

เอกสารแนบ ง
เอกสารสอบเทียบเครื่องมือ

บริษัท ยูไนเต็ด แอนนาลิสต์ แอนด์ เอ็นจิเนียริง
คอนซัลแตนท์ จำกัด

List of Instrument Certificates for Environmental Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*
1	Atomic Absorption Spectrometer	CADMIUM CHROMIUM COPPER LEAD MANGANESE MERCURY NICKEL ZINC	Agilent Technologies	AA240FS / MY13160001	Agilent Technologies (Thailand) Co.,Ltd.	Preventive Maintenance Checklist	30/1/2025	29/1/2026
2	Atomic Absorption Spectrometer	ARSENIC SELENIUM	Agilent Technologies	240Z AA / G8436A MY18130003	Agilent Technologies (Thailand) Co.,Ltd.	System Preventive Maintenance Checklist	15/10/2024	14/10/2025
3	Inductively Coupled Plasma- Optical Emission Spectrometer(ICP-OES)	BARIUM SILVER	Agilent Technologies, USA	5110 VDV(G8015AA) / MY8030001	Agilent Technologies (Thailand) Co.,Ltd.	Preventive Maintenance Checklist	4/11/2024	3/11/2025

Due Date of Calibration* : Based on the annual calibration plan. At least 1 time per year.

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1	Atomic Absorption Spectrometer	COPPER IRON	Agilent Technologies	AA240FS / MY13160001	Agilent Technologies (Thailand) Co.,Ltd.	Preventive Maintenance Checklist	30/1/2025	29/1/2026
2	Analytical Balance	TOTAL DISSOLVED SOLIDS	Mettler Toledo	XSR205DU / C210685394	National Food Institute,Ministry of Industry, Thailand	2502226-002-01	20/3/2025	19/3/2026
3	Mercury Analyzer	MERCURY	NIC. Japan	RA-4500 / 17780278	Coax Group Corporation Ltd.	Preventive Maintenance Report	9/7/2024	8/7/2025
4	UV-VIS Spectrophotometer	FLUORIDE NITRATE SULPHATE	Hitachi	U-2900 / 21E22-009	DQE Services Co.,Ltd.	SP25-001	3/1/2025	2/1/2026
5	Turbidity Meter (Portable)	TURBIDITY (NTU)	Oakton Instruments(China)	T100IR / 1120501017	Technology Promotion Association (Thailand-Japan)	24CH1115	6/9/2024	5/9/2025

Due Date of Calibration* : Based on the annual calibration plan. At least 1 time per year.

List of Instrument Certificates for Environmental Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*
1	Atomic Absorption Spectrometer	MERCURY	Agilent Technologies	AA240FS / MY13160001	Agilent Technologies (Thailand) Co.,Ltd.	Preventive Maintenance Checklist	30/1/2025	29/1/2026
2	DO Meter	DO	Horiba	LAQUA-DO210 / HE9M0011	Technology Promotion Association (Thailand-Japan)	25TW111	27/5/2025	25/5/2026
3	Incubator	FECAL COLIFORM BACTERIA	Binder	KB400 / 20220000022479	Technology Promotion Association (THAILAND-JAPAN)	24TM938	9/7/2024	8/7/2025
4	UV-VIS Spectrophotometer	NITRATE NITROGEN	Hitachi	U-2900 / 21E22-009	DQE Services Co.,Ltd.	SP25-001	3/1/2025	2/1/2026
5	Water Bath	FECAL COLIFORM BACTERIA	Memmert	WNB 14 / L407.0756	Technology Promotion Association (Thailand-Japan)	24TM1016/1	9/7/2024	8/7/2025

Due Date of Calibration* : Based on the annual calibration plan. At least 1 time per year.

Agilent 55 240 280 Series Atomic Absorption Spectroscopy Systems

Preventive Maintenance Checklist

Agilent Preventive Maintenance provides factory recommended service for your analytical systems to assure reliable operation and the accuracy of your results.

Delivered by highly trained and certified service engineers using genuine Agilent parts and supplies, Agilent Preventive Maintenance provides everything you need to reduce unplanned downtime and keep your systems operating at their peak. This checklist will be completed at the end of the service and provided to you as a record of the installation.

