

ภาคผนวกที่ 4

เอกสารการสอบเทียบความถูกต้องของเครื่องมือ



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
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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	05/01/2022	1,000	1,500	2,000	995	1,496	1,995	0.999x - 1.938	1.000
B02	SKC	224-PCXR4	626166	05/01/2022	1,000	1,500	2,000	998	1,504	2,001	1.011x - 24.413	0.999
B03	SKC	224-PCXR4	612968	05/01/2022	1,000	1,500	2,000	995	1,490	1,995	1.001x - 6.653	1.000
B04	SKC	224-PCXR4	602804	05/01/2022	1,000	1,500	2,000	996	1,496	1,993	0.999x - 4.391	1.000
B05	SKC	224-PCXR4	612693	05/01/2022	1,000	1,500	2,000	1,003	1,500	2,003	1.012x - 21.952	0.999
B06	SKC	224-PCXR4	262188	05/01/2022	1,000	1,500	2,000	996	1,504	2,000	1.012x - 26.866	0.999
B07	SKC	224-PCXR4	626262	05/01/2022	1,000	1,500	2,000	998	1,492	1,994	0.996x + 1.898	1.000
B08	SKC	224-PCXR4	626100	05/01/2022	1,000	1,500	2,000	1,003	1,499	2,003	1.011x - 21.912	0.999
B09	SKC	224-PCXR4	626479	05/01/2022	1,000	1,500	2,000	997	1,490	1,994	0.994x + 3.550	1.000
B10	SKC	224-PCXR4	091950	06/01/2022	1,000	1,500	2,000	994	1,504	2,001	1.016x - 32.434	0.999
B11	SKC	224-PCXR8	564315	06/01/2022	1,000	1,500	2,000	994	1,490	1,998	1.004x - 10.450	1.000
B12	SKC	224-PCXR4	034656	06/01/2022	1,000	1,500	2,000	1,001	1,503	2,003	1.012x - 22.618	0.999
B13	SKC	224-PCXR4	602073	06/01/2022	1,000	1,500	2,000	995	1,498	1,994	1.000x - 3.701	1.000
B14	SKC	224-PCXR4	626313	05/01/2022	1,000	1,500	2,000	998	1,491	1,988	0.992x + 6.286	1.000
B15	SKC	224-PCXR4	626474	07/01/2022	1,000	1,500	2,000	1,003	1,501	2,004	1.012x - 22.048	0.999
B16	SKC	224-PCXR4	626477	07/01/2022	1,000	1,500	2,000	993	1,504	2,000	1.015x - 31.345	0.999
B17	SKC	224-PCXR4	626860	07/01/2022	1,000	1,500	2,000	997	1,495	1,992	0.995x + 2.034	1.000
B18	SKC	224-PCXR4	691484	07/01/2022	1,000	1,500	2,000	1,003	1,501	2,001	1.009x - 18.586	0.999
B19	SKC	224-PCXR4	691599	07/01/2022	1,000	1,500	2,000	992	1,499	1,997	1.003x - 9.253	1.000
B20	SKC	224-PCXR4	691587	07/01/2022	1,000	1,500	2,000	992	1,504	1,999	1.015x - 31.915	0.999
B21	SKC	224-PCXR4	691531	07/01/2022	1,000	1,500	2,000	993	1,499	1,992	1.000x - 5.273	1.000
B22	SKC	224-PCXR4	691654	07/01/2022	1,000	1,500	2,000	1,005	1,501	2,003	1.010x - 18.195	0.999
B23	SKC	224-PCXR4	798393	07/01/2022	1,000	1,500	2,000	993	1,505	2,002	1.017x - 34.683	0.999
B24	SKC	224-PCXR4	626363	07/01/2022	1,000	1,500	2,000	1,000	1,501	2,005	1.016x - 28.338	0.999
B25	SKC	224-PCXR4	798489	06/01/2022	1,000	1,500	2,000	1,000	1,495	1,997	0.997x + 2.018	1.000
B26	SKC	224-PCXR4	798479	06/01/2022	1,000	1,500	2,000	997	1,497	1,990	0.994x + 3.251	1.000
B27	SKC	224-PCXR4	691673	06/01/2022	1,000	1,500	2,000	994	1,503	2,001	1.015x - 31.951	0.999
B28	SKC	224-PCXR4	691570	06/01/2022	1,000	1,500	2,000	1,000	1,500	2,003	1.015x - 27.022	0.999
B29	SKC	224-PCXR4	626472	06/01/2022	1,000	1,500	2,000	999	1,494	1,998	1.002x - 6.856	1.000
B30	SKC	224-PCXR4	691489	06/01/2022	1,000	1,500	2,000	1,003	1,500	2,004	1.013x - 24.106	0.999
B31	SKC	224-PCXR4	691509	06/01/2022	1,000	1,500	2,000	995	1,495	1,995	1.001x - 4.894	1.000
B32	SKC	224-PCXR4	091567	06/01/2022	1,000	1,500	2,000	994	1,504	2,001	1.014x - 28.868	0.999
B33	SKC	224-PCXR4	091756	06/01/2022	1,000	1,500	2,000	996	1,496	1,991	0.995x + 3.183	1.000
B34	SKC	224-PCXR4	612962	06/01/2022	1,000	1,500	2,000	1,001	1,501	2,002	1.012x - 22.531	0.999
B35	SKC	224-PCXR4	602682	06/01/2022	1,000	1,500	2,000	993	1,498	1,996	1.002x - 8.448	1.000
B36	SKC	224-PCXR4	626164	05/01/2022	1,000	1,500	2,000	1,000	1,497	1,999	0.999x - 3.231	1.000
B37	SKC	224-PCXR4	626256	05/01/2022	1,000	1,500	2,000	994	1,504	2,002	1.016x - 31.604	0.999
B38	SKC	224-PCXR4	626167	10/01/2022	1,000	1,500	2,000	999	1,497	1,996	1.000x - 1.875	1.000
B39	SKC	224-PCXR4	034637	10/01/2022	1,000	1,500	2,000	1,002	1,500	2,002	1.012x - 23.643	0.999
B40	SKC	224-PCXR4	798349	10/01/2022	1,000	1,500	2,000	993	1,505	2,000	1.016x - 32.992	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	R ²
B41	SKC	224-PCXR4	612669	10/01/2022	1,000	1,500	2,000	998	1,496	1,989	0.994x + 2.680	1.000
B42	SKC	224-PCXR4	626041	07/01/2022	1,000	1,500	2,000	1,003	1,498	1,993	0.990x + 11.710	1.000
B43	SKC	224-PCXR4	034636	05/01/2022	1,000	1,500	2,000	998	1,500	1,992	0.992x + 8.392	1.000
B44	SKC	224-PCXR8	529341	07/01/2022	1,000	1,500	2,000	1,004	1,500	2,003	1.011x – 21.139	0.999
B45	SKC	224-PCXR8	529594	07/01/2022	1,000	1,500	2,000	997	1,498	1,992	0.995x + 2.728	1.000
B46	SKC	224-PCXR8	566743	07/01/2022	1,000	1,500	2,000	994	1,504	2,002	1.015x – 32.087	0.999
B47	SKC	224-PCXR8	566747	07/01/2022	1,000	1,500	2,000	1,002	1,501	2,003	1.013x – 23.580	0.999
B48	SKC	224-PCXR8	566753	07/01/2022	1,000	1,500	2,000	1,000	1,494	1,996	0.996x + 1.567	1.000
B49	SKC	224-PCXR8	566780	07/01/2022	1,000	1,500	2,000	1,002	1,501	2,004	1.012x – 22.236	0.999
B50	SKC	224-PCXR8	500400	07/01/2022	1,000	1,500	2,000	1,000	1,493	1,996	0.995x + 3.641	1.000
B51	SKC	224-PCXR8	500363	07/01/2022	1,000	1,500	2,000	995	1,504	2,000	1.013x – 27.704	0.999
B52	SKC	224-PCXR8	093186	07/01/2022	1,000	1,500	2,000	995	1,498	1,994	0.997x – 0.283	1.000
B53	SKC	224-PCXR8	707670	10/01/2022	1,000	1,500	2,000	1,002	1,499	2,004	1.012x – 23.580	0.999
B54	SKC	224-PCXR3	509821	05/01/2022	1,000	1,500	2,000	994	1,501	2,001	1.015x – 32.043	0.999
B55	SKC	224-PCXR3	510710	06/01/2022	1,000	1,500	2,000	1,000	1,494	1,994	0.994x + 4.830	1.000
B56	SKC	224-PCXR3	511450	06/01/2022	1,000	1,500	2,000	1,004	1,502	2,002	1.010x – 19.248	0.999
B57	SKC	224-PCXR3	510798	06/01/2022	1,000	1,500	2,000	997	1,492	1,996	0.996x + 1.747	1.000
B58	SKC	224-PCXR3	509852	06/01/2022	1,000	1,500	2,000	997	1,499	2,000	1.011x – 27.010	0.999
B59	SKC	224-PCXR3	509862	06/01/2022	1,000	1,500	2,000	997	1,495	1,991	0.995x + 3.833	1.000
B60	SKC	224-PCXR3	512655	06/01/2022	1,000	1,500	2,000	1,002	1,500	2,004	1.013x – 24.688	0.999
B61	SKC	224-PCXR3	503915	06/01/2022	1,000	1,500	2,000	994	1,488	1,999	1.005x – 12.631	1.000
B62	SKC	224-PCXR3	505975	10/01/2022	1,000	1,500	2,000	994	1,491	1,995	1.002x – 8.089	1.000
B63	SKC	224-PCXR3	511432	10/01/2022	1,000	1,500	2,000	992	1,501	2,000	1.016x – 33.906	0.999
B64	SKC	224-PCXR3	508302	10/01/2022	1,000	1,500	2,000	998	1,493	1,990	0.994x + 4.272	1.000
B65	SKC	224-PCXR3	508310	10/01/2022	1,000	1,500	2,000	1,002	1,500	2,004	1.012x – 23.077	0.999
B66	SKC	224-PCXR3	509861	10/01/2022	1,000	1,500	2,000	997	1,494	1,994	0.995x + 3.953	1.000
B67	SKC	224-PCXR3	506295	10/01/2022	1,000	1,500	2,000	993	1,507	2,002	1.017x – 34.005	0.999
B68	SKC	224-PCXR3	505872	13/01/2022	1,000	1,500	2,000	1,000	1,495	1,994	0.995x + 4.188	1.000
B69	SKC	224-PCXR3	508375	13/01/2022	1,000	1,500	2,000	1,002	1,501	2,002	1.011x – 21.984	0.999
B70	SKC	224-PCXR3	510623	13/01/2022	1,000	1,500	2,000	995	1,490	1,997	1.001x – 7.267	1.000
B71	SKC	224-PCXR3	508367	13/01/2022	1,000	1,500	2,000	991	1,506	2,001	1.017x – 35.429	0.999
B72	SKC	224-PCXR3	505977	13/01/2022	1,000	1,500	2,000	1,001	1,498	1,991	0.991x + 8.882	1.000
B73	SKC	224-PCXR3	512606	13/01/2022	1,000	1,500	2,000	1,001	1,501	2,004	1.013x – 23.520	0.999
B74	SKC	224-PCXR3	505993	13/01/2022	1,000	1,500	2,000	996	1,495	1,995	1.000x – 5.161	1.000
B75	SKC	224-PCXR3	509820	13/01/2022	1,000	1,500	2,000	996	1,499	1,992	0.996x + 1.831	1.000
B76	SKC	224-PCXR3	509811	13/01/2022	1,000	1,500	2,000	995	1,496	1,998	1.003x – 9.050	1.000
B77	SKC	224-PCXR3	508301	13/01/2022	1,000	1,500	2,000	1,001	1,500	2,004	1.014x – 26.595	0.999
B78	SKC	224-PCXR3	510677	13/01/2022	1,000	1,500	2,000	994	1,504	1,999	1.013x – 28.238	0.999
B79	SKC	224-PCXR3	510920	12/01/2022	1,000	1,500	2,000	994	1,493	1,994	0.999x – 4.304	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 \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	R ²
B80	SKC	224-PCXR3	504569	12/01/2022	1,000	1,500	2,000	1,003	1,499	2,002	1.010x - 20.915	0.999
B81	SKC	224-PCXR3	503480	10/01/2022	1,000	1,500	2,000	994	1,499	2,000	1.015x - 31.401	0.999
B82	SKC	224-PCXR3	505673	10/01/2022	1,000	1,500	2,000	993	1,499	1,996	1.003x - 7.857	1.000
B83	SKC	224-PCXR3	510785	13/01/2022	1,000	1,500	2,000	1,000	1,500	2,002	1.012x - 23.548	0.999
B84	SKC	224-PCXR3	508333	12/01/2022	1,000	1,500	2,000	995	1,497	1,992	0.997x - 0.016	1.000
B85	SKC	224-PCXR3	505757	10/01/2022	1,000	1,500	2,000	993	1,502	1,999	1.014x - 30.555	0.999
B86	SKC	224-PCXR3	512625	10/01/2022	1,000	1,500	2,000	1,002	1,500	2,004	1.013x - 23.520	0.999
B87	SKC	224-PCXR3	504324	13/01/2022	1,000	1,500	2,000	997	1,499	1,997	1.000x - 1.667	1.000
B88	SKC	224-PCXR3	508307	13/01/2022	1,000	1,500	2,000	996	1,495	1,992	0.996x + 0.451	1.000
B89	SKC	224-PCXR3	509860	13/01/2022	1,000	1,500	2,000	1,000	1,501	2,003	1.013x - 25.008	0.999
B90	SKC	224-PCXR3	508366	13/01/2022	1,000	1,500	2,000	992	1,502	2,001	1.017x - 33.531	0.999
B91	SKC	224-PCXR3	510919	13/01/2022	1,000	1,500	2,000	998	1,498	1,997	1.001x - 4.563	1.000
B92	SKC	224-PCXR3	510987	13/01/2022	1,000	1,500	2,000	1,003	1,501	2,004	1.012x - 21.996	0.999
B93	SKC	224-PCXR3	509845	13/01/2022	1,000	1,500	2,000	1,000	1,498	1,999	1.000x - 3.059	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 \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
R01	SKC	224-PCXR4	602467	06/01/2022	1,000	1,500	2,000	995	1,505	2,002	1.017x – 33.519	0.999
R02	SKC	224-PCXR4	626450	06/01/2022	1,000	2,000	3,000	999	1,498	1,994	0.994x + 4.132	1.000
R03	SKC	224-PCXR4	691592	06/01/2022	1,000	1,500	2,000	1,003	1,500	2,004	1.013x – 23.436	0.999
R04	SKC	224-PCXR4	691672	06/01/2022	1,000	1,500	2,000	996	1,493	1,995	1.000x – 5.153	1.000
R05	SKC	224-PCXR4	798470	12/01/2022	1,000	1,500	2,000	994	1,506	2,000	1.015x – 31.632	0.999
R06	SKC	224-PCXR4	798456	12/01/2022	1,000	1,500	2,000	993	1,497	1,993	1.000x – 5.496	1.000
R07	SKC	224-PCXR4	798480	12/01/2022	1,000	1,500	2,000	995	1,493	1,993	0.999x – 6.070	1.000
R08	SKC	224-PCXR4	883215	12/01/2022	1,000	1,500	2,000	1,002	1,501	2,004	1.014x – 25.235	0.999
R09	SKC	224-PCXR4	034650	06/01/2022	1,000	1,500	2,000	991	1,504	2,002	1.019x – 37.567	0.999
R10	SKC	224-PCXR4	091765	06/01/2022	1,000	1,500	2,000	1,000	1,492	1,994	0.995x + 3.159	1.000
R11	SKC	224-PCXR4	091763	06/01/2022	1,000	1,500	2,000	1,001	1,501	2,002	1.013x – 24.082	0.999
R12	SKC	224-PCXR4	091568	12/01/2022	1,000	1,500	2,000	999	1,499	1,995	0.997x – 0.024	1.000
R13	SKC	224-PCXR4	091638	12/01/2022	1,000	1,500	2,000	1,000	1,498	1,993	0.992x + 8.280	1.000
R14	SKC	224-PCXR4	091764	12/01/2022	1,000	1,500	2,000	993	1,502	1,998	1.013x – 30.093	0.999
R15	SKC	224-PCXR8	529457	12/01/2022	1,000	1,500	2,000	1,002	1,500	2,005	1.013x – 23.915	0.999
R16	SKC	224-PCXR8	529643	12/01/2022	1,000	1,500	2,000	999	1,497	1,994	0.997x + 0.219	1.000
R17	SKC	224-PCXR8	529645	12/01/2022	1,000	1,500	2,000	996	1,507	2,000	1.013x – 28.545	0.999
R18	SKC	224-PCXR8	566756	12/01/2022	1,000	1,500	2,000	991	1,496	1,998	1.003x – 9.193	1.000
R19	SKC	224-PCXR8	566802	10/01/2022	1,000	1,500	2,000	1,003	1,500	2,003	1.011x – 21.306	0.999
R20	SKC	224-PCXR8	529089	10/01/2022	1,000	1,500	2,000	991	1,503	2,001	1.019x – 37.942	0.999
R21	SKC	224-PCXR8	665728	10/01/2022	1,000	1,500	2,000	999	1,496	1,998	0.998x – 1.376	1.000
R22	SKC	224-PCXR8	707444	07/01/2022	1,000	1,500	2,000	1,002	1,501	2,003	1.012x – 23.440	0.999
R23	SKC	224-PCXR8	761067	07/01/2022	1,000	1,500	2,000	998	1,494	1,992	0.992x + 6.270	1.000
R24	SKC	224-PCXR8	707893	10/01/2022	1,000	1,500	2,000	995	1,505	2,001	1.015x – 30.157	0.999
R25	SKC	224-PCXR8	761052	10/01/2022	1,000	1,500	2,000	998	1,500	1,994	0.995x + 4.519	1.000
R26	SKC	224-PCXR8	707956	10/01/2022	1,000	1,500	2,000	1,002	1,499	2,004	1.013x – 24.282	0.999
R27	SKC	224-PCXR8	707398	05/01/2022	1,000	1,500	2,000	996	1,503	2,001	1.014x – 29.522	0.999
R28	SKC	224-PCXR8	707481	05/01/2022	1,000	1,500	2,000	1,004	1,500	2,004	1.011x – 20.325	0.999
R29	SKC	224-PCXR8	707402	05/01/2022	1,000	1,500	2,000	1,003	1,493	1,991	0.991x + 9.245	1.000
R30	SKC	224-PCXR8	093811	05/01/2022	1,000	1,500	2,000	997	1,495	1,993	0.997x – 0.730	1.000
R31	SKC	224-PCXR8	093183	05/01/2022	1,000	1,500	2,000	1,000	1,500	2,001	1.013x – 25.087	0.999
R32	SKC	224-PCXR8	671950	05/01/2022	1,000	1,500	2,000	1,000	1,498	1,994	0.994x + 7.562	1.000
R33	SKC	224-PCXR4	626254	05/01/2022	1,000	1,500	2,000	992	1,502	2,000	1.017x – 35.697	0.999
R34	SKC	224-PCXR4	626131	05/01/2022	1,000	1,500	2,000	1,002	1,499	2,004	1.013x – 24.533	0.999
R35	SKC	224-PCXR8	707460	07/01/2022	1,000	1,500	2,000	999	1,496	1,995	0.996x + 3.275	1.000
R36	SKC	224-PCXR8	707446	07/01/2022	1,000	1,500	2,000	1,003	1,500	2,003	1.011x – 21.187	0.999
R37	SKC	224-PCXR8	707432	07/01/2022	1,000	1,500	2,000	999	1,499	1,998	0.998x + 0.044	1.000
R38	SKC	224-PCXR8	707349	07/01/2022	1,000	1,500	2,000	996	1,503	2,001	1.015x – 30.563	0.999
R39	SKC	224-PCXR8	761095	07/01/2022	1,000	1,500	2,000	998	1,494	1,995	0.995x + 1.599	1.000

