

ภาคผนวกที่ 4

เอกสารการสอบเทียบความถูกต้องของเครื่องมือ

**ตารางสรุปรายการเอกสารการสอบเทียบความถูกต้องของเครื่องมือเก็บตัวอย่าง
และเครื่องมือตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม**

รายการตรวจวัด	เครื่องมือเก็บตัวอย่าง	เครื่องมือตรวจวิเคราะห์
	ชื่อเครื่องมือ	ชื่อเครื่องมือ
1. คุณภาพอากาศในบรรยากาศ Total Suspended Particulate (TSP)	High Volume Air Sampler Rec No. R04, R12, R16 B. No. R04, R12, R16	Digital Balance
Carbon Monoxide	Personal Pump SKC No. B32, B39, B45	CO Analyzer No. R03
Nitrogen Dioxide	NO ₂ Analyzer No. R05, R07, R10	NO ₂ Analyzer No. R05, R07, R10
2. คุณภาพอากาศจากปล่อง Total Suspended Particulate (TSP)	Console No. R05 Pitot Tube No. B24, B34, B45, B58	Digital Balance
Carbon Monoxide (CO)	Personal Pump SKC No. R03, R13, R14 Rotameter No. H-R02	CO Analyzer No. B01
Oxides of Nitrogen (NO _x)	Vacuum Gauge	Spectrophotometer
Xylene	Personal Pump SKC No. R30 Rotameter No. L-R02	GC/FID
Acetic Acid	Personal Pump SKC No. R03 Rotameter No. L-R02	GC/FID
3. คุณภาพอากาศในสถานประกอบการ Total Dust	Personal Pump No. B45, R38, B31, B41 Rotameter No. H-R01, R03	Digital Balance
Xylene	Personal Pump SKC No. B32, B42, B44, B50, B52, R07, R12, R13, R38 Rotameter No. L-R01, R03	GC/FID
Acetic Acid	Personal Pump SKC No. B05, B32, B33, B42, B50, B52, R05, R07, R08, R13, R38 Rotameter No. L-R01, R03	GC/FID
Methyl Acetate	Personal Pump SKC No. B26, B72, R22, R45 Rotameter No. L-R01, R03	GC/FID
Methanol	Personal Pump SKC No. B07, R03 Rotameter No. L-R01, R03	GC/FID
4. ระดับเสียง L _{eq} 24 hr, L ₉₀ , L _{eq} 8 hr	Acoustic Calibrator Integrated Sound Level Meter No. ACO-R09, R11, R13, R14, R15, R19	-

ตารางสรุปรายการเอกสารการสอบเทียบความถูกต้องของเครื่องมือเก็บตัวอย่าง
และเครื่องมือตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม (ต่อ)

รายการตรวจวัด	เครื่องมือเก็บตัวอย่าง	เครื่องมือตรวจวิเคราะห์
	ชื่อเครื่องมือ	ชื่อเครื่องมือ
5. คุณภาพน้ำทิ้ง		
pH	-	pH Meter
Temperature	-	Thermometer
Total Suspended Solids	-	Digital Balance
Total Dissolved Solids	-	Digital Balance
BOD ₅	-	BOD Analyzer
COD	-	COD Reactor
Grease & Oil	-	Digital Balance
Manganese	-	Inductively Coupled Plasma
Conductivity	-	Conductivity Meter

คุณภาพอากาศในบรรยากาศ



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Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com, www.spscon.com

High Volume Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard

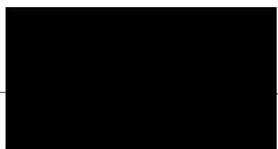
Model : TE 5025A

S/N : 3611

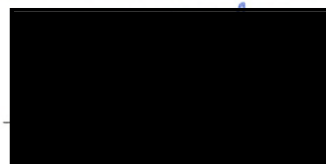
Calibration Data

High Volume Air Sampler Data		Calibration Data		
Recorder No.	Blower No.	Date	Actual Flowrate (ft ³ /min)	R ²
B35	B35	01/02/2023	y = 1.194x-4.992	0.995
B36	B36	02/02/2023	y = 1.201x-3.946	0.997
B37	B37	02/02/2023	y = 1.284x-6.745	0.997
B38	B38	02/02/2023	y = 1.250x-6.733	0.998
B39	B39	01/02/2023	y = 1.268x-7.186	0.998
B40	B40	03/02/2023	y = 1.214x-4.324	0.998
B41	B41	03/02/2023	y = 1.176x-2.734	0.999
B42	B42	02/02/2023	y = 1.283x-8.167	0.997
B43	B43	02/02/2023	y = 1.197x-3.772	0.996
B44	B44	02/02/2023	y = 1.249x-7.038	0.995
R01	R01	01/02/2023	y = 1.287x-8.462	0.998
R02	R02	01/02/2023	y = 1.239x-6.678	0.998
R03	R03	03/02/2023	y = 1.254x-7.928	0.999
R04	R04	02/02/2023	y = 1.206x-3.694	0.999
R05	R05	02/02/2023	y = 1.237x-6.503	0.997
R06	R06	02/02/2023	y = 1.239x-4.541	0.995
R07	R07	03/02/2023	y = 1.060x+1.983	0.999
R08	R08	03/02/2023	y = 1.274x-8.050	0.998
R09	R09	02/02/2023	y = 1.280x-7.005	0.998
R10	R10	03/02/2023	y = 1.244x-5.980	1.000
R11	R11	03/02/2023	y = 1.097x-0.462	0.998
R12	R12	02/02/2023	y = 1.151x-2.727	0.995
R13	R13	02/02/2023	y = 1.134x-1.526	1.000
R14	R14	02/02/2023	y = 1.172x-2.510	0.999
R15	R15	01/02/2023	y = 1.131x-2.129	0.998
R16	R16	01/02/2023	y = 1.202x-5.830	0.998
R17	R17	01/02/2023	y = 1.182x-3.281	0.998
R18	R18	03/02/2023	y = 1.217x-5.060	0.999
R19	R19	03/02/2023	y = 1.228x-6.084	0.998
R20	R20	03/02/2023	y = 1.277x-9.434	0.997

Calibrated by :



Approved by :





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Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

Temperature : 25 \pm 3 $^{\circ}$ C
Pressure : 1010 \pm 15 mmbar

Personal Pump Data				Calibration Data								
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)				
					1	2	3	1	2	3	y	R ²
B01	SKC	224-PCXR4	262101	03/01/2023	1,000	1,500	2,000	993	1,497	1,998	1.003x - 5.584	1.000
B02	SKC	224-PCXR4	626166	03/01/2023	1,000	1,500	2,000	1,003	1,505	2,001	1.009x - 19.667	0.999
B03	SKC	224-PCXR4	612968	03/01/2023	1,000	1,500	2,000	996	1,494	2,000	1.006x - 12.109	1.000
B04	SKC	224-PCXR4	602804	04/01/2023	1,000	1,500	2,000	1,000	1,502	1,995	1.000x - 0.893	1.000
B05	SKC	224-PCXR4	612693	04/01/2023	1,000	1,500	2,000	1,003	1,500	2,003	1.012x - 22.224	0.999
B06	SKC	224-PCXR4	262188	03/01/2023	1,000	1,500	2,000	995	1,508	2,005	1.011x - 20.273	1.000
B07	SKC	224-PCXR4	626262	03/01/2023	1,000	1,500	2,000	998	1,492	1,995	0.993x + 6.086	1.000
B08	SKC	224-PCXR4	626100	03/01/2023	1,000	1,500	2,000	1,003	1,500	2,003	1.012x - 23.308	0.999
B09	SKC	224-PCXR4	626479	03/01/2023	1,000	1,500	2,000	996	1,490	1,994	0.995x + 1.117	1.000
B10	SKC	224-PCXR4	091950	03/01/2023	1,000	1,500	2,000	992	1,503	2,001	1.018x - 36.582	0.999
B11	SKC	224-PCXR8	564315	05/01/2023	1,000	1,500	2,000	996	1,490	1,999	1.003x - 8.256	1.000
B12	SKC	224-PCXR4	034656	05/01/2023	1,000	1,500	2,000	1,003	1,503	2,003	1.010x - 19.324	0.999
B13	SKC	224-PCXR4	602073	05/01/2023	1,000	1,500	2,000	995	1,500	1,998	1.001x - 3.474	1.000
B14	SKC	224-PCXR4	626313	04/01/2023	1,000	1,500	2,000	999	1,491	1,988	0.992x + 6.844	1.000
B15	SKC	224-PCXR4	626474	04/01/2023	1,000	1,500	2,000	1,001	1,502	2,005	1.014x - 25.558	0.999
B16	SKC	224-PCXR4	626477	04/01/2023	1,000	1,500	2,000	994	1,504	2,001	1.015x - 31.345	0.999
B17	SKC	224-PCXR4	626860	04/01/2023	1,000	1,500	2,000	997	1,494	1,991	0.997x - 0.359	1.000
B18	SKC	224-PCXR4	691484	04/01/2023	1,000	1,500	2,000	1,003	1,500	2,001	1.008x - 17.589	0.999
B19	SKC	224-PCXR4	691599	03/01/2023	1,000	1,500	2,000	993	1,503	1,999	1.007x - 11.574	1.000
B20	SKC	224-PCXR4	691587	03/01/2023	1,000	1,500	2,000	992	1,504	1,999	1.015x - 32.235	0.999
B21	SKC	224-PCXR4	691531	03/01/2023	1,000	1,500	2,000	993	1,499	1,994	1.001x - 7.107	1.000
B22	SKC	224-PCXR4	691654	05/01/2023	1,000	1,500	2,000	1,003	1,501	2,003	1.011x - 21.107	0.999
B23	SKC	224-PCXR4	798393	05/01/2023	1,000	1,500	2,000	992	1,507	2,002	1.018x - 34.883	0.999
B24	SKC	224-PCXR4	626363	05/01/2023	1,000	1,500	2,000	1,000	1,502	2,000	1.011x - 22.387	0.999
B25	SKC	224-PCXR4	798489	05/01/2023	1,000	1,500	2,000	1,001	1,492	2,001	0.998x + 1.101	1.000
B26	SKC	224-PCXR4	798479	05/01/2023	1,000	1,500	2,000	999	1,500	1,993	0.996x + 4.008	1.000
B27	SKC	224-PCXR4	691673	04/01/2023	1,000	1,500	2,000	994	1,503	2,002	1.016x - 32.071	0.999
B28	SKC	224-PCXR4	691570	04/01/2023	1,000	1,500	2,000	1,002	1,500	2,002	1.012x - 22.515	0.999
B29	SKC	224-PCXR4	626472	04/01/2023	1,000	1,500	2,000	1,000	1,496	1,998	1.001x - 4.942	1.000
B30	SKC	224-PCXR4	691489	03/01/2023	1,000	1,500	2,000	1,004	1,510	2,004	1.008x - 12.460	0.999
B31	SKC	224-PCXR4	691509	03/01/2023	1,000	1,500	2,000	992	1,497	1,998	1.006x - 12.711	1.000
B32	SKC	224-PCXR4	091567	05/01/2023	1,000	1,500	2,000	991	1,504	2,001	1.016x - 32.322	0.999
B33	SKC	224-PCXR4	091756	05/01/2023	1,000	1,500	2,000	993	1,497	1,991	0.997x - 0.004	1.000
B34	SKC	224-PCXR4	612962	05/01/2023	1,000	1,500	2,000	1,002	1,501	2,002	1.007x - 14.195	1.000
B35	SKC	224-PCXR4	602682	05/01/2023	1,000	1,500	2,000	993	1,498	1,995	1.002x - 8.448	1.000
B36	SKC	224-PCXR4	626164	03/01/2023	1,000	1,500	2,000	999	1,496	1,999	1.001x - 5.424	1.000
B37	SKC	224-PCXR4	626256	03/01/2023	1,000	1,500	2,000	994	1,506	1,999	1.013x - 27.815	0.999
B38	SKC	224-PCXR4	626167	03/01/2023	1,000	1,500	2,000	997	1,496	1,996	0.999x - 0.997	1.000
B39	SKC	224-PCXR4	034637	03/01/2023	1,000	1,500	2,000	1,005	1,501	2,001	1.010x - 18.618	0.999
B40	SKC	224-PCXR4	798349	05/01/2023	1,000	1,500	2,000	994	1,506	1,999	1.014x - 29.602	0.999

Calibrated by :

Approved by :



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Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

Temperature : 25 \pm 3 °C
Pressure : 1010 \pm 15 mmbar

Personal Pump Data				Calibration Data								
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)				
					1	2	3	1	2	3	y	R²
B41	SKC	224-PCXR4	612669	05/01/2023	1,000	1,500	2,000	998	1,497	1,990	0.997x + 0.718	1.000
B42	SKC	224-PCXR4	626041	05/01/2023	1,000	1,500	2,000	1,004	1,498	1,991	0.986x + 18.291	1.000
B43	SKC	224-PCXR4	034636	05/01/2023	1,000	1,500	2,000	1,000	1,501	1,992	0.991x + 11.882	1.000
B44	SKC	224-PCXR8	529341	06/01/2023	1,000	1,500	2,000	1,002	1,502	2,002	1.005x - 9.213	1.000
B45	SKC	224-PCXR8	529594	06/01/2023	1,000	1,500	2,000	999	1,501	1,989	0.991x + 11.184	1.000
B46	SKC	224-PCXR8	566743	06/01/2023	1,000	1,500	2,000	995	1,504	2,002	1.014x - 30.571	0.999
B47	SKC	224-PCXR8	566747	06/01/2023	1,000	1,500	2,000	1,002	1,502	2,004	1.013x - 24.601	0.999
B48	SKC	224-PCXR8	566753	04/01/2023	1,000	1,500	2,000	1,000	1,494	1,998	0.998x + 0.319	1.000
B49	SKC	224-PCXR8	566780	04/01/2023	1,000	1,500	2,000	1,003	1,502	2,006	1.013x - 23.982	0.999
B50	SKC	224-PCXR8	500400	04/01/2023	1,000	1,500	2,000	1,001	1,496	2,002	1.001x - 3.538	1.000
B51	SKC	224-PCXR8	500363	04/01/2023	1,000	1,500	2,000	996	1,504	1,999	1.011x - 25.031	0.999
B52	SKC	224-PCXR8	093186	04/01/2023	1,000	1,500	2,000	995	1,496	1,994	0.997x - 0.602	1.000
B53	SKC	224-PCXR8	707670	03/01/2023	1,000	1,500	2,000	1,002	1,500	2,002	1.008x - 15.403	0.999
B54	SKC	224-PCXR3	509821	03/01/2023	1,000	1,500	2,000	993	1,502	2,001	1.017x - 34.237	0.999
B55	SKC	224-PCXR3	510710	03/01/2023	1,000	1,500	2,000	999	1,494	1,994	0.997x - 0.989	1.000
B56	SKC	224-PCXR3	511450	03/01/2023	1,000	1,500	2,000	1,002	1,500	2,001	1.004x - 8.081	1.000
B57	SKC	224-PCXR3	510798	06/01/2023	1,000	1,500	2,000	997	1,492	1,998	1.000x - 2.680	1.000
B58	SKC	224-PCXR3	509852	06/01/2023	1,000	1,500	2,000	1,000	1,498	1,999	1.007x - 18.953	0.999
B59	SKC	224-PCXR3	509862	06/01/2023	1,000	1,500	2,000	996	1,503	1,994	0.997x + 3.235	1.000
B60	SKC	224-PCXR3	512655	06/01/2023	1,000	1,500	2,000	1,002	1,500	2,003	1.006x - 11.407	1.000
B61	SKC	224-PCXR3	503915	06/01/2023	1,000	1,500	2,000	994	1,489	1,998	1.004x - 12.623	1.000
B62	SKC	224-PCXR3	505975	06/01/2023	1,000	1,500	2,000	999	1,494	1,996	0.997x + 0.343	1.000
B63	SKC	224-PCXR3	511432	03/01/2023	1,000	1,500	2,000	991	1,501	1,999	1.016x - 34.624	0.999
B64	SKC	224-PCXR3	508302	03/01/2023	1,000	1,500	2,000	997	1,492	1,989	0.992x + 6.226	1.000
B65	SKC	224-PCXR3	508310	03/01/2023	1,000	1,500	2,000	1,002	1,500	2,003	1.007x - 13.936	1.000
B66	SKC	224-PCXR3	509861	03/01/2023	1,000	1,500	2,000	1,002	1,491	1,991	0.987x + 14.183	1.000
B67	SKC	224-PCXR3	506295	04/01/2023	1,000	1,500	2,000	993	1,508	2,004	1.009x - 15.555	1.000
B68	SKC	224-PCXR3	505872	04/01/2023	1,000	1,500	2,000	1,002	1,490	1,997	0.995x + 3.841	1.000
B69	SKC	224-PCXR3	508375	04/01/2023	1,000	1,500	2,000	1,002	1,499	2,000	1.010x - 20.772	0.999
B70	SKC	224-PCXR3	510623	05/01/2023	1,000	1,500	2,000	992	1,503	1,997	1.002x - 5.855	1.000
B71	SKC	224-PCXR3	508367	05/01/2023	1,000	1,500	2,000	992	1,506	2,002	1.017x - 34.791	0.999
B72	SKC	224-PCXR3	505977	05/01/2023	1,000	1,500	2,000	1,001	1,498	1,993	0.991x + 8.962	1.000
B73	SKC	224-PCXR3	512606	05/01/2023	1,000	1,500	2,000	1,002	1,501	2,005	1.009x - 14.785	1.000
B74	SKC	224-PCXR3	505993	05/01/2023	1,000	1,500	2,000	996	1,495	1,994	1.000x - 6.916	1.000
B75	SKC	224-PCXR3	509820	04/01/2023	1,000	1,500	2,000	995	1,498	1,990	0.996x + 1.791	1.000
B76	SKC	224-PCXR3	509811	04/01/2023	1,000	1,500	2,000	993	1,498	1,998	1.006x - 14.322	1.000
B77	SKC	224-PCXR3	508301	04/01/2023	1,000	1,500	2,000	1,000	1,501	2,003	1.014x - 26.603	0.999
B78	SKC	224-PCXR3	510677	04/01/2023	1,000	1,500	2,000	995	1,503	1,999	1.013x - 28.158	0.999
B79	SKC	224-PCXR3	510920	03/01/2023	1,000	1,500	2,000	994	1,493	1,994	0.999x - 4.184	1.000