Note: While non-current production AA instrument and/or accessory models are not covered specifically in this document it can be used as a basic reference.

For more information about Agilent Technologies services please visit our web site using the following URL: <http://www.agilent.com/en-us/services>

Introduction

Customer Information

- Customers should provide all necessary operating supplies upon request of the engineer.
- A customer representative should be available to the engineer while performing the preventive maintenance procedures.
- Any parts, not included in the Parts Lists section of this document, are not part of the recommended Preventive Maintenance service, nor are they included in the price of this service.
- If a system requires the use of extra or special procedures and/or parts for the maintenance service, then these must be ordered separately and charged as a repair, which may incur additional costs.

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Important Customer Web Links

- For more information about Agilent Technologies services, please visit our website using the following URL: <http://www.agilent.com/en-us/products/crosslab-instrument-services/service-repair>
- To access Agilent University, visit <http://www.agilent.com/crosslab/university/> to learn about training options, which include online, classroom and onsite delivery. A training specialist can work directly with you to help determine your best options.
- A useful Agilent Resource Center web page is available, which includes short videos on maintenance, quick lists of consumables for new instruments, and other valuable information. Check out the Resource Page here: <https://www.agilent.com/en-us/agilentresources>
- Need technical support, FAQs, supplies? – visit our Support Home page at <http://www.agilent.com/search/support>
- Get answers. Share insights. Build connections: Join the Agilent Community at <https://community.agilent.com/welcome>

Service Engineer's Responsibilities

- Contact the customer and ensure that all necessary supplies are available before the preventive maintenance visit.
 - Confirm the ability of the instrument to deliver continued safe operation as established via the Agilent AA safe operation flow chart. (Refer directly to the AA 55/240/280 Preventive Maintenance Scope of Work to make this decision.)
 - Only select those pages that relate to the system or module being serviced.
 - Complete empty fields with the relevant information.
 - Complete the relevant checkboxes in the checklist using either a "X" or tick mark "✓".
 - Check "Section not applicable" check boxes to indicate services/tasks not delivered, as appropriate.
 - Complete the Preventive Maintenance service in the order of the tasks listed.
 - Complete the Service Review section together with the customer.
 - Complete the fields for page numbers at the foot of each selected page
 - Complete the total number of pages field in the Service Completion section
 - Ask the customer to sign the Service Completion section including the customer's and your signature.
- This information is subject to change without notice.

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Instrument Maintenance

System Information

- ☐ Check this box if an instrument configuration report is attached instead of completing the table.

Instrument System Name and ID	240 FS AAS
Instrument System Site and Location	United Analyst and Engineering Consultant

List System Component Product Numbers	List the Serial Numbers of each Component
1. G 9432 A	M 13160001
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	

Preparation, Safe operation and Initial performance checks

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- ☐ Agilent AA safe operation flow chart inspections (to determine if the PM can be performed).

NOTE: If by following the flow chart the instrument is deemed to be unsafe for continued use you MUST NOT continue PM work. Inform the customer immediately of the Agilent recommendation that use of the instrument be discontinued.

- ☒ Discuss any specific issues with the customer before starting.
- ☐ For HF application systems, if standard sample introduction system was not installed, ask the customer to install it. **NA**
- ☒ Review the instrument logbook for recorded problems and comments.
- ☒ Save instrument control settings before starting the procedure.
- ☒ Perform a general inspection of the system for cleanliness.
- ☒ Check for proper installation of parts, assemblies, sensors etc.
- ☒ Check system for required installation of components, settings as defined by current Service Notes
- ☒ Check for required firmware updates and verify with customers if they would like them installed.
- ☒ Use SVD to perform a Full Wavelength Scan for Cu HCL - "As found test_1"
- ☒ Perform a Basic Cu ABS test - "As found test_2"
- ☒ Print the Details page or screen captures of the test results and attach to the end of this checklist.

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Preventive Maintenance Procedures

FLAME SYSTEM section

☐ Section not applicable

Electronic components

- ☒ Review and confirm instrument configuration data in SVD
- ☒ Confirm power supply voltages using the *SVD Power Supply diagnostic*.
- ☒ For Dual Beam Instruments - Confirm RBC frequency using the *SVD RBC frequency diagnostic*.