Calibrated 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	R²
R40	SKC	224-PCXR4	612753	07/01/2022	1,000	1,500	2,000	1,003	1,500	2,003	1.013x – 24.242	0.999
R41	SKC	224-PCXR4	626140	07/01/2022	1,000	1,500	2,000	991	1,507	2,001	1.018x – 35.034	0.999
R42	SKC	224-PCXR4	626463	11/01/2022	1,000	1,500	2,000	993	1,496	1,997	1.002x – 6.685	1.000
R43	SKC	224-PCXR4	626129	11/01/2022	1,000	1,500	2,000	1,002	1,501	2,004	1.013x – 23.691	0.999
R44	SKC	224-PCXR4	602753	11/01/2022	1,000	1,500	2,000	1,001	1,495	1,994	0.993x + 5.600	1.000
R45	SKC	224-PCXR4	626137	11/01/2022	1,000	1,500	2,000	992	1,505	2,001	1.018x – 36.115	0.999

Calibrated 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	R²
B01	SKC	224-PCXR4	262101	01/04/2022	1,000	1,500	2,000	994	1,497	1,998	1.001x - 3.749	1.000
B02	SKC	224-PCXR4	626166	04/04/2022	1,000	1,500	2,000	1,002	1,505	2,001	1.010x - 20.465	0.999
B03	SKC	224-PCXR4	612968	04/04/2022	1,000	1,500	2,000	996	1,494	2,000	1.006x - 12.986	1.000
B04	SKC	224-PCXR4	602804	01/04/2022	1,000	1,500	2,000	1,000	1,502	1,996	1.001x - 2.928	1.000
B05	SKC	224-PCXR4	612693	12/04/2022	1,000	1,500	2,000	1,003	1,499	2,003	1.012x - 23.061	0.999
B06	SKC	224-PCXR4	262188	01/04/2022	1,000	1,500	2,000	995	1,508	1,999	1.012x - 25.219	0.999
B07	SKC	224-PCXR4	626262	01/04/2022	1,000	1,500	2,000	998	1,492	1,995	0.992x + 6.804	1.000
B08	SKC	224-PCXR4	626100	12/04/2022	1,000	1,500	2,000	1,003	1,499	2,003	1.012x - 22.750	0.999
B09	SKC	224-PCXR4	626479	11/04/2022	1,000	1,500	2,000	997	1,490	1,994	0.994x + 3.231	1.000
B10	SKC	224-PCXR4	091950	04/04/2022	1,000	1,500	2,000	994	1,503	2,001	1.016x - 32.594	0.999
B11	SKC	224-PCXR8	564315	06/04/2022	1,000	1,500	2,000	995	1,490	1,998	1.003x - 9.054	1.000
B12	SKC	224-PCXR4	034656	01/04/2022	1,000	1,500	2,000	1,003	1,503	2,003	1.011x - 19.603	0.999
B13	SKC	224-PCXR4	602073	12/04/2022	1,000	1,500	2,000	995	1,500	1,999	1.001x - 4.072	1.000
B14	SKC	224-PCXR4	626313	05/04/2022	1,000	1,500	2,000	998	1,491	1,988	0.992x + 5.727	1.000
B15	SKC	224-PCXR4	626474	01/04/2022	1,000	1,500	2,000	1,003	1,502	2,005	1.012x - 22.726	0.999
B16	SKC	224-PCXR4	626477	11/04/2022	1,000	1,500	2,000	994	1,504	2,000	1.014x - 30.627	0.999
B17	SKC	224-PCXR4	626860	04/04/2022	1,000	1,500	2,000	997	1,495	1,991	0.997x + 0.479	1.000
B18	SKC	224-PCXR4	691484	04/04/2022	1,000	1,500	2,000	1,003	1,501	2,001	1.010x - 19.424	0.999
B19	SKC	224-PCXR4	691599	01/04/2022	1,000	1,500	2,000	995	1,503	1,999	1.005x - 8.224	1.000
B20	SKC	224-PCXR4	691587	04/04/2022	1,000	1,500	2,000	993	1,504	1,999	1.014x - 30.520	0.999
B21	SKC	224-PCXR4	691531	04/04/2022	1,000	1,500	2,000	993	1,499	1,992	1.000x - 4.714	1.000
B22	SKC	224-PCXR4	691654	04/04/2022	1,000	1,500	2,000	1,004	1,501	2,004	1.012x - 20.788	0.999
B23	SKC	224-PCXR4	798393	12/04/2022	1,000	1,500	2,000	994	1,505	2,002	1.017x - 33.567	0.999
B24	SKC	224-PCXR4	626363	04/04/2022	1,000	1,500	2,000	1,000	1,502	2,005	1.016x - 28.210	0.999
B25	SKC	224-PCXR4	798469	01/04/2022	1,000	1,500	2,000	1,001	1,512	2,001	0.998x + 5.009	1.000
B26	SKC	224-PCXR4	798479	12/04/2022	1,000	1,500	2,000	998	1,499	1,993	0.997x + 1.855	1.000
B27	SKC	224-PCXR4	691673	04/04/2022	1,000	1,500	2,000	993	1,503	2,001	1.017x - 33.826	0.999
B28	SKC	224-PCXR4	691570	04/04/2022	1,000	1,500	2,000	1,001	1,500	2,002	1.013x - 24.230	0.999
B29	SKC	224-PCXR4	626472	06/04/2022	1,000	1,500	2,000	999	1,494	1,998	1.002x - 6.378	1.000
B30	SKC	224-PCXR4	691489	06/04/2022	1,000	1,500	2,000	1,004	1,500	2,004	1.012x - 22.431	0.999
B31	SKC	224-PCXR4	691509	12/04/2022	1,000	1,500	2,000	993	1,495	1,995	1.002x - 7.965	1.000
B32	SKC	224-PCXR4	091567	04/04/2022	1,000	1,500	2,000	993	1,504	2,001	1.015x - 30.208	0.999
B33	SKC	224-PCXR4	091756	01/04/2022	1,000	1,500	2,000	994	1,496	1,991	0.996x + 0.475	1.000
B34	SKC	224-PCXR4	612962	04/04/2022	1,000	1,500	2,000	1,002	1,501	2,002	1.011x - 21.135	0.999
B35	SKC	224-PCXR4	602682	11/04/2022	1,000	1,500	2,000	994	1,498	1,996	1.001x - 6.493	1.000
B36	SKC	224-PCXR4	626164	04/04/2022	1,000	1,500	2,000	1,000	1,497	1,999	0.999x - 2.393	1.000
B37	SKC	224-PCXR4	626256	01/04/2022	1,000	1,500	2,000	994	1,506	2,002	1.016x - 31.285	0.999
B38	SKC	224-PCXR4	626167	04/04/2022	1,000	1,500	2,000	997	1,497	1,996	1.001x - 4.387	1.000
B39	SKC	224-PCXR4	034637	04/04/2022	1,000	1,500	2,000	1,003	1,500	2,002	1.012x - 22.527	0.999
B40	SKC	224-PCXR4	798349	12/04/2022	1,000	1,500	2,000	992	1,505	2,000	1.017x - 34.109	0.999