Calibrated by :

Approved by :



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com., www.spscon.com

CALIBRATION REPORT

CHEMILUMINESCENT NO / NO₂ / NO_x ANALYZER

DATE : 14 March 2023

BRAND : API

MODEL : 200E

NO. NOX-R05

SERIAL NO. 4413

Calibrator (Dilution System)

Brand : API Model : 700

Last Cal. Date : 04 August 2022 Serial No. : 911

Reference Standard Gas

Standard Gas : Nitric Oxide (NO) Cylinder No. : D636192

Certified Date : 20 April 2022 Expired Date : 20 April 2024 Cylinder Conc. : 49.1 ppm

CALIBRATING CONDITION

Pressure 1011 mmbar Temp. 24.6 °C % RH 48

CALIBRATION SETTING

Span Set Point	Initial Reading (Before Adj.),PPB			Final Reading (After Adj.),PPB	
	Expected Concentration	Analyzer Response	%Dif	Analyzer Response	Slope
Zero	0	0.10	-	0	-
NO Span	400	399.9	-0.025	400.0	1.005
NO _x Span	400	400.1	0.025	400.0	1.008

API Model 200E NO_x Analyzer Check List

Test Values	Observed Value	Units	Nominal Range
RANGE	500	PPB	500 standard
STABILITY (Zero Gas)	0.1	PPB	< 2 with zero air
SAMPLE FLOW	503	cc/min	500 ± 50
OZONE FLOW	78	cc/min	80 ± 15
PMT	102.9	mV	-20 - 150
AZERO	93.8	mV	-20 - 150
HVPS	670	V	420 - 900 constant
RCELL TEMP	50.3	°C	50 ± 1
BOX TEMP	29.1	°C	8 - 48
PMT TEMP	7.4	°C	7 ± 2
MOLY TEMP	315.1	°C	315 ± 5
RCELL PRESS	8.2	IN-Hg-A	2 - 10 constant
SAMPLE PRESS	28.5	IN-Hg-A	25 - 30 constant
NO Span Conc	400	PPB	20 - 20,000
NO _x Span Conc	400	PPB	20 - 20,000
NO Slope	1.005	-	1.0 ± 0.3
NO _x Slope	1.008	-	1.0 ± 0.3
NO Offset	1.1	mV	-20 to +150
NO _x Offset	0.7	mV	-20 to 150
Stability at Zero	0.1	PPB	< 0.2
Stability at Span	0.2	PPB	< 2 ppb @ 400 ppb span gas

Calibrated by :

Approved by :



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Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com, www.spscon.com

CALIBRATION REPORT

CHEMILUMINESCENT NO / NO₂ / NO_x ANALYZER

DATE : 14 March 2023

BRAND : API

MODEL : 200E

NO. NOX-R07

SERIAL NO. 4468

Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 04 August 2022

Serial No. : 911

Reference Standard Gas

Standard Gas : Nitric Oxide (NO)

Cylinder No. : D636192

Certified Date : 20 April 2022

Expired Date : 20 April 2024

Cylinder Conc. : 49.1 ppm

CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.6 °C

% RH 48

CALIBRATION SETTING

Span	Initial Reading (Before Adj.),PPB			Final Reading (After Adj.),PPB	
Set Point	Expected Concentration	Analyzer Response	%Dif	Analyzer Response	Slope
Zero	0	0.10	-	0	-
NO Span	400	399.6	-0.100	400.0	0.999
NO _x Span	400	399.8	-0.050	400.0	1.003

API Model 200E NO_x Analyzer Check List

Test Values	Observed Value	Units	Nominal Range
RANGE	500	PPB	500 standard
STABILITY (Zero Gas)	0.1	PPB	< 2 with zero air
SAMPLE FLOW	506	cc/min	500 ± 50
OZONE FLOW	78	cc/min	80 ± 15
PMT	103.0	mV	-20 - 150
AZERO	93.7	mV	-20 - 150
HVPS	672	V	420 - 900 constant
RCELL TEMP	50.5	°C	50 ± 1
BOX TEMP	29.4	°C	8 - 48
PMT TEMP	7.2	°C	7 ± 2
MOLY TEMP	315.4	°C	315 ± 5
RCELL PRESS	8.4	IN-Hg-A	2 - 10 constant
SAMPLE PRESS	28.6	IN-Hg-A	25 - 30 constant
NO Span Conc	400	PPB	20 - 20,000
NO _x Span Conc	400	PPB	20 - 20,000
NO Slope	0.999	-	1.0 ± 0.3
NO _x Slope	1.003	-	1.0 ± 0.3
NO Offset	0.9	mV	-20 to +150
NO _x Offset	0.5	mV	-20 to 150
Stability at Zero	0.1	PPB	< 0.2
Stability at Span	0.2	PPB	< 2 ppb @ 400 ppb span gas

Calibrated by :

Approved by :



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CALIBRATION REPORT

CHEMILUMINESCENT NO / NO₂ / NO_x ANALYZER

DATE : 14 March 2023

BRAND : API

MODEL : 200E

NO. NOX-R10

SERIAL NO. 1991

Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 04 August 2022

Serial No. : 911

Reference Standard Gas

Standard Gas : Nitric Oxide (NO)

Cylinder No. : D636192

Certified Date : 20 April 2022

Expired Date : 20 April 2024

Cylinder Conc. : 49.1 ppm

CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.6 °C

% RH 48

CALIBRATION SETTING

Span	Initial Reading (Before Adj.),PPB			Final Reading (After Adj.),PPB	
	Expected Concentration	Analyzer Response	%Dif	Analyzer Response	Slope
Zero	0	0.11	-	0	-
NO Span	400	400.2	0.050	400.0	1.010
NO _x Span	400	400.4	0.100	400.0	1.015

API Model 200E NO_x Analyzer Check List

Test Values	Observed Value	Units	Nominal Range
RANGE	500	PPB	500 standard
STABILITY (Zero Gas)	0.1	PPB	< 2 with zero air
SAMPLE FLOW	512	cc/min	500 ± 50
OZONE FLOW	79	cc/min	80 ± 15
PMT	103.3	mV	-20 - 150
AZERO	94.1	mV	-20 - 150
HVPS	675	V	420 - 900 constant
RCELL TEMP	50.4	°C	50 ± 1
BOX TEMP	29.2	°C	8 - 48
PMT TEMP	7.1	°C	7 ± 2
MOLY TEMP	314.9	°C	315 ± 5
RCELL PRESS	8.5	IN-Hg-A	2 - 10 constant
SAMPLE PRESS	28.7	IN-Hg-A	25 - 30 constant
NO Span Conc	400	PPB	20 - 20,000
NO _x Span Conc	400	PPB	20 - 20,000
NO Slope	1.010	-	1.0 ± 0.3
NO _x Slope	1.015	-	1.0 ± 0.3
NO Offset	1.7	mV	-20 to +150
NO _x Offset	0.9	mV	-20 to 150
Stability at Zero	0.1	PPB	< 0.2
Stability at Span	0.2	PPB	< 2 ppb @ 400 ppb span gas

Calibrated by :

Approved by :



QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

www.qcalibration.com



CERTIFICATE No : 23M2441

REFERENCE No : 68471-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : METTLER TOLEDO

MODEL : XS105DU

SERIAL No : 1126422905

ID No : BA 05/50

CONDITION AS RECEIVED : USED ITEM

SUBMITTED BY : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN RD.,
JOMPOL, CHATUCHAK, BANGKOK 10900

CALIBRATED BY :

CALIBRATION DATE :

10-Mar-23

APPROVED BY :

ISSUED DATE :

16-Mar-23

RECEIVED DATE :

10-Mar-23

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF
QUALITY CALIBRATION CO., LTD.



CERTIFICATE No : 23M2441

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : XS105DU
MANUFACTURER : METTLER TOLEDO S/N : 1126422905
ID No : BA 05/50 RECEIVED DATE : 10-Mar-23
AIR PRESSURE : 1010mbar \pm 1mbar CALIBRATION DATE : 10-Mar-23
AMBIENT TEMPERATURE : 23°C \pm 1°C RELATIVE HUMIDITY : 49 %RH \pm 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY ACCORDING TO UKAS LAB 14 EDITION 6:2019 BY USING KNOWN WEIGHT STANDARD WEIGHT. THE BALANCE WAS NOT ADJUSTED BEFORE CALIBRATION. THE BALANCE HAS NO ZERO TRACKING FUNCTION. REPEATABILITY WAS MEASURED BY USING 10 REPEATED MEASUREMENTS. LINEARITY WAS MEASURED COVERING 10 POINTS, EVENLY SPREAD OVER THE RANGE. THE INSTRUMENT WAS SET ZERO BEFORE PERFORMING THE LINEARITY TEST. OFF-CENTER LOADING WAS MEASURED BY USING STANDARD WEIGHTS PLACED ON THE PAN AND MOVED TO VARIOUS POSITIONS ON THE PAN.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) STANDARD WEIGHT SET	E2	QK-I-151	M2302013S	02-Feb-25
2) STANDARD WEIGHT	E2	15843	M2302014S	02-Feb-25

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.

4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-

- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL BUREAU OF WEIGHTS&MEASURES

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

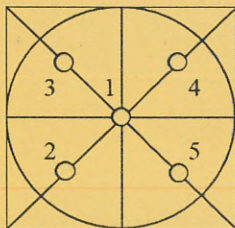
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (\pm g)
0.00	0.00000	0.00000	0.000039
0.02	0.02000	0.00000	0.000039
0.10	0.10000	0.00000	0.000039
0.20	0.20001	-0.00001	0.000040
0.50	0.50001	-0.00001	0.000040
1.00	1.00000	0.00000	0.000041
2.00	2.00003	-0.00003	0.000042
5.00	5.00001	-0.00001	0.000046
10.00	10.00003	-0.00003	0.000053
20.00	20.00005	-0.00005	0.000067
50.00	50.00001	-0.00001	0.00011
100.00	100.00001	-0.00001	0.00019
200.00	200.00001	-0.00001	0.00032

5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	50.0000
2	50.0001
3	50.0000
4	50.0000
5	49.9999
OFF-CENTER LOADING	0.0001

NOTE: THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR $k=2$, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



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7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
Tel : (662) 939-4370-72 Fax : (662) 513-4221 E-mail : sale@spscon.com.. www.spscon.com

Calibration Report

Non-Dispersive Infrared CO Analyzer

Date : 02 March 2023

Brand : API

Model : 300E

No. CO-R03

Serial No. 1352

Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 06 September 2022

Serial No. : 421

Reference Standard Gas

Standard Gas : Carbon Monoxide (CO)

Cylinder No. : D196045

Certified Date : 16 April 2022

Expired Date : 15 April 2024

Cylinder Conc. : 4,570 ppm

Calibrating Condition

Pressure 1011 mmbar

Temp. 24.6 °C

% RH 49

Calibration Setting

Span Set Point	Initial Reading (Before Adj.), PPM			Final Reading (After Adj.), PPM
	Expected Concentration	Analyzer Response	%Dif	Analyzer Response
Zero	0	0.11	-	0
CO Span	40.00	39.93	-0.175	40.00

API Model 300E CO Analyzer Check List

Parameter	Observed Value	Units	Nominal Range
Range	50	PPM	0-1000 ppm
Stability	0.10	PPM	< 1 ppm With Zero Air
CO Measure	4015.7	mV	2500-4800 mV
CO Reference	3948.5	mV	2500-4800 mV
Measure/Reference Ratio	1.180	-	1.1-1.3 W/Zero Air
Sample Pressure	28.7	In-Hg-A	-2" < Ambient Absolute Pressure
Sample Flow	804	CC/Min	800 ± 10%
Sample Temperature	48.4	°C	48 ± 4
Bench Temperature	48.1	°C	48 ± 2
Wheel Temperature	68.3	°C	68 ± 2
Box Temperature	30.6	°C	Ambient Temp + 7 ± 10
Photo-Drive	3045.3	mV	250 mV to 4750 mV
Slope	1.017	-	1.0 ± 0.3
Offset	0.2	-	0 ± 0.3

Calibrated by :

Approved by :

คุณภาพอากาศจากปล่อง



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด

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Console Calibration Report

Calibration Method

Critical Orifices

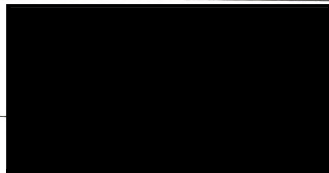
Calibration Data

Console Data		Calibration Data		
No.	Serial No.	Date	y	DH _@ (mmH ₂ O)
B01	1563	02/03/2023	0.998	50.11
B02	8002514	03/03/2023	1.004	49.25
B03	1503016	03/03/2023	1.002	50.62
B04	00006659	02/03/2023	1.004	50.14
B05	00007428	03/03/2023	1.001	49.76
R01	1561	01/03/2023	0.997	49.86
R02	8002513	03/03/2023	0.996	49.93
R03	1570	02/03/2023	1.003	49.57
R04	8002519	01/03/2023	1.002	48.90
R05	1503015	01/03/2023	0.998	50.20

Remark : Accept Value of y (test) is $0.97 < y < 1.03$

Accept Value of $\Delta H_{@}$ (test) is 46.7 ± 6.4 (mmH₂O)

Calibrated by :



Approved by :





บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
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Pitot Tube Calibration Report

Calibration Method

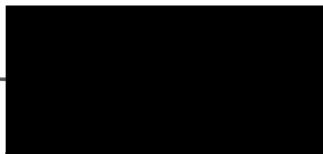
Standard Pitot Tube

Calibration Data

Pitot Tube Data			Calibration Data		
No.	Type of Pitot	Coefficient of Standard Pitot	Date	Avg. of Cp (test)	
				Side A	Side B
B03	S	0.99	02/02/2023	0.84	0.84
B04	S	0.99	01/02/2023	0.84	0.83
B05	S	0.99	02/02/2023	0.84	0.85
B07	S	0.99	02/02/2023	0.85	0.84
B08	S	0.99	01/02/2023	0.83	0.84
B09	S	0.99	01/02/2023	0.84	0.84
B11	S	0.99	01/02/2023	0.84	0.84
B16	S	0.99	01/02/2023	0.84	0.83
B18	S	0.99	02/02/2023	0.84	0.84
B19	S	0.99	02/02/2023	0.85	0.84
B21	S	0.99	03/02/2023	0.84	0.84
B24	S	0.99	03/02/2023	0.84	0.83
B27	S	0.99	02/02/2023	0.84	0.84
B30	S	0.99	01/02/2023	0.83	0.84
B31	S	0.99	02/02/2023	0.84	0.85
B33	S	0.99	03/02/2023	0.84	0.84
B35	S	0.99	02/02/2023	0.84	0.85

Remark : Accept value of Cp (test) is 0.84 ± 0.01

Calibrated by :



Approved by :





บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
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Pitot Tube Calibration Report

Calibration Method

Standard Pitot Tube

Calibration Data

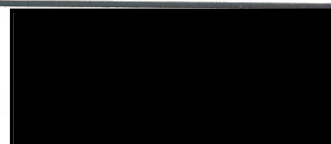
Pitot Tube Data			Calibration Data		
No.	Type of Pitot	Coefficient of Standard Pitot	Date	Avg. of Cp (test)	
				Side A	Side B
B36	S	0.99	02/02/2023	0.85	0.84
B37	S	0.99	02/02/2023	0.84	0.85
B38	S	0.99	01/02/2023	0.84	0.84
B39	S	0.99	03/02/2023	0.85	0.84
B40	S	0.99	02/02/2023	0.84	0.84
B41	S	0.99	02/02/2023	0.84	0.85
B44	S	0.99	03/02/2023	0.84	0.84
B45	S	0.99	01/02/2023	0.84	0.85
B46	S	0.99	01/02/2023	0.84	0.83
B47	S	0.99	01/02/2023	0.84	0.84
B48	S	0.99	03/02/2023	0.84	0.83
B49	S	0.99	03/02/2023	0.83	0.84
B54	S	0.99	03/02/2023	0.85	0.84
B56	S	0.99	02/02/2023	0.84	0.83
B57	S	0.99	02/02/2023	0.84	0.84
B58	S	0.99	02/02/2023	0.84	0.84

Remark : Accept value of Cp (test) is 0.84 ± 0.01

Calibrated by : _____



Approved by : _____





บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
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Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com, www.spscon.com

Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

Temperature : 25 \pm 3 $^{\circ}$ C
Pressure : 1010 \pm 15 mmbar

Personal Pump Data				Calibration Data								
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)				
					1	2	3	1	2	3	y	R ²
R01	SKC	224-PCXR4	602467	03/01/2023	1,000	1,500	2,000	993	1,508	2,004	1.008x - 13.936	0.999
R02	SKC	224-PCXR4	626450	06/01/2023	1,000	2,000	3,000	998	1,499	1,990	0.989x + 12.268	1.000
R03	SKC	224-PCXR4	691592	06/01/2023	1,000	1,500	2,000	1,003	1,500	2,004	1.011x - 21.761	0.999
R04	SKC	224-PCXR4	691672	06/01/2023	1,000	1,500	2,000	996	1,493	1,995	0.997x - 1.563	1.000
R05	SKC	224-PCXR4	798470	06/01/2023	1,000	1,500	2,000	993	1,505	1,999	1.014x - 31.752	0.999
R06	SKC	224-PCXR4	798456	06/01/2023	1,000	1,500	2,000	993	1,498	1,994	1.003x - 8.555	1.000
R07	SKC	224-PCXR4	798480	04/01/2023	1,000	1,500	2,000	994	1,490	1,999	1.007x - 16.073	1.000
R08	SKC	224-PCXR4	883215	04/01/2023	1,000	1,500	2,000	1,011	1,501	2,005	0.999x + 3.207	1.000
R09	SKC	224-PCXR4	034650	04/01/2023	1,000	1,500	2,000	991	1,504	2,002	1.018x - 35.900	0.999
R10	SKC	224-PCXR4	091765	04/01/2023	1,000	1,500	2,000	997	1,512	1,994	0.999x + 0.977	1.000
R11	SKC	224-PCXR4	091763	03/01/2023	1,000	1,500	2,000	1,000	1,499	2,002	1.013x - 25.119	0.999
R12	SKC	224-PCXR4	091568	03/01/2023	1,000	1,500	2,000	997	1,501	1,999	1.001x - 4.906	1.000
R13	SKC	224-PCXR4	091638	03/01/2023	1,000	1,500	2,000	1,002	1,499	1,994	0.992x + 9.636	1.000
R14	SKC	224-PCXR4	091764	03/01/2023	1,000	1,500	2,000	994	1,502	1,999	1.014x - 30.212	0.999
R15	SKC	224-PCXR8	529457	03/01/2023	1,000	1,500	2,000	1,001	1,500	2,004	1.006x - 11.941	1.000
R16	SKC	224-PCXR8	529643	05/01/2023	1,000	1,500	2,000	998	1,497	1,994	1.000x - 4.686	1.000
R17	SKC	224-PCXR8	529645	05/01/2023	1,000	1,500	2,000	994	1,509	2,000	1.015x - 30.731	0.999
R18	SKC	224-PCXR8	566756	05/01/2023	1,000	1,500	2,000	991	1,498	1,998	1.001x - 6.840	1.000
R19	SKC	224-PCXR8	566802	05/01/2023	1,000	1,500	2,000	1,002	1,499	2,000	1.010x - 21.027	0.999
R20	SKC	224-PCXR8	529089	03/01/2023	1,000	1,500	2,000	991	1,501	2,003	1.020x - 39.916	0.999
R21	SKC	224-PCXR8	665728	03/01/2023	1,000	1,500	2,000	998	1,493	1,999	1.000x - 5.404	1.000
R22	SKC	224-PCXR8	707444	03/01/2023	1,000	1,500	2,000	1,002	1,500	2,002	1.004x - 7.135	1.000
R23	SKC	224-PCXR8	761067	03/01/2023	1,000	1,500	2,000	998	1,494	1,991	0.993x + 4.132	1.000
R24	SKC	224-PCXR8	707893	04/01/2023	1,000	1,500	2,000	996	1,505	2,000	1.008x - 17.553	0.999
R25	SKC	224-PCXR8	761052	04/01/2023	1,000	1,500	2,000	1,010	1,499	1,993	0.984x + 23.464	1.000
R26	SKC	224-PCXR8	707956	04/01/2023	1,000	1,500	2,000	1,002	1,500	2,004	1.009x - 15.842	1.000
R27	SKC	224-PCXR8	707398	04/01/2023	1,000	1,500	2,000	996	1,503	2,001	1.005x - 13.449	1.000
R28	SKC	224-PCXR8	707481	04/01/2023	1,000	1,500	2,000	1,004	1,500	2,002	1.010x - 19.288	0.999
R29	SKC	224-PCXR8	707402	03/01/2023	1,000	1,500	2,000	1,004	1,493	1,991	0.988x + 14.167	1.000
R30	SKC	224-PCXR8	093811	03/01/2023	1,000	1,500	2,000	1,000	1,495	1,994	0.996x + 1.922	1.000
R31	SKC	224-PCXR8	093183	03/01/2023	1,000	1,500	2,000	1,001	1,501	2,001	1.002x - 3.618	1.000
R32	SKC	224-PCXR8	671950	03/01/2023	1,000	1,500	2,000	998	1,498	1,994	0.995x + 4.970	1.000
R33	SKC	224-PCXR4	626254	03/01/2023	1,000	1,500	2,000	995	1,502	1,999	1.014x - 31.070	0.999
R34	SKC	224-PCXR4	626131	03/01/2023	1,000	1,500	2,000	1,002	1,498	2,004	1.006x - 11.810	1.000
R35	SKC	224-PCXR8	707460	03/01/2023	1,000	1,500	2,000	999	1,498	1,995	0.994x + 6.669	1.000
R36	SKC	224-PCXR8	707446	03/01/2023	1,000	1,500	2,000	1,004	1,499	2,001	1.009x - 18.036	0.999
R37	SKC	224-PCXR8	707432	03/01/2023	1,000	1,500	2,000	996	1,499	1,998	1.000x - 2.070	1.000
R38	SKC	224-PCXR8	707349	03/01/2023	1,000	1,500	2,000	996	1,500	2,001	1.004x - 9.345	1.000
R39	SKC	224-PCXR8	761095	03/01/2023	1,000	1,500	2,000	1,001	1,496	1,994	0.997x + 2.373	1.000

Calibrated by :

Adul Dangklom
(Mr. Adul Dangklom)

Approved by :

(Mr. Peera Detudom)



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com., www.spscon.com

Rotameter Calibration Report (For Personal Pump High Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Calibration Data

Rotameter Data			Calibration Data								
No.	Brand	Model	Date	Flow Rate (ml/min)						Value From Calibration Curve	
				Flow Rate (Reading)			Actual (Q std.)				
				1	2	3	1	2	3	y	R²
H-R01	Dwyer	VFB-65	05/01/2023	500	1,000	2,000	503.3	992.4	1978.7	0.999x - 3.199	0.999
H-R02	Dwyer	VFB-65	04/01/2023	500	1,000	2,000	501.2	995.3	1985.7	1.002x - 5.186	1.000
H-R03	Dwyer	VFB-65	04/01/2023	500	1,000	2,000	501.7	987.7	1996.9	0.994x + 1.679	1.000
H-R04	Dwyer	VFB-65	04/01/2023	500	1,000	2,000	496.4	989.6	2019.5	1.008x - 13.614	1.000
H-R05	Dwyer	VFB-65	06/01/2023	500	1,000	2,000	497.2	987.7	1988.1	1.004x - 9.360	1.000
H-R06	Dwyer	VFB-65	06/01/2023	500	1,000	2,000	505.2	992.4	1979.8	0.999x - 2.816	0.999

Calibrated by :

Approved by :



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
 7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
 7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
 Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com., www.spscon.com

Rotameter Calibration Report (For Personal Pump Low Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter

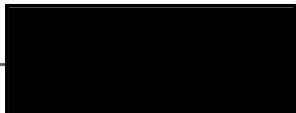
Model : Defender 510-H

S/N : 136164

Calibration Data

Rotameter Data			Calibration Data								
No.	Brand	Model	Date	Flow Rate (ml/min)						Value From Calibration Curve	
				Flow Rate (Reading)			Actual (Q std.)				
				1	2	3	1	2	3	y	R ²
L-R01	Dwyer	VFA-21	04/01/2023	50	100	200	50.6	100.6	203.9	0.982x + 2.803	1.000
L-R02	Dwyer	VFA-21	04/01/2023	50	100	200	49.7	101.3	200.1	1.008x – 1.204	0.999
L-R03	Dwyer	VFA-21	04/01/2023	50	100	200	50.5	99.8	202.3	1.017x – 0.913	1.000
L-R04	Dwyer	VFA-21	03/01/2023	50	100	200	49.8	100.5	201.0	1.010x – 1.439	0.999
L-R05	Dwyer	VFA-21	03/01/2023	50	100	200	50.6	100.0	203.4	0.991x + 1.807	1.000
L-R06	Dwyer	VFA-21	03/01/2023	50	100	200	50.6	99.1	201.9	1.003x – 0.031	1.000

Calibrated by :



Approved by :



CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : VACUUM GAUGE
MANUFACTURER : HI-LIGHT
MODEL / TYPE : N/A
SERIAL NO. : N/A[64-220066-1]
CLID. NO. : 212201112
JOB CONTROL NO. : 220720073201

CUSTOMER : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24 ROAD., JOMPOL,
CHATUCHAK, BANGKOK 10900

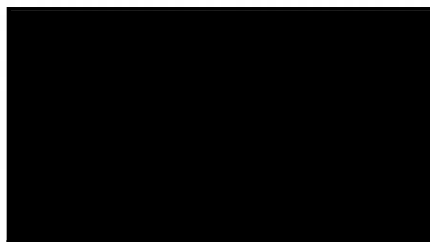
DATE OF RECEIVED : 20 July 2022

DATE OF ISSUED : 22 July 2022

Report of calibration screening must not be taken in part. Except complete. Without the approval of the Calibration Laboratory Co., Ltd.

Calibrated By : Sittipong Pimdee
Calibration Engineer

Approved By :



Authorized Signatory
22 July 2022



This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI)

Certificate No. Q22073201

F3-011-04/01-12

page 1 of 3



@clccalibration

REPORT OF CALIBRATION

FOR

NOMENCLATURE : **VACUUM GAUGE**
MANUFACTURER : **HI-LIGHT**
MODEL / TYPE : **N/A**
SERIAL NO. : **N/A[64-220066-1]**
DATE OF CALIBRATION : **21 July 2022**

ENVIRONMENT CONDITIONS :

Temperature : $(23 \pm 2) ^\circ\text{C}$

Relative Humidity : $(55 \pm 10) \% \text{RH}$

PROCEDURE USED :

This instrument was calibrated under procedure No. **CLC-CPPP-05** according to **DKD-R 6-1** as calibration guidelines.

The calibration was performed by direct measurement with Document Process Calibrator and Pressure Module which maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

Document Process Calibrator, Fluke Model 744 S/N. 9226007 with Pressure Module Model 700PV4 S/N. 19298401.

TRACEABILITY :

The measurements are traceable to International System of Units (SI), through National Institute of Metrology (Thailand).
Certificate No. MP-0196-21, Due Date 17 November 2022.

UNCERTAINTY :

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor of $k = 2$. It has been evaluated according to the "Calibration of Pressure Gauges (DKD-R 6-1)" which provides a level of confidence approximately 95%.

Certificate No. **Q22073201**

F3-011-04/01-12

page 2 of 3





CLC
Accredited
ISO/IEC 17025

CALIBRATION LABORATORY Co., LTD.

2/10-11,14,55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com



CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (X) without adjustment () adjustment

The DUC was exercised by applying a known pressure from its zero to full scale 1 times. Then 2 series of known gauge pressure were applied. The STD reading were recorded and the means value were reported in the table below.

CALIBRATION DATA

CORRECTION OF PRESSURE

DUC Test point (inHg)	STD Reading (inHg)		Correction (inHg)	
	Up	Down	Up	Down
0	0.0	0.0	0.0	0.0
-5	-4.6	-4.7	+0.4	+0.3
-10	-9.5	-9.6	+0.5	+0.4
-15	-14.4	-14.5	+0.6	+0.5
-20	-19.4	-19.5	+0.6	+0.5
-25	-24.5	-24.5	+0.5	+0.5
-30	-29.5	-29.5	+0.5	+0.5

Uncertainty of measurement ± 0.2 inHg

Transmitting fluid : Air.

Technical Note. k factor 1 kPa = 0.2952998 inHg

Note. The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 008 Page 36 of 54

This report is valid for the above stated instrument/s only.

End of Certificate

Certificate No. Q22073201

F3-011-04/01-12

page 3 of 3



@clccalibration



QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

www.qcalibration.com



CERTIFICATE No : 23M2441

REFERENCE No : 68471-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : METTLER TOLEDO

MODEL : XS105DU

SERIAL No : 1126422905

ID No : BA 05/50

CONDITION AS RECEIVED : USED ITEM

SUBMITTED BY : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN RD.,
JOMPOL, CHATUCHAK, BANGKOK 10900

CALIBRATED BY :

CALIBRATION DATE :

10-Mar-23

APPROVED BY :

ISSUED DATE :

16-Mar-23

RECEIVED DATE :

10-Mar-23

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF
QUALITY CALIBRATION CO., LTD.



CERTIFICATE No : 23M2441

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : XS105DU
MANUFACTURER : METTLER TOLEDO S/N : 1126422905
ID No : BA 05/50 RECEIVED DATE : 10-Mar-23
AIR PRESSURE : 1010mbar \pm 1mbar CALIBRATION DATE : 10-Mar-23
AMBIENT TEMPERATURE : 23°C \pm 1°C RELATIVE HUMIDITY : 49 %RH \pm 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY ACCORDING TO UKAS LAB 14 EDITION 6:2019 BY USING KNOWN WEIGHT STANDARD WEIGHT. THE BALANCE WAS NOT ADJUSTED BEFORE CALIBRATION. THE BALANCE HAS NO ZERO TRACKING FUNCTION. REPEATABILITY WAS MEASURED BY USING 10 REPEATED MEASUREMENTS. LINEARITY WAS MEASURED COVERING 10 POINTS, EVENLY SPREAD OVER THE RANGE. THE INSTRUMENT WAS SET ZERO BEFORE PERFORMING THE LINEARITY TEST. OFF-CENTER LOADING WAS MEASURED BY USING STANDARD WEIGHTS PLACED ON THE PAN AND MOVED TO VARIOUS POSITIONS ON THE PAN.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) STANDARD WEIGHT SET	E2	QK-I-151	M2302013S	02-Feb-25
2) STANDARD WEIGHT	E2	15843	M2302014S	02-Feb-25

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.

4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-

- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL BUREAU OF WEIGHTS&MEASURES

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

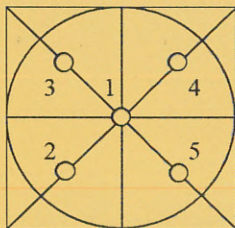
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (\pm g)
0.00	0.00000	0.00000	0.000039
0.02	0.02000	0.00000	0.000039
0.10	0.10000	0.00000	0.000039
0.20	0.20001	-0.00001	0.000040
0.50	0.50001	-0.00001	0.000040
1.00	1.00000	0.00000	0.000041
2.00	2.00003	-0.00003	0.000042
5.00	5.00001	-0.00001	0.000046
10.00	10.00003	-0.00003	0.000053
20.00	20.00005	-0.00005	0.000067
50.00	50.00001	-0.00001	0.00011
100.00	100.00001	-0.00001	0.00019
200.00	200.00001	-0.00001	0.00032

5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	50.0000
2	50.0001
3	50.0000
4	50.0000
5	49.9999
OFF-CENTER LOADING	0.0001

NOTE: THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR $k=2$, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

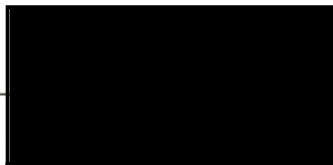
END OF CALIBRATION REPORT



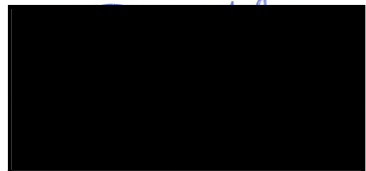
บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com., www.spscon.com

Calibration Report					
Non-Dispersive Infrared CO Analyzer					
Date :	03 March 2023	Brand :	API	Model :	300E
No.	CO-B01			Serial No.	782
Calibrator (Dilution System)					
Brand : API			Model : 700		
Last Cal. Date : 06 September 2022			Serial No. : 421		
Reference Standard Gas					
Standard Gas : Carbon Monoxide (CO)			Cylinder No. : D196045		
Certified Date : 16 April 2022		Expired Date : 15 April 2024		Cylinder Conc. : 4,570 ppm	
Calibrating Condition					
Pressure	1011	mmbar	Temp.	24.6	°C
			% RH	49	
Calibration Setting					
Span	Initial Reading (Before Adj.), PPM			Final Reading (After Adj.), PPM	
Set Point	Expected Concentration	Analyzer Response	%Dif	Analyzer Response	
Zero	0	-0.10	-	0	
CO Span	40.00	39.94	-0.150	40.00	
API Model 300E CO Analyzer Check List					
Parameter	Observed Value	Units	Nominal Range		
Range	50	PPM	0-1000 ppm		
Stability	0.10	PPM	< 1 ppm With Zero Air		
CO Measure	4016.4	mV	2500-4800 mV		
CO Reference	3948.6	mV	2500-4800 mV		
Measure/Reference Ratio	1.180	-	1.1-1.3 W/Zero Air		
Sample Pressure	28.7	In-Hg-A	~2" < Ambient Absolute Pressure		
Sample Flow	807	CC/Min	800 ± 10%		
Sample Temperature	48.3	°C	48 ± 4		
Bench Temperature	48.0	°C	48 ± 2		
Wheel Temperature	68.2	°C	68 ± 2		
Box Temperature	30.7	°C	Ambient Temp + 7 ± 10		
Photo-Drive	3024.1	mV	250 mV to 4750 mV		
Slope	1.017	-	1.0 ± 0.3		
Offset	0.2	-	0 ± 0.3		

Calibrated by :



Approved by :



SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY



451-451/1 Sirinthorn Rd.,Bangbumru, Bangplud Bangkok 10700 THAILAND.
Tel.0-2435-8800 Fax.0-2433-1679 e-mail:cal-center@sithiphorn.com http://www.sithiphorn.com

NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : SP22018

Pages 1 of 3

Calibration Certificate

Equipment : UV-VIS SPECTROPHOTOMETER
Manufacturer : PERKINELMER
Model : LAMBDA 25
Serial No.: 501S14123010
ID No.: SP03/58
Calibration Mode : WAVELENGTH ACCURACY
PHOTOMETRIC ACCURACY

Condition As Found : GOOD

Customer : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN ROAD,
CHOMPHON, CHATUCHAK,
BANGKOK 10900, THAILAND.