Mechanical components

- ☒ Check the burner adjuster controls for complete and free movement. If the burner adjuster needs lubrication, use Molykote 321 or mineral-based molybdenum disulphide grease.
- ☒ Run SVD tests to exercise all motor drives over the full range of their travel:
 - ☒ Monochromator drive
 - ☒ Slit drive
 - ☒ Lamp selector
 - ☐ ABA

Optics components

- ☒ Check that external optical surfaces are clean – Clean or replace as required.
- ☒ Use SVD and perform *Mono Wavelength Correction*.
- ☒ Use SVD and perform *Slit Calibration*.
- ☒ Use SVD and perform *Grating Squareness Diagnostic*.
- ☒ Use SVD and perform *Zero Order Offset/Mono Correction*.
- ☒ Use SVD and perform *Wavelength Repeatability*.
- ☒ Physically inspect selected HC lamps (customer to supply per their choice) and measure the % Gain for each lamp. Advise customer if lamps are showing emission degradation due to age.
- ☒ Check that the signal energy of the D2 and HC lamps track properly. Advise customer if their D2 lamp is showing emission degradation due to age.

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Sample Introduction and Atomization

- ☒ Inspect the burner interlock plate to ensure that the interlock pin is secure and correct for the burner type.
- ☒ Clean the burner slot with a clean white card.
- ☒ Check the uniformity of the slot width.
- ☒ Clean the burner if required.
- ☒ Change the burner o-ring.
- ☒ Clean the nebulizer, spray chamber and liquid trap.
- ☒ Change all o-rings and seals in the nebulizer, nebulizer block and spray chamber.
- ☒ Check that the pressure relief bung releases readily.
- ☒ Change o-rings on the fuel and oxidant delivery bars.
- ☒ Leave the liquid trap EMPTY and verify the flame will not ignite in this state.
- ☒ Refill liquid trap and check that overflow drains freely into the drain/waste tube.
- ☒ Check the drain/waste tube for good drainage. It should not have tight bends, kinks or loops and the lower end must be above the liquid level in the waste vessel
- ☒ Check and clean the igniter electrode

Gas handling components and safety interlocks

- ☒ Pressure test for leaks
- ☒ Leak test gasbox internal components and connections
- ☒ Check safety interlock status and operation using the *SVD interlock monitoring diagnostic*.

Analytical performance for Flame systems

- ☒ Ignite a flame.
- ☒ Check that you can adjust the nebulizer uptake rate from 4 to 6.5 mL per minute.
- ☒ Optimize the instrument ready to perform Cu sensitivity test.
- ☒ Create a manual method to perform a Basic Cu ABS test - "Final Performance Testing"
- ☒ Run a PM completed sensitivity test for a 5 ppm copper sample and record the results in the AA PM Performance test results and measurements table.

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FURNACE SYSTEM section

☒ Section not applicable

Electronic components

- ☐ Review and confirm instrument configuration data in SVD
- ☐ Confirm power supply voltages using the *SVD Power Supply diagnostic*.

Mechanical components

- ☐ Run SVD tests to exercise all motor drives over the full range of their travel:
 - ☐ Monochromator drive
 - ☐ Slit drive
 - ☐ Lamp selector

Optics components

- ☐ Check that external optical surfaces are clean – Clean or replace as required.
- ☐ Use SVD and perform *Mono Wavelength Correction*.
- ☐ Use SVD and perform *Slit Calibration*.
- ☐ Use SVD and perform *Grating Squareness Diagnostic*.
- ☐ Use SVD and perform *Zero Order Offset/Mono Correction*.
- ☐ Use SVD and perform *Wavelength Repeatability*.
- ☐ Physically inspect selected HC lamps (customer to supply per their choice) and measure the % Gain for each lamp. Advise customer if lamps are showing emission degradation due to age.

Gas handling, water system and workhead component checks

- ☐ Inspect the GTA workhead gas hoses and connections for leaks.
- ☐ Pressure test for gas leaks
- ☐ If the cooler system is accessible (stand-alone) check for correct operation and coolant/water level – this includes any temperature and pressure settings plus filter cleaning (air flow and water).
- ☐ Inspect the GTA workhead water hoses and connections for leaks.
- ☐ Check all graphite components and replace if necessary.