Calibrated 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	04/04/2022	1,000	1,500	2,000	998	1,496	1,989	0.994x + 3.829	1.000
B42	SKC	224-PCXR4	626041	01/04/2022	1,000	1,500	2,000	1,003	1,498	1,993	0.990x + 12.348	1.000
B43	SKC	224-PCXR4	034636	11/04/2022	1,000	1,500	2,000	1,001	1,501	1,992	0.990x + 12.839	1.000
B44	SKC	224-PCXR8	529341	01/04/2022	1,000	1,500	2,000	1,002	1,501	2,002	1.011x - 21.577	0.999
B45	SKC	224-PCXR8	529594	12/04/2022	1,000	1,500	2,000	997	1,498	1,992	0.995x + 2.928	1.000
B46	SKC	224-PCXR8	566743	04/04/2022	1,000	1,500	2,000	994	1,504	2,002	1.016x - 33.204	0.999
B47	SKC	224-PCXR8	566747	01/04/2022	1,000	1,500	2,000	1,002	1,500	2,004	1.013x - 24.202	0.999
B48	SKC	224-PCXR8	566753	01/04/2022	1,000	1,500	2,000	999	1,494	1,997	0.999x + 1.795	1.000
B49	SKC	224-PCXR8	566780	12/04/2022	1,000	1,500	2,000	1,003	1,502	2,003	1.011x - 21.031	0.999
B50	SKC	224-PCXR8	500400	01/04/2022	1,000	1,500	2,000	1,002	1,495	2,002	1.001x + 2.900	1.000
B51	SKC	224-PCXR8	500363	01/04/2022	1,000	1,500	2,000	995	1,504	2,000	1.012x - 26.268	0.999
B52	SKC	224-PCXR8	093186	11/04/2022	1,000	1,500	2,000	995	1,498	1,994	0.997x - 1.240	1.000
B53	SKC	224-PCXR8	707870	01/04/2022	1,000	1,500	2,000	1,002	1,499	2,004	1.012x - 22.742	0.999
B54	SKC	224-PCXR3	509821	11/04/2022	1,000	1,500	2,000	993	1,501	2,001	1.016x - 33.718	0.999
B55	SKC	224-PCXR3	510710	01/04/2022	1,000	1,500	2,000	1,000	1,494	1,994	0.994x + 4.635	1.000
B56	SKC	224-PCXR3	511450	01/04/2022	1,000	1,500	2,000	1,002	1,500	2,001	1.011x - 20.684	0.999
B57	SKC	224-PCXR3	510798	12/04/2022	1,000	1,500	2,000	997	1,493	1,998	1.001x + 3.398	1.000
B58	SKC	224-PCXR3	509852	04/04/2022	1,000	1,500	2,000	1,001	1,498	2,000	1.007x - 19.631	0.999
B59	SKC	224-PCXR3	509862	01/04/2022	1,000	1,500	2,000	996	1,503	1,995	0.998x + 2.916	1.000
B60	SKC	224-PCXR3	512655	01/04/2022	1,000	1,500	2,000	1,002	1,500	2,004	1.013x - 23.891	0.999
B61	SKC	224-PCXR3	503915	12/04/2022	1,000	1,500	2,000	994	1,489	1,999	1.004x - 11.786	1.000
B62	SKC	224-PCXR3	505975	12/04/2022	1,000	1,500	2,000	999	1,494	1,995	0.997x - 0.503	1.000
B63	SKC	224-PCXR3	511432	01/04/2022	1,000	1,500	2,000	991	1,501	2,000	1.017x - 36.139	0.999
B64	SKC	224-PCXR3	508302	04/04/2022	1,000	1,500	2,000	997	1,493	1,990	0.994x + 3.992	1.000
B65	SKC	224-PCXR3	508310	01/04/2022	1,000	1,500	2,000	1,002	1,500	2,003	1.012x - 23.109	0.999
B66	SKC	224-PCXR3	509861	12/04/2022	1,000	1,500	2,000	1,002	1,491	1,991	0.987x + 14.701	1.000
B67	SKC	224-PCXR3	506295	12/04/2022	1,000	1,500	2,000	993	1,507	2,004	1.017x - 33.104	0.999
B68	SKC	224-PCXR3	505872	12/04/2022	1,000	1,500	2,000	1,002	1,491	1,997	0.994x + 5.556	1.000
B69	SKC	224-PCXR3	508375	01/04/2022	1,000	1,500	2,000	1,001	1,500	2,000	1.010x - 21.689	0.999
B70	SKC	224-PCXR3	510623	11/04/2022	1,000	1,500	2,000	992	1,503	1,997	1.002x - 6.693	1.000
B71	SKC	224-PCXR3	508367	12/04/2022	1,000	1,500	2,000	991	1,506	2,002	1.018x - 36.227	0.999
B72	SKC	224-PCXR3	505977	12/04/2022	1,000	1,500	2,000	1,001	1,498	1,993	0.992x + 7.087	1.000
B73	SKC	224-PCXR3	512606	01/04/2022	1,000	1,500	2,000	1,001	1,501	2,005	1.014x - 24.517	0.999
B74	SKC	224-PCXR3	505993	12/04/2022	1,000	1,500	2,000	996	1,495	1,994	0.999x - 4.363	1.000
B75	SKC	224-PCXR3	509820	12/04/2022	1,000	1,500	2,000	996	1,499	1,992	0.995x + 2.429	1.000
B76	SKC	224-PCXR3	509811	12/04/2022	1,000	1,500	2,000	992	1,498	1,998	1.007x - 15.040	1.000
B77	SKC	224-PCXR3	508301	12/04/2022	1,000	1,500	2,000	1,000	1,501	2,003	1.014x - 26.643	0.999
B78	SKC	224-PCXR3	510677	01/04/2022	1,000	1,500	2,000	996	1,503	1,999	1.012x - 27.520	0.999
B79	SKC	224-PCXR3	510920	01/04/2022	1,000	1,500	2,000	994	1,493	1,994	0.999x - 3.705	1.000

Calibrated 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
B80	SKC	224-PCXR3	504569	01/04/2022	1,000	1,500	2,000	1,003	1,499	2,001	1.010x - 20.517	0.999
B81	SKC	224-PCXR3	503480	01/04/2022	1,000	1,500	2,000	994	1,499	2,000	1.015x - 31.561	0.999
B82	SKC	224-PCXR3	505673	01/04/2022	1,000	1,500	2,000	993	1,499	1,996	1.002x - 7.299	1.000
B83	SKC	224-PCXR3	510785	04/04/2022	1,000	1,500	2,000	1,000	1,500	2,002	1.012x - 23.787	0.999
B84	SKC	224-PCXR3	508333	04/04/2022	1,000	1,500	2,000	995	1,497	1,991	0.997x - 0.383	1.000
B85	SKC	224-PCXR3	505757	04/04/2022	1,000	1,500	2,000	993	1,502	1,999	1.014x - 30.476	0.999
B86	SKC	224-PCXR3	512625	12/04/2022	1,000	1,500	2,000	1,003	1,502	2,004	1.012x - 22.463	0.999
B87	SKC	224-PCXR3	504324	11/04/2022	1,000	1,500	2,000	998	1,496	2,000	1.001x - 2.305	1.000
B88	SKC	224-PCXR3	508307	04/04/2022	1,000	1,500	2,000	997	1,498	1,993	0.996x + 1.212	1.000
B89	SKC	224-PCXR3	509860	12/04/2022	1,000	1,500	2,000	1,000	1,501	2,003	1.014x - 25.646	0.999
B90	SKC	224-PCXR3	508356	04/04/2022	1,000	1,500	2,000	992	1,502	2,001	1.017x - 33.850	0.999
B91	SKC	224-PCXR3	510919	04/04/2022	1,000	1,500	2,000	998	1,498	1,996	1.000x - 3.765	1.000
B92	SKC	224-PCXR3	510987	04/04/2022	1,000	1,500	2,000	1,003	1,501	2,004	1.012x - 21.916	0.999
B93	SKC	224-PCXR3	509845	12/04/2022	1,000	1,500	2,000	1,000	1,498	1,998	1.000x - 2.261	1.000

Calibrated by :





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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

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
R01	SKC	224-PCXR4	602467	04/04/2022	1,000	1,500	2,000	993	1,508	2,004	1.020x - 38.784	0.999
R02	SKC	224-PCXR4	626450	04/04/2022	1,000	2,000	3,000	999	1,499	1,990	0.989x + 12.627	1.000
R03	SKC	224-PCXR4	691592	04/04/2022	1,000	1,500	2,000	1,003	1,500	2,004	1.012x - 22.479	0.999
R04	SKC	224-PCXR4	691672	01/04/2022	1,000	1,500	2,000	996	1,493	1,993	0.998x - 2.561	1.000
R05	SKC	224-PCXR4	798470	01/04/2022	1,000	1,500	2,000	994	1,506	1,999	1.015x - 30.635	0.999
R06	SKC	224-PCXR4	798456	04/04/2022	1,000	1,500	2,000	994	1,498	1,994	1.002x - 7.438	1.000
R07	SKC	224-PCXR4	798480	04/04/2022	1,000	1,500	2,000	994	1,490	2,000	1.008x - 16.831	1.000
R08	SKC	224-PCXR4	883215	01/04/2022	1,000	1,500	2,000	1,001	1,502	2,005	1.015x - 26.627	0.999
R09	SKC	224-PCXR4	034650	01/04/2022	1,000	1,500	2,000	991	1,504	2,002	1.018x - 36.538	0.999
R10	SKC	224-PCXR4	091765	01/04/2022	1,000	1,500	2,000	996	1,512	1,993	1.000x + 0.219	1.000
R11	SKC	224-PCXR4	091763	12/04/2022	1,000	1,500	2,000	1,001	1,499	2,002	1.012x - 23.923	0.999
R12	SKC	224-PCXR4	091568	12/04/2022	1,000	1,500	2,000	997	1,501	1,999	1.001x - 4.986	1.000
R13	SKC	224-PCXR4	091638	04/04/2022	1,000	1,500	2,000	1,002	1,498	1,993	0.991x + 10.793	1.000
R14	SKC	224-PCXR4	091764	04/04/2022	1,000	1,500	2,000	994	1,502	1,998	1.013x - 29.256	0.999
R15	SKC	224-PCXR8	529457	01/04/2022	1,000	1,500	2,000	1,002	1,500	2,004	1.013x - 24.345	0.999
R16	SKC	224-PCXR8	529643	04/04/2022	1,000	1,500	2,000	998	1,497	1,994	0.997x + 0.060	1.000
R17	SKC	224-PCXR8	529645	04/04/2022	1,000	1,500	2,000	994	1,509	2,000	1.015x - 30.571	0.999
R18	SKC	224-PCXR8	566756	04/04/2022	1,000	1,500	2,000	991	1,496	1,998	1.002x - 7.678	1.000
R19	SKC	224-PCXR8	566802	01/04/2022	1,000	1,500	2,000	1,003	1,499	2,000	1.010x - 20.189	0.999
R20	SKC	224-PCXR8	529089	04/04/2022	1,000	1,500	2,000	990	1,501	2,003	1.020x - 40.036	0.999
R21	SKC	224-PCXR8	665728	01/04/2022	1,000	1,500	2,000	999	1,493	1,999	1.000x - 5.364	1.000
R22	SKC	224-PCXR8	707444	04/04/2022	1,000	1,500	2,000	1,002	1,500	2,001	1.011x - 21.215	0.999
R23	SKC	224-PCXR8	761067	11/04/2022	1,000	1,500	2,000	998	1,494	1,992	0.994x + 3.095	1.000
R24	SKC	224-PCXR8	707893	01/04/2022	1,000	1,500	2,000	996	1,505	2,001	1.014x - 29.040	0.999
R25	SKC	224-PCXR8	761052	01/04/2022	1,000	1,500	2,000	998	1,500	1,992	0.992x + 7.630	1.000
R26	SKC	224-PCXR8	707956	12/04/2022	1,000	1,500	2,000	1,002	1,500	2,004	1.013x - 24.417	0.999
R27	SKC	224-PCXR8	707398	04/04/2022	1,000	1,500	2,000	996	1,503	2,001	1.013x - 28.725	0.999
R28	SKC	224-PCXR8	707481	11/04/2022	1,000	1,500	2,000	1,004	1,500	2,003	1.010x - 19.368	0.999
R29	SKC	224-PCXR8	707402	01/04/2022	1,000	1,500	2,000	1,005	1,491	1,991	0.988x + 14.326	1.000
R30	SKC	224-PCXR8	093811	01/04/2022	1,000	1,500	2,000	998	1,495	1,994	0.998x - 1.268	1.000
R31	SKC	224-PCXR8	093183	01/04/2022	1,000	1,500	2,000	1,001	1,501	2,001	1.012x - 23.001	0.999
R32	SKC	224-PCXR8	671950	04/04/2022	1,000	1,500	2,000	1,000	1,498	1,994	0.994x + 7.762	1.000
R33	SKC	224-PCXR4	626254	12/04/2022	1,000	1,500	2,000	992	1,502	1,999	1.016x - 34.141	0.999
R34	SKC	224-PCXR4	626131	01/04/2022	1,000	1,500	2,000	1,002	1,498	2,004	1.012x - 24.294	0.999
R35	SKC	224-PCXR8	707460	04/04/2022	1,000	1,500	2,000	998	1,498	1,995	0.994x + 5.672	1.000
R36	SKC	224-PCXR8	707446	01/04/2022	1,000	1,500	2,000	1,003	1,500	2,001	1.010x - 19.192	0.999
R37	SKC	224-PCXR8	707432	01/04/2022	1,000	1,500	2,000	999	1,499	1,998	0.999x + 0.554	1.000
R38	SKC	224-PCXR8	707349	01/04/2022	1,000	1,500	2,000	996	1,500	2,002	1.015x - 31.640	0.999
R39	SKC	224-PCXR8	761095	12/04/2022	1,000	1,500	2,000	1,001	1,496	1,994	0.997x + 2.652	1.000

