136.5	136.5	0.0	1.5	0.20	0.25

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by :

.....

Approved by :

.....

Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 9 Feb. 2023

Date of Issue : 9 Feb. 2023

Ref : 2011266011300149009

End of Certificate

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CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer:	BANGKOK INDUSTRIAL GAS CO LTD	Customer PO Number: 5222002512
Part Number:	E02NI99E15AC255	Reference Number: 160-402443704-1
Cylinder Number:	EB0152519	Cylinder Volume: 144.0 CF
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure: 2015 PSIG
PGVP Number:	A12022	Valve Outlet: 330
Gas Code:	H2S,BALN	Certification Date: May 31, 2022

Expiration Date: May 31, 2025

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 mole/mole 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
HYDROGEN SULFIDE	50.00 PPM	49.58 PPM	G1	+/- 2.0% NIST Traceable	05/23/2022, 05/31/2022
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
GMIS	122401193440103	CC215534	49.62 PPM HYDROGEN SULFIDE/NITROGEN	+/-0.7%	Jul 15, 2023
RGM	12338	CC162437	49.14 PPM HYDROGEN SULFIDE/NITROGEN	+/-0.7%	Jan 25, 2021

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
AAI-OMA406-AA210275	NDUV	May C4, 2022

Triad Data Available Upon Request

PERMANENT NOTES: PRODUCED IN ACCORDANCE WITH ISO17025 REQUIREMENTS

K=2 95% UNCERTAINTY

NOTES: PRODUCED IN ACCORDANCE WITH ISO17025 REQUIREMENTS

K=2 95% UNCERTAINTY

PO# 5222002512

NET WEIGHT 4.74 Kgs

GROSS WEIGHT 28.5 Kgs



CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number:	E03NI99E80A0020	Reference Number:	82-401285019-1
Cylinder Number:	LL193324	Cylinder Volume:	83.4 CF
Laboratory:	124 - Riverton (SAP) - NJ	Cylinder Pressure:	2215 PSIG
PGVP Number:	B52018	Valve Outlet:	660
Gas Code:	NO,NOX,SO2,BALN	Certification Date:	Sep 05, 2018

Expiration Date: Sep 05, 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	50.00 PPM	50.71 PPM	G1	+/- 1.4% NIST Traceable	08/27/2018, 09/05/2018
NITRIC OXIDE	50.00 PPM	50.67 PPM	G1	+/- 1.4% NIST Traceable	08/27/2018, 09/05/2018
SULFUR DIOXIDE	50.00 PPM	50.54 PPM	G1	+/- 1.0% NIST Traceable	08/27/2018, 09/05/2018
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	16060625	CC442585	50.42 PPM NITRIC OXIDE/NITROGEN	+/- 0.8%	Jun 27, 2020
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	14010327	KAL004376	49.08 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Apr 17, 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 APW1100391 NO	FTIR	Aug 09, 2018
Nicolet 6700 APW1100391 NO2	FTIR	Aug 31, 2018
Nicolet 6700 APW1100391 SO2	FTIR	Aug 30, 2018

Triad Data Available Upon Request

NOTES:PO# 5218003935

Net weight: 2736 grams

Gross weight: 17393 grams

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