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- ☐ Tube
- ☐ Electrodes
- ☐ Shroud

- ☐ Check and clean the end windows on the workhead.
- ☐ Check safety interlock operation.

Analytical performance for Furnace systems

- ☐ Optimize the instrument ready to perform Cu sensitivity test.
- ☐ Run the sensitivity test for a 25 ppb copper sample and record the results in the results table.

PSD autosampler accessory for Furnace systems

- ☒ Section NOT Applicable
- ☐ Check condition of the PSD capillary – replace if necessary
- ☐ Check condition and operation of PSD syringe – ensure it does not have air locks and bubbles.
- ☐ Change PSD rinse bottle o-ring.
- ☐ Check and clean the rinse vessel.
- ☐ Check the drain tube for good drainage. It should not have tight bends, kinks or loops and the lower end must be above the liquid level in the waste vessel.
- ☐ Ensure that the waste vessel is suitable for use with the furnace system.

Sample introduction pump system (SIPS) accessory

- ☒ Section NOT Applicable
- ☐ Re-torque screws securing the hubs, presser arms and pump rotors.
- ☐ Adjust each roller so that it rotates freely.
- ☐ Wipe clean the pump rotor rollers and pump bands with a dry clean cloth.
- ☐ Ensure that the presser arms and the surfaces near the pump are free from dirt and spills.
- ☐ Remove the pump module rear cover and check for the incursion of liquids and any signs of corrosion.
- ☐ Re-torque the nuts that fasten the motor mounting plates to the chassis.
- ☐ Check clips securing the diluents holder and replace if necessary.
- ☐ Disconnect, clean T-piece, and reassemble the tubing using the following steps.

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- ☐ Remove the T-piece by disconnecting the pump tubes, the pump bands and all other tubing.
- ☐ Place the T-piece in an ultrasonic bath containing strong detergent 1-5% Decon 30 or similar, for approximately 5-10 minutes.
- ☐ Wash the T-piece under a tap with a strong flow of water.
- ☐ Rinse with distilled water through all of the inlets in the reverse direction to normal sample flow.
- ☐ Reassemble.

Sample preparation system (SPS 4) accessory

☒ Section NOT Applicable

The Agilent SPS 4 autosampler is designed to need minimal maintenance.

The following maintenance requirements are suggested to maintain the performance of the autosampler.

- ☐ Cleaning the spill tray, rack location mat, end frames and chassis accessories with a damp soft cloth and diluted mild detergent.
- ☐ Cleaning the autosampler cover panels with domestic window cleaner.
- ☐ Checking the X- axis and Z- axis drive belts for cracks, splits, damaged teeth, excessive fraying, color changes or degradation from fumes.
- ☐ Check the X- axis, Theta- axis and Z- axis FFC cables for cracks, incorrect positioning, damaged edge or damaged connectors.

NOTE: The autosampler requires no extra lubrication throughout its lifetime.

For further details refer to the SPS 4 service manual G8410-90050.

Sample preparation system (SPS 3) accessory

☒ Section NOT Applicable

- ☐ Check the x-axis and z-axis timing belts – Replace if there is any cracks, splits or color deterioration and belt tension.
- ☐ Check belt tensions - adjust if required
- ☐ Check the lubrication pad for single x-axis shaft. If pad is dry or customer has observed any vibration or erratic movements of the x-axis carriage, add 1 mL of Dow Corning 200 @ Fluid, 200 CS into the well.
- ☐ Check the auto-sampler ability to find tube positions - Calibrate if required.
- ☐ Clean the exterior surfaces of the accessory with soft lint free cloth. This cloth can be dampened with warm water or a mild detergent. Do not use organic solvents or abrasive cleaning agents.

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Vapor generation accessory VGA (hydride generator)

☒ Section NOT Applicable

- ☐ Inspect VGA gas supply hose.
- ☐ Inspect/replace VGA pump tubing.
- ☐ Check low gas pressure interlock setting – adjust if required.
- ☐ Check precision orifice gas flow setting – adjust if required.
- ☐ Check gas regulator pressure to 46 psi (325 kPa) – adjust if required.
- ☐ Clean the exterior surfaces of the accessory with soft lint free cloth. This cloth can be dampened with warm water or a mild detergent. Do not use organic solvents or abrasive cleaning agents.