Calibrated by :





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

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	01/04/2022	1,000	1,500	2,000	1,002	1,501	2,003	1.012x - 23.005	0.999
R41	SKC	224-PCXR4	626140	01/04/2022	1,000	1,500	2,000	991	1,509	2,002	1.018x - 35.114	0.999
R42	SKC	224-PCXR4	626463	01/04/2022	1,000	1,500	2,000	995	1,493	2,000	1.003x - 7.470	1.000
R43	SKC	224-PCXR4	626129	04/04/2022	1,000	1,500	2,000	1,002	1,501	2,003	1.012x - 22.495	0.999
R44	SKC	224-PCXR4	602753	01/04/2022	1,000	1,500	2,000	1,002	1,495	1,994	0.996x + 1.133	1.000
R45	SKC	224-PCXR4	626137	01/04/2022	1,000	1,500	2,000	992	1,505	2,002	1.019x - 37.368	0.999

Calibrated by :





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 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	R ²
H-R01	Dwyer	VFB-65	05/01/2022	500	1,000	2,000	502.4	997.7	1997.7	0.996x + 3.587	1.000
H-R02	Dwyer	VFB-65	05/01/2022	500	1,000	2,000	500.5	998.1	1995.7	0.992x + 7.068	1.000
H-R03	Dwyer	VFB-65	06/01/2022	500	1,000	2,000	497.1	994.3	1976.7	0.990x + 4.620	1.000
H-R04	Dwyer	VFB-65	06/01/2022	500	1,000	2,000	495.2	990.5	1995.3	1.001x – 7.907	1.000
H-R05	Dwyer	VFB-65	06/01/2022	500	1,000	2,000	495.3	999.3	1995.6	1.003x – 3.4893	1.000
H-R06	Dwyer	VFB-65	07/01/2022	500	1,000	2,000	493.0	1000.9	1990.9	0.996x + 1.905	1.000

Calibrated by :





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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

Rotameter Calibration Report (For Personal Pump High Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

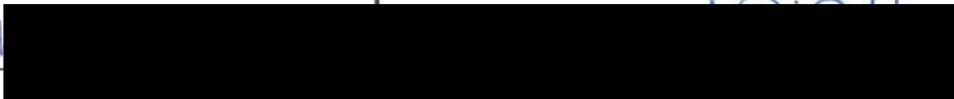
S/N : 136164

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	04/04/2022	500	1,000	2,000	503.1	992.4	1979.1	0.999x + 3.360	0.999
H-R02	Dwyer	VFB-65	01/04/2022	500	1,000	2,000	500.8	995.3	1986.1	1.002x + 5.536	1.000
H-R03	Dwyer	VFB-65	04/04/2022	500	1,000	2,000	502.1	987.7	1997.3	0.994x + 1.910	1.000
H-R04	Dwyer	VFB-65	04/04/2022	500	1,000	2,000	496.4	989.6	2019.5	1.009x - 13.763	1.000
H-R05	Dwyer	VFB-65	01/04/2022	500	1,000	2,000	496.8	987.7	1987.7	1.004x - 9.632	1.000
H-R06	Dwyer	VFB-65	01/04/2022	500	1,000	2,000	505.2	992.4	1979.4	0.999x + 2.749	0.999

Calibrated by :

pl





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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	05/01/2022	50	100	200	50.0	100.0	202.1	1.000x + 0.189	1.000
L-R02	Dwyer	VFA-21	05/01/2022	50	100	200	49.5	100.9	198.9	1.002x - 0.324	1.000
L-R03	Dwyer	VFA-21	06/01/2022	50	100	200	49.8	99.4	201.7	1.004x - 0.164	1.000
L-R04	Dwyer	VFA-21	06/01/2022	50	100	200	49.6	100.3	200.0	1.002x - 0.421	1.000
L-R05	Dwyer	VFA-21	06/01/2022	50	100	200	50.0	99.8	202.4	0.987x + 1.729	1.000
L-R06	Dwyer	VFA-21	07/01/2022	50	100	200	49.8	99.5	198.1	1.005x - 1.417	1.000

Calibrated by :





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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	04/04/2022	50	100	200	50.2	100.6	203.5	0.983x + 2.458	1.000
L-R02	Dwyer	VFA-21	01/04/2022	50	100	200	49.7	100.9	200.5	1.008x - 1.306	0.999
L-R03	Dwyer	VFA-21	04/04/2022	50	100	200	50.1	99.8	202.3	1.018x - 1.156	1.000
L-R04	Dwyer	VFA-21	04/04/2022	50	100	200	49.8	100.9	200.6	1.009x - 1.349	0.999
L-R05	Dwyer	VFA-21	01/04/2022	50	100	200	49.8	100.4	203.4	0.992x + 1.525	1.000
L-R06	Dwyer	VFA-21	01/04/2022	50	100	200	50.2	99.1	201.9	1.003x - 0.172	1.000

Calibrated by :





Certificate of Calibration

Certificate Number : SPR21060189-1

Page : 1 of 3

Customer : S.P.S. CONSULTING SERVICE CO., LTD.

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

Equipment Name : Mass Flow Meter

Manufacturer : Dwyer

Model : GMF-2101

Serial Number : N/A

ID. Number : N/A

Environmental Conditions

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

Received Date : 11 Jun 2021

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

Calibration Date : 12 Jun 2021

Location of Calibration : In-Lab

Recommend Due Date : 12 Jun 2022

Calibration Procedure : In-House Method

Date of Issue : 13 Jun 2021

Method of Calibration

This certifies that the above instrument was calibrated in compliance with the calibration system requirement of ISO/IEC 17025:2017 in accordance with reference procedure. Standards used to perform this calibration are certified by to NIST or equivalent, National metrology institute, Natural physical constants, consensus standards. The result reported herein apply only to the calibration of the item described above as received. Our decision rule is to contact the customer if the item pass and fail calibration when the results include the uncertainties and the customer must determine if the results meets their needs.

All calibrations are performed within manufacture's specifications. The calibration certificate shall not be reproduced except in full, without written approval of SP Metrology System (Thailand).

Calibrated by : Mr.Jirasak Pumbut

Approved by :

Calibration Officer

Authorized Signatory



Calibration Report

Certificate Number : SPR21060189-1

Page : 2 of 3

Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due. Date
Mass Flow Calibrator	AFC-COMplete-10	12532	AD2007-056-0001	09 Jul 2021

Traceability

This certification is traceable to the International System of Unit maintained at :
MIT - Miracle International Technology Co.,Ltd.



Result of Calibration

69/29 Moo 1 Klongsi Klongluang Pathumthani 12120 (Thailand) Tel: (662) 193-2220 5 คู่มือการใช้งานเครื่องวัด www.spsystem.co.th

Certificate No. : SPR21060189-1

Page : 3 of 3

Function : Air Flow Measurement

Unit : CFM

Calibration Point	UUC Reading	Standard Reading	UUC Error	K Factor Value	Uncertainty (±)
0.0	0.00	0.00	0.00	1.0	0.12
3.3	3.30	3.45	-0.15	1.0	0.26
7.3	7.30	7.62	-0.32	1.0	0.26
13.5	13.50	14.12	-0.62	1.0	0.26
17.0	17.00	17.65	-0.65	1.0	0.26

Note:
The result of calibration was found accurate as show on date and place of calibration only.
This Certificate is not certified for any commercial transaction.

Measurement Uncertainty

The reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor k = 2, providing a level of confidence approximately 95 %
- End of Certificate -

Certificate of System Qualification

GC-OQ + GCMS-OQ

System ID: GC/MS
Organization Name: S.P.S. Consulting service
Organization Location: 7 Soi Phaholyothin Road, Ladyao, Khet Jatujak, Bangkok, 10900
Date: March 22, 2021 10:41:18 AM
EQP Name: AgilentRecommended , AgilentRecommended
EQP Revision: GC.02.51, GCMS.02.51
Overall Qualification Status: Pass

System Inspection and Basic Safety and Operation

Name: 7890

Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Accuracy

Name: 7890

Front SSL

Setpoint Status: Pass

	Setpoint		Actual
Inlet Pressure:	25.0	psi	24.9

Accuracy: 0.1 psi

Agilent Recommended: <= 1.2

Overall Inlet Pressure Accuracy Test Status

Pass

Inlet Pressure Decay

Date: March 22, 2021 10:41:18 AM
System ID: GC/MS

Name: 7890
Back SSL

Setpoint Status:

Pass

Pressure:

25.0 psi

Pressure Change:

-0.1 psi /5 minutes

Agilent Recommended:

>= -2.0 and <= 0.5

Overall Inlet Pressure Decay Test Status

Pass

Inlet Pressure Accuracy

Name: 7890
Back SSL

Setpoint Status:

Pass

Setpoint

Actual

Inlet Pressure: 25.0 psi

24.9 psi

Accuracy:

0.1 psi

Agilent Recommended:

<= 1.2

Overall Inlet Pressure Accuracy Test Status

Pass

Detector Flow Accuracy

Name: 7890
Front FID

Setpoint Status:

Pass

Flow Type:

Fuel

Setpoint:

30.0 mL/min

Measured Flow:

29.9 mL/min

Accuracy:

0.1 mL/min

Agilent Recommended:

<= 10.0 % setpoint

(3.0 mL/min)

Limit is percentage of setpoint or 0.5 ml/minute, whichever is largest.

Date: March 22, 2021 10:41:18 AM
System ID: GC/MS

Setpoint Status:

Pass

Flow Type:

Oxidizer

Setpoint:

400.0

mL/min

Measured Flow:

399.8

mL/min

Accuracy:

0.2

mL/min

Agilent Recommended:

<=

10.0

% setpoint

(

40.0

ml/min

)

Limit is percentage of setpoint or 0.5 ml/minute, whichever is largest.

Setpoint Status:

Pass

Flow Type:

Makeup

Setpoint:

25.0

mL/min

Measured Flow:

24.9

mL/min

Accuracy:

0.1

mL/min

Agilent Recommended:

<=

10.0

% setpoint

(

2.5

ml/min

)

Limit is percentage of setpoint or 0.5 ml/minute, whichever is largest.

Overall Detector Flow Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name:

7890

Setpoint Status:

Pass

Zone:

Oven

Setpoint/Actual

Temperature:

230.0

230.0

°C

Accuracy:

0.0

°C

Agilent Recommended:

>=

-1.0

% setpoint in K

(

-5.0

°C

)

<=

1.0

% setpoint in K

(

5.0

°C

)

Date:

March 22, 2021 10:41:18 AM

System ID:

GC/MS

Setpoint Status:

Pass

Zone:

Oven

Setpoint/Actual

Temperature:

100.0 100.0 °C

Accuracy:

0.0 °C

Agilent Recommended:

>= -1.0 % setpoint in K

(-3.7 °C)

<= 1.0 % setpoint in K

(3.7 °C)

Overall GC Oven Temperature Accuracy Test Status

Pass

GC Oven Temperature Stability

Name:

7890

Setpoint Status:

Pass

Setpoint/Average

Temperature:

100.0 100.05 °C

Stability:

0.1 °C

Agilent Recommended:

<= 0.5

Overall GC Oven Temperature Stability Test Status

Pass

Scouting Run

Tested Combination2

Back

SSL

/ Front

FID

Manual Injection

Name:

Not applicable

Setpoint Status:

Completed

Injection Volume on Column:

1.0 uL

Overall Scouting Run Status

Completed

Signal to Noise

Tested Combination2

Back

SSL

/ Front

FID

Date:

March 22, 2021 10:41:18 AM

System ID:

GC/MS

Manual Injection

Name: 7890

Setpoint Status:

Pass

Signal to Noise:

1711991

Agilent Recommended:

>=

300000

Overall Signal to Noise Test Status

Pass

Noise and Drift

Tested Combination2

Back

SSL

/ Front

FID

Name: 7890

Setpoint Status:

Pass

Base Signal:

14.0

pA

ASTM Noise

counts

384.56

Agilent Recommended:

<=

768.00

Drift

counts/Hr

178.79

Status:

Pass

<=

19200.00

Pass

Overall Noise and Drift Test Status

Pass

Log Amp

Tested Combination1

Front

SSL

/ External

SQ

Name: 5975C inert XL with TAD

Setpoint Status:

Pass

Overall Log Amp Test Status

Pass

RFPA

Date:

March 22, 2021 10:41:18 AM

System ID:

GC/MS

Tested Combination1	Front	SSL	/ External	SQ
Name:	5975C inert XL with TAD			
Setpoint Status:	Pass			
Amu:	1050	m/z	Drift After Five Minutes:	RFPA Voltage:
			4	485
			mV	mV
Agilent Recommended:	>=	-100	and	<= 100
				<= 1100

Overall RFPA Test Status

Pass

Tune EI

Tested Combination1	Front	SSL	/ External	SQ
Name:	5975C inert XL with TAD			
Setpoint Status:	Pass			
Filament:	1			
Setpoint Status:	Pass			
Filament:	2			

Overall Tune EI Test Status

Pass

Signal to Noise EI

Tested Combination1	Front	SSL	/ External	SQ
Name:	5975C inert XL with TAD			
Source:	EI - Standard (Stainless Steel)		Filament:	1
Setpoint Status:	Pass			
Signal to Noise:	925			
Agilent Recommended:	>= 320			

Date: March 22, 2021 10:41:18 AM
System ID: GC/MS

Source: EI - Standard (Stainless Steel) Filament: 2

Setpoint Status: Pass

Signal to Noise: 672

Agilent Recommended: \geq 320

Overall Signal to Noise EI Test Status

Pass

Instrument Details

Purpose

This section describes the as found system configuration.

