

ภาคผนวกที่ 4

เอกสารสอบเทียบความถูกต้องของเครื่องมือ



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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	03/08/2023	y = 1.221x-4.116	0.995
B36	B36	03/08/2023	y = 1.247x-6.537	0.999
B37	B37	03/08/2023	y = 1.313x-8.352	0.997
B38	B38	03/08/2023	y = 1.279x-8.340	0.998
B39	B39	03/08/2023	y = 1.286x-6.520	0.999
B40	B40	03/08/2023	y = 1.241x-6.104	1.000
B41	B41	03/08/2023	y = 1.203x-4.249	0.999
B42	B42	03/08/2023	y = 1.296x-8.828	0.999
B43	B43	04/08/2023	y = 1.245x-5.710	0.997
B44	B44	04/08/2023	y = 1.262x-5.417	0.999
R01	R01	04/08/2023	y = 1.285x-8.953	0.999
R02	R02	04/08/2023	y = 1.268x-8.283	0.998
R03	R03	04/08/2023	y = 1.283x-9.563	0.999
R04	R04	04/08/2023	y = 1.234x-5.231	0.999
R05	R05	04/08/2023	y = 1.303x-10.505	0.999
R06	R06	04/08/2023	y = 1.287x-7.927	0.997
R07	R07	04/08/2023	y = 1.084x+0.577	0.999
R08	R08	04/08/2023	y = 1.304x-9.687	0.998
R09	R09	04/08/2023	y = 1.286x-8.387	0.998
R10	R10	03/08/2023	y = 1.241x-6.099	0.996
R11	R11	03/08/2023	y = 1.112x-1.473	0.998
R12	R12	03/08/2023	y = 1.250x-6.933	0.997
R13	R13	02/08/2023	y = 1.142x-2.480	0.998
R14	R14	02/08/2023	y = 1.205x-3.813	0.998
R15	R15	01/08/2023	y = 1.160x-3.518	0.999
R16	R16	01/08/2023	y = 1.229x-7.416	0.998
R17	R17	01/08/2023	y = 1.209x-4.808	0.998
R18	R18	01/08/2023	y = 1.257x-6.979	0.999
R19	R19	01/08/2023	y = 1.256x-7.676	0.996
R20	R20	01/08/2023	y = 1.279x-8.603	0.996



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High Volume PM-10 Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard

Model : TE 5025A

S/N : 3611

Calibration Data

High Volume PM-10 Data

Calibration Data

Recorder No.	Blower No.	Date	Actual Flowrate (ft ³ /min)	R ²
R01	R01	01/08/2023	y = 1.244x-6.482	0.998
R02	R02	01/08/2023	y = 1.274x-6.620	0.998
R03	R03	02/08/2023	y = 1.268x-7.028	0.999
R04	R04	02/08/2023	y = 1.259x-8.726	0.998
R05	R05	02/08/2023	y = 1.210x-5.918	0.999
R06	R06	02/08/2023	y = 1.246x-5.062	0.998
R07	R07	02/08/2023	y = 1.222x-4.950	0.999
R08	R08	02/08/2023	y = 1.287x-8.890	0.998
R09	R09	02/08/2023	y = 1.245x-8.340	0.998
R10	R10	02/08/2023	y = 1.228x-6.133	0.999
R11	R11	04/08/2023	y = 1.282x-6.014	0.997
R12	R12	04/08/2023	y = 1.303x-9.748	0.998
R13	R13	04/08/2023	y = 1.305x-8.462	0.997
R14	R14	04/08/2023	y = 1.299x-7.936	0.997
R15	R15	02/08/2023	y = 1.291x-7.250	0.999
R16	R16	02/08/2023	y = 1.275x-7.402	0.995
R17	R17	02/08/2023	y = 1.292x-8.739	0.999
R18	R18	02/08/2023	y = 1.215x-5.881	0.998
R19	R19	02/08/2023	y = 1.273x-7.472	0.999
R20	R20	02/08/2023	y = 1.288x-10.308	0.997



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CALIBRATION REPORT					
NON-DISPERSIVE INFRARED CO ANALYZER					
DATE :	14 August 2023	BRAND :	API	MODEL :	300E
NO.	CO-R01	SERIAL NO.	704		
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.	24.5	°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	40.06	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	4013.2	mV	2500-4800 mV		
CO REFERENCE	3947.8	mV	2500-4800 mV		
MEASURE/REFERENCE RATIO	1.179	-	1.1-1.3 w/zero air		
SAMPLE PRESSURE	28.5	In-Hg-A	~2" < ambient absolute pressure		
SAMPLE FLOW	804	cc/min	800 ± 10%		
SAMPLE TEMPERATURE	48.3	°C	48 ± 4		
BENCH TEMPERATURE	48.0	°C	48 ± 2		
WHEEL TEMPERATURE	68.5	°C	68 ± 2		
BOX TEMPERATURE	30.6	°C	Ambient temp + 7 ± 10		
PHOTO-DRIVE	3037.9	mV	250 mV to 4750 mV		
SLOPE	1.017	-	1.0 ± 0.3		
OFFSET	0.2	-	0 ± 0.3		



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CALIBRATION REPORT					
NON-DISPERSIVE INFRARED CO ANALYZER					
DATE :	12 November 2023	BRAND :	API	MODEL :	300E
NO.	CO-R03	SERIAL NO.	1352		
Calibrator (Dilution System)					
Brand	: API		Model	: 700	
Last Cal. Date	: 30 October 2023		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.	24.5	°C
% RH	48				
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	39.95	-0.125	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	4014.1	mV	2500-4800 mV		
CO REFERENCE	3947.5	mV	2500-4800 mV		
MEASURE/REFERENCE RATIO	1.180	-	1.1-1.3 w/zero air		
SAMPLE PRESSURE	28.6	In-Hg-A	~2" < ambient absolute pressure		
SAMPLE FLOW	809	cc/min	800 ± 10%		
SAMPLE TEMPERATURE	48.2	°C	48 ± 4		
BENCH TEMPERATURE	48.0	°C	48 ± 2		
WHEEL TEMPERATURE	68.3	°C	68 ± 2		
BOX TEMPERATURE	30.8	°C	Ambient temp + 7 ± 10		
PHOTO-DRIVE	3047.9	mV	250 mV to 4750 mV		
SLOPE	1.017	-	1.0 ± 0.3		
OFFSET	0.2	-	0 ± 0.3		



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CALIBRATION REPORT					
SO ₂ FLUORESCENT ANALYZER					
DATE :	14 August 2023	BRAND :	API	MODEL :	100E
NO.	SO ₂ -R03	SERIAL NO.	3488		
Calibrator (Dilution System)					
Brand :	API	Model :	700		
Last Cal. Date :	08 August 2023	Serial No. :	911		
Reference Standard Gas					
Standard Gas :	Sulphur Dioxide (SO ₂)	Cylinder No. :	A00814SK		
Certified Date :	21 June 2021	Expired Date :	21 June 2029	Cylinder Conc. :	50.0 ppm
CALIBRATING CONDITION					
Pressure	1011	mmbar	Temp.	24.5	°C
			% RH	49	
CALIBRATION SETTING					
Span	Initial Reading (Before Adj.),PPB			Final Reading (After Adj.),PPB	
Set Point	Expected Concentration	Analyzer Response	%Diff	Analyzer Response	Slope
Zero	0	0.11	-	0	-
SO ₂ Span	400.0	400.2	0.050	400.0	1.013
API Model 100E SO ₂ Analyzer Check list					
Test Values	Observed Value	Units	Nominal Range		
RANGE	500	PPB	0-500		
SAMPLE PRESS	28.7	in-Hg	25-35		
SAMPLE FLOW	656	cc/min	650 ± 10%		
PMT	103.2	mV	-20-150 with Zero Air		
UV LAMP	3024.1	mV	1000-4900		
STR. LGT	61.6	PPB	<100		
DRK PMT	63.1	mV	-50 - 200		
DRK LMP	57.8	mV	-50 - 200		
HVPS	672	V	550-900 constant		
DCPS	2524	mV	2500 ± 200		
RCCELL TEMP	50.2	°C	50 ± 1		
BOX TEMP	29.3	°C	5-40		
PMT TEMP	7.4	°C	7 ± 2.0		
SO ₂ Span Conc	400	PPB	20-20,000		
SO ₂ Slope	1.013	-	1.0 ± 0.3		
SO ₂ Offset	22.1	mV	<250		
Stability at Zero	0.1	PPB	<0.2		
Stability at Span	0.2	PPB	0.5% of reading (above 50 ppb)		