UltrAA lamp accessory (external)

☒ Section NOT Applicable

- ☐ Check the condition of the power cable.
- ☐ Clean the exterior surfaces of the accessory with soft lint free cloth. This cloth can be dampened with warm water or a mild detergent. Do not use organic solvents or abrasive cleaning agents.

Restore System

- ☐ If you have altered the customer's instrumentation during the course of PM, restore to the original status to allow the customer to conduct their normal activities (e.g., reload the customer's method.)

Guidance

If the PM service is performed prior to a qualification service, then use the qualification procedure as a guide for final instrument set up and checkout.

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Signature Page

Service Review

- ☒ Attach available reports/printouts of all tests to this documentation.
- ☒ Record the Preventive Maintenance service activity in the customer's records/logbook.
- ☒ Update/reset instrument maintenance counters as appropriate.
- ☒ Affix the PM sticker to the system or instrument logbook based on the customer's request.
- ☒ Complete the Service Engineer Comments section if there are additional comments.
- ☒ Review this service, parts replaced, and test results obtained with the customer.
- ☒ If the instrument firmware was updated, record the details of the change in the Service Engineer's Comments box or if necessary, in the customer's IQ records.

Test Results

Test Description	Expected Test Result	Actual Test Result
Flame optics PMT Gain test		
For copper at 324.8 nm, 4 mA, 0.5 nm slit width	< 55 %	49 %
Flame performance test with 5 ppm copper sample		
Air /acetylene, mixing paddle removed	Abs value > 0.5	0.5599
Air /acetylene, mixing paddle installed, 10 replicates	%RSD < 1.0	0.2 %
Deuterium furnace optics PMT Gain test		
For copper at 324.8 nm, 4 mA, 0.5 nm slit width	< 55 %	—
Deuterium furnace performance test with 25 ppb copper sample (324.8 nm)		
Precision %RSD	≤ 4.0%	—
Abs value	≥ 0.15	—
Zeeman furnace analytical performance: 25 ppb copper sample (327.4 nm)		
Precision %RSD	≤ 4.0%	—
Abs value	≥ 0.10	—
MSRP%	≥ 70 %	—

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AA consumable and parts list table

Part Description	Part Number	Product/Model # where used	PM supplied or Consumable	Instrument-Type
Test Solution – Cu 5ppm solution	6610030100	50 55 140 240 280	PM supplied	Common
Test Solution - Blank solution	5190-7001	50 55 140 240 280	PM supplied	Common
Copper, 1000 ug/ml, 100ml	5190-8279	50 55 140 240 280	*	Common
Kit, Mk 7 O-rings, aqueous, complete set	9910093400	50 55 140 240 280	PM supplied	Flame
Organic Kit	9910093500	50 55 140 240 280	PM supplied	Flame
Wire Nebulizer Cleaning	9910024700	50 55 140 240 280	consumable	Flame
Tubing-Capillary Std Nebs	9910024800	50 55 140 240 280	consumable	Flame
Capillary Tube Hivac Neb (3) (organics only)	9910044000	50 55 140 240 280	consumable	Flame
Glass impact beads (5/pk)	9910025700	50 55 140 240 280	consumable	Flame
Teflon impact beads (5/pk): (organics only)	9910053300	50 55 140 240 280	consumable	Flame
Burner cleaning strip (100/pk)	9910053900	50 55 140 240 280	consumable	Flame
Window UV silica – round (right side)	2010082500	50 55 140 240 280	PM supplied	Common
Window UV silica – rectangular (left side)	2010082500	50 55 140 240 280	PM supplied	Common
Pad adhesive window (round)	4910012700	50 55 140 240 280	PM supplied	Common
Pad adhesive window (rectangular)	4910012800	50 55 140 240 280	PM supplied	Common
Electrode kit (1 pr) (D2)	6310003400	GTA120	PM supplied	Furnace
Shroud (D2)	6310003100	GTA120	PM supplied	Furnace
Zeeman electrode kit (1 pr)	6310003500	GTA120	PM supplied	Furnace
Zeeman shroud	6310003600	GTA120	PM supplied	Furnace
O-ring PSD rinse bottle	6910025900	PSD120	PM supplied	Furnace

* For engineers who only service AA instruments 5190-8279 can be used as a cheaper alternative for 6610030100.