Location : ORGANIC LABORATORY IV

Ambient Temperature : (24.4 ± 5) °C
Relative Humidity : (60.1 ± 25) %

Received Date : 30 AUGUST 2022
Calibration Date : 30 AUGUST 2022
Date of Issue : 31 AUGUST 2022

Calibrated by :

Nathakorn Pisutpaisan

Approved by :



This certificate is issued in accordance with the requirements of ISO/IEC 17025 standard, may not be reproduced other than in full, except with the prior written approval of the head of Calibration Laboratory.

Continuation of Calibration Certificate

Cert. No. : SP22018

Job No. : VC65SP0008

Pages : 2 of 3

Calibration Method :

This instrument was calibrated by using on-site calibration procedure In-house method : CP-SP-01

The calibration procedure to direct measurement wavelength accuracy by using wavelength standard solution, Photometric accuracy by using absorbance standard filter and absorbance standard solution

The calibration procedure used was based on ASTM E275-01,ASTM E925-02

Condition of this result of calibration :

1. Certified reference materials

Material	Ref. type	Cell serial No.	Cert. No.	Due Date
Holmium liquid	RM-HL	29706	87569	13/10/2022
Didymium liquid	RM-DL	28912	87588	15/10/2022
Neutral density filter	RM-1N2N3N	13877	87600	15/10/2022
Potassium dichromate solutions	RM-0204060810	14204	87614	16/10/2022
Potassium Iodide solution	-	KI-0701-001	CI-0090-22	08/04/2024

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

3. This certificate is traceable to the international system of unit maintained at :

3.1 The UK National Physical Laboratory (NPL)

3.2 The National Institute of Standards and Technology,NIST.

Result of calibration : Wavelength Accuracy

(Without adjustment)

Material	Certified Values of Reference Material (nm)	UUC* Reading (nm)	Error (nm)	Uncertainty ± (nm)	k Factor
RM-HL	278.13	278.3	0.17	0.16	2.00
	361.25	361.4	0.15	0.16	2.00
	467.82	467.8	-0.02	0.16	2.00
	536.56	536.5	-0.06	0.16	2.00
	640.50	640.5	0.00	0.16	2.00
RM-DL	740.09	740.0	-0.09	0.16	2.00
	864.94	865.2	0.26	0.16	2.00

UUC* = Unit Under Calibration

Continuation of Calibration Certificate

Cert. No. : SP22018
Job No. : VC65SP0008
Pages : 3 of 3

Result of calibration : Photometric Accuracy

(Without adjustment)

Material	Wavelength (nm)	Filter: S/N	Nominal Absorbance (A)	Certified Absorbance (A)	UUC* Reading Absorbance (A)	Error (A)	Uncertainty ± (A)	k Factor
Neutral Density glass filter	440.0	29360	1.0	1.0524	1.0539	0.0015	0.0028	2.00
		29914	0.7	0.7454	0.7459	0.0005	0.0029	2.00
		29381	0.5	0.5426	0.5426	0.0000	0.0028	2.00
	546.1	29360	1.0	0.9822	0.9810	-0.0012	0.0028	2.00
		29914	0.7	0.6962	0.6960	-0.0002	0.0028	2.00
		29381	0.5	0.5076	0.5070	-0.0006	0.0029	2.00
	590.0	29360	1.0	1.0221	1.0202	-0.0019	0.0028	2.00
		29914	0.7	0.7238	0.7230	-0.0008	0.0029	2.00
		29381	0.5	0.5364	0.5360	-0.0004	0.0031	2.00
	635.0	29360	1.0	0.9751	0.9732	-0.0019	0.0028	2.00
		29914	0.7	0.6912	0.6902	-0.0010	0.0029	2.00
		29381	0.5	0.5214	0.5210	-0.0004	0.0032	2.00
Material	Wavelength (nm)	Solution (mg/l)	Certified Absorbance (A)	UUC* Reading Absorbance (A)	Error (A)	Uncertainty ± (A)	k Factor	
RM-0204060810	235.0	20	0.2436	0.2419	-0.0017	0.0101	2.00	
		40	0.4905	0.4855	-0.0050	0.0115	2.00	
		60	0.7453	0.7388	-0.0065	0.0067	2.00	
		80	0.9920	0.9839	-0.0081	0.0071	2.00	
		100	1.2487	1.2414	-0.0073	0.0073	2.00	

UUC* = Unit Under Calibration

Condition of this result of calibration : Spectrophotometer PERKINELMER Model Lambda 25 S/N 501S141230

Resolution of Wavelength Mode 0.1 nm
Resolution of Photometric Mode 0.0001 A
Parameter Setting
Measurement Mode Wavelength, Absorbance
Wavelength Scan 1100 nm-190 nm
Scanning Speed 7.5 nm/min
Data Pitch 0.1 nm
Band width(Wavelength) 1.0 nm
Band width(Vis) 1.0 nm
Band width(Uv) 1.0 nm

Stray Light** UUC* Reading at 220 nm	
Transimission T(%)	Absorbance(A)
0.0107	3.9886

**Specific Acceptance :

Transmission ≤ 1.0 T(%), Absorbance ≥ 2.0 A

**Stray light not TISI Accredited

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

End of Calibration Certificate



GAS CHROMATOGRAPH TEST CERTIFICATION

Certificate No. : SV0822/20530

Instrument Type : GC

Model : CP-3800

Serial Number : 00734

Organization : S.P.S. Consulting Service Co., Ltd.

Address : 7 Phahonyothin Soi 24 Phahonyothin Rd. Ladyao Chatuchak Bangkok 10900

Date : 10/08/2022

ELECTRONIC TEST

CPU	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
LCD TEST	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
VENT TEST	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
KEY ECHO TEST	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
DESTRUCTION RAM TEST	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL

RUN CHROMATOGRAM TEST

DETECTOR : Flame Ionization Detector (FID Channel Front)

INJECTOR : Capillary Injector Model 1079

GC CONDITION:

Column	80 °C hold 1 min., rate 20 °C/min. to 200 °C hold 1min.
Injector	220 °C
Detector	300 °C
Column flow	5 mL/min
Makeup flow	25 mL/min
Air flow	300 mL/min
Hydrogen flow	30 mL/min

Column: Capillary Column CP sil 5 CB 0.25 ID x 15 M

Sample: 1 µL Injection FID Test Sample 0.218 g/L C14, C15, C16 in hexane

SENSITIVITY TEST: C15. (Area count) = 118,103 Counts.





Detector Sensitivity (FID)

Detector Response	Result	Specification
Baseline Noise (μ V)	2.94	≤ 50
Baseline Drift (%)	0.18	≤ 1
Sensitivity (S/N for C15)	4,000	$\geq 1,024$

Temperature Specification

Temperature	Set	Result	Specification
Column Oven (° C)	80	80	± 5
Injector (° C)	220	220	± 5
Detector (° C)	300	300	± 5
Incubator (° C)	60	N/A	± 5

Relative Standard Deviation % (% RSD)

Checkout Procedure	Result	Specification
Area C15 (%)	1.68	≤ 5
Retention Time C15(%)	0.01	≤ 0.5

APPROVAL

Signature:

Engineer

Date : 10/08/2022





บริษัท ไทยยูนิค จำกัด

THAI UNIQUE CO., LTD.

80-82 ถนนประชาธิปไตย แขวงบางขุนพรหม เขตพระนคร กรุงเทพฯ 10200

80-82 Prachathipatai Rd., Bangkhunphrom, Pranakorn, Bangkok 10200

Tel. 0-2629-0191-6, 0-2280-1787, Fax. 0-2280-1788, E-mail : thawatt@thaiunique.com, Website : www.thaiunique.com

Results Integrated System Testing

Checkout Procedure	FID
Detector Position	Front
Inlet Type	1079 Injector
C15 Area 1	117,172
C15 Area 2	119,182
C15 Area 3	117,982
C15 Area 4	118,589
C15 Area 5	117,592
C15 Area Average	118,103
* % RSD (< 5 %)	1.68

* The precision specification should be less than 2.0 % RSD ** (Relative Standard Deviation) for an Auto sampler injection and less than 5 % for Manual injections. To calculate the %RSD, select the C15 peak area for each of the five (5) samples.

** (Relative Standard Deviation is determined by dividing the standard deviation by the average and multiplying by 100.)

$$\% \text{ RSD} = (\text{std.dev} / \text{avg}) * 100$$

Compliance	<input checked="" type="checkbox"/> Pass	<input type="checkbox"/> Fail
Performance by		
Date		



Comments			
Reviewed by		Date	10/08/2022



VARIAN



Results Integrated System Testing

Checkout Procedure	FID
Detector Position	Front
Inlet Type	1079 Injector
C15 RT 1	4.048
C15 RT 2	4.048
C15 RT 3	4.048
C15 RT 4	4.048
C15 RT 5	4.048
C15 RT Average	4.000
* % RSD (< 0.5 %)	0.01

* The precision specification should be less than 0.5 % RSD ** (Relative Standard Deviation) for an Auto sampler injection and less than 0.5 % for Manual injections. To calculate the %RSD, select the RT C15 peak for each of the five (5) samples.

** (Relative Standard Deviation is determined by dividing the standard deviation by the average and multiplying by 100.)

$$\% \text{ RSD} = (\text{std.dev} / \text{avg}) * 100$$

Compliance	<input checked="" type="checkbox"/> Pass	<input type="checkbox"/> Fail
Performance by		
Date		



Comments				
Reviewed by				
			Date	10/08/2022



คุณภาพอากาศในสถานประกอบการ



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
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7 Soi Phaholyothin 24, Phaholyothin Rd., Jompot, Chatuchak, Bangkok 10900
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com, www.spscon.com

Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

Temperature : 25 \pm 3 $^{\circ}\text{C}$
Pressure : 1010 \pm 15 mmbar

Personal Pump Data				Calibration Data								
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)				
					1	2	3	1	2	3	y	R ²
B01	SKC	224-PCXR4	262101	03/01/2023	1,000	1,500	2,000	993	1,497	1,998	1.003x - 5.584	1.000
B02	SKC	224-PCXR4	626166	03/01/2023	1,000	1,500	2,000	1,003	1,505	2,001	1.009x - 19.667	0.999
B03	SKC	224-PCXR4	612968	03/01/2023	1,000	1,500	2,000	996	1,494	2,000	1.006x - 12.109	1.000
B04	SKC	224-PCXR4	602804	04/01/2023	1,000	1,500	2,000	1,000	1,502	1,995	1.000x - 0.893	1.000
B05	SKC	224-PCXR4	612693	04/01/2023	1,000	1,500	2,000	1,003	1,500	2,003	1.012x - 22.224	0.999
B06	SKC	224-PCXR4	262188	03/01/2023	1,000	1,500	2,000	995	1,508	2,005	1.011x - 20.273	1.000
B07	SKC	224-PCXR4	626262	03/01/2023	1,000	1,500	2,000	998	1,492	1,995	0.993x + 6.086	1.000
B08	SKC	224-PCXR4	626100	03/01/2023	1,000	1,500	2,000	1,003	1,500	2,003	1.012x - 23.308	0.999
B09	SKC	224-PCXR4	626479	03/01/2023	1,000	1,500	2,000	996	1,490	1,994	0.995x + 1.117	1.000
B10	SKC	224-PCXR4	091950	03/01/2023	1,000	1,500	2,000	992	1,503	2,001	1.018x - 36.582	0.999
B11	SKC	224-PCXR8	564315	05/01/2023	1,000	1,500	2,000	996	1,490	1,999	1.003x - 8.256	1.000
B12	SKC	224-PCXR4	034656	05/01/2023	1,000	1,500	2,000	1,003	1,503	2,003	1.010x - 19.324	0.999
B13	SKC	224-PCXR4	602073	05/01/2023	1,000	1,500	2,000	995	1,500	1,998	1.001x - 3.474	1.000
B14	SKC	224-PCXR4	626313	04/01/2023	1,000	1,500	2,000	999	1,491	1,988	0.992x + 6.844	1.000
B15	SKC	224-PCXR4	626474	04/01/2023	1,000	1,500	2,000	1,001	1,502	2,005	1.014x - 25.558	0.999
B16	SKC	224-PCXR4	626477	04/01/2023	1,000	1,500	2,000	994	1,504	2,001	1.015x - 31.345	0.999
B17	SKC	224-PCXR4	626860	04/01/2023	1,000	1,500	2,000	997	1,494	1,991	0.997x - 0.359	1.000
B18	SKC	224-PCXR4	691484	04/01/2023	1,000	1,500	2,000	1,003	1,500	2,001	1.008x - 17.589	0.999
B19	SKC	224-PCXR4	691599	03/01/2023	1,000	1,500	2,000	993	1,503	1,999	1.007x - 11.574	1.000
B20	SKC	224-PCXR4	691587	03/01/2023	1,000	1,500	2,000	992	1,504	1,999	1.015x - 32.235	0.999
B21	SKC	224-PCXR4	691531	03/01/2023	1,000	1,500	2,000	993	1,499	1,994	1.001x - 7.107	1.000
B22	SKC	224-PCXR4	691654	05/01/2023	1,000	1,500	2,000	1,003	1,501	2,003	1.011x - 21.107	0.999
B23	SKC	224-PCXR4	798393	05/01/2023	1,000	1,500	2,000	992	1,507	2,002	1.018x - 34.883	0.999
B24	SKC	224-PCXR4	626363	05/01/2023	1,000	1,500	2,000	1,000	1,502	2,000	1.011x - 22.387	0.999
B25	SKC	224-PCXR4	798489	05/01/2023	1,000	1,500	2,000	1,001	1,492	2,001	0.998x + 1.101	1.000
B26	SKC	224-PCXR4	798479	05/01/2023	1,000	1,500	2,000	999	1,500	1,993	0.996x + 4.008	1.000
B27	SKC	224-PCXR4	691673	04/01/2023	1,000	1,500	2,000	994	1,503	2,002	1.016x - 32.071	0.999
B28	SKC	224-PCXR4	691570	04/01/2023	1,000	1,500	2,000	1,002	1,500	2,002	1.012x - 22.515	0.999
B29	SKC	224-PCXR4	626472	04/01/2023	1,000	1,500	2,000	1,000	1,496	1,998	1.001x - 4.942	1.000
B30	SKC	224-PCXR4	691489	03/01/2023	1,000	1,500	2,000	1,004	1,510	2,004	1.008x - 12.460	0.999
B31	SKC	224-PCXR4	691509	03/01/2023	1,000	1,500	2,000	992	1,497	1,998	1.006x - 12.711	1.000
B32	SKC	224-PCXR4	091567	05/01/2023	1,000	1,500	2,000	991	1,504	2,001	1.016x - 32.322	0.999
B33	SKC	224-PCXR4	091756	05/01/2023	1,000	1,500	2,000	993	1,497	1,991	0.997x - 0.004	1.000
B34	SKC	224-PCXR4	612962	05/01/2023	1,000	1,500	2,000	1,002	1,501	2,002	1.007x - 14.195	1.000
B35	SKC	224-PCXR4	602682	05/01/2023	1,000	1,500	2,000	993	1,498	1,995	1.002x - 8.448	1.000
B36	SKC	224-PCXR4	626164	03/01/2023	1,000	1,500	2,000	999	1,496	1,999	1.001x - 5.424	1.000
B37	SKC	224-PCXR4	626256	03/01/2023	1,000	1,500	2,000	994	1,506	1,999	1.013x - 27.815	0.999
B38	SKC	224-PCXR4	626167	03/01/2023	1,000	1,500	2,000	997	1,496	1,996	0.999x - 0.997	1.000
B39	SKC	224-PCXR4	034637	03/01/2023	1,000	1,500	2,000	1,005	1,501	2,001	1.010x - 18.618	0.999
B40	SKC	224-PCXR4	798349	05/01/2023	1,000	1,500	2,000	994	1,506	1,999	1.014x - 29.602	0.999

Calibrated by :

Approved by :



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Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