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CALIBRATION REPORT					
SO ₂ FLUORESCENT ANALYZER					
DATE :	12 November 2023	BRAND :	API	MODEL :	100E
NO.	SO ₂ -R02	SERIAL NO.	3431		
Calibrator (Dilution System)					
Brand :	API	Model :	700		
Last Cal. Date :	30 October 2023	Serial No. :	421		
Reference Standard Gas					
Standard Gas :	Sulphur Dioxide (SO ₂)	Cylinder No. :	A00814SK		
Certified Date :	21 June 2021	Expired Date :	21 June 2029	Cylinder Conc. :	49.8 ppm
CALIBRATING CONDITION					
Pressure	1011	mmbar	Temp.	24.5	°C
			% RH	48	
CALIBRATION SETTING					
Span	Initial Reading (Before Adj.),PPB			Final Reading (After Adj.),PPB	
Set Point	Expected Concentration	Analyzer Response	%Diff	Analyzer Response	Slope
Zero	0	-0.10	-	0	-
SO ₂ Span	400.0	400.1	0.025	400.0	1.010
API Model 100E SO ₂ Analyzer Check list					
Test Values	Observed Value	Units	Nominal Range		
RANGE	500	PPB	0-500		
SAMPLE PRESS	28.5	in-Hg	25-35		
SAMPLE FLOW	656	cc/min	650 ± 10%		
PMT	103.1	mV	-20-150 with Zero Air		
UV LAMP	3022.8	mV	1000-4900		
STR. LGT	61.5	PPB	<100		
DRK PMT	63.1	mV	-50 - 200		
DRK LMP	58.0	mV	-50 - 200		
HVPS	671	V	550-900 constant		
DCPS	2517	mV	2500 ± 200		
RCCELL TEMP	50.0	°C	50 ± 1		
BOX TEMP	29.2	°C	5-40		
PMT TEMP	7.4	°C	7 ± 2.0		
SO ₂ Span Conc	400	PPB	20-20,000		
SO ₂ Slope	1.010	-	1.0 ± 0.3		
SO ₂ Offset	21.9	mV	<250		
Stability at Zero	0.1	PPB	<0.2		
Stability at Span	0.2	PPB	0.5% of reading (above 50 ppb)		



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CALIBRATION REPORT					
CHEMILUMINESCENT NO / NO ₂ / NO _x ANALYZER					
DATE :	14 August 2023	BRAND :	API	MODEL :	200E
NO.	NOX-R10	SERIAL NO.	1991		
Calibrator (Dilution System)					
Brand :	API		Model :	700	
Last Cal. Date :	06 August 2023		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.	24.5	°C
% RH	49				
CALIBRATION SETTING					
Span	Initial Reading (Before Adj.),PPB			Final Reading (After Adj.),PPB	
Set Point	Expected Concentration	Analyzer Response	%Diff	Analyzer Response	Slope
Zero	0	-0.10	-	0	-
NO Span	400	399.8	-0.050	400.0	1.005
NO _x Span	400	400.1	0.025	400.0	1.009
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	504	cc/min	500 ± 50		
OZONE FLOW	78	cc/min	80 ± 15		
PMT	103.3	mV	-20 ~ 150		
AZERO	94.1	mV	-20 ~ 150		
HVPS	672	V	420 ~ 900 constant		
RCELL TEMP	50.3	°C	50 ± 1		
BOX TEMP	29.1	°C	8 ~ 48		
PMT TEMP	7.2	°C	7 ± 2		
MOLY TEMP	315.2	°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	1.005	-	1.0 ± 0.3		
NO _x Slope	1.009	-	1.0 ± 0.3		
NO Offset	1.5	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		



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CALIBRATION REPORT					
CHEMILUMINESCENT NO / NO ₂ / NO _x ANALYZER					
DATE :	12 November 2023	BRAND :	API	MODEL :	200E
NO.	NOX-R05	SERIAL NO.	4413		
Calibrator (Dilution System)					
Brand :	API		Model :	700	
Last Cal. Date :	30 October 2023		Serial No. :	421	
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.	24.5	°C
% RH	48				
CALIBRATION SETTING					
Span	Initial Reading (Before Adj.),PPB			Final Reading (After Adj.),PPB	
Set Point	Expected Concentration	Analyzer Response	%Diff	Analyzer Response	Slope
Zero	0	0.10	-	0	-
NO Span	400	399.6	-0.100	400.0	1.005
NO _x Span	400	399.9	-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	504	cc/min	500 ± 50		
OZONE FLOW	78	cc/min	80 ± 15		
PMT	103.0	mV	-20 ~ 150		
AZERO	93.7	mV	-20 ~ 150		
HVPS	674	V	420 ~ 900 constant		
RCELL TEMP	50.2	°C	50 ± 1		
BOX TEMP	29.1	°C	8 ~ 48		
PMT TEMP	7.0	°C	7 ± 2		
MOLY TEMP	314.8	°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	1.3	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		



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CALIBRATION REPORT			
Total Hydrocarbon Analyzer			
DATE :	14 August 2023	BRAND :	HORIBA
MODEL :	APHA-370	SERIAL NO. :	AEENMBBT
NO. :	THC-R03		
Calibrator (Dilution System)			
Brand :	API	Model :	700
Last Cal. Date :	06 September 2022	Serial No. :	421
Reference Standard Gas			
Standard Gas :	Methane (CH ₄)	Cylinder No. :	D59075
Certified Date :	17 March 2015	Expired Date :	17 March 2023
Cylinder Conc. :	456 ppm		
Calibrating Condition			
Pressure :	1011 mmbar	Temp. :	24.5 °C
% RH :	49	Start Time :	1:00 PM
Pre-Calibration Checks			
Change Particulate Filter :	YES	Station Temp. :	25.0 °C
Leak Test :	YES		
Calibration Setting			
Span Set Point	Initial Reading (Before Adj)		Final Reading (After Adj)
	Expected Concentration (PPM)	Analyzer Response (PPM)	Analyzer Response (PPM)
Zero	0	0.10	0
Span	10	10.03	10
Calibration Setting (Final)			
Span Instrument Gain:	0.997	Finish Time:	2:00 PM
APHA-370 Total Hydrocarbon Analyzer			
Test Values	Observed Value	Units	Nominal Range
SIGNAL (CH ₄)	911.3	mV	800-1,350
SIGNAL (THC)	916.7	mV	800-1,350
DETECTOR	77.9	kPa	((Pressure air/1013)x100)-20 ± 4 kPa
PURIFIER	19.2	kPa	8 - 25
NMC	259.3	°C	260 ± 10
BYPATH	0.9	L / min	0.9 ± 0.3
OVER FLOW	0.8	L / min	0.8



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

CALIBRATION REPORT			
Total Hydrocarbon Analyzer			
DATE :	12 November 2023	BRAND :	HORIBA
MODEL :	APHA-370	SERIAL NO. :	AEENMBBT
NO. :	THC-R03		
Calibrator (Dilution System)			
Brand :	API	Model :	700
Last Cal. Date :	30 October 2023	Serial No. :	421
Reference Standard Gas			
Standard Gas :	Methane (CH ₄)	Cylinder No. :	D612165
Certified Date :	25 February 2023	Expired Date :	25 February 2031
Cylinder Conc. :	453 ppm		
Calibrating Condition			
Pressure :	1011 mmbar	Temp. :	24.5 °C
% RH :	48	Start Time :	1:00 PM
Pre-Calibration Checks			
Change Particulate Filter :	YES	Station Temp. :	25.0 °C
Leak Test :	YES		
Calibration Setting			
Span Set Point	Initial Reading (Before Adj)		Final Reading (After Adj)
	Expected Concentration (PPM)	Analyzer Response (PPM)	Analyzer Response (PPM)
Zero	0	-0.10	0
Span	10	10.03	10
Calibration Setting (Final)			
Span Instrument Gain:	0.997	Finish Time:	2:00 PM
APHA-370 Total Hydrocarbon Analyzer			
Test Values	Observed Value	Units	Nominal Range
SIGNAL (CH ₄)	912.6	mV	800-1,350
SIGNAL (THC)	917.1	mV	800-1,350
DETECTOR	78.0	kPa	((Pressure air/1013)x100)-20 ± 4 kPa
PURIFIER	19.3	kPa	8 - 25
NMC	259.7	°C	260 ± 10
BYPATH	0.9	L / min	0.9 ± 0.3
OVER FLOW	0.8	L / min	0.8