Items classified as PM supplied in the above table are included in the standard PM

Those classified as consumable should be provided by the customer or charged to the customer if supplied by the Agilent service engineer.

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Service Engineer Comments (optional)

If there are any specific points you wish to note as part of performing the installation or other items of interest for the customer, please write in this box.

Report ID: Diagnostic Start Time: 1/30/2025 9:14:28 AM Diagnostic End Time: 1/30/2025 9:46:08 AM
Customer: UAE Service Engineer: Kanyakorn S.
Address: Soi Udomsuk 41, Sukhumvit Rd, Bangkok Contact Details: 026376363#1

Configuration:

Serial Number: MY13160001 Turret Type: Automatic
Instrument Model: Varian AA140/240/280 Number Of Lamps: 4
Flame Instrument: True Mono Type: Automatic
Furnace Instrument: True Gasbox Type: Y Gas Box
Zeeman Present: False Auto Burner Adjuster: False
Internal Zeeman: False Mains Frequency: 50
Internal UltraAA: False Firmware Version: 2.11
Optics Type: Double Beam Photomultiplier Type: Normal(900nm)
D2 BG Correction Fitted: True PWB Version: 45
Boot Block Version: 1.00

EEPROM Data:

Instrument Run Hours: 62819.180 D2 Run Hours: 53396.500
Zero Wavelength Offset: 0.133 D2 Serial Number: not set!
Mono Correction: 0.770 D2 Install Date: 1/1/1970
Flame Hours: 32411.634 D2 Original Intensity: 1.000
D2 Last Intensity: 475.000

Service Completion

Service request number: 6007549143 Date service completed: 30 Jan 2025
Agilent signature: Kanyakorn S. Customer signature: David Y.
Total number of pages in this document: 13

Frequency:

Averaging Period: 30.0
Datapoint Count: 20
Upper Limit: 51.00 Highest Measured Frequency: 50.00
Average Frequency: 50.00
Lower Limit: 49.00 Lowest Measured Frequency: 50.00
Result: Passed

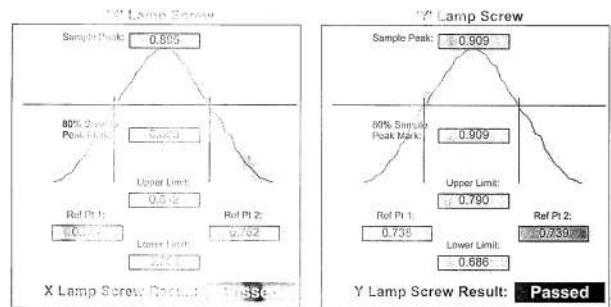
Power Supply:

Averaging Period: 30.0
Datapoint Count: 20

	Lower Limit (V)	Actual (V)	Upper Limit (V)	Result:
12.00 V Rail	10.80	12.12	13.20	Passed
-12.00 V Rail	-13.20	-11.90	-10.80	Passed
5.00 V Rail	4.50	5.04	5.50	Passed
310.00 V Rail	279.00	330.00	341.00	Passed

Beam Balance:

Lamp Type: Copper
Lamp Socket Used: 3
Peak Selected: 324.80
Lamp Alignment: Performed



Grating Scan Results:

Lamp Element(s): Copper
Lamp Turret Position: 3
Lamp Current(mA): 4.00
Scan Wavelength(nm): 0.5
1st Order Wavelength(nm): 324.80
Lamp Alignment: Performed

	Lower Limit (nm)	Actual (nm)	Upper Limit (nm)	Result:
Zero Order	-0.10	0.00	0.10	Passed
First Order	324.45	324.75	325.15	Passed
Second Order	648.90	649.50	649.97	Passed

Wavelength Repeatability

Lamp Used: Copper
Peak Used(nm): 324.759
Connected to Socket: 3

Lamp Current(mA): 4
Slit Width(nm): 0.2
Slit Height: Normal

Lamp Alignment:

Lower Limit(nm) 324.759 Upper Limit(nm) 324.888

(Approach from Zero Drive) (Approach from end)

Sample 1: 324.823 Sample 2: 324.823
Sample 3: 324.823 Sample 4: 324.823
Sample 5: 324.823 Sample 6: 324.819
Sample 7: 324.819 Sample 8: 324.819
Sample 9: 324.823 Sample 10: 324.819