Temperature : 25 \pm 3 °C
Pressure : 1010 \pm 15 mmbar

Personal Pump Data				Calibration Data								
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)				
					1	2	3	1	2	3	y	R²
B41	SKC	224-PCXR4	612669	05/01/2023	1,000	1,500	2,000	998	1,497	1,990	0.997x + 0.718	1.000
B42	SKC	224-PCXR4	626041	05/01/2023	1,000	1,500	2,000	1,004	1,498	1,991	0.986x + 18.291	1.000
B43	SKC	224-PCXR4	034636	05/01/2023	1,000	1,500	2,000	1,000	1,501	1,992	0.991x + 11.882	1.000
B44	SKC	224-PCXR8	529341	06/01/2023	1,000	1,500	2,000	1,002	1,502	2,002	1.005x - 9.213	1.000
B45	SKC	224-PCXR8	529594	06/01/2023	1,000	1,500	2,000	999	1,501	1,989	0.991x + 11.184	1.000
B46	SKC	224-PCXR8	566743	06/01/2023	1,000	1,500	2,000	995	1,504	2,002	1.014x - 30.571	0.999
B47	SKC	224-PCXR8	566747	06/01/2023	1,000	1,500	2,000	1,002	1,502	2,004	1.013x - 24.601	0.999
B48	SKC	224-PCXR8	566753	04/01/2023	1,000	1,500	2,000	1,000	1,494	1,998	0.998x + 0.319	1.000
B49	SKC	224-PCXR8	566780	04/01/2023	1,000	1,500	2,000	1,003	1,502	2,006	1.013x - 23.982	0.999
B50	SKC	224-PCXR8	500400	04/01/2023	1,000	1,500	2,000	1,001	1,496	2,002	1.001x - 3.538	1.000
B51	SKC	224-PCXR8	500363	04/01/2023	1,000	1,500	2,000	996	1,504	1,999	1.011x - 25.031	0.999
B52	SKC	224-PCXR8	093186	04/01/2023	1,000	1,500	2,000	995	1,496	1,994	0.997x - 0.602	1.000
B53	SKC	224-PCXR8	707670	03/01/2023	1,000	1,500	2,000	1,002	1,500	2,002	1.008x - 15.403	0.999
B54	SKC	224-PCXR3	509821	03/01/2023	1,000	1,500	2,000	993	1,502	2,001	1.017x - 34.237	0.999
B55	SKC	224-PCXR3	510710	03/01/2023	1,000	1,500	2,000	999	1,494	1,994	0.997x - 0.989	1.000
B56	SKC	224-PCXR3	511450	03/01/2023	1,000	1,500	2,000	1,002	1,500	2,001	1.004x - 8.081	1.000
B57	SKC	224-PCXR3	510798	06/01/2023	1,000	1,500	2,000	997	1,492	1,998	1.000x - 2.680	1.000
B58	SKC	224-PCXR3	509852	06/01/2023	1,000	1,500	2,000	1,000	1,498	1,999	1.007x - 18.953	0.999
B59	SKC	224-PCXR3	509862	06/01/2023	1,000	1,500	2,000	996	1,503	1,994	0.997x + 3.235	1.000
B60	SKC	224-PCXR3	512655	06/01/2023	1,000	1,500	2,000	1,002	1,500	2,003	1.006x - 11.407	1.000
B61	SKC	224-PCXR3	503915	06/01/2023	1,000	1,500	2,000	994	1,489	1,998	1.004x - 12.623	1.000
B62	SKC	224-PCXR3	505975	06/01/2023	1,000	1,500	2,000	999	1,494	1,996	0.997x + 0.343	1.000
B63	SKC	224-PCXR3	511432	03/01/2023	1,000	1,500	2,000	991	1,501	1,999	1.016x - 34.624	0.999
B64	SKC	224-PCXR3	508302	03/01/2023	1,000	1,500	2,000	997	1,492	1,989	0.992x + 6.226	1.000
B65	SKC	224-PCXR3	508310	03/01/2023	1,000	1,500	2,000	1,002	1,500	2,003	1.007x - 13.936	1.000
B66	SKC	224-PCXR3	509861	03/01/2023	1,000	1,500	2,000	1,002	1,491	1,991	0.987x + 14.183	1.000
B67	SKC	224-PCXR3	506295	04/01/2023	1,000	1,500	2,000	993	1,508	2,004	1.009x - 15.555	1.000
B68	SKC	224-PCXR3	505872	04/01/2023	1,000	1,500	2,000	1,002	1,490	1,997	0.995x + 3.841	1.000
B69	SKC	224-PCXR3	508375	04/01/2023	1,000	1,500	2,000	1,002	1,499	2,000	1.010x - 20.772	0.999
B70	SKC	224-PCXR3	510623	05/01/2023	1,000	1,500	2,000	992	1,503	1,997	1.002x - 5.855	1.000
B71	SKC	224-PCXR3	508367	05/01/2023	1,000	1,500	2,000	992	1,506	2,002	1.017x - 34.791	0.999
B72	SKC	224-PCXR3	505977	05/01/2023	1,000	1,500	2,000	1,001	1,498	1,993	0.991x + 8.962	1.000
B73	SKC	224-PCXR3	512606	05/01/2023	1,000	1,500	2,000	1,002	1,501	2,005	1.009x - 14.785	1.000
B74	SKC	224-PCXR3	505993	05/01/2023	1,000	1,500	2,000	996	1,495	1,994	1.000x - 6.916	1.000
B75	SKC	224-PCXR3	509820	04/01/2023	1,000	1,500	2,000	995	1,498	1,990	0.996x + 1.791	1.000
B76	SKC	224-PCXR3	509811	04/01/2023	1,000	1,500	2,000	993	1,498	1,998	1.006x - 14.322	1.000
B77	SKC	224-PCXR3	508301	04/01/2023	1,000	1,500	2,000	1,000	1,501	2,003	1.014x - 26.603	0.999
B78	SKC	224-PCXR3	510677	04/01/2023	1,000	1,500	2,000	995	1,503	1,999	1.013x - 28.158	0.999
B79	SKC	224-PCXR3	510920	03/01/2023	1,000	1,500	2,000	994	1,493	1,994	0.999x - 4.184	1.000

Calibrated by :

Approved by :



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com, www.spscon.com

Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

Temperature : 25 \pm 3 $^{\circ}$ C
Pressure : 1010 \pm 15 mmbar

Personal Pump Data				Calibration Data								
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)				
					1	2	3	1	2	3	y	R ²
R01	SKC	224-PCXR4	602467	03/01/2023	1,000	1,500	2,000	993	1,508	2,004	1.008x - 13.936	0.999
R02	SKC	224-PCXR4	626450	06/01/2023	1,000	2,000	3,000	998	1,499	1,990	0.989x + 12.268	1.000
R03	SKC	224-PCXR4	691592	06/01/2023	1,000	1,500	2,000	1,003	1,500	2,004	1.011x - 21.761	0.999
R04	SKC	224-PCXR4	691672	06/01/2023	1,000	1,500	2,000	996	1,493	1,995	0.997x - 1.563	1.000
R05	SKC	224-PCXR4	798470	06/01/2023	1,000	1,500	2,000	993	1,505	1,999	1.014x - 31.752	0.999
R06	SKC	224-PCXR4	798456	06/01/2023	1,000	1,500	2,000	993	1,498	1,994	1.003x - 8.555	1.000
R07	SKC	224-PCXR4	798480	04/01/2023	1,000	1,500	2,000	994	1,490	1,999	1.007x - 16.073	1.000
R08	SKC	224-PCXR4	883215	04/01/2023	1,000	1,500	2,000	1,011	1,501	2,005	0.999x + 3.207	1.000
R09	SKC	224-PCXR4	034650	04/01/2023	1,000	1,500	2,000	991	1,504	2,002	1.018x - 35.900	0.999
R10	SKC	224-PCXR4	091765	04/01/2023	1,000	1,500	2,000	997	1,512	1,994	0.999x + 0.977	1.000
R11	SKC	224-PCXR4	091763	03/01/2023	1,000	1,500	2,000	1,000	1,499	2,002	1.013x - 25.119	0.999
R12	SKC	224-PCXR4	091568	03/01/2023	1,000	1,500	2,000	997	1,501	1,999	1.001x - 4.906	1.000
R13	SKC	224-PCXR4	091638	03/01/2023	1,000	1,500	2,000	1,002	1,499	1,994	0.992x + 9.636	1.000
R14	SKC	224-PCXR4	091764	03/01/2023	1,000	1,500	2,000	994	1,502	1,999	1.014x - 30.212	0.999
R15	SKC	224-PCXR8	529457	03/01/2023	1,000	1,500	2,000	1,001	1,500	2,004	1.006x - 11.941	1.000
R16	SKC	224-PCXR8	529643	05/01/2023	1,000	1,500	2,000	998	1,497	1,994	1.000x - 4.686	1.000
R17	SKC	224-PCXR8	529645	05/01/2023	1,000	1,500	2,000	994	1,509	2,000	1.015x - 30.731	0.999
R18	SKC	224-PCXR8	566756	05/01/2023	1,000	1,500	2,000	991	1,498	1,998	1.001x - 6.840	1.000
R19	SKC	224-PCXR8	566802	05/01/2023	1,000	1,500	2,000	1,002	1,499	2,000	1.010x - 21.027	0.999
R20	SKC	224-PCXR8	529089	03/01/2023	1,000	1,500	2,000	991	1,501	2,003	1.020x - 39.916	0.999
R21	SKC	224-PCXR8	665728	03/01/2023	1,000	1,500	2,000	998	1,493	1,999	1.000x - 5.404	1.000
R22	SKC	224-PCXR8	707444	03/01/2023	1,000	1,500	2,000	1,002	1,500	2,002	1.004x - 7.135	1.000
R23	SKC	224-PCXR8	761067	03/01/2023	1,000	1,500	2,000	998	1,494	1,991	0.993x + 4.132	1.000
R24	SKC	224-PCXR8	707893	04/01/2023	1,000	1,500	2,000	996	1,505	2,000	1.008x - 17.553	0.999
R25	SKC	224-PCXR8	761052	04/01/2023	1,000	1,500	2,000	1,010	1,499	1,993	0.984x + 23.464	1.000
R26	SKC	224-PCXR8	707956	04/01/2023	1,000	1,500	2,000	1,002	1,500	2,004	1.009x - 15.842	1.000
R27	SKC	224-PCXR8	707398	04/01/2023	1,000	1,500	2,000	996	1,503	2,001	1.005x - 13.449	1.000
R28	SKC	224-PCXR8	707481	04/01/2023	1,000	1,500	2,000	1,004	1,500	2,002	1.010x - 19.288	0.999
R29	SKC	224-PCXR8	707402	03/01/2023	1,000	1,500	2,000	1,004	1,493	1,991	0.988x + 14.167	1.000
R30	SKC	224-PCXR8	093811	03/01/2023	1,000	1,500	2,000	1,000	1,495	1,994	0.996x + 1.922	1.000
R31	SKC	224-PCXR8	093183	03/01/2023	1,000	1,500	2,000	1,001	1,501	2,001	1.002x - 3.618	1.000
R32	SKC	224-PCXR8	671950	03/01/2023	1,000	1,500	2,000	998	1,498	1,994	0.995x + 4.970	1.000
R33	SKC	224-PCXR4	626254	03/01/2023	1,000	1,500	2,000	995	1,502	1,999	1.014x - 31.070	0.999
R34	SKC	224-PCXR4	626131	03/01/2023	1,000	1,500	2,000	1,002	1,498	2,004	1.006x - 11.810	1.000
R35	SKC	224-PCXR8	707460	03/01/2023	1,000	1,500	2,000	999	1,498	1,995	0.994x + 6.669	1.000
R36	SKC	224-PCXR8	707446	03/01/2023	1,000	1,500	2,000	1,004	1,499	2,001	1.009x - 18.036	0.999
R37	SKC	224-PCXR8	707432	03/01/2023	1,000	1,500	2,000	996	1,499	1,998	1.000x - 2.070	1.000
R38	SKC	224-PCXR8	707349	03/01/2023	1,000	1,500	2,000	996	1,500	2,001	1.004x - 9.345	1.000
R39	SKC	224-PCXR8	761095	03/01/2023	1,000	1,500	2,000	1,001	1,496	1,994	0.997x + 2.373	1.000

Calibrated by :

Approved by :



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Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

Temperature . 25 \pm 3 °C
Pressure . 1010 \pm 15 mmbar

Personal Pump Data				Calibration Data								
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)				
					1	2	3	1	2	3	y	R²
R40	SKC	224-PCXR4	612753	05/01/2023	1,000	1,500	2,000	1,001	1,502	2,003	1.012x – 23.564	0.999
R41	SKC	224-PCXR4	626140	05/01/2023	1,000	1,500	2,000	992	1,509	2,001	1.017x – 32.442	0.999
R42	SKC	224-PCXR4	626463	05/01/2023	1,000	1,500	2,000	998	1,493	1,999	1.001x – 2.963	1.000
R43	SKC	224-PCXR4	626129	05/01/2023	1,000	1,500	2,000	1,003	1,501	2,003	1.010x – 18.945	0.999
R44	SKC	224-PCXR4	602753	05/01/2023	1,000	1,500	2,000	1,002	1,496	1,993	0.995x + 2.529	1.000
R45	SKC	224-PCXR4	626137	05/01/2023	1,000	1,500	2,000	992	1,505	2,002	1.019x – 37.408	0.999

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Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

Temperature : 25 \pm 3 $^{\circ}$ C
Pressure : 1010 \pm 15 mmbar

Personal Pump Data				Calibration Data								
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)				
					1	2	3	1	2	3	y	R²
B01	SKC	224-PCXR4	262101	04/04/2023	1,000	1,500	2,000	994	1,498	2,003	1.005x - 7.897	1.000
B02	SKC	224-PCXR4	626166	04/04/2023	1,000	1,500	2,000	1,004	1,503	2,003	1.010x - 19.866	0.999
B03	SKC	224-PCXR4	612968	07/04/2023	1,000	1,500	2,000	995	1,496	2,001	1.007x - 13.664	1.000
B04	SKC	224-PCXR4	602804	05/04/2023	1,000	1,500	2,000	998	1,499	1,994	0.999x - 1.611	1.000
B05	SKC	224-PCXR4	612693	07/04/2023	1,000	1,500	2,000	1,002	1,501	2,004	1.014x - 24.856	0.999
B06	SKC	224-PCXR4	262188	07/04/2023	1,000	1,500	2,000	994	1,509	2,006	1.012x - 21.589	0.999
B07	SKC	224-PCXR4	626262	04/04/2023	1,000	1,500	2,000	997	1,490	1,996	0.994x + 3.454	1.000
B08	SKC	224-PCXR4	626100	04/04/2023	1,000	1,500	2,000	1,001	1,499	2,005	1.015x - 27.137	0.999
B09	SKC	224-PCXR4	626479	05/04/2023	1,000	1,500	2,000	997	1,492	1,994	0.994x + 2.385	1.000
B10	SKC	224-PCXR4	091950	03/04/2023	1,000	1,500	2,000	993	1,504	2,005	1.013x - 23.779	1.000
B11	SKC	224-PCXR8	564315	10/04/2023	1,000	1,500	2,000	995	1,492	1,998	1.002x - 7.259	1.000
B12	SKC	224-PCXR4	034656	04/04/2023	1,000	1,500	2,000	1,002	1,504	2,001	1.009x - 17.609	0.999
B13	SKC	224-PCXR4	602073	04/04/2023	1,000	1,500	2,000	997	1,501	2,000	1.004x - 7.622	1.000
B14	SKC	224-PCXR4	626313	03/04/2023	1,000	1,500	2,000	997	1,492	1,991	0.996x + 1.699	1.000
B15	SKC	224-PCXR4	626474	07/04/2023	1,000	1,500	2,000	1,003	1,503	2,006	1.013x - 23.245	0.999
B16	SKC	224-PCXR4	626477	03/04/2023	1,000	1,500	2,000	995	1,506	2,003	1.011x - 22.132	0.999
B17	SKC	224-PCXR4	626860	04/04/2023	1,000	1,500	2,000	996	1,493	1,993	1.000x - 4.627	1.000
B18	SKC	224-PCXR4	691484	04/04/2023	1,000	1,500	2,000	1,001	1,496	2,002	1.010x - 21.179	0.999
B19	SKC	224-PCXR4	691599	04/04/2023	1,000	1,500	2,000	994	1,504	2,000	1.006x - 10.498	1.000
B20	SKC	224-PCXR4	691587	03/04/2023	1,000	1,500	2,000	991	1,502	2,000	1.016x - 35.102	0.999
B21	SKC	224-PCXR4	691531	04/04/2023	1,000	1,500	2,000	994	1,501	1,995	1.001x - 5.153	1.000
B22	SKC	224-PCXR4	691654	07/04/2023	1,000	1,500	2,000	1,000	1,502	2,004	1.014x - 25.574	0.999
B23	SKC	224-PCXR4	798393	05/04/2023	1,000	1,500	2,000	990	1,508	2,004	1.013x - 23.994	1.000
B24	SKC	224-PCXR4	626363	03/04/2023	1,000	1,500	2,000	1,002	1,503	1,999	1.009x - 18.837	0.999
B25	SKC	224-PCXR4	798489	07/04/2023	1,000	1,500	2,000	1,002	1,494	2,000	0.997x + 3.494	1.000
B26	SKC	224-PCXR4	798479	07/04/2023	1,000	1,500	2,000	1,001	1,501	1,994	0.995x + 5.564	1.000
B27	SKC	224-PCXR4	691673	04/04/2023	1,000	1,500	2,000	995	1,505	2,004	1.013x - 25.091	0.999
B28	SKC	224-PCXR4	691570	04/04/2023	1,000	1,500	2,000	1,003	1,501	2,001	1.010x - 19.922	0.999
B29	SKC	224-PCXR4	626472	05/04/2023	1,000	1,500	2,000	1,001	1,498	2,000	0.999x - 1.831	1.000
B30	SKC	224-PCXR4	691489	04/04/2023	1,000	1,500	2,000	1,002	1,507	2,003	1.009x - 13.936	0.999
B31	SKC	224-PCXR4	691509	07/04/2023	1,000	1,500	2,000	994	1,496	1,997	1.004x - 9.680	1.000
B32	SKC	224-PCXR4	091567	10/04/2023	1,000	1,500	2,000	992	1,506	2,001	1.013x - 25.542	0.999
B33	SKC	224-PCXR4	091756	05/04/2023	1,000	1,500	2,000	993	1,498	1,992	0.998x - 1.121	1.000
B34	SKC	224-PCXR4	612962	07/04/2023	1,000	1,500	2,000	1,002	1,503	2,003	1.008x - 14.753	0.999
B35	SKC	224-PCXR4	602682	05/04/2023	1,000	1,500	2,000	991	1,497	1,996	1.003x - 11.598	1.000
B36	SKC	224-PCXR4	626164	05/04/2023	1,000	1,500	2,000	997	1,495	1,998	1.002x - 8.097	1.000
B37	SKC	224-PCXR4	626256	07/04/2023	1,000	1,500	2,000	993	1,505	1,996	1.012x - 27.161	0.999
B38	SKC	224-PCXR4	626167	07/04/2023	1,000	1,500	2,000	998	1,493	1,997	1.003x - 8.615	1.000
B39	SKC	224-PCXR4	034637	10/04/2023	1,000	1,500	2,000	1,003	1,500	2,003	1.013x - 23.125	0.999
B40	SKC	224-PCXR4	798349	07/04/2023	1,000	1,500	2,000	993	1,507	1,998	1.015x - 30.204	0.999