Details

System

System ID	GC/MS
Manufacturer	Agilent Technologies
Name	7890
Flow Data Input	Manual Data
Temperature Data Input	Manual Data or Other Data Logging

Tested Combination1

Injection Technique	Manual Injection
Sampler Identifier	Sampler 1
Inlet	Front
Detector	External
LTM Included?	No

Tested Combination2

Injection Technique	Manual Injection
Sampler Identifier	Sampler 2
Inlet	Back
Detector	Front
LTM Included?	No

Sampler 1

Manufacturer	Agilent Technologies
Type	Manual Injection
Usage	Sample Injection
Syringe Volume (µL)	10

Sampler 2

Manufacturer	Agilent Technologies
Type	Manual Injection
Usage	Sample Injection
Syringe Volume (µL)	10

Date: March 22, 2021 10:41:18 AM
System ID: GC/MS

Mainframe 1

Manufacturer	Agilent Technologies
Name	7890
Model Number	G3440A
Serial Number	CN10925120
Firmware Revision	A.01.10.3
Oven Type	Standard

Inlet 1

Manufacturer	Agilent Technologies
Name	7890
Type	SSL
Location	Front
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes

Inlet 2

Manufacturer	Agilent Technologies
Name	7890
Type	SSL
Location	Back
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes

Detector 1

Manufacturer	Agilent Technologies
Name	Mass Spectrometer
Type	Mass Spectrometer
Location	External

Detector 2

Manufacturer	Agilent Technologies
Name	7890
Type	FID
Adapter	Capillary
Control Type	Electronic Pressure Control (EPC)
Location	Front
Makeup Gas	Nitrogen

Mass Spectrometer 1

Manufacturer	Agilent Technologies
Type	SQ
Name	5975C inert XL with TAD
Serial Number	US91732743
Firmware Revision	Not applicable
High Vacuum System	Turbo Pump
Scouting Run Standard	OFN Std

MS EI Source 1

Manufacturer	Agilent Technologies
Source Type	EI - Standard (Stainless Steel)
Number of filaments	2

Electronic Signature

Purpose

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Details

Full Name of Signer:	Nattapat Hengcharoen
Logged On User Name:	nattapat.hengcharoen@agilent.com
Signature Creation Date:	March 22, 2021
Reason for Signature:	Executed protocol and published this original version of document

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Date:	March 22, 2021 10:41:18 AM
System ID:	GC/MS

User Name: nattapat.hengcharoen
 Hostname: 5CG70212Y1

System Id: GC/MS
 Print Date: March 22, 2021 10:41:24 AM

OQ_SPS_GC-MS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
March 19, 2021 12:15:46 PM	Audit	SessionCreated	Session	None
March 19, 2021 12:15:46 PM	Start	Configuration	Session	None
March 19, 2021 12:15:46 PM	Audit	Entitlement	Licensing	User is FieldEngineer and does not require an unlock code
March 19, 2021 12:21:07 PM	Audit	EqpLoaded	Session	EQP details for primary technique [Gc] - File path: [ProtocolPacks/Gc/Configurations/02.51/Gc.02.51.eqp], EQP File Name: [Gc.02.51.eqp], EQP Name: [AgilentRecommended] EQP details for hyphenated technique [GcMs] - File path: [ProtocolPacks/GcMs/Configurations/02.51/GcMs.02.51.eqp], EQP File Name: [GcMs.02.51.eqp], EQP Name: [AgilentRecommended]
March 19, 2021 12:21:16 PM	End	Configuration	Session	None
March 19, 2021 12:21:22 PM	Start	Qualification	Session	OQ
March 19, 2021 12:21:22 PM	Start	Execution	System Inspection and Basic Safety and Operation - 7890; - Qualitative Test - No setpoints associated	None

User Name: nattapat.hengcharoen
 Hostname: 5CG70212Y1

System Id: GC/MS
 Print Date: March 22, 2021 10:41:24 AM

OQ_SPS_GC-MS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
March 19, 2021 1:38:58 PM	Start	Execution	System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated	None
March 19, 2021 1:39:56 PM	Start	Execution	System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated	None
March 19, 2021 1:40:12 PM	End	Execution	System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated	Run Count : 1
March 19, 2021 1:40:14 PM	Start	Execution	Inlet Pressure Accuracy - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
March 19, 2021 1:40:21 PM	End	Execution	Inlet Pressure Accuracy - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count : 1
March 19, 2021 1:40:24 PM	Start	Execution	Inlet Pressure Decay - Back SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi	None
March 19, 2021 1:40:34 PM	End	Execution	Inlet Pressure Decay - Back SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi	Run Count : 1
March 19, 2021 1:40:36 PM	Start	Execution	Inlet Pressure Accuracy - Back SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
March 19, 2021 1:40:41 PM	End	Execution	Inlet Pressure Accuracy - Back SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count : 1

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Date: March 22, 2021 10:41:18 AM
 System ID: GC/MS

User Name: nattapat.hengcharoen
 Hostname: 5CG70212Y1

System Id: GC/MS
 Print Date: March 22, 2021 10:41:24 AM

OQ_SPS_GC-MS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
March 19, 2021 1:40:42 PM	Start	Execution	Detector Flow Accuracy - Front FID: - Type : Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	None
March 19, 2021 1:41:20 PM	Audit	Data	Detector Flow Accuracy - Front FID: - Type : Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
March 19, 2021 1:41:22 PM	End	Execution	Detector Flow Accuracy - Front FID: - Type : Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Run Count : 1
March 19, 2021 1:41:24 PM	Start	Execution	Detector Flow Accuracy - Front FID: - Type : Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	None
March 19, 2021 1:41:37 PM	Audit	Data	Detector Flow Accuracy - Front FID: - Type : Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
March 19, 2021 1:41:40 PM	End	Execution	Detector Flow Accuracy - Front FID: - Type : Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	Run Count : 1
March 19, 2021 1:41:42 PM	Start	Execution	Detector Flow Accuracy - Front FID: - Type : Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	None
March 19, 2021 1:41:55 PM	Audit	Data	Detector Flow Accuracy - Front FID: - Type : Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
March 19, 2021 1:41:56 PM	End	Execution	Detector Flow Accuracy - Front FID: - Type : Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Run Count : 1
March 19, 2021 1:41:59 PM	Start	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None

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Date: March 22, 2021 10:41:18 AM
 System ID: GC/MS

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User Name: nattapat.hengcharoen
 Hostname: 5CG70212Y1

System Id: GC/MS
 Print Date: March 22, 2021 10:41:24 AM

OQ_SPS_GC-MS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
March 19, 2021 1:42:27 PM	Audit	Data	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
March 19, 2021 1:43:21 PM	Audit	Data	DataManager	DataManager was in a data verification state but the user chose to start over.
March 19, 2021 1:43:55 PM	Audit	Data	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
March 19, 2021 1:43:57 PM	End	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count : 1
March 19, 2021 1:43:59 PM	Start	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
March 19, 2021 1:44:12 PM	Audit	Data	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
March 19, 2021 1:44:14 PM	End	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count : 1
March 19, 2021 1:44:17 PM	Start	Execution	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	None
March 19, 2021 1:45:12 PM	Audit	Data	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Manual Data Entry

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Date: March 22, 2021 10:41:18 AM
 System ID: GC/MS

User Name: nattapat.hengcharoen
 Hostname: 5CG70212Y1

System Id: GC/MS
 Print Date: March 22, 2021 10:41:24 AM

OQ_SPS_GC-MS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
March 19, 2021 1:45:19 PM	End	Execution	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Run Count : 1
March 19, 2021 1:54:29 PM	Start	Execution	GC Scouting Run - Manual Injection, Back SSL, Front FID: - Part of System Preparation - No limits associated	None
March 19, 2021 2:33:24 PM	Start	Execution	GC Scouting Run - Manual Injection, Back SSL, Front FID: - Part of System Preparation - No limits associated	None
March 19, 2021 2:35:01 PM	Audit	AceClosed	Session	None
March 19, 2021 2:35:37 PM	Audit	AceRestarted	Session	None
March 19, 2021 2:35:38 PM	Audit	SessionReloaded	Session	None
March 19, 2021 2:35:41 PM	Start	Qualification	Session	OQ
March 19, 2021 2:35:41 PM	Start	Execution	GC Scouting Run - Manual Injection, Back SSL, Front FID: - Part of System Preparation - No limits associated	None
March 19, 2021 2:36:12 PM	Audit	Data	GC Scouting Run - Manual Injection, Back SSL, Front FID: - Part of System Preparation - No limits associated	Data files Path : E:\SPS\SCOUNT_FID.D\FID 1A.ch
March 19, 2021 2:36:32 PM	End	Execution	GC Scouting Run - Manual Injection, Back SSL, Front FID: - Part of System Preparation - No limits associated	Run Count : 1
March 19, 2021 2:36:36 PM	Start	Execution	Signal to Noise - Manual Injection, Back SSL, Front FID: - Detector FID - L: >= 300000	None

User Name: nattapat.hengcharoen
 Hostname: 5CG70212Y1

System Id: GC/MS
 Print Date: March 22, 2021 10:41:24 AM

OQ_SPS_GC-MS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
March 19, 2021 2:36:46 PM	Audit	Data	Signal to Noise - Manual Injection, Back SSL, Front FID: - Detector FID - L: >= 300000	Data files Path : E:\SPS\SN_FID.D\FID1A.ch
March 19, 2021 2:37:00 PM	End	Execution	Signal to Noise - Manual Injection, Back SSL, Front FID: - Detector FID - L: >= 300000	Run Count : 1
March 19, 2021 2:37:06 PM	Start	Execution	Noise and Drift - Front FID: - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour	None
March 19, 2021 3:46:48 PM	Start	Execution	Noise and Drift - Front FID: - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour	None
March 19, 2021 3:47:08 PM	Audit	Data	Noise and Drift - Front FID: - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour	Data files Path : E:\SPS\ND_FID.D\FID1A.ch
March 19, 2021 3:47:30 PM	End	Execution	Noise and Drift - Front FID: - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour	Run Count : 1
March 19, 2021 3:47:32 PM	Start	Execution	Log Amp - 5975C inert XL with TAD SQ: - Source: EI - Standard (Stainless Steel)	None
March 19, 2021 3:49:54 PM	Start	Execution	RFP A - 5975C inert XL with TAD SQ: - Source: EI - Standard (Stainless Steel)	None
March 19, 2021 3:52:45 PM	Start	Execution	Log Amp - 5975C inert XL with TAD SQ: - Source: EI - Standard (Stainless Steel)	None

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Date: March 22, 2021 10:41:18 AM
 System ID: GC/MS

User Name: nattapat.hengcharoen
 Hostname: 5CG70212Y1

System Id: GC/MS
 Print Date: March 22, 2021 10:41:24 AM

OQ_SPS_GC-MS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
March 19, 2021 3:53:16 PM	End	Execution	Log Amp - 5975C inert XL with TAD SQ: - Source: EI - Standard (Stainless Steel)	Run Count : 1
March 19, 2021 3:53:19 PM	Start	Execution	RFPA - 5975C inert XL with TAD SQ: - Source: EI - Standard (Stainless Steel)	None
March 19, 2021 3:58:14 PM	End	Execution	RFPA - 5975C inert XL with TAD SQ: - Source: EI - Standard (Stainless Steel)	Run Count : 1
March 19, 2021 3:59:01 PM	Start	Execution	Tune EI - 5975C inert XL with TAD SQ: - Source: - EI - Standard (Stainless Steel) Filament 1 (Qualitative - No setpoints associated)	None
March 19, 2021 3:59:37 PM	End	Execution	Tune EI - 5975C inert XL with TAD SQ: - Source: - EI - Standard (Stainless Steel) Filament 1 (Qualitative - No setpoints associated)	Run Count : 1
March 19, 2021 3:59:39 PM	Start	Execution	Tune EI - 5975C inert XL with TAD SQ: - Source: - EI - Standard (Stainless Steel) Filament 2 (Qualitative - No setpoints associated)	None
March 19, 2021 4:00:01 PM	End	Execution	Tune EI - 5975C inert XL with TAD SQ: - Source: - EI - Standard (Stainless Steel) Filament 2 (Qualitative - No setpoints associated)	Run Count : 1
March 19, 2021 4:00:05 PM	Audit	AccClosed	Session	None
March 22, 2021 9:39:45 AM	Audit	AccRestarted	Session	None
March 22, 2021 9:39:49 AM	Audit	SessionReloaded	Session	None
March 22, 2021 9:40:02 AM	Start	Qualification	Session	OQ