Absorbance: 0.000 Standard Deviation: 0.003

Result:

เอกสารไม่ควบคุม

Wavelength Drive:

Slit Drive:

Turret Drive:

Auto Burner/Water Valve:

Signal Processing Linearity:

Calibrate Auto: New Data Mode

	Lower Limit	Absorbance	Upper Limit	Result:
S0	114	1	297	
S1	198	114	191	
S2	271	110	332	
S3	474	17	679	
S4	936	1	1008	
S5	1435	19	1754	
S6	2108	1109	3053	
S7	4547	1101	5313	

Interlock:

Burner Flame:

Flame Detect:

NO Burner Flame:

SCU Active:

Flame Shield Closed:

Oxidant Pressure:

Gas Control Flame:

Oxidant Changeover:

Pressure Release During Flame:

Liquid Trap Thaw:

Ignition:

เอกสารไม่ควบคุม

Auto Lamp Recognition:

Lamp 1: Unlabeled Lamp/Not Connected Lamp 5: Not Supported
Lamp 2: 87 - Silver/Cadmium/Lamp/Not Connected Lamp 6: Not Supported
Lamp 3: 14 - Copper (Cu) Lamp 7: Not Supported
Lamp 4: Unlabeled Lamp/Not Connected Lamp 8: Not Supported

Result:

GTA Temperature Monitoring:

Notes:

Signatures:

Signature:

เอกสารไม่ควบคุม

Sequential by time report 1/30/2025 10:53 AM Page 1 of 1 SpectraAA

Analyst:

Date Started: 1/30/2025 10:33 AM GMT: 1/30/2025 3:33 AM

Worksheet: Sensitivity Test 01

Comment:

Methods: Cu

Computer name: DESKTOP-R3UFRS

Serial Number: MY13160001

Method: Cu (Flame)

Sample ID	Conc. mg/L	%RSD	Mean Abs
CAL ZERO	0.000	38.8	0.0002
Readings			
0.0002	0.0003	0.0001	1/30/2025 10:51:46 AM
STANDARD 1	5.000	0.1	0.5571
Readings			
0.5574	0.5563	0.5575	1/30/2025 10:52:22 AM

Abs Linear Origin - Cal. Set 1

Curve Fit = Linear Origin
Characteristic Conc = 0.030 mg/L
r = 1.0000
Calculated Conc = 0.002 5.000
Residuals = -0.007 0.000

Abs = 0.11141 x C

5 ppm Cu	Abs	%RSD	Mean Abs
5.025	0.3	0.5558	
Readings			
0.5582	0.5596	0.5615	1/30/2025 10:52:54 AM

เอกสารไม่ควบคุม

Analyst:
Date Started: 1/30/2025 10:33 AM GMT: 1/30/2025 3:33 AM
Worksheet: Precision Test
Comment:
Methods: Cu
Computer name: DESKTOP-PSUFRS
Serial Number: MY13160001

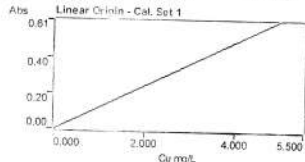
Method: Cu (Flame)

Sample ID	Conc. mg/L	%RSD	Mean Abs
CAL ZERO	0.000	64.1	-0.0002
Readings:			
	-0.0003	-0.0003	-0.0001

1/30/2025 10:46:52 AM

STANDARD 1	Conc. mg/L	%RSD	Mean Abs
5.000	0.3	0.6052	
Readings:			
	0.6036	0.6073	0.6047

1/30/2025 10:47:24 AM

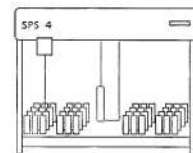
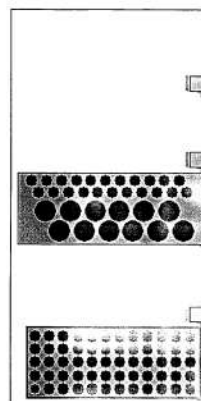


Curve Fit = Linear Origin
Characteristic Conc = 0.009 mg/L
r = 1.0000
Calculated Conc = -0.002 5.090
Residuals = 0.002 0.000