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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 °C
Pressure 1010 ± 3 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	60246T	06/07/2023	1,000	1,500	2,000	991	1,506	2,002	1.001x - 14.479	1.000	
R02	SKC	224-PCXR4	626450	06/07/2023	1,000	2,000	3,000	997	1,497	1,986	0.988x + 12.256	1.000	
R03	SKC	224-PCXR4	691592	06/07/2023	1,000	1,500	2,000	1,002	1,498	2,002	1.003x + 5.881	1.000	
R04	SKC	224-PCXR4	691672	06/07/2023	1,000	1,500	2,000	995	1,491	1,994	0.997x + 2.717	1.000	
R05	SKC	224-PCXR4	798470	06/07/2023	1,000	1,500	2,000	992	1,505	1,997	1.001x - 6.538	1.000	
R06	SKC	224-PCXR4	798456	06/07/2023	1,000	1,500	2,000	994	1,497	1,993	0.994x - 0.976	1.000	
R07	SKC	224-PCXR4	798480	06/07/2023	1,000	1,500	2,000	993	1,490	1,997	1.007x - 16.177	1.000	
R08	SKC	224-PCXR4	883215	04/07/2023	1,000	1,500	2,000	1,010	1,499	2,003	0.989x + 11.332	0.999	
R09	SKC	224-PCXR4	034650	04/07/2023	1,000	1,500	2,000	990	1,503	2,000	1.011x - 24.548	1.000	
R10	SKC	224-PCXR4	091765	07/07/2023	1,000	1,500	2,000	996	1,509	1,992	0.999x + 0.299	1.000	
R11	SKC	224-PCXR4	091763	07/07/2023	1,000	1,500	2,000	999	1,497	1,985	1.000x - 9.834	0.999	
R12	SKC	224-PCXR4	091568	07/07/2023	1,000	1,500	2,000	995	1,499	1,998	1.001x + 6.774	1.000	
R13	SKC	224-PCXR4	091638	07/07/2023	1,000	1,500	2,000	1,001	1,510	1,989	0.988x + 16.559	1.000	
R14	SKC	224-PCXR4	091764	07/07/2023	1,000	1,500	2,000	993	1,501	1,997	1.013x - 30.102	0.999	
R15	SKC	224-PCXR8	529457	07/07/2023	1,000	1,500	2,000	1,000	1,499	2,001	0.998x - 3.662	0.999	
R16	SKC	224-PCXR8	529443	05/07/2023	1,000	1,500	2,000	997	1,494	1,992	0.992x + 2.530	1.000	
R17	SKC	224-PCXR8	529445	05/07/2023	1,000	1,500	2,000	994	1,507	1,998	1.006x - 15.440	0.999	
R18	SKC	224-PCXR8	566756	05/07/2023	1,000	1,500	2,000	990	1,496	1,986	1.000x - 6.873	1.000	
R19	SKC	224-PCXR8	566802	05/07/2023	1,000	1,500	2,000	1,001	1,497	1,998	1.003x - 14.352	0.999	
R20	SKC	224-PCXR8	529089	03/07/2023	1,000	1,500	2,000	990	1,499	2,001	1.019x - 39.318	0.999	
R21	SKC	224-PCXR8	665728	03/07/2023	1,000	1,500	2,000	997	1,493	1,997	0.999x - 3.765	1.000	
R22	SKC	224-PCXR8	707444	03/07/2023	1,000	1,500	2,000	1,002	1,511	2,001	1.000x + 2.666	0.999	
R23	SKC	224-PCXR8	761067	05/07/2023	1,000	1,500	2,000	1,011	1,475	1,989	0.980x + 20.504	0.999	
R24	SKC	224-PCXR8	707893	04/07/2023	1,000	1,500	2,000	995	1,507	1,998	1.007x - 16.619	0.999	
R25	SKC	224-PCXR8	761052	04/07/2023	1,000	1,500	2,000	1,009	1,494	1,993	0.984x + 21.169	1.000	
R26	SKC	224-PCXR8	707956	06/07/2023	1,000	1,500	2,000	1,011	1,499	2,004	1.001x + 3.674	0.999	
R27	SKC	224-PCXR8	707398	06/07/2023	1,000	1,500	2,000	995	1,499	1,999	1.005x - 14.830	1.000	
R28	SKC	224-PCXR8	707481	04/07/2023	1,000	1,500	2,000	1,003	1,499	2,000	1.001x + 11.858	0.998	
R29	SKC	224-PCXR8	707402	06/07/2023	1,000	1,500	2,000	1,002	1,492	1,987	0.985x + 16.145	1.000	
R30	SKC	224-PCXR8	093811	07/07/2023	1,000	1,500	2,000	999	1,492	1,991	0.994x + 4.391	1.000	
R31	SKC	224-PCXR8	093183	04/07/2023	1,000	1,500	2,000	1,000	1,499	1,999	0.989x + 8.339	0.999	
R32	SKC	224-PCXR8	671950	04/07/2023	1,000	1,500	2,000	997	1,499	1,991	0.995x + 0.048	1.000	
R33	SKC	224-PCXR4	626254	04/07/2023	1,000	1,500	2,000	993	1,501	1,998	1.016x - 32.194	0.999	
R34	SKC	224-PCXR4	626131	04/07/2023	1,000	1,500	2,000	1,001	1,498	2,002	1.006x - 12.316	1.000	
R35	SKC	224-PCXR8	707460	03/07/2023	1,000	1,500	2,000	998	1,496	1,993	0.993x + 5.945	1.000	
R36	SKC	224-PCXR8	707446	07/07/2023	1,000	1,500	2,000	1,003	1,497	1,999	1.008x - 18.814	0.999	
R37	SKC	224-PCXR8	707432	07/07/2023	1,000	1,500	2,000	995	1,497	1,998	0.995x + 5.662	1.000	
R38	SKC	224-PCXR8	707349	07/07/2023	1,000	1,500	2,000	996	1,498	1,999	1.002x - 7.662	1.000	
R39	SKC	224-PCXR8	761095	04/07/2023	1,000	1,500	2,000	1,000	1,514	1,992	0.984x + 18.826	0.999	



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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

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-801	Dwyer	VFA-21	04/07/2023	50	100	200	50.2	99.7	198.7	0.994x + 0.959	0.999
L-802	Dwyer	VFA-21	07/07/2023	50	100	200	49.1	98.9	198.5	0.999x - 0.773	1.000
L-803	Dwyer	VFA-21	07/07/2023	50	100	200	49.1	99.5	198.1	1.006x - 0.411	1.000
L-804	Dwyer	VFA-21	06/07/2023	50	100	200	49.2	100.7	202.6	1.005x + 0.438	1.000
L-805	Dwyer	VFA-21	07/07/2023	50	100	200	50.1	98.9	198.0	0.999x - 0.013	0.999
L-806	Dwyer	VFA-21	06/07/2023	50	100	200	50.4	99.9	200.4	1.007x - 0.221	1.000
L-807	Dwyer	VFA-21	04/07/2023	50	100	200	50.5	99.6	199.1	0.995x + 1.029	0.999
L-808	Dwyer	VFA-21	05/07/2023	50	100	200	49.4	101.7	197.5	1.001x + 0.332	1.000
L-809	Dwyer	VFA-21	07/07/2023	50	100	200	49.7	98.5	199.6	1.003x - 0.786	1.000
L-810	Dwyer	VFA-21	10/07/2023	50	100	200	49.9	98.8	200.4	1.007x - 1.164	1.000




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 : ATSAWIN Y.
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.