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Date: March 22, 2021 10:41:18 AM
 System ID: GC/MS

User Name: naitapat.hengcharoen
 Hostname: 5CG70212Y1

System Id: GC/MS
 Print Date: March 22, 2021 10:41:24 AM

OQ_SPS_GC-MS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
March 22, 2021 9:40:26 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Standard (Stainless Steel) using Filament 1 - L: >= 320	None
March 22, 2021 9:41:14 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Standard (Stainless Steel) using Filament 1 - L: >= 320	None
March 22, 2021 9:41:58 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Standard (Stainless Steel) using Filament 1 - L: >= 320	Data files Path : E:\SPS\SN_F1.D\DATA.MS
March 22, 2021 9:43:36 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Standard (Stainless Steel) using Filament 1 - L: >= 320	Run Count : 1
March 22, 2021 9:43:44 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Standard (Stainless Steel) using Filament 2 - L: >= 320	None
March 22, 2021 9:44:03 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Standard (Stainless Steel) using Filament 2 - L: >= 320	Data files Path : E:\SPS\SN_F2.D\DATA.MS
March 22, 2021 9:44:34 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Standard (Stainless Steel) using Filament 2 - L: >= 320	Run Count : 1

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Date: March 22, 2021 10:41:18 AM
 System ID: GC/MS

User Name: nattapat.hengcharoen
Hostname: 5GG70212Y1

System Id: GC/MS
Print Date: March 22, 2021 10:41:24 AM

OQ_SPS_GC-MS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
March 22, 2021 9:44:37 AM	End	Qualification	Session	OQ
March 22, 2021 9:44:37 AM	Start	Reporting	Session	None
March 22, 2021 10:40:26 AM	Audit	Reporting	Session	Report Generated : Certificate

GC Clarus 600/680 Preventive Maintenance (PM)

Company Name:	S.P.S. Consulting Service Co.,Ltd		
Address (Instrument Location):	7 Soi Phaholyothin24 Phaholyothin Road, Jompol, Chatuchak, Bangkok, 10900.		
Serial Number:	680S14042502	Service Tag:	N68APSSFXMP
Customer Name (if applicable):	Ms.Sujinda	PM number:	1 of 2
Service Engineer Name:	Pramote Chaisorn	Service Order Number:	WO-01624977
Date PM Performed: (DD-MMM-YYYY)	04-Mar-2022	Next PM Due Date: (DD-MMM-YYYY)	04-Sep-2022

Part Number	Release	Publication Date	
TH09370070	C	August 2016	

Scope

The purpose of this PM is to ensure the continued functionality of the Clarus 600 and Clarus 680 GC by inspecting and replacing any worn or damaged parts. This service should only be performed by a trained representative of PerkinElmer. The customer should save their method before the PM begins.

General Instructions:

The customer must provide the engineer operational data to demonstrate recent instrument performance prior to starting the PM. Always check with the customer before making any changes that may affect the customer's analysis or calibration, including a current back-up of system software and/or data files. The completed document should be signed by an authorized PerkinElmer and customer representative and left with the customer. Update the PM sticker and instrument logbook as required.

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Component List

Component / Specific Model	Serial #	Software Version	Configuration Notes
Clarus680	680S14042502	Totalchrom6.3.2	
Clarus SQ8T	648N4050804	Turbomass 6.4	
AtomX	US14113002	Tekma AtomX	

Parts Lists

Additional Tools Required for PM				
Part Number (if applicable)	Description	Quantity	Serial #	Calibration Due Date (MM/YY)
LF21-0503	Fluke179 multimeter	1	22460228	04-Nov-2022
Additional Reagents and Standards Required for PM				
Part Number (if applicable)	Description	Quantity	Batch/Lot #	Expiration Date (MM/YY)
N/A				

Procedure Checklist

Use () to check off those steps in the checklist that have been completed.

1. General:

- ☒ Review the instrument performance with the customer and document any recent problems.

- ☒ Check incoming AC line voltage for proper levels and grounding.

L-N 220 Volt

L-G 220 Volt

N-G 0.35 Volt

**Neutral to ground not more than 0.5 volts peak to peak*

- ☒ Inspect all gas line filters and traps; Replace if necessary with customer supplied spares.

Carrier gas ☒ Helium ☐ Nitrogen ☐ Hydrogen

Moisture level ☒ Good ☐ Need to replace ☐ Other _____

Detector gas ☒ Air Zero ☒ Hydrogen ☐ Nitrogen ☐ Helium

Moisture level ☒ Good ☐ Need to replace ☐ Other _____

- ☒ Inspect the customer log book and make any appropriate PM entries.

- ☒ Leak check all fittings from the gas source to instrument.

Gas leakage ☒ Pass ☐ Fail Comment _____

- ☒ Perform general inspection of system for cleanliness.

- ☒ Inspect for functional and clean electronic cooling and oven vent fans

Electronic cooling fan ☒ Yes ☐ No

Oven cooling fan ☒ Yes ☐ No

2. Electronic :

- ☒ Check oven temperature. Calibrate if necessary.

Oven temperature set point 150 °C ☒ Pass ☐ Fail

- ☐ Check sub-ambient option. (If installed).

Oven temperature set point 5 °C ☐ Pass ☐ Fail

- ☒ Perform routine maintenance on detector/injector. Replace parts as necessary with customer supplied spares.

- ☒ Check flows, including split flows if applicable. Calibrate if necessary.

Carrier flow	Pass
Split flow	Pass
- ☒ Check detector gas flows and adjust if necessary.

Detector flow	Pass
---------------	------
- ☒ Autosampler installed ☒ Yes ☐ No

Check autosampler sensor for wear and replace if necessary.	
Vial sensor	Pass
Door sensor	Pass
Tower sensor	Pass
Plunger sensor	Pass
Elevator sensor	Pass
- ☒ Remove syringe, manually flush. Replace with customer supplied spare if necessary.
- ☒ Check firmware version. Upgrade to current levels if necessary.

Firmware version	6.5
------------------	-----
- ☒ Measure all accessible power supply voltages.

5 Volt	Pass
+15 Volt	Pass
-15 Volt	Pass
24 Volt	Pass
- ☒ Record all detector voltage signal.

Detector Channel A	0.91	mV.
Detector Channel B	NA	mV.

3. Diagnostics Tests:

- ☒ Run instrument diagnostics.

BRAM	Pass
EPROM	Pass
- ☒ Run Autosampler diagnostics.

BRAM	Pass
EPROM	Pass

4. Review:

- ☒ Review with the customer PM work performed.
- ☒ Review with the customer routine maintenance procedures.
- ☒ Discuss recommended customer-supplied materials to have on hand
- ☒ Attach PM sticker.
- ☒ Update Logbook.

Additional Comments

Additional Comments Regarding the PM

Review

<i>The preventive maintenance checks and if applicable performance tests for Clarus600/680 GC have been completed.</i>	
<i>This Clarus600/680 GC</i>	<i>Pass</i>
<i>the preventive maintenance.</i>	
Review of Preventive Maintenance:	
Authorized PerkinElmer Representative: Pramote Chaisorn	Date: 04-Mar-2022 (DD-MMM-YYYY)
Authorized Customer Representative:	Date: 04-Mar-2022 (DD-MMM-YYYY)



GAS CHROMATOGRAPH TEST CERTIFICATION

Certificate No. : SV0821/20202

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 : 10/08/2021

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) = 144,661 Counts.





Detector Sensitivity (FID)

Detector Response	Result	Specification
Baseline Noise (μ V)	2.94	≤ 50
Baseline Drift (%)	0.24	≤ 1
Sensitivity (S/N for C15)	2,295	$\geq 1,024$

Temperature Specification

Temperature	Set	Result	Specification
Column Oven ($^{\circ}$ C)	80	80	± 5
Injector ($^{\circ}$ C)	220	220	± 5
Detector ($^{\circ}$ C)	300	300	± 5
Incubator ($^{\circ}$ C)	60	N/A	± 5

Relative Standard Deviation % (% RSD)

Checkout Procedure	Result	Specification
Area C15 (%)	2.53	≤ 5
Retention Time C15(%)	0.04	≤ 0.5

APPROVAL

Signature:

Engineer

Date : 10/08/2021



VARIAN



Results Integrated System Testing

Checkout Procedure	FID
Detector Position	Front
Inlet Type	1079 Injector
C15 Area 1	149,057
C15 Area 2	140,715
C15 Area 3	146,288
C15 Area 4	140,957
C15 Area 5	146,288
C15 Area Average	144,661
* % RSD (< 5 %)	2.53

* 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
------------	--	-------------------------------

Comments
Reviewed by



**Results Integrated System Testing**

Checkout Procedure	FID
Detector Position	Front
Inlet Type	1079 Injector
C15 Area 1	149,057
C15 Area 2	140,715
C15 Area 3	146,288
C15 Area 4	140,957
C15 Area 5	146,288
C15 Area Average	144,661
* % RSD (< 5 %)	2.53

* 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
------------	--	-------------------------------

Comments
Reviewed by





CERTIFICATE No : 21M3169

REFERENCE No : 60627-5

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 : 19-Mar-21

APPROVED BY : 

ISSUED DATE : 20-Mar-21

RECEIVED DATE : 19-Mar-21



CERTIFICATE No : 21M3169

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : XS105DU
MANUFACTURER : METTLER TOLEDO S/N : 1126422905
ID No : BA 05/50 RECEIVED DATE : 19-Mar-21
AIR PRESSURE : 1009mbar \pm 1mbar CALIBRATION DATE : 19-Mar-21
AMBIENT TEMPERATURE : 24°C \pm 1°C RELATIVE HUMIDITY : 52 %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 ADJUSTED USING WEIGHT OF QUALITY CALIBRATION TO ADJUST. 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	C02210415	09-Feb-23
2) STANDARD WEIGHT	E2	15843	C02210419	10-Feb-23
3) STANDARD WEIGHT	E2	QK-I-349	M2103235S	26-Mar-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 CENTRAL BUREAU OF WEIGHTS&MEASURES

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

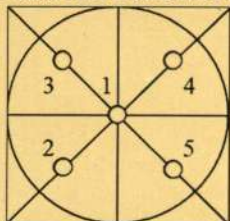
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 100 g WAS 0.000055 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (\pm g)
0.00	0.00000	0.00000	0.000066
0.02	0.01998	0.00002	0.000066
0.10	0.10001	-0.00001	0.000066
0.20	0.20001	-0.00001	0.000067
0.50	0.49996	0.00004	0.000065
1.00	0.99997	0.00003	0.000066
2.00	2.00000	0.00000	0.000067
5.00	5.00002	-0.00002	0.000068
10.00	10.00003	-0.00003	0.000070
20.00	20.0000	0.0000	0.000075
50.00	50.0000	0.0000	0.00013
100.00	100.0001	-0.0001	0.00019
120.00	120.0001	-0.0001	0.00022

5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	50.0000
2	50.0000
3	50.0000
4	50.0000
5	50.0000
OFF-CENTER LOADING	0.0000

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

**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 : 22M2567

REFERENCE No : 64386-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : METTLER TOLEDO

MODEL : XS 105DU

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 : TETNITHI W.