Calibrated by :

Approved by :



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Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

Temperature : 25 \pm 3 $^{\circ}$ C
Pressure : 1010 \pm 15 mmbar

Personal Pump Data				Calibration Data								
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)				
					1	2	3	1	2	3	y	R ²
B41	SKC	224-PCXR4	612669	07/04/2023	1,000	1,500	2,000	997	1,496	1,991	0.998x - 1.396	1.000
B42	SKC	224-PCXR4	626041	10/04/2023	1,000	1,500	2,000	1,006	1,496	1,992	0.988x + 14.223	1.000
B43	SKC	224-PCXR4	034636	07/04/2023	1,000	1,500	2,000	1,001	1,503	1,993	0.992x + 8.810	1.000
B44	SKC	224-PCXR8	529341	10/04/2023	1,000	1,500	2,000	1,000	1,499	2,005	1.008x - 14.358	1.000
B45	SKC	224-PCXR8	529594	10/04/2023	1,000	1,500	2,000	998	1,506	1,987	0.990x + 12.580	1.000
B46	SKC	224-PCXR8	566743	05/04/2023	1,000	1,500	2,000	996	1,502	2,000	1.012x - 26.902	0.999
B47	SKC	224-PCXR8	566747	07/04/2023	1,000	1,500	2,000	998	1,501	2,002	1.014x - 27.552	0.999
B48	SKC	224-PCXR8	566753	10/04/2023	1,000	1,500	2,000	998	1,493	1,996	0.997x - 0.359	1.000
B49	SKC	224-PCXR8	566780	05/04/2023	1,000	1,500	2,000	1,007	1,501	2,007	1.011x - 19.156	0.999
B50	SKC	224-PCXR8	500400	07/04/2023	1,000	1,500	2,000	1,004	1,495	2,004	1.000x - 1.663	1.000
B51	SKC	224-PCXR8	500363	04/04/2023	1,000	1,500	2,000	997	1,502	1,998	1.008x - 21.322	0.999
B52	SKC	224-PCXR8	093186	05/04/2023	1,000	1,500	2,000	993	1,493	1,995	1.000x - 6.106	1.000
B53	SKC	224-PCXR8	707670	05/04/2023	1,000	1,500	2,000	1,000	1,498	2,002	1.009x - 18.883	0.999
B54	SKC	224-PCXR3	509821	05/04/2023	1,000	1,500	2,000	995	1,500	2,001	1.016x - 32.482	0.999
B55	SKC	224-PCXR3	510710	10/04/2023	1,000	1,500	2,000	998	1,497	1,992	0.996x - 0.191	1.000
B56	SKC	224-PCXR3	511450	05/04/2023	1,000	1,500	2,000	1,003	1,501	2,003	1.005x - 8.081	1.000
B57	SKC	224-PCXR3	510798	05/04/2023	1,000	1,500	2,000	999	1,490	2,000	1.001x - 2.920	1.000
B58	SKC	224-PCXR3	509852	10/04/2023	1,000	1,500	2,000	1,002	1,496	1,998	1.004x - 15.922	0.999
B59	SKC	224-PCXR3	509862	10/04/2023	1,000	1,500	2,000	998	1,501	1,996	0.996x + 4.471	1.000
B60	SKC	224-PCXR3	512655	07/04/2023	1,000	1,500	2,000	1,003	1,499	2,004	1.005x - 9.971	1.000
B61	SKC	224-PCXR3	503915	10/04/2023	1,000	1,500	2,000	993	1,488	1,999	1.007x - 15.934	1.000
B62	SKC	224-PCXR3	505975	10/04/2023	1,000	1,500	2,000	1,001	1,495	1,997	1.000x - 4.802	1.000
B63	SKC	224-PCXR3	511432	07/04/2023	1,000	1,500	2,000	993	1,500	2,000	1.015x - 32.709	0.999
B64	SKC	224-PCXR3	508302	05/04/2023	1,000	1,500	2,000	998	1,491	1,987	0.989x + 9.855	1.000
B65	SKC	224-PCXR3	508310	10/04/2023	1,000	1,500	2,000	998	1,502	2,005	1.012x - 20.596	1.000
B66	SKC	224-PCXR3	509861	10/04/2023	1,000	1,500	2,000	1,000	1,492	1,992	0.990x + 10.912	1.000
B67	SKC	224-PCXR3	506295	07/04/2023	1,000	1,500	2,000	993	1,506	2,002	1.007x - 13.999	1.000
B68	SKC	224-PCXR3	505872	05/04/2023	1,000	1,500	2,000	998	1,488	1,997	0.998x - 1.743	1.000
B69	SKC	224-PCXR3	508375	04/04/2023	1,000	1,500	2,000	1,004	1,502	2,002	1.009x - 18.897	0.999
B70	SKC	224-PCXR3	510623	05/04/2023	1,000	1,500	2,000	994	1,505	1,998	1.004x - 8.846	1.000
B71	SKC	224-PCXR3	508367	10/04/2023	1,000	1,500	2,000	994	1,503	2,003	1.011x - 23.544	0.999
B72	SKC	224-PCXR3	505977	10/04/2023	1,000	1,500	2,000	1,005	1,493	1,992	0.988x + 13.309	1.000
B73	SKC	224-PCXR3	512606	05/04/2023	1,000	1,500	2,000	1,000	1,504	2,004	1.008x - 14.506	1.000
B74	SKC	224-PCXR3	505993	05/04/2023	1,000	1,500	2,000	997	1,497	1,996	1.001x - 7.514	1.000
B75	SKC	224-PCXR3	509820	07/04/2023	1,000	1,500	2,000	997	1,496	1,992	0.997x + 0.195	1.000
B76	SKC	224-PCXR3	509811	05/04/2023	1,000	1,500	2,000	995	1,498	1,999	1.004x - 11.212	1.000
B77	SKC	224-PCXR3	508301	10/04/2023	1,000	1,500	2,000	1,003	1,502	2,004	1.013x - 23.811	0.999
B78	SKC	224-PCXR3	510677	04/04/2023	1,000	1,500	2,000	997	1,505	2,000	1.007x - 16.113	0.999
B79	SKC	224-PCXR3	510920	10/04/2023	1,000	1,500	2,000	996	1,495	1,993	0.998x - 1.232	1.000

Calibrated by :

Approved by :



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com., www.spscon.com

Rotameter Calibration Report (For Personal Pump High Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Calibration Data

Rotameter Data			Calibration Data								
No.	Brand	Model	Date	Flow Rate (ml/min)						Value From Calibration Curve	
				Flow Rate (Reading)			Actual (Q std.)				
				1	2	3	1	2	3	y	R²
H-R01	Dwyer	VFB-65	05/01/2023	500	1,000	2,000	503.3	992.4	1978.7	0.999x - 3.199	0.999
H-R02	Dwyer	VFB-65	04/01/2023	500	1,000	2,000	501.2	995.3	1985.7	1.002x - 5.186	1.000
H-R03	Dwyer	VFB-65	04/01/2023	500	1,000	2,000	501.7	987.7	1996.9	0.994x + 1.679	1.000
H-R04	Dwyer	VFB-65	04/01/2023	500	1,000	2,000	496.4	989.6	2019.5	1.008x - 13.614	1.000
H-R05	Dwyer	VFB-65	06/01/2023	500	1,000	2,000	497.2	987.7	1988.1	1.004x - 9.360	1.000
H-R06	Dwyer	VFB-65	06/01/2023	500	1,000	2,000	505.2	992.4	1979.8	0.999x - 2.816	0.999

Calibrated by :

Approved by :



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
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Rotameter Calibration Report (For Personal Pump Low Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter

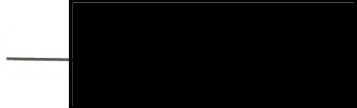
Model : Defender 510-H

S/N : 136164

Calibration Data

Rotameter Data			Calibration Data								
No.	Brand	Model	Date	Flow Rate (ml/min)						Value From Calibration Curve	
				Flow Rate (Reading)			Actual (Q std.)				
				1	2	3	1	2	3	y	R²
L-R01	Dwyer	VFA-21	04/01/2023	50	100	200	50.6	100.6	203.9	0.982x + 2.803	1.000
L-R02	Dwyer	VFA-21	04/01/2023	50	100	200	49.7	101.3	200.1	1.008x - 1.204	0.999
L-R03	Dwyer	VFA-21	04/01/2023	50	100	200	50.5	99.8	202.3	1.017x - 0.913	1.000
L-R04	Dwyer	VFA-21	03/01/2023	50	100	200	49.8	100.5	201.0	1.010x - 1.439	0.999
L-R05	Dwyer	VFA-21	03/01/2023	50	100	200	50.6	100.0	203.4	0.991x + 1.807	1.000
L-R06	Dwyer	VFA-21	03/01/2023	50	100	200	50.6	99.1	201.9	1.003x - 0.031	1.000

Calibrated by :



Approved by :





บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
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Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Calibration Data

Rotameter Data			Calibration Data								
No.	Brand	Model	Date	Flow Rate (ml/min)						Value From Calibration Curve	
				Flow Rate (Reading)			Actual (Q std.)				
				1	2	3	1	2	3	y	R ²
H-R01	Dwyer	VFB-65	05/04/2023	500	1,000	2,000	502.1	993.6	1981.1	1.000x - 3.647	0.999
H-R02	Dwyer	VFB-65	10/04/2023	500	1,000	2,000	500.4	998.7	1988.7	1.001x - 3.457	1.000
H-R03	Dwyer	VFB-65	07/04/2023	500	1,000	2,000	502.1	990.3	1997.7	0.993x + 4.022	1.000
H-R04	Dwyer	VFB-65	10/04/2023	500	1,000	2,000	497.2	992.2	2016.9	1.007x - 11.203	1.000
H-R05	Dwyer	VFB-65	05/04/2023	500	1,000	2,000	499.2	988.5	1990.7	1.003x - 7.136	1.000
H-R06	Dwyer	VFB-65	10/04/2023	500	1,000	2,000	504.8	994.6	1982.6	0.999x - 1.961	0.999

Calibrated by :

Approved by :



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
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Rotameter Calibration Report (For Personal Pump Low Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Calibration Data

Rotameter Data			Calibration Data								
No.	Brand	Model	Date	Flow Rate (ml/min)						Value From Calibration Curve	
				Flow Rate (Reading)			Actual (Q std.)				
				1	2	3	1	2	3	y	R ²
L-R01	Dwyer	VFA-21	05/04/2023	50	100	200	50.2	101.0	204.3	0.981x + 2.956	0.999
L-R02	Dwyer	VFA-21	10/04/2023	50	100	200	50.1	102.0	201.0	1.007x - 0.506	0.999
L-R03	Dwyer	VFA-21	07/04/2023	50	100	200	50.1	100.2	202.7	1.015x - 0.825	1.000
L-R04	Dwyer	VFA-21	10/04/2023	50	100	200	50.2	100.9	200.6	1.005x - 0.751	0.999
L-R05	Dwyer	VFA-21	05/04/2023	50	100	200	50.2	101.0	202.6	0.994x + 1.409	1.000
L-R06	Dwyer	VFA-21	10/04/2023	50	100	200	50.8	100.2	202.3	1.001x + 0.717	1.000

Calibrated by :

Approved by :

**QUALITY CALIBRATION CO.,LTD.**

235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

www.qcalibration.com

CERTIFICATE No : 23M2441

REFERENCE No : 68471-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : METTLER TOLEDO

MODEL : XS105DU

SERIAL No : 1126422905

ID No : BA 05/50

CONDITION AS RECEIVED : USED ITEM

SUBMITTED BY : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN RD.,
JOMPOL, CHATUCHAK, BANGKOK 10900

CALIBRATED BY

:

**CALIBRATION DATE**

:

10-Mar-23

APPROVED BY

:

**ISSUED DATE**

:

16-Mar-23

RECEIVED DATE

:

10-Mar-23

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF
QUALITY CALIBRATION CO., LTD.



CERTIFICATE No : 23M2441

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : XS105DU
MANUFACTURER : METTLER TOLEDO S/N : 1126422905
ID No : BA 05/50 RECEIVED DATE : 10-Mar-23
AIR PRESSURE : 1010mbar \pm 1mbar CALIBRATION DATE : 10-Mar-23
AMBIENT TEMPERATURE : 23°C \pm 1°C RELATIVE HUMIDITY : 49 %RH \pm 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY ACCORDING TO UKAS LAB 14 EDITION 6:2019 BY USING KNOWN WEIGHT STANDARD WEIGHT. THE BALANCE WAS NOT ADJUSTED BEFORE CALIBRATION. THE BALANCE HAS NO ZERO TRACKING FUNCTION. REPEATABILITY WAS MEASURED BY USING 10 REPEATED MEASUREMENTS. LINEARITY WAS MEASURED COVERING 10 POINTS, EVENLY SPREAD OVER THE RANGE. THE INSTRUMENT WAS SET ZERO BEFORE PERFORMING THE LINEARITY TEST. OFF-CENTER LOADING WAS MEASURED BY USING STANDARD WEIGHTS PLACED ON THE PAN AND MOVED TO VARIOUS POSITIONS ON THE PAN.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) STANDARD WEIGHT SET	E2	QK-I-151	M2302013S	02-Feb-25
2) STANDARD WEIGHT	E2	15843	M2302014S	02-Feb-25

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.

4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-

- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL BUREAU OF WEIGHTS&MEASURES

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

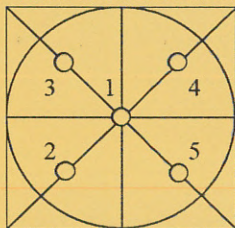
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (\pm g)
0.00	0.00000	0.00000	0.000039
0.02	0.02000	0.00000	0.000039
0.10	0.10000	0.00000	0.000039
0.20	0.20001	-0.00001	0.000040
0.50	0.50001	-0.00001	0.000040
1.00	1.00000	0.00000	0.000041
2.00	2.00003	-0.00003	0.000042
5.00	5.00001	-0.00001	0.000046
10.00	10.00003	-0.00003	0.000053
20.00	20.00005	-0.00005	0.000067
50.00	50.00001	-0.00001	0.00011
100.00	100.00001	-0.00001	0.00019
200.00	200.00001	-0.00001	0.00032

5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	50.0000
2	50.0001
3	50.0000
4	50.0000
5	49.9999
OFF-CENTER LOADING	0.0001

NOTE: THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR $k=2$, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



GAS CHROMATOGRAPH TEST CERTIFICATION

Certificate No. : SV0822/20530

Instrument Type : GC

Model : CP-3800

Serial Number : 00734

Organization : S.P.S. Consulting Service Co., Ltd.

Address : 7 Phahonyothin Soi 24 Phahonyothin Rd. Ladyao Chatuchak Bangkok 10900

Date : 10/08/2022

ELECTRONIC TEST

CPU	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
LCD TEST	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
VENT TEST	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
KEY ECHO TEST	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
DESTRUCTION RAM TEST	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL

RUN CHROMATOGRAM TEST

DETECTOR : Flame Ionization Detector (FID Channel Front)

INJECTOR : Capillary Injector Model 1079

GC CONDITION:

Column	80 °C hold 1 min., rate 20 °C/min. to 200 °C hold 1min.
Injector	220 °C
Detector	300 °C
Column flow	5 mL/min
Makeup flow	25 mL/min
Air flow	300 mL/min
Hydrogen flow	30 mL/min

Column:Capillary Column CP sil 5 CB 0.25 ID x 15 M

Sample: 1 µL Injection FID Test Sample 0.218 g/L C14,C15,C16 in hexane

SENSITIVITY TEST: C15. (Area count) = 118,103 Counts.