F-G010 REV 02



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

- 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.
- 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
- THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.
- THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
- 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

- ZERO SETTING FUNCTION : NORMAL
- TARE FUNCTION : NORMAL
- REPEATABILITY OF READING AT 200 g WAS 0 g
- 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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Console Calibration Report

Calibration Method

Critical Orifices

Calibration Data

Console Data		Calibration Data		
No.	Serial No.	Date	γ	DH _g (mmH ₂ O)
B01	1563	04/09/2023	0.997	50.11
B02	8002514	06/09/2023	1.002	49.25
B03	1503016	05/09/2023	0.998	50.44
B04	00006659	05/09/2023	1.004	49.37
B05	00007428	05/09/2023	0.996	49.77
R01	1561	06/09/2023	1.004	49.86
R02	8002513	08/09/2023	1.005	50.36
R03	1570	07/09/2023	0.997	49.55
R04	8002519	04/09/2023	1.004	49.69
R05	1503015	07/09/2023	0.999	50.08

Remark : Accept Value of γ (test) is $0.97 < \gamma < 1.03$

Accept Value of DH_g (test) is 46.7 ± 6.4 (mmH₂O)



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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	01/08/2023	0.85	0.84
B37	S	0.99	02/08/2023	0.84	0.84
B38	S	0.99	03/08/2023	0.84	0.83
B39	S	0.99	03/08/2023	0.84	0.84
B40	S	0.99	01/08/2023	0.85	0.84
B41	S	0.99	02/08/2023	0.84	0.85
B44	S	0.99	01/08/2023	0.84	0.84
B45	S	0.99	01/08/2023	0.85	0.84
B46	S	0.99	01/08/2023	0.84	0.85
B47	S	0.99	01/08/2023	0.84	0.84
B48	S	0.99	01/08/2023	0.84	0.85
B49	S	0.99	03/08/2023	0.85	0.84
B54	S	0.99	03/08/2023	0.83	0.84
B56	S	0.99	03/08/2023	0.84	0.85
B57	S	0.99	03/08/2023	0.84	0.83
B58	S	0.99	03/08/2023	0.85	0.84

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



CALIBRATION LABORATORY Co.,LTD.

2/10-11,14,55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230
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CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : VACUUM GAUGE
MANUFACTURER : HI-LIGHT
MODEL / TYPE : N/A
SERIAL NO. : N/A[64-220088-1]
CLID. NO. : 212301419
JOB CONTROL NO. : 230725081570

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

DATE OF RECEIVED : 25 July 2023

DATE OF ISSUED : 31 July 2023

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

Calibrated By : Sittipong Pimdee
Calibration Engineer



Approved By : Mongkol Yotsoontorn
Authorized Signatory
31 July 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. Q23081570

F3-011-04/01-12

page 1 of 3



@clccalibration



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REPORT OF CALIBRATION

FOR

NOMENCLATURE : VACUUM GAUGE
MANUFACTURER : HI-LIGHT
MODEL / TYPE : N/A
SERIAL NO. : N/A[64-220088-1]
DATE OF CALIBRATION : 26 July 2023
DUE DATE OF CALIBRATION : 26 July 2024

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 741B S/N. 8295020 with Pressure Module Model 700PD5 S/N. 89404505.

TRACEABILITY :

The measurements are traceable to International System of Units (SI), through National Institute of Metrology (Thailand).
Certificate No. MP-0035-23, Due Date 02 February 2024.

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. Q23081570

F3-011-04/01-12

page 2 of 3



@clccalibration



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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 (kPa)		Conversion to inHg		Correction (inHg)	
	Up	Down	Up	Down	Up	Down
0	0.00	0.00	0.0	0.0	0.0	0.0
-5	-15.07	-15.10	-4.5	-4.5	+0.5	+0.5
-10	-32.10	-32.13	-9.5	-9.5	+0.5	+0.5
-15	-49.20	-49.23	-14.5	-14.5	+0.5	+0.5
-20	-66.26	-66.26	-19.6	-19.6	+0.4	+0.4
-25	-83.30	-83.33	-24.6	-24.6	+0.4	+0.4
-30	-100.39	-100.39	-29.6	-29.6	+0.4	+0.4

Uncertainty of measurement ± 0.2 inHg

Transmitting fluid : Air.

Technical Note. Conversion factor 1 kPa ; 0.2953003 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. Q23081570

F3-011-04/01-12

page 3 of 3



@clcalibration



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S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจตุจักร กรุงเทพฯ 10000
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 : 136154		
Environmental Conditions												
Temperature		25		± 3		°C						
Pressure		1010		± 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
841	SKC	224-PCXR4	612569	10/10/2023	1.000	1.500	2.000	999	1.491	1.993	0.994x + 2.802	1.000
842	SKC	224-PCXR4	626041	10/10/2023	1.000	1.500	2.000	995	1.490	1.989	0.995x + 1.759	1.000
843	SKC	224-PCXR4	034636	07/10/2023	1.000	1.500	2.000	995	1.488	1.989	0.991x + 2.866	1.000
844	SKC	224-PCXR8	529341	07/10/2023	1.000	1.500	2.000	992	1.503	1.998	1.000x - 23.051	0.999
845	SKC	224-PCXR8	529594	10/10/2023	1.000	1.500	2.000	1.000	1.495	1.989	0.989x + 10.094	1.000
846	SKC	224-PCXR8	566743	02/10/2023	1.000	1.500	2.000	1.000	1.500	1.998	1.000x - 19.564	0.999
847	SKC	224-PCXR8	566747	02/10/2023	1.000	1.500	2.000	994	1.502	1.996	1.011x - 27.787	0.999
848	SKC	224-PCXR8	566753	03/10/2023	1.000	1.500	2.000	1.000	1.495	1.995	1.005x - 13.577	1.000
849	SKC	224-PCXR8	566780	02/10/2023	1.000	1.500	2.000	998	1.498	1.998	1.010x - 21.853	0.999
850	SKC	224-PCXR8	500480	07/10/2023	1.000	1.500	2.000	999	1.495	1.989	0.991x + 5.648	1.000
851	SKC	224-PCXR3	500365	07/10/2023	1.000	1.500	2.000	993	1.501	1.996	1.009x - 24.941	0.999
852	SKC	224-PCXR8	093186	07/10/2023	1.000	1.500	2.000	994	1.500	1.991	0.990x + 2.910	1.000
853	SKC	224-PCXR8	707670	06/10/2023	1.000	1.500	2.000	990	1.498	1.996	1.014x - 33.836	0.999
854	SKC	224-PCXR3	509821	05/10/2023	1.000	1.500	2.000	991	1.499	1.995	1.012x - 36.696	0.999
855	SKC	224-PCXR3	510710	05/10/2023	1.000	1.500	2.000	996	1.493	1.996	0.999x - 2.301	1.000
856	SKC	224-PCXR3	511450	05/10/2023	1.000	1.500	2.000	992	1.487	1.996	1.006x - 16.797	1.000
857	SKC	224-PCXR3	510788	04/10/2023	1.000	1.500	2.000	989	1.493	1.994	1.001x - 9.175	1.000
858	SKC	224-PCXR3	509852	04/10/2023	1.000	1.500	2.000	1.000	1.497	1.997	1.009x + 21.172	0.999
859	SKC	224-PCXR3	509862	04/10/2023	1.000	1.500	2.000	995	1.495	1.988	0.991x + 2.723	1.000
860	SKC	224-PCXR3	512655	07/10/2023	1.000	1.500	2.000	992	1.498	1.997	1.013x - 31.979	0.999
861	SKC	224-PCXR3	503915	07/10/2023	1.000	1.500	2.000	1.000	1.502	1.997	1.007x - 20.035	0.999
862	SKC	224-PCXR3	505975	07/10/2023	1.000	1.500	2.000	996	1.489	1.991	0.990x + 6.791	1.000
863	SKC	224-PCXR3	511452	07/10/2023	1.000	1.500	2.000	993	1.500	1.995	1.003x - 8.208	1.000
864	SKC	224-PCXR3	508302	05/10/2023	1.000	1.500	2.000	991	1.496	1.988	0.996x - 5.262	1.000
865	SKC	224-PCXR3	508310	05/10/2023	1.000	1.500	2.000	993	1.492	1.991	0.999x - 4.864	1.000
866	SKC	224-PCXR3	509861	06/10/2023	1.000	1.500	2.000	996	1.493	1.989	0.992x + 2.675	1.000
867	SKC	224-PCXR3	506293	04/10/2023	1.000	1.500	2.000	1.000	1.498	1.998	1.009x - 21.534	0.999
868	SKC	224-PCXR3	505872	04/10/2023	1.000	1.500	2.000	994	1.493	1.987	0.993x + 3.176	1.000
869	SKC	224-PCXR3	508375	07/10/2023	1.000	1.500	2.000	999	1.495	1.996	1.005x - 19.592	0.999
870	SKC	224-PCXR3	510623	04/10/2023	1.000	1.500	2.000	992	1.486	1.995	1.003x - 11.783	1.000
871	SKC	224-PCXR3	508567	05/10/2023	1.000	1.500	2.000	999	1.497	1.996	1.005x - 21.646	0.999
872	SKC	224-PCXR3	505977	05/10/2023	1.000	1.500	2.000	993	1.490	1.990	0.997x + 4.295	1.000
873	SKC	224-PCXR3	512606	05/10/2023	1.000	1.500	2.000	995	1.495	1.989	0.994x + 1.210	1.000
874	SKC	224-PCXR3	505993	05/10/2023	1.000	1.500	2.000	997	1.496	1.986	0.981x + 12.602	1.000
875	SKC	224-PCXR3	509820	05/10/2023	1.000	1.500	2.000	994	1.490	1.991	0.998x - 5.143	1.000
876	SKC	224-PCXR3	509811	06/10/2023	1.000	1.500	2.000	1.000	1.497	1.999	1.010x - 23.063	0.999
877	SKC	224-PCXR3	508301	06/10/2023	1.000	1.500	2.000	992	1.501	1.998	1.013x - 32.023	0.999
878	SKC	224-PCXR3	510677	05/10/2023	1.000	1.500	2.000	1.001	1.498	1.997	1.007x - 18.549	0.999
879	SKC	224-PCXR3	510920	03/10/2023	1.000	1.500	2.000	999	1.509	1.997	0.996x + 8.999	1.000