CALIBRATION DATE : 11-Mar-22

APPROVED BY : 

ISSUED DATE : 17-Mar-22

RECEIVED DATE : 11-Mar-22

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



CERTIFICATE No : 22M2567

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : XS 105DU
MANUFACTURER : METTLER TOLEDO S/N : 1126422905
ID No : BA 05/50 RECEIVED DATE : 11-Mar-22
AIR PRESSURE : 1008mbar \pm 1mbar CALIBRATION DATE : 11-Mar-22
AMBIENT TEMPERATURE : 22° 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	C02210415	09-Feb-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 CENTRAL BUREAU OF WEIGHTS&MEASURES

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

2. TARE FUNCTION : NORMAL

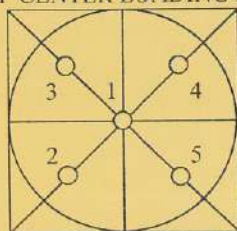
3. REPEATABILITY OF READING AT 20 g WAS 0.000004 g

4. REPEATABILITY OF READING AT 100 g WAS 0.000048 g

5. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (\pm g)
0.00	0.00000	0.00000	0.000058
0.02	0.01999	0.00001	0.000058
0.10	0.09999	0.00001	0.000059
0.20	0.19999	0.00001	0.000059
0.50	0.50001	-0.00001	0.000058
1.00	1.00001	-0.00001	0.000059
2.00	2.00000	0.00000	0.000059
5.00	5.00001	-0.00001	0.000061
10.00	10.00005	-0.00005	0.000063
20.00	20.00006	-0.00006	0.000069
50.00	50.0000	0.0000	0.00011
100.00	100.0001	-0.0001	0.00019
120.00	120.0001	-0.0001	0.00022

6. OFF CENTER LOADING ERROR



POINT	READING (g)	
1	10.00001	50.0000
2	10.00002	50.0000
3	10.00001	50.0000
4	10.00001	50.0000
5	10.00002	50.0001
OFF-CENTER LOADING	0.00001	0.0001

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

DATA SHEET FOR CALIBRATION / VERIFICATION AND INSPECTION


Calibration

Verification

Inspection
เครื่องมือ / อุปกรณ์ ที่สอบเทียบหรือทวนสอบ

Equipment / Tools : Multimeter (pH , DO) Tag No. / I.D. No. : L09-AT-SP003-A2 Serial No. : 130500088588

Cal. / Ver. date : 4/4/2022
เครื่องมือ / อุปกรณ์ที่เป็น Master

Equipment / Tools :	I.D. No.	Model /Serial No.	Cert. No.	Expired date

Reference Materials ที่ใช้

Chemical	Grade	Assay (%)	Cert. No.	Expired date
Buffer pH 4.00 ; Lot No. HC99677935				31/7/2022
Buffer pH 7.00 ; Lot No. HC04269139				31/10/2023
Buffer pH 10.00 ; Lot No. HC02905338				30/6/2023

Calibration / verification item	Result	Error	Acceptance Criteria	Pass / Fail
1.การสอบเทียบ Observed Slope (slope)	98	-	95 to 105%	Pass
2.verification pH6.86	6.85	-0.01	± 0.05	Pass

Inspection item	Result	Correction
1.ตรวจเช็คสภาพพร้อมใช้งาน	ปกติ	

Next Due date 31/5/2022

Performed by :


Date : 4/4/2022

Date : 4/4/2022

Certificate of Analysis – Certified Reference Material

Certipur® Buffer solution pH 10.00 (20°C)

Certified Reference Material for pH measurement

Product no.: 1.09438.1000
Lot no.: HC02905338
Description of CRM: Certipur® Buffer solution pH 10.00 (20°C)
Certified Reference Material for pH measurement
Expiry date: 2023/06/30
Storage: +15°C to +25°C tightly closed in the original container
Composition: boric acid / potassium chloride / sodium hydroxide



Certified value

Associated uncertainty, $U = k \cdot u$
($k = 2$)

pH value 10.01

 ± 0.03 (20°C)

Metrological traceability:

The pH value of this certified buffer solution is directly traceable to primary certified reference materials characterised by PTB and verified by SRMs from NIST.

NIST 189c, 188, 185i, 186 Ig, 186 IIg, 187f

PTB OX-405/18, TA-442/19, PHT-340/16, PHO-346/16, BO-373/17

PTB: Physikalisch Technische Bundesanstalt, Braunschweig, Germany

NIST: National Institute of Standards and Technology, Gaithersburg, USA.

Measurement method:

pH value is measured with a combined glass electrode after 5-point calibration according to DIN 19268 with reference buffer solutions according to DIN 19266, IUPAC, NIST, Ph.Eur. and USP.

Accreditation:

Merck KGaA, Darmstadt, Germany is accredited by the German accreditation authority DAkkS as registered reference material producer D-RM-15185-01-00 in accordance with ISO 17034 and registered calibration laboratory D-K-15185-01-00 according to DIN EN ISO/IEC 17025.

Certificate issue date:

2020/06/24



ISO 17034



ISO/IEC 17025

CRM released by Approving Officer
or delegate LS-OII-QS3

Dipl.-Ing. Ayfer Yildirim
Responsible Manager of LS-OII-QS3
(Calibration Laboratory D-K-15185-01)



Intended use:	This reference material is intended for use as a calibration standard for pH instruments or pH electrodes or as a control sample for measuring the pH value.
Instructions for handling and correct use:	The pH value is strongly dependent on the temperature. It is therefore necessary to keep the temperature constant within the measurement.
Health and safety information:	Please refer to the Safety Data Sheet for detailed information about the nature of any hazard and appropriate precautions to be taken.
Preparation:	This reference material is prepared gravimetrically from boric acid, potassium chloride, sodium hydroxide and high purity water.

Associated uncertainty:

The expanded uncertainty U_{CRM} is calculated as $U_{CRM} = k \cdot u_{CRM}$, where $k = 2$ is the coverage factor for a 95% coverage probability and u_{CRM} is the combined standard uncertainty in accordance to ISO 17034.

The combined uncertainty u_{CRM} is derived from combination of the squared uncertainty contributions:

$$u_{CRM} = \sqrt{u^2_{Characterisation} + u^2_{Homogeneity} + u^2_{Stability}}$$

$u_{characterisation}$:	is the uncertainty in accordance with DIN EN ISO/IEC 17025 which includes the contributions of the primary reference material and the measuring system.
$u_{homogeneity}$:	is the between-bottle variation in accordance with ISO 17034. The assessment of homogeneity is performed by analysis of a representative number of systematically chosen sample units.
$u_{stability}$:	is the uncertainty obtained from short-term and long-term stability in accordance with ISO 17034. The stability studies are the basis for the quantification of the expiry date of this reference material for the unopened bottle.

Informative values:

Temperature dependence ¹ :	Temperature [°C]	Δ pH
	0	+ 0.26
	5	+ 0.17
	10	+ 0.11
	15	+ 0.05
	20	± 0
	25	- 0.06
	30	- 0.11
	35	- 0.16
	40	- 0.18
	50	- 0.26

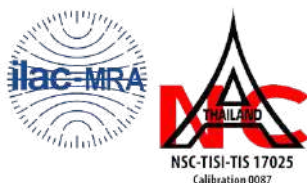
¹Temperature deviation data provided for reference only. Values are not batch-specific and should not be considered certified values.

For more detailed information please read the certification report on our website.

Certificate of analysis revision history:

Certificate version	Date	Reason for version
01	2020/06/24	Initial version





Certificate of Calibration

Equipment: pH METER Certificate No.: C07220217
Model: HQ40d Issued Date: 27 April 2022
Serial No. (or ID.): 130500088588 (201000002308) Job No.: KSPR2205346
Manufacturer: Hach Page: 1 of 3
Electrode Serial No.: 210362614404 Model: PHC201 Brand: Hach
Condition: In Condition

Customer: IRPC PUBLIC CO., LTD.
299 Moo 5, Sukhumvit Road, Tambol Choengneon,
Amphur Muang, Rayong 21000 Thailand

Environment Condition: Temperature 25.7 °C ± 0.8 °C
Humidity 66.5 %RH ± 2.4 %RH

Calibration Place: IRPC PUBLIC CO., LTD.(Gc Lab 207)
299 Moo 5, Sukhumvit Road, Tambol Choengneon,
Amphur Muang, Rayong 21000 Thailand

Calibration By: Mr. Dumrong Boonsopon

Calibration Date: 27 April 2022

The Method used: In house method, SPCC-WI-58, base on ASTM E 70-07

Traceability: This certificate is traceable to SI Units, Sample Test is assured through primary measurement method Harned cell, through CPAchem Ltd. (ISO/IEC 17034) Certificate No. 794132, 794134, 794133 And pH Scale traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through Industrial Foundation Electrical and Electronics Institute Certificate No. CA20210028EA



Person in Charge

Authorized Signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).

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

Calibration Results:**pH Scale**

Input (mV)	pH Meter Reading			Uncertainty of Measurement (mV)	Coverage Factor (k)
	(mV)	Error (mV)	(pH)		
414.12	414.0	-0.12	-	0.065	2.00
354.96	354.8	-0.16	0.999	0.065	2.00
295.8	295.7	-0.10	1.999	0.065	2.00
236.64	236.6	-0.04	2.999	0.065	2.00
177.48	177.4	-0.08	4.000	0.065	2.00
118.32	118.3	-0.02	5.000	0.065	2.00
59.16	59.1	-0.06	6.000	0.065	2.00
0	0.0	0.00	7.000	0.065	2.00
-59.16	-59.2	-0.04	8.000	0.065	2.00
-118.32	-118.3	0.02	9.000	0.065	2.00
-177.48	-177.5	-0.02	10.000	0.065	2.00
-236.64	-236.6	0.04	11.001	0.065	2.00
-295.8	-295.7	0.10	12.001	0.065	2.00
-354.96	-354.9	0.06	13.002	0.065	2.00
-414.12	-414.0	0.12	-	0.065	2.00

Electrode Test Results*

The three-point calibration using three standard buffer solutions; pH 4.008 , pH 6.985 and pH 10.015

The practical slope of the pH electrode; 58.09 (mV/pH), 98.19%

The zero point of the pH electrode; 6.70 (pH)

Sample Test Results

Standard Buffer Solution (pH)	Unit Under Calibration (pH)	Difference (pH)	Uncertainty of Measurement (pH)	Coverage Factor (k)
4.008	4.008	0.000	0.012	2.43
6.985	6.998	0.013	0.0097	2.05
10.015	10.023	0.008	0.013	2.00

* Calibration Marked " Not TISI Accredited " in this Certificate have been included for completeness.

The End of Certificate

ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2205346

ชนิดเครื่องมือ: pH METER

รุ่น: HQ40d

หมายเลขเครื่อง: 130500088588

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
27 Apr 2022			27 Apr 2022		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		General			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. ความสมบูรณ์เครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. สวิตช์ ปิด – เปิด เครื่อง (On-Off Swicth)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. ปุ่มกด (Keypad)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. หน้าจอ (Display, Screen Contrast)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
		Spectrophotometer			
<input type="checkbox"/>	<input type="checkbox"/>	6. แรงดันไฟฟ้า (Battery Backup) ≥ 2.5 VDC	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	7. ตัวหมุนเลือกความยาวคลื่น (Wavelength Control)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	8. ความยาวคลื่น (Wavelength Check)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	9. แหล่งกำเนิดแสง (UV $< 3,000$ hour)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	10. แหล่งกำเนิดแสง (Visible $< 5,000$ hour)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	11. ช่องวัดหลายตัวอย่าง (Carousel Module)	<input type="checkbox"/>	<input type="checkbox"/>	
		pH Meter and Conductivity Meter			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	12. อิเล็กโทรด (Electrode and Connection Cable)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	13. ระดับสารละลายใน Electrode (Level KCl)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	14. ฝาปิดกันปลาย Electrode (Dust Protection Hood)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	15. ขาจับอิเล็กโทรด (Stand)	<input type="checkbox"/>	<input type="checkbox"/>	
		Turbidimeter			
<input type="checkbox"/>	<input type="checkbox"/>	16. ค่าความขุ่นที่ต่ำสุด (No Sample)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	17. ระดับการส่องสว่างของแสง (≥ 2.5 ไม่เกิน 3.0)	<input type="checkbox"/>	<input type="checkbox"/>	
		Automatic titrator			
<input type="checkbox"/>	<input type="checkbox"/>	18. สภาพ Piston Burettes	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	19. Function Rinsing and Dosing	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	20. ระบบท่อสายยางและอุปกรณ์ประกอบ	<input type="checkbox"/>	<input type="checkbox"/>	

เพิ่มเติม/ข้อแนะนำ : Electrode วัดอุณหภูมิได้ 25.1°C โดย Control Waterbath ที่ $25.0 \pm 0.5^{\circ}\text{C}$ Mr. Dumrong Boonsopon
Service Engineer

Certificate No.: CP20220218EA

Operation No.: CP2022060016

Certificate of Calibration

Equipment: Sound Level Meter

Manufacturer: RION

Model/Type: NL-42 (Meter), UC-52 (Microphone), NH-24 (Preamplifier)

Serial No.: 00546402 (Meter), 152919 (Microphone), 46613 (Preamplifier)

ID No.: -

Customer: IRPC Public Company Limited.

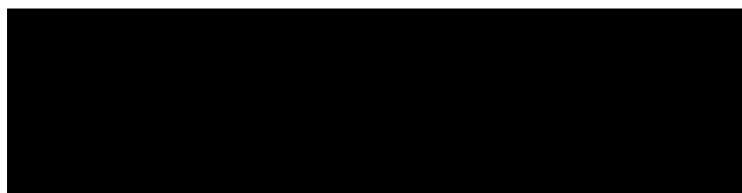
Address: 299 Moo 5, Sukhumvit Rd., Tumbon Chungnern,
Amphor Muang, Rayong 21000

Received Date: 10 June 2022

Calibrated Date: 27 - 29 June 2022

Issued Date: 30 June 2022

Calibrated by: Ms. Juntaporn Kunhakom



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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.: CP20220218EA

Calibration Report

Equipment: Sound Level Meter
 Manufacturer: RION
 Model/Type: NL-42 (Meter), UC-52 (Microphone), NH-24 (Preamplifier)
 Serial No.: 00546402 (Meter), 152919 (Microphone), 46613 (Preamplifier)
 ID No.: -
 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-1017-21	16 November 2022
2) Arbitrary Function Generator	AFG2021	C010063	CK20220059EA	19 June 2023
3) Programmable Attenuator	PA5	2755	EF-0030-21	1 November 2022
4) 6.5 Digit precision multimeter	8846A	9610014	CB20210023EA	1 November 2022
5) Pressure humidity and Temperature Transmitter	PTU301	F0640002	CL1-P220024 0255TE21	17 March 2023 7 July 2022
6) Pressure humidity and Temperature Transmitter	PTU301	F0640003	CL1-P220029 0256TE21	31 March 2023 7 July 2022
7) Performance Audio Analyzer	U8903B	MY56510003	CB20220063EA 0172RF21	15 February 2023 9 September 2022

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; ONSC 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)
94.0	94.0	0.0	±1.0

Note : Absolute sensitivity was established by the use of the Sound Calibrator RION Type NL-74 S/N : 34615278.