Detector Sensitivity (FID)

Detector Response	Result	Specification
Baseline Noise (μ V)	2.94	≤ 50
Baseline Drift (%)	0.18	≤ 1
Sensitivity (S/N for C15)	4,000	$\geq 1,024$

Temperature Specification

Temperature	Set	Result	Specification
Column Oven (° C)	80	80	± 5
Injector (° C)	220	220	± 5
Detector (° C)	300	300	± 5
Incubator (° C)	60	N/A	± 5

Relative Standard Deviation % (% RSD)

Checkout Procedure	Result	Specification
Area C15 (%)	1.68	≤ 5
Retention Time C15(%)	0.01	≤ 0.5

APPROVAL :

Signature:

Engineer :

Date : 10/08/2022





บริษัท ไทยยูนิค จำกัด

THAI UNIQUE CO., LTD.

80-82 ถนนประชาธิปไตย แขวงบางขุนพรหม เขตพระนคร กรุงเทพฯ 10200

80-82 Prachathipatai Rd., Bangkhunphrom, Pranakorn, Bangkok 10200

Tel. 0-2629-0191-6, 0-2280-1787, Fax. 0-2280-1788, E-mail : thawatt@thaiunique.com, Website : www.thaiunique.com

Results Integrated System Testing

Checkout Procedure	FID
Detector Position	Front
Inlet Type	1079 Injector
C15 Area 1	117,172
C15 Area 2	119,182
C15 Area 3	117,982
C15 Area 4	118,589
C15 Area 5	117,592
C15 Area Average	118,103
* % RSD (< 5 %)	1.68

* The precision specification should be less than 2.0 % RSD ** (Relative Standard Deviation) for an Auto sampler injection and less than 5 % for Manual injections. To calculate the %RSD, select the C15 peak area for each of the five (5) samples.

** (Relative Standard Deviation is determined by dividing the standard deviation by the average and multiplying by 100.)

$$\% \text{ RSD} = (\text{std.dev} / \text{avg}) * 100$$

Compliance	<input checked="" type="checkbox"/> Pass	<input type="checkbox"/> Fail
Performance by		
Date		



Comments			
Reviewed by		Date	10/08/2022



VARIAN



Results Integrated System Testing

Checkout Procedure	FID
Detector Position	Front
Inlet Type	1079 Injector
C15 RT 1	4.048
C15 RT 2	4.048
C15 RT 3	4.048
C15 RT 4	4.048
C15 RT 5	4.048
C15 RT Average	4.000
* % RSD (< 0.5 %)	0.01

* The precision specification should be less than 0.5 % RSD ** (Relative Standard Deviation) for an Auto sampler injection and less than 0.5 % for Manual injections. To calculate the %RSD, select the RT C15 peak for each of the five (5) samples.

** (Relative Standard Deviation is determined by dividing the standard deviation by the average and multiplying by 100.)

$$\% \text{ RSD} = (\text{std.dev} / \text{avg}) * 100$$

Compliance	<input checked="" type="checkbox"/> Pass	<input type="checkbox"/> Fail
Performance by		
Date		



Comments				
Reviewed by			Date	10/08/2022



ระดับเสียง

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0413

MTC No. EEL. BP. 109/0366

CALIBRATION CERTIFICATE

Submitted by : S.P.S. Consulting Service Co.,Ltd.

Address : 7 Soi Phaholyothin 24, Phaholyothin Road, Jompol, Chatuchak, Bangkok 10900.

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. : 130006

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 : 27 Mar. 2023

Date of Calibration : 29 Mar. 2023

1

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

Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

FM.BL.MTC.002 Rev.4

Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0413

MTC No. EEL. BP. 109/0366

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	93.94	-0.06	± 0.10	± 0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	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	1.80	± 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 :

.....
(Mr. [Redacted] ae)

Approved by :

[Redacted Signature]

Director
TISTR

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 29 Mar. 2023

Date of Issue : 30 Mar. 2023

Ref : 2011266032701228001

End of Certificate

2 / 2

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

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FM.BL.MTC.002 Rev.4

Head Office

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Office/Laboratory

Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com., www.spscon.com

Noise R_089/23

Sound Level Meter Calibration Report

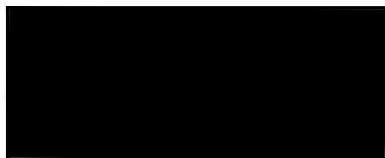
Acoustic Calibrator Data

Brand	ACO	Number	AC 03/56
Model	2127	Serial No.	130006
Calibration Range	94 dB, 1000 Hz	Last Calibration	28 April 2022
		Due Date	28 April 2023

Calibration Data

Sound Level Meter Data				Calibration Data		
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]	
					Before Adjustment	After Adjustment
ACO-R11	ACO	6236	00172038	12 February 2023	94.0	94.0
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					93.93 ± 0.10 dB	

Calibrated by :



Approved by :





บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com., www.spscon.com

Noise R_294/23

Sound Level Meter Calibration Report

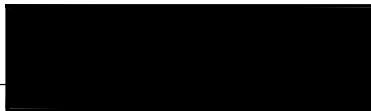
Acoustic Calibrator Data

Brand	ACO	Number	AC 03/56
Model	2127	Serial No.	130006
Calibration Range	94 dB, 1000 Hz	Last Calibration	29 March 2023
		Due Date	29 March 2024

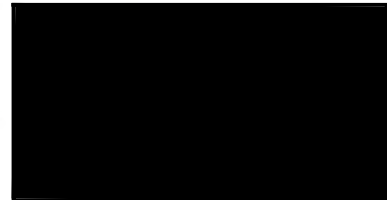
Calibration Data

Sound Level Meter Data				Calibration Data		
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]	
					Before Adjustment	After Adjustment
ACO-R09	ACO	6236	00172035	05 June 2023	94.1	94.0
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					93.94 ± 0.10 dB	

Calibrated by :



Approved by :





บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com, www.spscon.com

Noise R_095/23

Sound Level Meter Calibration Report

Acoustic Calibrator Data

Brand	ACO	Number	AC 03/56
Model	2127	Serial No.	130006
Calibration Range	94 dB, 1000 Hz	Last Calibration	28 April 2022
		Due Date	28 April 2023

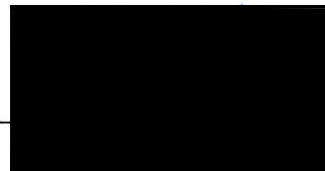
Calibration Data

Sound Level Meter Data				Calibration Data		
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]	
					Before Adjustment	After Adjustment
ACO-R14	ACO	6236	00172061	12 February 2023	94.0	94.0
ACO-R15	ACO	6236	00172062	12 February 2023	94.1	94.0
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					93.93 ± 0.10 dB	

Calibrated by :



Approved by :





บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com, www.spscon.com

Noise R_295/23

Sound Level Meter Calibration Report

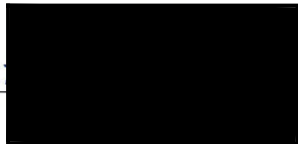
Acoustic Calibrator Data

Brand	ACO	Number	AC 03/56
Model	2127	Serial No.	130006
Calibration Range	94 dB, 1000 Hz	Last Calibration	29 March 2023
		Due Date	29 March 2024

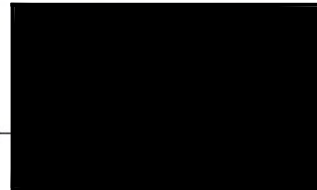
Calibration Data

Sound Level Meter Data				Calibration Data		
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]	
					Before Adjustment	After Adjustment
ACO-B18	ACO	6236	00172048	05 June 2023	94.0	94.0
ACO-B29	ACO	6236	00182011	05 June 2023	94.1	94.0
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					93.94 ± 0.10 dB	

Calibrated by :



Approved by :



คุณภาพน้ำทิ้ง



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



Cert.No.: 21CH1216

Page.: 1 of 2

Certificate of Calibration

Equipment : pH Meter
Manufacturer : HANNA
Model : HI 3512
Serial No. : 08685754
ID No. : -
Condition As-Received: Used Item
Received Date : 14 September 2021
Calibration Date : 16 September 2021
Reference : 2109-0508WN-1
Submitted by : S.P.S. Consulting Service Co.,Ltd.
7 Phaholyothin 24, Phaholyothin Road,
Jompol, Chatuchak, Bangkok10900
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In - house method :
- CP-CH5 by direct measurement with standard
voltage calibrator and direct measurement
with certified reference material (CRM)

Calibrated by : Walalak Sirithean

Approved by :

Approved Signatory

- (✓) Malee Butkruea
() Saithip Meangmai
() Warakorn Lernagatrakul

Issue Date : 22 September 2021

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.

A 0032410



Cert. No.: 21CH1216

Page.: 2 of 2

Condition of this calibration result

1. Reference Standard Instrument : -

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Document Process Calibrator	46530031	130RC098	20E3666	14 Oct 2021

This certification is traceable to the International System of Unit maintained at:-

- Traceable to National Institute of Metrology (Thailand), NIMT

2. Certified Reference Materials : The measurement results are traceable to SI through CPA chem Ltd.,
ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

<u>Buffer Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
pH 4.008	CPA chem	754028	28 June 2023
pH 6.985	CPA chem	725927	12 Jan 2022
pH 10.015	CPA chem	761018	02 Aug 2022

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

Calibration Results**Function : mV Measurement****Performing standard curve by Fluke at pH (4,7,10)**

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (\pm mV)	Coverage factor <i>k</i>
	pH	mV	mV	pH		
pH Meter S/N.: 08685754	4.000	177.48	177.9	4.000	0.058	2.00
	7.000	0.00	0.4	7.000	0.058	2.00
	10.000	-177.48	-177.2	10.000	0.058	2.00

Function : pH Measurement**Performing three buffers standard curve by using buffer nominal pH (4,7,10)**

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (\pm)	Coverage factor <i>k</i>
pH Electrode S/N.: 061416CM	4.008	4.008	169.2	0.0046	2.00
	6.985	6.985	-4.4	0.0075	2.00
	10.015	10.013	-178.9	0.013	2.05

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

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a 1072797

**QUALITY CALIBRATION CO.,LTD.**

235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584



CERTIFICATE No : 22E9693

REFERENCE No : 66476-1

PAGE : 1 OF 3

Certificate of Calibration

EQUIPMENT : pH METER

MANUFACTURER : HANNA

MODEL : HI 3512

SERIAL No : TH118035


ID No : pH 04/56

CONDITION AS RECEIVED : USED ITEM

SUBMITTED BY : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN RD.,
JOMPOL, CHATUCHAK, BANGKOK 10900

CALIBRATED BY

:

**CALIBRATION DATE**

:

15-Sep-22

APPROVED BY

:

**ISSUED DATE**

:

15-Sep-22

RECEIVED DATE

:

14-Sep-22

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF
QUALITY CALIBRATION CO., LTD.



QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksong, Bangkai, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

CERTIFICATE No : 22E9693

PAGE : 2 OF 3

Calibration Report

EQUIPMENT : pH METER
MANUFACTURER : HANNA
ID No : pH 04/56
RECEIVED DATE : 14-Sep-22
AMBIENT TEMPERATURE : 20 ° C ± 1 ° C
MODEL : HI 3512
SERIAL NUMBER : TH118035
CALIBRATION DATE : 15-Sep-22
RELATIVE HUMIDITY : 50 % RH ± 10% RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY DIRECT MEASUREMENT METHOD BASED ON WI-TQ-062 AND WI-TQ-063. THE DISPLAY UNIT WAS TESTED BY GENERATING STANDARD VOLTAGE TO THE UNIT AND READ THE VALUE COMPARED WITH CALCULATED VALUE. THE DISPLAY AND ELECTRODE WAS CALIBRATED BY USING STANDARD pH BUFFER
2. REFERENCE STANDARD INSTRUMENTS :-

<u>INSTRUMENT</u>	<u>MODEL</u>	<u>SERIAL No/</u> <u>LOT No</u>	<u>CERTIFICATE No</u>	<u>DUE DATE</u>
1) pH STANDARD SOLUTION	00651-06	CC719181	4880-12119147	05-Apr-23
2) pH STANDARD SOLUTION	00651-08	CC718727	4881-12110709	31-Mar-23
3) pH STANDARD SOLUTION	00651-10	CC717045	4882-12065386	17-Mar-23
4) PROCESS CALIBRATOR	CA150	91S6079	22E1145	31-Mar-23
5) BATH	260014	1247 48074	22T9870	13-Sep-23
6) THERMOMETER WITH PROBE	421504	55000379	22T9904	13-Sep-23

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
5. THIS CERTIFICATE IS TRACEABLE TO SI UNIT MAINTAINED AT :-
 - NATIONAL INSTITUTE OF STANDARD AND TECHNOLOGY, USA.
 - NATIONAL INSTITUTE OF METROLOGY (THAILAND)

RESULT OF CALIBRATION : ADJUSTMENT

1. DISPLAY UNIT ONLY

SLOPE FACTOR $k = 2.303 RT/F = 59 \text{ mV/pH}$

mV APPLIED	UUC READING (mV)	CORRECTION (mV)	UUC READING (pH)	UNCERTAINTY OF MEASUREMENT (± mV)	COVERAGE FACTOR k
414.11	414.8	-0.69	-0.171	0.14	2.0
354.95	355.6	-0.65	0.860	0.14	2.0
295.80	296.4	-0.60	1.892	0.14	2.0
236.64	237.2	-0.56	2.922	0.14	2.0
177.48	178.0	-0.52	3.954	0.14	2.0
118.32	118.8	-0.48	4.985	0.14	2.0
59.16	59.7	-0.54	6.016	0.14	2.0
0.00	0.5	-0.50	7.049	0.14	2.0
-59.16	-58.8	-0.36	8.136	0.14	2.0
-118.32	-117.9	-0.42	9.223	0.14	2.0
-177.48	-177.1	-0.38	10.311	0.14	2.0
-236.64	-236.3	-0.34	11.399	0.14	2.0
-295.80	-295.5	-0.30	12.487	0.14	2.0
-354.95	-354.7	-0.25	13.575	0.14	2.0
-414.11	-413.9	-0.21	14.662	0.14	2.0

END OF CALIBRATION REPORT PAGE 2 OF 3



QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

CERTIFICATE No : 22E9693

PAGE : 3 OF 3

Calibration Report

RESULT OF CALIBRATION (CONTINUE) :

2. DISPLAY UNIT WITH pH ELECTRODE S/N: 09081C6M

STANDARD pH BUFFER SOLUTION (pH)	UUC READING (pH)	CORRECTION (pH)	VALUE BEFORE ADJUSTMENT	UNCERTAINTY OF MEASUREMENT (\pm pH)	COVERAGE FACTOR k
4.007	4.007	0.000	3.996	0.012	2.0
7.004	7.006	-0.002	6.944	0.012	2.0
10.016	10.012	0.004	10.194	0.014	2.0

3. DISPLAY UNIT WITH TEMPERATURE

STANDARD READING ($^{\circ}$ C)	UUC READING ($^{\circ}$ C)	CORRECTION ($^{\circ}$ C)	VALUE BEFORE ADJUSTMENT	UNCERTAINTY OF MEASUREMENT (\pm $^{\circ}$ C)	COVERAGE FACTOR k
25.003	25.0	0.003	---	0.0085	2.0

4. PERCENT SLOPE 100%

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 APPROXIMATELY 95%.

END OF CALIBRATION REPORT

Certificate of Calibration

Certificate No. : 66-400065-2

Page : 1 of 2

Submitted by : S. P. S Consulting Service Co.,Ltd.

7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900

Equipment : Liquid in Glass Thermometer

Manufacturer : SK

Model : N/A

Range : 0 °C to 100 °C

Resolution : 1 °C

Serial No. : N/A

Immersion : Total

ID No. : TM21/59

Environment : Ambient Temperature : (23 ± 2) °C

Relative Humidity : (50 ± 15) %

Line Voltage : (220 ± 22) VAC

Date of Received : 01 February 2023

Date of Calibration : 06 February 2023

Date of Issue : 06 February 2023

Calibrated by : Chortip Samchusri

Calibration Method : This instrument was calibrated by In-house method comparison technique CAL-M4001 based on ASTM E77-07 by compared with PRT in the liquid bath at the constant controlled temperature.

The temperature scale used was based on ITS-90

Reference Standard Instruments : This certification is traceable to the International System of Units

1. Platinum Resistance Thermometer (PRT)

ID No.	Cert. No.	Due Date	Traceability
400001	TT-0016-22	07 Feb 2024	National Institute of Metrology Thailand (NIMT)

2. Standard Digital Thermometer

ID No.	Cert. No.	Due Date	Traceability
400003	21E1850	14 Jun 2023	National Institute of Metrology Thailand (NIMT)
400004	21E1850	14 Jun 2023	National Institute of Metrology Thailand (NIMT)

Approved by



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 Calibratech Co.,Ltd.