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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 °C
Pressure : 1010 ± 3 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	02/10/2023	1,000	1,500	2,000	1,001	1,499	1,999	1.010x - 22.581	0.999	
R02	SKC	224-PCXR4	626450	06/10/2023	1,000	2,000	3,000	996	1,493	1,986	0.992x + 3.742	1.000	
R03	SKC	224-PCXR4	691592	06/10/2023	1,000	1,500	2,000	989	1,495	1,994	0.999x - 6.866	1.000	
R04	SKC	224-PCXR4	691672	06/10/2023	1,000	1,500	2,000	998	1,491	1,989	0.991x + 5.421	1.000	
R05	SKC	224-PCXR4	798470	06/10/2023	1,000	1,500	2,000	999	1,495	1,995	1.005x - 18.995	0.999	
R06	SKC	224-PCXR4	798456	02/10/2023	1,000	1,500	2,000	1,000	1,488	1,987	0.986x + 13.396	1.000	
R07	SKC	224-PCXR4	798480	02/10/2023	1,000	1,500	2,000	1,000	1,497	1,996	1.009x - 21.689	0.999	
R08	SKC	224-PCXR4	883215	05/10/2023	1,000	1,500	2,000	994	1,500	1,990	0.995x + 3.109	1.000	
R09	SKC	224-PCXR4	034650	05/10/2023	1,000	1,500	2,000	999	1,497	1,996	1.008x - 21.526	0.999	
R10	SKC	224-PCXR4	091765	05/10/2023	1,000	1,500	2,000	996	1,493	1,994	1.000x - 6.596	1.000	
R11	SKC	224-PCXR4	091763	04/10/2023	1,000	1,500	2,000	998	1,496	1,983	0.998x - 9.546	0.999	
R12	SKC	224-PCXR4	091568	04/10/2023	1,000	1,500	2,000	1,000	1,497	1,999	1.009x - 21.988	0.999	
R13	SKC	224-PCXR4	091638	02/10/2023	1,000	1,500	2,000	994	1,495	1,986	0.993x + 2.981	1.000	
R14	SKC	224-PCXR4	091764	05/10/2023	1,000	1,500	2,000	998	1,498	1,990	1.012x - 26.788	0.999	
R15	SKC	224-PCXR6	529457	06/10/2023	1,000	1,500	2,000	995	1,492	1,987	0.994x + 1.457	1.000	
R16	SKC	224-PCXR6	529643	04/10/2023	1,000	1,500	2,000	1,000	1,496	1,997	1.007x - 17.900	0.999	
R17	SKC	224-PCXR6	529645	07/10/2023	1,000	1,500	2,000	998	1,496	1,998	1.011x - 25.546	0.999	
R18	SKC	224-PCXR6	566756	03/10/2023	1,000	1,500	2,000	994	1,490	1,989	0.995x - 1.759	1.000	
R19	SKC	224-PCXR6	566802	02/10/2023	1,000	1,500	2,000	1,000	1,496	1,989	1.010x - 22.864	0.999	
R20	SKC	224-PCXR6	529089	06/10/2023	1,000	1,500	2,000	992	1,506	1,996	1.006x - 22.151	0.999	
R21	SKC	224-PCXR6	665728	02/10/2023	1,000	1,500	2,000	992	1,486	1,994	1.002x - 11.682	1.000	
R22	SKC	224-PCXR6	707444	03/10/2023	1,000	1,500	2,000	1,001	1,500	1,999	1.007x - 16.171	0.999	
R23	SKC	224-PCXR6	761067	06/10/2023	1,000	1,500	2,000	1,000	1,488	1,993	0.992x + 5.744	1.000	
R24	SKC	224-PCXR6	707893	05/10/2023	1,000	1,500	2,000	994	1,505	1,996	1.005x - 13.010	0.999	
R25	SKC	224-PCXR6	761052	06/10/2023	1,000	1,500	2,000	999	1,495	1,989	0.991x + 3.640	1.000	
R26	SKC	224-PCXR6	707956	07/10/2023	1,000	1,500	2,000	1,010	1,497	2,002	0.999x - 2.874	0.999	
R27	SKC	224-PCXR6	707398	07/10/2023	1,000	1,500	2,000	1,001	1,496	1,997	1.006x - 20.237	0.999	
R28	SKC	224-PCXR6	707481	07/10/2023	1,000	1,500	2,000	993	1,506	1,995	1.002x - 10.719	1.000	
R29	SKC	224-PCXR6	707402	04/10/2023	1,000	1,500	2,000	995	1,495	1,989	0.995x + 1.091	1.000	
R30	SKC	224-PCXR6	093811	04/10/2023	1,000	1,500	2,000	998	1,495	1,992	0.997x - 0.693	1.000	
R31	SKC	224-PCXR6	093183	06/10/2023	1,000	1,500	2,000	999	1,502	1,997	0.998x + 9.127	0.999	
R32	SKC	224-PCXR6	671950	07/10/2023	1,000	1,500	2,000	998	1,495	1,994	0.998x - 3.451	1.000	
R33	SKC	224-PCXR4	626254	07/10/2023	1,000	1,500	2,000	992	1,503	1,995	1.011x - 30.016	0.999	
R34	SKC	224-PCXR4	626151	03/10/2023	1,000	1,500	2,000	990	1,499	1,997	1.014x - 32.986	0.999	
R35	SKC	224-PCXR6	707460	07/10/2023	1,000	1,500	2,000	990	1,501	1,997	1.005x - 15.898	1.000	
R36	SKC	224-PCXR6	707446	05/10/2023	1,000	1,500	2,000	1,000	1,497	1,997	1.002x - 7.587	1.000	
R37	SKC	224-PCXR6	707432	02/10/2023	1,000	1,500	2,000	995	1,498	1,995	0.999x + 4.856	1.000	
R38	SKC	224-PCXR6	707349	02/10/2023	1,000	1,500	2,000	991	1,498	1,992	1.000x - 7.364	1.000	
R39	SKC	224-PCXR6	761095	06/10/2023	1,000	1,500	2,000	995	1,489	1,985	0.990x + 6.253	1.000	



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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	R ²
H-R01	Dwyer	VFB-65	02/10/2023	500	1,000	2,000	502.9	994.2	1977.4	1.003x - 7.740	0.999
H-R02	Dwyer	VFB-65	06/10/2023	500	1,000	2,000	495.9	996.6	2008.4	0.995x + 3.124	1.000
H-R03	Dwyer	VFB-65	04/10/2023	500	1,000	2,000	504.3	990.1	1969.6	0.987x + 9.890	1.000
H-R04	Dwyer	VFB-65	02/10/2023	500	1,000	2,000	496.9	986.1	2006.2	1.004x - 15.756	0.999
H-R05	Dwyer	VFB-65	03/10/2023	500	1,000	2,000	503.1	991.3	2014.3	1.000x - 1.636	1.000
H-R06	Dwyer	VFB-65	05/10/2023	500	1,000	2,000	499.2	997.2	1974.6	0.994x + 3.462	0.999




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 : ATSAWIN Y.
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.