Certificate No.: CP20220218EA

Calibration Report

Function : 2. Self-generated Noise

2.1 Microphone Installed

Measured value (dB)
16.2

2.2 Microphone replaced by the electrical input signal device

Frequency Weighting	Measured value (dB)
A-weighting	11.6
C-weighting	17.9
Z-weighting	23.8

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	0.6	0.5	0.6	±1.5
1000	0.0	0.0	0.0	±1.0
8000	-1.4	-1.3	-1.4	±5.0

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	-0.1	-0.1	0.0	±2.0
125	0.0	-0.1	0.0	±1.5
250	0.0	-0.1	0.0	±1.5
500	0.0	-0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.1	0.1	0.0	±5.0

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

Certificate No.: CP20220218EA

Calibration Report

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	±0.3

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	±1.1
99.0	99.0	0.0	±1.1
104.0	104.0	0.0	±1.1
109.0	109.0	0.0	±1.1
114.0	114.0	0.0	±1.1
119.0	119.0	0.0	±1.1
124.0	124.0	0.0	±1.1
129.0	129.0	0.0	±1.1
130.0	130.0	0.0	±1.1
131.0	131.0	0.0	±1.1
132.0	132.0	0.0	±1.1
133.0	133.0	0.0	±1.1
134.0	134.0	0.0	±1.1
135.0	135.0	0.0	±1.1
136.0	136.0	0.0	±1.1
137.0	137.0	0.0	±1.1

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	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1

Certificate No.: CP20220218EA

Calibration Report

7.2 Level Linearity on the reference level range, Lower (Cont.)

Anticipated Value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limits (dB)
54.0	54.0	0.0	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	39.0	0.0	±1.1
34.0	34.0	0.0	±1.1
29.0	29.0	0.0	±1.1

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	±1.0
	2	108.9	-0.1	+1.0 ; -2.5
	0.25	99.9	-0.1	+1.5 ; -5.0
Slow	200	119.6	0.0	±1.0
	2	100.0	0.0	+1.0 ; -5.0
LAE	200	120.0	0.0	±1.0
	2	100.0	0.0	+1.0 ; -2.5
	0.25	90.8	-0.2	+1.5 ; -5.0

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	125.4	0.0	±3.0
Positive half cycle	124.4	124.1	-0.3	±2.0
Negative half cycle	124.4	124.1	-0.3	±2.0

Function : 10. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limits (dB)
Positive one-half cycle	Negative one-half cycle		
139.4	139.4	0.0	±1.5

Certificate No.: CP20220218EA

Calibration Report

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	±0.3

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 2.
3. The coverage factor $k = 2.00$

- - End of Report - -

Certificate No.: CP20220219EA

Operation No.: CP2022060017

Certificate of Calibration

Equipment: Sound Level Meter

Manufacturer: RION

Model/Type: NL-52 (Meter), UC-59 (Microphone), NH-25 (Preamplifier)

Serial No.: 00632062 (Meter), 05229 (Microphone), 32090 (Preamplifier)

ID No.: -

Customer: IRPC Public Company Limited.

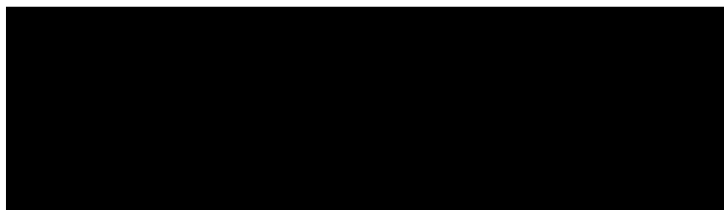
Address: 299 Moo 5, Sukhumvit Rd., Tumbon Chungnern,
Amphor Muang, Rayong 21000

Received Date: 10 June 2022

Calibrated Date: 23 - 29 June 2022

Issued Date: 30 June 2022

Calibrated by: Ms. Juntaporn Kunhakom



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.: CP20220219EA

Calibration Report

Equipment: Sound Level Meter
 Manufacturer: RION
 Model/Type: NL-52 (Meter), UC-59 (Microphone), NH-25 (Preamplifier)
 Serial No.: 00632062 (Meter), 05229 (Microphone), 32090 (Preamplifier)
 ID No.: -
 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-1017-21	16 November 2022
2)	Arbitrary Function Generator	AFG2021	C010063	CK20220059EA	19 June 2023
3)	Programmable Attenuator	PA5	2755	EF-0030-21	1 November 2022
4)	6.5 Digit precision multimeter	8846A	9610014	CB20210023EA	1 November 2022
5)	Pressure humidity and Temperature Transmitter	PTU301	F0640002	CL1-P220024 0255TE21	17 March 2023 7 July 2022
6)	Pressure humidity and Temperature Transmitter	PTU301	F0640003	CL1-P220029 0256TE21	31 March 2023 7 July 2022
7)	Performance Audio Analyzer	U8903B	MY56510003	CB20220063EA 0172RF21	15 February 2023 9 September 2022

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; ONSC 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)
94.0	94.0	0.0	±0.7

Note : Absolute sensitivity was established by the use of the Sound Calibrator RION Type NC-74 S/N : 34615278.

Certificate No.: CP20220219EA

Calibration Report

Function : 2. Self-generated Noise

2.1 Microphone Installed

Measured value (dB)
15.0

2.2 Microphone replaced by the electrical input signal device

Frequency Weighting	Measured value (dB)
A-weighting	8.7
C-weighting	14.1
Z-weighting	20.2

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	0.2	0.1	0.2	±1.0
1000	0.1	0.1	0.1	±0.7
8000	-1.8	-1.7	-1.8	+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	-0.1	0.0	0.0	±1.0
125	0.0	-0.1	0.0	±1.0
250	0.0	-0.1	0.0	±1.0
500	0.0	-0.1	0.0	±1.0
1000	0.0	0.0	0.0	±0.7
2000	0.0	0.0	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	-1.4	0.0	+2.5; -16.0

Certificate No.: CP20220219EA

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.: CP20220219EA

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	34.0	0.0	±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	91.0	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	125.4	125.3	-0.1	±2.0
Positive half cycle	124.4	124.0	-0.4	±1.0
Negative half cycle	124.4	124.0	-0.4	±1.0

Certificate No.: CP20220219EA

Calibration Report

Function : 10. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limits (dB)
Positive one-half cycle	Negative one-half cycle		
139.4	139.4	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 - -

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0528

MTC No. EEL. BP. 17/0564

CALIBRATION CERTIFICATE

Submitted by : S.P.S. Consulting Services 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 generated by sound calibrator under test shall be measured by standard microphone using an insert voltage technique.

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

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

Date of Receipt : 6 May 2021

Date of Calibration : 15 May 2021

1 / 2 ✓

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

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0528

MTC No. EEL. BP. 17/0564

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

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

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjaer 4180	93.96	-0.04	± 0.10	± 0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjaer 4180	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 Brüel&Kjaer 4180	1.26	± 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 :



Acting Director

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 15 May 2021

Date of Issue : 18 May 2021

Ref : 2011264050601894002

End of Certificate

2 / 2

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.BLMTC.002 Rev.4

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E-mail : sumalee@tistr.or.th

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp° 46

SERIAL NO. : TSH120011

CLID. NO. : 232000795

JOB CONTROL NO. : 210403031523

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

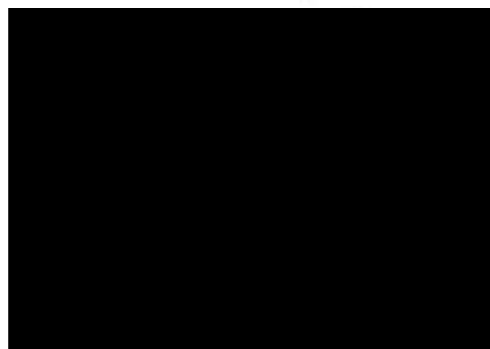
DATE OF RECEIVED : 03 April 2021

DATE OF ISSUED : 08 April 2021

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

Calibrated By : Tanawan Seenam-Ngoen
Calibration Engineer

Approved By :



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. Q21031523

F3-011-04/01-12

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@clccalibration

REPORT OF CALIBRATION

FOR

NOMENCLATURE : **DIGITAL THERMOHYGRO METER**
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : **3M**

MODEL / TYPE : **QUESTemp° 46**

SERIAL NO. : **TSH120011**

DATE OF CALIBRATION : **06 April 2021**

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. **WI-305-74** as calibration guidelines.

The calibration was performed by using Chilled Mirror Hygrometer and Temperature & Humidity Chamber which maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

Chilled Mirror Hygrometer, Edgetech Model Dew Master S/N. 44602.

Temperature & Humidity Chamber, PGC Model 9141-5116 S/N. 1304261.

TRACEABILITY :

The measurements are traceable to International System of Units (SI) , through Thunder Scientific Corporation.

Certificate No.18815, Due Date 11 November 2021.

UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2,00$ 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:2013)"

Certificate No. **Q21031523**

F3-011-04/01-12

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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 the measuring digital thermohygro meter (thermal environment monitor).

CALIBRATION DATA

*1. CORRECTION OF TEMPERATURE [WET]

Test point (° C)	Actual Temperature (° C)	DUC Reading (° C)	Correction (° C)	Uncertainty ± (° C)
30.0	29.98	30.2	-0.22	0.40
35.0	34.99	35.3	-0.31	
40.0	40.01	40.2	-0.19	

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

2. CORRECTION OF TEMPERATURE [DRY]

Test point (° C)	Actual Temperature (° C)	DUC Reading (° C)	Correction (° C)	Uncertainty ± (° C)
30.0	29.98	29.8	+0.18	0.40
35.0	34.99	34.8	+0.19	
40.0	40.01	39.8	+0.21	

3. CORRECTION OF TEMPERATURE [GLOBE BULB]

Test point (° C)	Actual Temperature (° C)	DUC Reading (° C)	Correction (° C)	Uncertainty ± (° C)
30.0	29.98	29.8	+0.18	0.40
35.0	34.99	34.9	+0.09	
40.0	40.01	39.9	+0.11	

Note. The Scope of Accredited TISI Certificate No. 19C087/0655 Issue 1 Page 36 of 111

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

End of Certificate

Certificate No. Q21031523

F3-011-04/01-12

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CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp[®]32

SERIAL NO. : TPE070001

CLID. NO. : 231801941

JOB CONTROL NO. : 211125114743

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

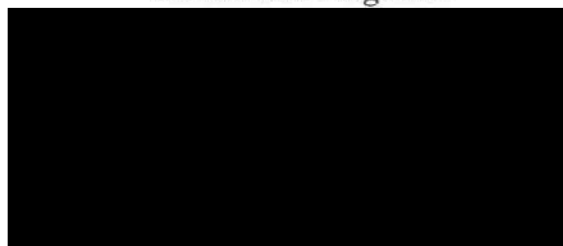
DATE OF RECEIVED : 25 November 2021

DATE OF ISSUED : 29 November 2021

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

Calibrated By : Tanawan Seenam-Ngoen
Calibration Engineer

Approved By :



Authorized Signatory
29 November 2021



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. Q21114743

F3-011-04/01-12

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@clccalibration

REPORT OF CALIBRATION

FOR

NOMENCLATURE : **DIGITAL THERMOHYGRO METER**
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : **3M**

MODEL / TYPE : **QUESTemp°32**

SERIAL NO. : **TPE070001**

DATE OF CALIBRATION : **26 November 2021**

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. **WI-305-74**. The calibration was performed by using Chilled Mirror Hygrometer and Temperature & Humidity Chamber which maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

Chilled Mirror Hygrometer, Edgetech Model Dew Master S/N. 36151.

Temperature & Humidity Chamber, PGC Model 9141-5114 S/N.0802282.

TRACEABILITY :

The measurements are traceable to International System of Units (SI) , through Thunder Scientific Corporation.

Certificate No. 19317, Due Date 09 July 2022.

UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2,00$ 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:2013)"

Certificate No. Q21114743

F3-011-04/01-12

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@clccalibration

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 the measuring digital thermohygro meter (thermal environment monitor).

CALIBRATION DATA

1. CORRECTION OF TEMPERATURE : WET

Test point (° C)	Actual Temperature (° C)	DUC Reading (° C)	Correction (° C)	Uncertainty ± (° C)
30.0	29.97	29.9	+0.07	0.40
35.0	34.95	34.9	+0.05	
40.0	39.93	39.9	+0.03	

2. CORRECTION OF TEMPERATURE : DRY

Test point (° C)	Actual Temperature (° C)	DUC Reading (° C)	Correction (° C)	Uncertainty ± (° C)
30.0	29.97	30.0	-0.03	0.42
35.0	34.95	34.9	+0.05	
40.0	39.93	39.9	+0.03	

3. CORRECTION OF TEMPERATURE : GLOBE BULB

Test point (° C)	Actual Temperature (° C)	DUC Reading (° C)	Correction (° C)	Uncertainty ± (° C)
30.0	29.97	29.9	+0.07	0.40
35.0	34.95	34.9	+0.05	
40.0	39.93	40.1	-0.17	

Note. The Scope of Accredited TISI Certificate No. 19C087/0655 Issue 1 Page 36 of 111

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

End of Certificate

Certificate No. Q21114743

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