Certificate of Calibration

Certificate No. : 66-400065-2

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

Ice point check : UUC* reading 0 ° C Standard reading 0.3606 ° C

Standard Reading (° C)	UUC Reading (° C)	Correction (° C)	Uncertainty (± ° C)
20.3607	20	0.4	0.31

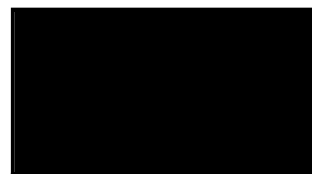
Remark

UUC : Unit Under Calibration

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

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2$,
providing a level of confidence of approximately 95%

- o0o -





CERTIFICATE No : 23M2442

REFERENCE No : 68471-2

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : SARTORIUS

MODEL : BSA224S-CW

SERIAL No : 36591843

ID No : BA 09/61

CONDITION AS RECEIVED : USED ITEM

SUBMITTED BY : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN RD.,
JOMPOL, CHATUCHAK, BANGKOK 10900

CALIBRATED BY :

[Redacted Signature]

CALIBRATION DATE :

10-Mar-23

APPROVED BY :

[Redacted Signature]

ISSUED DATE :

16-Mar-23

RECEIVED DATE :

10-Mar-23



CERTIFICATE No : 23M2442

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : BSA224S-CW
MANUFACTURER : SARTORIUS S/N : 36591843
ID No : BA 09/61 RECEIVED DATE : 10-Mar-23
AIR PRESSURE : 1010mbar \pm 1mbar CALIBRATION DATE : 10-Mar-23
AMBIENT TEMPERATURE : 23°C \pm 1°C RELATIVE HUMIDITY : 49 %RH \pm 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY ACCORDING TO UKAS LAB 14 EDITION 6:2019 BY USING KNOWN WEIGHT STANDARD WEIGHT. THE BALANCE WAS NOT ADJUSTED BEFORE CALIBRATION. THE BALANCE HAS NO ZERO TRACKING FUNCTION. REPEATABILITY WAS MEASURED BY USING 10 REPEATED MEASUREMENTS. LINEARITY WAS MEASURED COVERING 10 POINTS, EVENLY SPREAD OVER THE RANGE. THE INSTRUMENT WAS SET ZERO BEFORE PERFORMING THE LINEARITY TEST. OFF-CENTER LOADING WAS MEASURED BY USING STANDARD WEIGHTS PLACED ON THE PAN AND MOVED TO VARIOUS POSITIONS ON THE PAN.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) STANDARD WEIGHT SET	E2	QK-I-151	M2302013S	02-Feb-25
2) STANDARD WEIGHT	E2	15843	M2302014S	02-Feb-25

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.

4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-

- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL BUREAU OF WEIGHTS&MEASURES

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

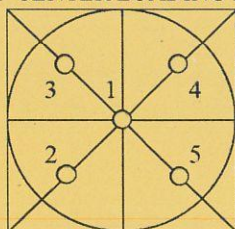
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (\pm g)
0.0	0.0000	0.0000	0.000058
0.1	0.1000	0.0000	0.000059
0.2	0.2000	0.0000	0.000059
0.5	0.5000	0.0000	0.000060
1.0	1.0000	0.0000	0.000060
2.0	2.0000	0.0000	0.000061
5.0	5.0000	0.0000	0.000063
10.0	10.0000	0.0000	0.000067
20.0	20.0001	-0.0001	0.000073
50.0	50.0000	0.0000	0.00011
100.0	100.0001	-0.0001	0.00019
200.0	200.0000	0.0000	0.00032

5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	100.0000
2	99.9999
3	99.9998
4	100.0001
5	100.0000
OFF-CENTER LOADING	0.0002

NOTE: THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR $k = 2$, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT

CERT.No.: HS-U017D

Calibration Date : 3 Apr 23
 Submitted by : S.P.S CONSULTING SERVICE CO.,LTD
 7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol,
 Chatuchak, Bangkok, Thailand 10900

Model : YSI 5000
 S/N : 15B100751
 Probe : YSI 5010
 S/N : 22D100097
 ID NO. : -
 Air Temp ref : S/N. E00522
 Barometric ref : S/N. E00522
 Water Temp ref : S/N. 11431
 Technician : Kittipong M.

Avg Room Temp : 20 °C
 Avg Water Temp : 20 °C
 Air Pressure : 760.00 mmHg
 Salinity : 0 ppt

Calibration Details

Calibration Point	100% air sat. (@20 °C, DO = 9.09 mg/l)	(status)	(status)
Measurement 1 (mg/l)	9.08	(PASS)	-
Measurement 2 (mg/l)	9.08	(PASS)	-
Measurement 3 (mg/l)	9.08	(PASS)	-
Measurement 4 (mg/l)	9.08	(PASS)	-
Measurement 5 (mg/l)	9.08	(PASS)	-
Measurement 6 (mg/l)	9.08	(PASS)	-
Measurement 7 (mg/l)	9.08	(PASS)	-
Measurement 8 (mg/l)	9.08	(PASS)	-
Measurement 9 (mg/l)	9.08	(PASS)	-
Measurement 10 (mg/l)	9.08	(PASS)	-
<hr/>			
Mean Measurement	9.08	mg/l	-
Inaccuracy	0.01	mg/l	-
<hr/>			
Overall Status	(PASS)		

Manufacturer Specification

Accuracy = +/- 0.02 mg/l

- 1) This certificate is issued based on the result that are found as shown on date and place of test only.
- 2) The calibration procedure followed in accordance with Harikul Science Co., Ltd.
- 3) This result shall not be used for advertising purpose.

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CERTIFICATE No : 22T10972
REFERENCE No : 66837-1

PAGE : 1 OF 3

Certificate of Calibration

EQUIPMENT : COD REACTOR
MANUFACTURER : HACH
MODEL : DRB 200
SERIAL No : 15110C0497
ID No : DRB 04/59
SUBMITTED BY : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN RD.,
JOMPOL, CHATUCHAK, BANGKOK 10900

CALIBRATED BY :

CALIBRATION DATE :

20-Dec-22

APPROVED BY :

ISSUED DATE :

20-Dec-22

RECEIVED DATE :

20-Dec-22



CERTIFICATE No : 22T10972

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : COD REACTOR
MANUFACTURER : HACH
ID NUMBER : DRB 04/59
RECEIVED DATE : 20-Dec-22
AMBIENT TEMPERATURE : 23° C ± 1° C

MODEL : DRB 200
SERIAL NUMBER : 15110C0497
CALIBRATION DATE : 20-Dec-22
RELATIVE HUMIDITY : 52 %RH ± 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

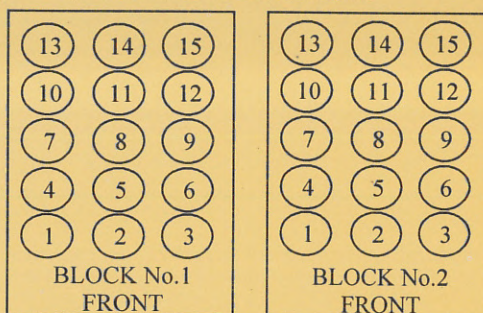
1. THIS INSTRUMENT WAS CALIBRATED BY DIRECT MEASUREMENT TEMPERATURE RECORDER WITH THERMOCOUPLE TYPE K UNDER NO LOAD CONDITION. THE THERMOCOUPLES WERE PLACED ON 15 POINTS AND LOCATED ONE THERMOCOUPLE IN EACH OF THE FOUR CORNERS OF THE REACTOR AND PLACED THE EIGHTH THERMOCOUPLE AT THE CENTER OF THE REACTOR.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) DATA LOGGER WITH TC TYPE K	HYDRA 2635A	8009008	22T7511	10-Jul-23

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO.,LTD.

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



TEMPERATURE MEASUREMENT ACCURACY TEST

Block No.	1	2
Controller temperature (°C)	145	145
Indicating Temperature	145	145
Measured Temperature (°C) at Spread Locations	1	149.8
	2	149.6
	3	149.7
	4	149.8
	5	149.9
	6	149.8
	7	149.8
	8	149.8
	9	149.9
	10	149.8
	11	149.9
	12	149.7
	13	149.9
	14	149.9
	15	149.7
Uncertainty of Measurement(± °C)	0.86	0.86

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER

NOTE 2 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR k =2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

Customer : <u>S.P.S.Consulting Service Co.,Ltd</u>	Date Tested: <u>January 11, 2023</u>	
	Recommendation Recertification	
Address : <u>7 Soi Phaholyothin 24</u>	Period <u>6</u> Months	
<u>Paholyothin Road</u>	Recertification Due: <u>July 11, 2023</u>	
<u>Jompol Chatuchak, Bangkok 1090</u>	Date Last Certified: <u>July 11, 2022</u>	
User Name: <u>K.Phenpha Vipasthawatt</u>	Visit Number: <u>2 of 2</u>	
Phone: <u>083-9269252</u>	PerkinElmer Phone: <u>02-719-6420 ext 206</u>	
Fax: <u>02-513-4221</u>	PerkinElmer Fax: <u>02-318-5597</u>	

CONFIGURATION TESTED		ACCESSORIES/COMPONENT NOT INCLUDED
MODEL	SERIAL NUMBER	
<u>OPTIMA 5300DV</u>	<u>077C7042401</u>	
TESTED EQUIPMENT	CALIBRATION NUMBER	EXPIRATION
<u>IPV Methods</u>		
TEST STANDARD USED	PART NUMBER	EXPIRATION DATE
<u>Multielement Standard</u>	<u>N069-1579</u>	<u>May 30, 2023</u>
<u>Wavecal Solution</u>	<u>N058-2152</u>	<u>February 28, 2023</u>
<u>VIS Wavecal solution</u>	<u>N930-2946</u>	<u>August 30, 2023</u>
<u>Instrument Cal. STD4</u>	<u>N930-0221</u>	<u>November 30, 2023</u>
CUSTOMER SUPPLIED	COMMENTS	CUSTOMER INITIALS
<u>2 % HNO3</u>		
<u>10 % HNO3</u>		



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER 077C7042401

DATE TESTED January 11, 2023

1. MECHANICAL CHECKS

- | | |
|--|-----------------------------|
| A. Inspect and clean all fans and filters. | <input type="checkbox"/> OK |
| B. Inspect and replace as necessary, all torch components including the RF coil. | <input type="checkbox"/> OK |
| C. Inspect all tubing for sign of clacking or leaking. | <input type="checkbox"/> OK |
| D. Adjust water and gas pressure regulator settings. | <input type="checkbox"/> OK |
| E. Inspect and leak check pneumatics drawers. | <input type="checkbox"/> OK |
| F. Clean the exterior of the instrument. | <input type="checkbox"/> OK |

2. OPTICAL CHECKS

- | | |
|---|-----------------------------|
| A. Inspect and clean all optical components. | <input type="checkbox"/> OK |
| B. As required, check and replace all purgefilters. | <input type="checkbox"/> OK |
| C. Recheck optical alignment. | <input type="checkbox"/> OK |

3. COOLING SYSTEM CHECKS

- | | |
|---|------------------------------|
| A. Perform preventive maintenance on chiller. | <input type="checkbox"/> OK |
| B. Flush out the chiller every year. | <input type="checkbox"/> N/A |

4. PERFORMANCE CHECKS

- | | |
|----------------------------|-----------------------------|
| A. Torch View Alignment. | <input type="checkbox"/> OK |
| B. Wavelength Calibration. | <input type="checkbox"/> OK |



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER : 077C7042401
DATE TESTED : January 11, 2023

PARAMETER		SPECIFICATION		FINAL VALUE	
Spectral Resolution : UV	As 193.696 nm	≤ 0.007		<u>0.00504</u>	
	Ni 231.604 nm	≤ 0.008		<u>0.00646</u>	
	Ni 341.476 nm	≤ 0.012		<u>0.00768</u>	
Spectral Resolution : VIS	La 408.672 nm	≤ 0.020		<u>0.01597</u>	
	Ba 455.403 nm	≤ 0.025		<u>0.02185</u>	
Precision					
	As 193.656 nm	% RSD	< 1.0	<u>0.89</u>	%
	Zn 213.856 nm	% RSD	< 1.0	<u>0.77</u>	%
	Mn 257.610 nm	% RSD	< 1.0	<u>0.51</u>	%
	La 379.478 nm	% RSD	< 1.0	<u>0.44</u>	%
	Ba 455.403 nm	% RSD	< 1.0	<u>0.44</u>	%
	Ba 493.408 nm	% RSD	< 1.0	<u>0.46</u>	%
Detection Limits : Axial	Tl 190.080 nm	3(sd)		<u>4.04</u>	ppb
	As 193.696 nm	3(sd)		<u>3.58</u>	ppb
	Pb 220.353 nm	3(sd)		<u>1.90</u>	ppb
Detection Limits : Radial	As 193.696 nm	3(sd)		<u>47.72</u>	ppb
	Zn 213.856 nm	3(sd)		<u>1.02</u>	ppb
	Mn 257.610 nm	3(sd)		<u>0.68</u>	ppb
	La 379.478 nm	3(sd)		<u>1.43</u>	ppb
	Ba 455.403 nm	3(sd)		<u>0.10</u>	ppb
	Ba 493.408 nm	3(sd)		<u>0.36</u>	ppb
BEC : Axial (IB X 500)/(IS-IB)	Cd 226.502 nm	≤ 150 ppb		<u>58.36</u>	
BEC : Radial (IB X 1000)/(IS-IB)	Mn 257.610 nm	≤ 45 ppb		<u>104142.80</u>	



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER 077C7042401**DATE TESTED** January 11, 2023**Remarks :**

Commissioning follow as commissioning performance sheets.

This is to certify that the above tests have been performed and the configuration tested

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meets

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does not meet

the PerkinElmer Specifications listed on this certificate.

This certificate does not modify PerkinElmer's standard terms and condition of sale, including warranty terms.

Service Department PerkinElmer Ltd.

Authorized Representative:

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Service Engineer

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : CONDUCTIVITY METER
MANUFACTURER : METTLER TOLEDO
MODEL / TYPE : SEVEN COMPACT S230
SERIAL NO. : C141708983/5821320179
CLID. NO. : 272300452
JOB CONTROL NO. : 230211016445

CUSTOMER : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24 ROAD, JOMPOL,
CHATUCHAK, BANGKOK 10900

DATE OF RECEIVED : 11 February 2023

DATE OF ISSUED : 15 February 2023

Report of calibration screening must not be taken in part. Except complete. Without the approval of the Calibration Laboratory Co., Ltd.

Calibrated By : Sukgasem Seehanart
Calibration Engineer

Approved By :

Authorized Signatory
15 February 2023



This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI)

Certificate No. Q23016445

F3-011-04/01-12

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@clccalibration

REPORT OF CALIBRATION

FOR

NOMENCLATURE : CONDUCTIVITY METER
MANUFACTURER : METTLER TOLEDO
MODEL / TYPE : SEVEN COMPACT S230
SERIAL NO. : C141708983/5821320179
DATE OF CALIBRATION : 13 February 2023

ENVIRONMENT CONDITIONS :

Temperature : $(25 \pm 2.5) ^\circ\text{C}$ Relative Humidity : $(50 \pm 15) \% \text{ RH}$

PROCEDURE USED :

This instrument [Conductivity Meter] was calibrated under procedure No. **WI-305-130**. The calibration was performed by direct measurement with Certified Reference Material (CRM) and Reference Material (RM) .

This instrument [Temperature] was calibrated under procedure No. **WI-305-244**. The calibration was performed by Comparison with Calibration Bath, Precision Thermometer and IPRT which maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

1. Potassium Chloride Solution (nominal 1.41 mS/cm , nominal 12.8 mS/cm)
2. Conductivity Solution , Hanna Product Code HI 7033L Lot Number 6436.
3. Calibration Bath, Kambic Model OB-22/2 ULT S/N. 17115653.
4. Precision Thermometer, ASL Model F250 S/N. 1334023800.
5. IPRT, ASL Model T100-250-1D S/N. L0193A-1-1.



TRACEABILITY :

1. The measurements are traceable to International System of Units (SI) , through Merck Co., Ltd.

Certificate No. HC02139203 , HC04515254. Due Date 30 June 2023 , 30 November 2023.

2. The measurements are traceable to International System of Units (SI) , through Hanna instruments.

Certificate No. 12E12 , Due Date May 2024 .

3. The measurements are traceable to International System of Units (SI) , through Calibration Laboratory Co., Ltd.

Certificate No. Q22130792, Due Date 05 January 2024.

4. The measurements are traceable to International System of Units (SI) , through Thailand Institute of Scientific and Technological Research (TISTR). Certificate No. PSL-T 0823/65, Due Date 22 August 2023.

5. The measurements are traceable to International System of Units (SI) , through National Institute of Metrology (Thailand).

Certificate No. TT-0166-22, Due Date 01 December 2023.

UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor complies with the table which for a normal distribution corresponds to a coverage probability of approximately 95 %.

It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2022)"



CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (X) without adjustment () adjustment

The table in the following gives the calibration results and associated measurement uncertainties of Conductivity Meter.

CALIBRATION DATA

1. Conductivity Solution Test @ 25°C

Standard Conductivity Solution	DUC Reading	Uncertainty of Measurement	k Factor
*84.00 µS/cm	84.04 µS/cm [Cell Constant 0.548589]	± 1.00 µS/cm	2,00
1412.0 µS/cm	1413 µS/cm [Cell Constant 0.548589]	± 21.0 µS/cm	2,00
12.85 mS/cm	12.88 mS/cm [Cell Constant 0.573538]	± 0.19 mS/cm	2,00

Note. * means Calibrations marked "Not TISI Accredited" in this Certificate have been included for completeness.

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*2. Temperature Result [Probe Conductivity]

Immersion depth (mm)	Actual Temperature (°C)	DUC Reading (°C)	Correction (°C)	Uncertainty ± (°C)
100	25.00	25.0	0.00	0.07

Note. The reported uncertainty is based on a standard uncertainty multiplied by coverage factor of $k = 2,00$.

* means Calibrations marked " Not TISI Accredited " in this Certificate have been included for completeness.

This report is valid for the above stated instrument/s only.

End of Certificate