F-G010 REV 02



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

- 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.
- 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
- THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.
- THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
- 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

- ZERO SETTING FUNCTION : NORMAL
- TARE FUNCTION : NORMAL
- REPEATABILITY OF READING AT 200 g WAS 0 g
- 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	50.0001	-0.0001	0.00011
100.00	100.0001	-0.0001	0.00019
200.00	200.0001	-0.0001	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

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY



NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : SP23016

Pages 1 of 3

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

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 : (25.0 ± 5) °C
Relative Humidity : (48.4 ± 25) %
Received Date : 30 AUGUST 2023
Calibration Date : 30 AUGUST 2023
Date of Issue : 31 AUGUST 2023

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.

SITHIPORN
associates

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : SP23016

Job No. : VC66SP0014

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	106864	01/11/2024
Didymium liquid	RM-DL	28912	106905	02/11/2024
Neutral density filter	RM-1N2N3N	13877	106918	03/11/2024
Potassium dichromate solutions	RM-0204060810	14204	106902	02/11/2024
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	361.3	0.05	0.16	2.00
	467.82	468.0	0.18	0.16	2.00
	536.56	536.6	0.04	0.16	2.00
	640.50	640.4	-0.10	0.16	2.00
RM-DL	740.09	740.0	-0.09	0.16	2.00
	864.94	865.0	0.06	0.16	2.00

UUC* = Unit Under Calibration

Continuation of Calibration Certificate

Cert. No. : SP23016
Job No. : VC66SP0014
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	1.0517	1.0564	0.0047	0.0031	2.00
		29914	0.7	0.7445	0.7460	0.0015	0.0032	2.00
		29381	0.5	0.5416	0.5429	0.0013	0.0032	2.00
	546.1	29360	1.0	0.9821	0.9849	0.0028	0.0030	2.00
		29914	0.7	0.6961	0.6961	0.0000	0.0030	2.00
		29381	0.5	0.5073	0.5073	0.0000	0.0030	2.00
	590.0	29360	1.0	1.0222	1.0244	0.0022	0.0030	2.00
		29914	0.7	0.7237	0.7234	-0.0003	0.0030	2.00
		29381	0.5	0.5361	0.5360	-0.0001	0.0031	2.00
	635.0	29360	1.0	0.9753	0.9775	0.0022	0.0030	2.00
		29914	0.7	0.6910	0.6910	0.0000	0.0030	2.00
		29381	0.5	0.5211	0.5210	-0.0001	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	0.2422	0.2462	0.0040	0.0101	2.00	
		40	0.4866	0.4900	0.0034	0.0115	2.00	
		60	0.7414	0.7390	-0.0024	0.0068	2.00	
		80	0.9858	0.9871	0.0013	0.0093	2.00	
		100	1.2442	1.2480	0.0038	0.0087	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	
Transmission T(%)	Absorbance(A)
0.0111	3.9564

**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

บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 แขวงพหลโยธิน เขตพญาไท กรุงเทพมหานคร 10400
7 Soi Phaholyothin 24, Phra-Nayothin Rd., Jompol, Chulachitlada, Bangkok 10900
Tel : (662) 939-6170-72 Fax : (662) 513-4221 E-mail : ssp@spscs.com www.spscs.com

Calibration Report			
Non-Dispersive Infrared CO Analyzer			
Date :	09 November 2023	Brand :	API
No.	CO-802	Model :	300E
		Serial No.	965
Calibrator (Dilution System)			
Brand :	API	Model :	700
Last Cal. Date :	08 August 2023	Serial No.	911
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. :	24.5 °C
		% RH :	48
Calibration Setting			
Span	Initial Reading (Before Adj.), PPM		Final Reading (After Adj.), PPM
Set Point	Expected Concentration	Analyzer Response	%Diff
Zero	0	-0.10	-
CO Span	40.00	40.04	0.100
			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	4016.5	mV	2500-4800 mV
CO Reference	3949.8	mV	2500-4800 mV
Measure/Reference Ratio	1.180	-	1.1-1.3 W/Zero Air
Sample Pressure	28.5	In-Hg-A	~2" ± Ambient Absolute Pressure
Sample Flow	806	CC/Min	800 ± 10%
Sample Temperature	48.5	°C	48 ± 4
Bench Temperature	48.2	°C	48 ± 2
Wheel Temperature	68.3	°C	68 ± 2
Box Temperature	50.6	°C	Ambient Temp + 7 ± 10
Photo-Drive	3035.3	mV	250 mV to 4750 mV
Slope	1.017	-	1.0 ± 0.3
Offset	0.2	-	0 ± 0.3



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจตุจักร เขตจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chaitumak, Bangkok 10900
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sales@sps.co.th, www.sps.co.th

Calibration Report			
Non-Dispersive Infrared CO Analyzer			
Date :	09 November 2023	Brand :	API
No.	CO-B03	Model :	300E
		Serial No.	3019
Calibrator (Dilution System)			
Brand :	API	Model :	700
Last Cal. Date :	08 August 2023	Serial No.	911
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. :	24.5 °C
		% RH :	48
Calibration Setting			
Span	Initial Reading (Before Adj.), PPM		Final Reading (After Adj.), PPM
Set Point	Expected Concentration	Analyzer Response	%Diff
Zero	0	0.11	-
CO Span	40.00	40.10	0.250
			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	4014.4	mV	2500-4800 mV
CO Reference	3947.7	mV	2500-4800 mV
Measure/Reference Ratio	1.180	-	1.1-1.3 W/Zero Air
Sample Pressure	28.6	in-Hg-A	~2"± Ambient Absolute Pressure
Sample Flow	804	CC/Min	800 ± 10%
Sample Temperature	48.4	°C	48 ± 4
Bench Temperature	48.2	°C	48 ± 2
Wheel Temperature	68.5	°C	68 ± 2
Box Temperature	30.8	°C	Ambient Temp + 7 ± 10
Photo-Drive	3045.2	mV	250 mV to 4750 mV
Slope	1.017	-	1.0 ± 0.3
Offset	0.2	-	0 ± 0.3



Certificate of Calibration

Aquion : Anion (ID#894)

This certificate is to verify that instrument below are calibrated

by Archemica Lab Co.,Ltd.

AQUION S/N : 190840059

AS-DV S/N : 190915235

for
S.P.S. Consulting Service Co., Ltd.

ARCHÉMICA LAB
บริษัท อาร์เคมิคา แล็บ จำกัด
ARCHEMICA LAB CO.,LTD.

Operator Signature : _____ Date : Jul 3, 2023

(Mr.Nutdanai Laekhwan)

Applications Chemist

Certificate No.: CP20230387EA

Calibration Report

Equipment: Sound Level Meter
Manufacturer: RION
Model/Type: NL-52 (Meter), UC-59 (Microphone), NH-25 (Preamplifier)
Serial No.: 00632063 (Meter), 05230 (Microphone), 32091 (Preamplifier)
ID No.: -
Ambient Temperature: $(23 \pm 2) ^\circ\text{C}$
Relative Humidity: $(50 \pm 15) \%$
Pressure: $(101.3 \pm 1.5) \text{ kPa}$

Method of Calibration :-

IEC 61672-3:2013.

Condition of this result of calibration

1. Reference standards instrument :-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Standard microphone	4180	2661000	AA-1006-23	7 June 2024
2) Arbitrary Function Generator	AFG2021	C010063	CK20230040EA	26 June 2024
3) Programmable Attenuator	PA5	2755	EF-0040-23	1 October 2024
4) 6.5 Digit precision multimeter	8846A	9610014	CB20220223EA	14 November 2023
5) Pressure humidity and Temperature Transmitter	PTU301	F0640002	CL1-P230024	20 March 2024
			CD20230196EA	23 July 2024
6) Pressure humidity and Temperature Transmitter	PTU301	F0640003	CL1-P230032	4 April 2024
			CD20230197EA	23 July 2024
7) Performance Audio Analyzer	U8903B	MY56510003	CB20230038EA	14 February 2024
			CK20230072EA	13 September 2024

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

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

- Reference standards instrument for Acoustic function
 - National Institute of Metrology (Thailand)
- Reference standards instrument for Electrical function
 - National Institute of Metrology (Thailand)
 - Electrical and Electronics Institute; NSC Accredited Calibration No.0119

Result of Calibration:-

Function : 1. Indication at the calibration check frequency

Reference Acoustic Signal (dB)	Measured value (dB)	Deviation (dB)	Acceptance limits (dB)
94.1	94.1	0.0	± 0.7

Note : Absolute sensitivity was established by the use of the Sound Calibrator RION Type NC-74 S/N : 34904949.

Certificate No.: CP20230387EA

Calibration Report

Function : 2. Self-generated Noise

2.1 Microphone Installed

Measured value (dB)
15.7

2.2 Microphone replaced by the electrical input signal device

Frequency Weighting	Measured value (dB)
A-weighting	10.4
C-weighting	15.7
Z-weighting	20.4

Function : 3. Acoustical signal tests of frequency weightings (Without Windscreen)

Meter free-field acoustic response at a level of 84 dB.

Frequency (Hz)	Deviation from various Frequency Weighting Response Curve			
	C-Weighting (dB)	A-Weighting (dB)	Z-Weighting (dB)	Acceptance limits (dB)
125	0.3	0.2	0.3	± 1.0
1000	0.0	0.0	0.0	± 0.7
8000	-0.6	-0.6	-0.7	+1.5; -2.5

Function : 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various Frequency Weighting Response Curve			
	C-Weighting (dB)	A-Weighting (dB)	Z-Weighting (dB)	Acceptance limits (dB)
63	0.0	0.0	0.0	± 1.0
125	0.0	-0.1	0.0	± 1.0
250	0.0	0.0	-0.1	± 1.0
500	0.0	0.0	-0.1	± 1.0
1000	0.0	0.0	0.0	± 0.7
2000	0.0	0.1	0.0	± 1.0
4000	0.0	0.0	0.0	± 1.0
8000	0.0	0.1	0.0	+1.5; -2.5
16000	-1.4	-1.3	0.0	+2.5; -16.0

Certificate No.: CP20230387EA

Calibration Report

Function : 5. Frequency and time weighting at 1 kHz

5.1 Frequency weighting at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
C-weighting	94.0	0.0	±0.2
A-weighting	94.0	0.0	±0.2
Z-weighting	94.0	0.0	±0.2

5.2 Time weighting at 1 kHz

Time Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
Fast	94.0	0.0	±0.1
Slow	94.0	0.0	±0.1
LAeq	94.0	0.0	±0.1

Function : 6. Long-Term Stability

Long-term stability over 30 minutes, with steady 1 kHz signal at reference level.

Time Period to Apply Signal (min)	Reference SPL (dB)	Record SPL at Conclusion of Time Period (dB)	Deviated value (dB)	Acceptance limits (dB)
30	94.0	94.0	0.0	±0.1

Function : 7. Level Linearity on the reference level range

7.1 Level Linearity on the reference level range, Upper

Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
94.0	94.0	0.0	±0.8
99.0	99.0	0.0	±0.8
104.0	104.0	0.0	±0.8
109.0	109.0	0.0	±0.8
114.0	114.0	0.0	±0.8
119.0	119.0	0.0	±0.8
124.0	124.0	0.0	±0.8
129.0	129.0	0.0	±0.8
130.0	130.0	0.0	±0.8
131.0	131.0	0.0	±0.8
132.0	132.0	0.0	±0.8
133.0	133.0	0.0	±0.8
134.0	134.0	0.0	±0.8
135.0	135.0	0.0	±0.8
136.0	136.0	0.0	±0.8
137.0	137.0	0.0	±0.8

Certificate No.: CP20230387EA

Calibration Report

7.2 Level Linearity on the reference level range, Lower

Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
94.0	94.0	0.0	±0.8
89.0	89.0	0.0	±0.8
84.0	84.0	0.0	±0.8
79.0	79.0	0.0	±0.8
74.0	74.0	0.0	±0.8
69.0	69.0	0.0	±0.8
64.0	64.0	0.0	±0.8
59.0	59.0	0.0	±0.8
54.0	54.0	0.0	±0.8
49.0	49.0	0.0	±0.8
44.0	44.0	0.0	±0.8
39.0	39.0	0.0	±0.8
34.0	33.9	-0.1	±0.8
29.0	28.9	-0.1	±0.8

Function : 8. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
Fast	200	126.0	0.0	±0.5
	2	109.0	0.0	+1.0 ; -1.5
	0.25	99.9	-0.1	+1.0 ; -3.0
Slow	200	119.6	0.0	±0.5
	2	100.0	0.0	+1.0 ; -3.0
	0.25	120.0	0.0	±0.5
LAE	200	100.0	0.0	+1.0 ; -1.5
	2	100.0	0.0	+1.0 ; -1.5
	0.25	90.9	-0.1	+1.0 ; -3.0

Function : 9. Peak C sound level

Number of cycles in test signal	Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
Complete cycle	125.4	125.2	-0.2	±2.0
Positive half cycle	124.4	124.1	-0.3	±1.0
Negative half cycle	124.4	124.1	-0.3	±1.0

Certificate No.: CP20230387EA

Calibration Report

Function : 10. Overload Indication

Measured value (dB)		Deviated value (dB)	Acceptance limits (dB)
Positive one-half cycle	Negative one-half cycle		
139.5	139.5	0.0	±1.5

Function : 11. High-Level Stability

High-level stability over 5 minutes, with steady 1 kHz signal, 1 dB below upper boundary.

Time Period to Apply Signal (min)	Reference SPL (dB)	Record SPL at Conclusion of Time Period (dB)	Deviated value (dB)	Acceptance limits (dB)
5	129.0	129.0	0.0	±0.1

Uncertainty of measurement

Function	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1) Indication at the calibration check frequency	0.30	Not applicable
2) Self-generated Noise	0.10	Not applicable
3) Acoustical signal tests of frequency weightings - Free-field sound pressure response level	0.30	0.60 (10Hz to 4kHz) 0.70 (>4kHz to 10kHz)
4) Electrical signal tests of frequency weightings	0.20	0.20
5) Frequency and time weighting at 1 kHz	0.20	0.20
6) Long-Term Stability	0.10	0.10
7) Level Linearity on the reference level range	0.30	0.30
8) Tone burst response	0.20	0.30
9) Peak C sound level	0.20	0.35
10) Overload indication	0.20	0.25
11) High-Level Stability	0.10	0.10

- Remarks:
1. The acceptance limit is for the deviated value.
 2. Acceptance limits was IEC61672-3:2013 Class 1.
 3. The coverage factor $k = 2.00$

-- End of Report --

Certificate No.: CP20230372EA

Operation No.: CP2023090018

Certificate of Calibration

Equipment: Sound Level Meter

Manufacturer: 01dB (Meter), G.R.A.S. (Microphone), 01dB (Preamplifier)

Model/Type: CUBE (Meter), 40CD (Microphone), PRE22 (Preamplifier)

Serial No.: 14257 (Meter), 494247 (Microphone), 2138114 (Preamplifier)

ID No.: 14257 (Extension cable)

Customer: IRPC Public Company Limited.

Address: 299 Moo 5, Sukhumvit Rd., Tumbon Chungnern, Amphor Muang, Rayong 21000

Received Date: 22 September 2023

Calibrated Date: 18 - 19 October 2023

Issued Date: 20 October 2023

Calibrated by: Ms. Juntaporn Kunhakom

Approved by:

(Mr. Sittichai Swaksuriyawong)
Group Manager

This report was prepared electronically using applicable electronic signature. Printing or copy of file are considered as a copy of the document.

The reported uncertainty of measurement was based on standard uncertainty multiplied by a coverage factor (k) providing a level of confidence of approximately 95%. This certificate may not be reproduced other than in full except with the prior written approval of the Electrical and Electronics Institute, Foundation for Industrial Development.

Certificate No.: CP20230372EA

Calibration Report

Equipment: Sound Level Meter
Manufacturer: 01dB (Meter), G.R.A.S. (Microphone), 01dB (Preamplifier)
Model/Type: CUBE (Meter), 40CD (Microphone), PRE22 (Preamplifier)
Serial No.: 14257 (Meter), 494247 (Microphone), 2138114 (Preamplifier)
ID No.: 14257 (Extension cable)
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %
Pressure: (101.3 ± 1.5) kPa

Method of Calibration :-

IEC 61672-3:2013.

Condition of this result of calibration

1. Reference standards instrument :-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Standard microphone	4180	2787490	AA-1024-22	6 November 2023
2) Arbitrary Function Generator	AFG2021	C010063	CK20230040EA	26 June 2024
3) Programmable Attenuator	PA5	2755	EF-0034-22	30 October 2023
4) 6.5 Digit precision multimeter	8846A	9610014	CB20220223EA	14 November 2023
5) Pressure humidity and Temperature Transmitter	PTU301	F0640002	CL1-P230024	20 March 2024
			CD20230196EA	23 July 2024
6) Pressure humidity and Temperature Transmitter	PTU301	F0640003	CL1-P230032	4 April 2024
			CD20230197EA	23 July 2024
7) Performance Audio Analyzer	U8903B	MY56510003	CB20230038EA	14 February 2024
			CK20230072EA	13 September 2024

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

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

Reference standards instrument for Acoustic function

- National Institute of Metrology (Thailand)

Reference standards instrument for Electrical function

- National Institute of Metrology (Thailand)

- Electrical and Electronics Institute; NSC Accredited Calibration No.0119

Result of Calibration:-

Function : 1. Indication at the calibration check frequency

Reference Acoustic Signal (dB)	Correction for Microphone Model 40CD (dB)	Effective Calibration Level (dB)	Measured value (dB)	Deviation (dB)	Acceptance limits (dB)
-	-	-	-	-	-

Certificate No.: CP20230372EA

Calibration Report

Function : 2. Self-generated Noise

2.1 Microphone Installed

Measured value (dB)
17.5

2.2 Microphone replaced by the electrical input signal device

Frequency Weighting	Measured value (dB)
A-weighting	11.7
C-weighting	11.5
Z-weighting	19.3

Function : 3. Acoustical signal tests of frequency weightings (With Windscreen)

Meter free-field acoustic response at a level of 84 dB.

Frequency (Hz)	Deviation from various Frequency Weighting Response Curve			
	C-Weighting (dB)	A-Weighting (dB)	Z-Weighting (dB)	Acceptance limits (dB)
125	0.0	-0.1	0.0	±1.0
1000	0.1	0.1	0.1	±0.7
8000	-1.2	-1.2	-0.7	+1.5; -2.5

Function : 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various Frequency Weighting Response Curve			
	C-Weighting (dB)	A-Weighting (dB)	Z-Weighting (dB)	Acceptance limits (dB)
63	0.0	-0.2	0.1	±1.0
125	0.2	-0.1	0.0	±1.0
250	0.2	0.1	0.1	±1.0
500	0.3	0.1	0.2	±1.0
1000	0.2	0.2	0.2	±0.7
2000	0.2	0.1	0.1	±1.0
4000	0.8	0.8	0.8	±1.0
8000	0.0	-0.1	0.4	+1.5; -2.5
16000	-9.8	-9.7	-4.3	+2.5; -16.0

Certificate No.: CP20230372EA

Calibration Report

Function : 5. Frequency and time weighting at 1 kHz

5.1 Frequency weighting at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
C-weighting	94.0	0.0	±0.2
A-weighting	94.0	0.0	±0.2
Z-weighting	94.0	0.0	±0.2

5.2 Time weighting at 1 kHz

Time Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
Fast	94.0	0.0	±0.1
Slow	94.0	0.0	±0.1
LAeq	94.0	0.0	±0.1

Function : 6. Long-Term Stability

Long-term stability over 30 minutes, with steady 1 kHz signal at reference level.

Time Period to Apply Signal (min)	Reference SPL (dB)	Record SPL at Conclusion of Time Period (dB)	Deviated value (dB)	Acceptance limits (dB)
30	94.0	94.0	0.0	±0.1

Function : 7. Level Linearity on the reference level range

7.1 Level Linearity on the reference level range, Upper

Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
94.0	94.0	0.0	±0.8
99.0	99.0	0.0	±0.8
104.0	104.0	0.0	±0.8
109.0	108.9	-0.1	±0.8
114.0	113.8	-0.2	±0.8
119.0	118.8	-0.2	±0.8
124.0	123.8	-0.2	±0.8
129.0	128.8	-0.2	±0.8

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7.2 Level Linearity on the reference level range, Lower

Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
94.0	94.0	0.0	±0.8
89.0	89.0	0.0	±0.8
84.0	84.0	0.0	±0.8
79.0	79.0	0.0	±0.8
74.0	74.0	0.0	±0.8
69.0	69.0	0.0	±0.8
64.0	64.0	0.0	±0.8
59.0	59.0	0.0	±0.8
54.0	54.0	0.0	±0.8
49.0	49.0	0.0	±0.8
44.0	44.0	0.0	±0.8
39.0	39.0	0.0	±0.8
34.0	33.8	-0.2	±0.8
29.0	28.8	-0.2	±0.8
24.0	24.0	0.0	±0.8

Function : 8. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
Fast	200	134.0	0.0	±0.5
	2	117.0	0.0	+1.0 ; -1.5
	0.25	107.8	-0.2	+1.0 ; -3.0
Slow	200	127.6	0.0	±0.5
	2	108.0	0.0	+1.0 ; -3.0
LAE	200	128.0	0.0	±0.5
	2	108.0	0.0	+1.0 ; -1.5
	0.25	99.0	0.0	+1.0 ; -3.0

Function : 9. Peak C sound level

Number of cycles in test signal	Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
Complete cycle	133.4	134.6	1.2	±2.0
Positive half cycle	132.4	131.5	-0.9	±1.0
Negative half cycle	132.4	131.5	-0.9	±1.0

Function : 10. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limits (dB)
Positive one-half cycle	Negative one-half cycle		
139.2	139.6	0.4	±1.5

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Function : 11. High-Level Stability

High-level stability over 5 minutes, with steady 1 kHz signal, 1 dB below upper boundary.

Time Period to Apply Signal (min)	Reference SPL (dB)	Record SPL at Conclusion of Time Period (dB)	Deviated value (dB)	Acceptance limits (dB)
5	137.0	137.0	0.0	±0.1

Uncertainty of measurement

Function	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1) Indication at the calibration check frequency	0.30	Not applicable
2) Self-generated Noise	0.10	Not applicable
3) Acoustical signal tests of frequency weightings - Free-field sound pressure response level	0.30	0.60 (10Hz to 4kHz) 0.70 (>4kHz to 10kHz)
4) Electrical signal tests of frequency weightings	0.20	0.20
5) Frequency and time weighting at 1 kHz	0.20	0.20
6) Long-Term Stability	0.10	0.10
7) Level Linearity on the reference level range	0.30	0.30
8) Tone burst response	0.20	0.30
9) Peak C sound level	0.20	0.35
10) Overload indication	0.20	0.25
11) High-Level Stability	0.10	0.10

Remarks:

1. Indication at the calibration check frequency can not measured because customer does not provide a sound calibrator.
2. The acceptance limit is for the deviated value.
3. Acceptance limits was IEC61672-3:2013 Class 1.
4. The coverage factor $k = 2.00$

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