Abs = 0.12105 x C

5 ppm Cu	Conc. mg/L	%RSD	Mean Abs
5.007	0.2	0.6051	
Readings:			
	0.6005	0.5952	0.6047
	0.6055	0.6076	0.6064

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Down height 0.5 (mm)

Pump speed Medium

Key to tube colors

Sample

Calibration

Calibration/QC

Sample/QC

Not Assigned

Sampler Offline

Goto Tube

Back 1

Tube 1

Goto Tube

Align Probe

Rinse

Store/Freeze

Park

Sensitivity Check 1.5 mg/L gives about 0.2 Abs at 324.8 nm, A/A burner

Important Customer Web Links

- For more information about Agilent Technologies services, please visit our website using the following URL: <http://www.agilent.com/en-us/products/crosslab-instrument-services/service-repair>
- To access Agilent University, visit <http://www.agilent.com/crosslab/university/> to learn about training options, which include online, classroom and onsite delivery. A training specialist can work directly with you to help determine your best options.
- A useful Agilent Resource Center web page is available, which includes short videos on maintenance, quick lists of consumables for new instruments, and other valuable information. Check out the Resource Page here: <https://www.agilent.com/en-us/agilentresources>
- Need technical support, FAQs, supplies? – visit our Support Home page at <http://www.agilent.com/search/support>
- Get answers. Share insights. Build connections: Join the Agilent Community at <https://community.agilent.com/welcome>

Service Engineer's Responsibilities

- Contact the customer and ensure that all necessary supplies are available before the preventive maintenance visit.
- Confirm the ability of the instrument to deliver continued safe operation as established via the Agilent AA safe operation flow chart. (Refer directly to the AA 55/240/280 Preventive Maintenance Scope of Work to make this decision.)
- Only select those pages that relate to the system or module being serviced.
- Complete empty fields with the relevant information.
- Complete the relevant checkboxes in the checklist using either a "X" or tick mark "✓".
- Check "Section not applicable" check boxes to indicate services/tasks not delivered, as appropriate.
- Complete the Preventive Maintenance service in the order of the tasks listed.
- Complete the Service Review section together with the customer.
- Complete the fields for page numbers at the foot of each selected page.
- Complete the total number of pages field in the Service Completion section.
- Ask the customer to sign the Service Completion section including the customer's and your signature.

This information is subject to change without notice.

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Instrument Maintenance

System Information

- ☒ Check this box if an instrument configuration report is attached instead of completing the table.

Instrument System Name and ID	64436A / MY13160003
Instrument System Site and Location	United Analyst And Engineering Consultant Co., Ltd

List System Component Product Numbers	List the Serial Numbers of each Component
1. 64436A	MY13160003
2. 64436A	MY13160003
3. P50 120	MY13160001
4. 64436A	1301-017583
5.	
6.	
7.	
8.	
9.	

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- ☒ Agilent AA safe operation flow chart inspections (to determine if the PM can be performed).

NOTE: If by following the flow chart the instrument is deemed to be unsafe for continued use you MUST NOT continue PM work. Inform the customer immediately of the Agilent recommendation that use of the instrument be discontinued.

- ☒ Discuss any specific issues with the customer before starting.
- ☐ For HF application systems, if standard sample introduction system was not installed, ask the customer to install it.
- ☒ Review the instrument logbook for recorded problems and comments.
- ☒ Save instrument control settings before starting the procedure.
- ☒ Perform a general inspection of the system for cleanliness.
- ☒ Check for proper installation of parts, assemblies, sensors etc.
- ☒ Check system for required installation of components, settings as defined by current Service Notes
- ☒ Check for required firmware updates and verify with customers if they would like them installed.
- ☒ Use SVD to perform a Full Wavelength Scan for Cu HCL - "As found test_1"
- ☒ Perform a Basic Cu ABS test - "As found test_2"
- ☒ Print the Details page or screen captures of the test results and attach to the end of this checklist.

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Preventive Maintenance Procedures

FLAME SYSTEM section

- ☒ Section not applicable

Electronic components

- ☐ Review and confirm instrument configuration data in SVD
- ☐ Confirm power supply voltages using the **SVD Power Supply diagnostic**.
- ☐ For Dual Beam instruments - Confirm RBC frequency using the **SVD RBC frequency diagnostic**.

Mechanical components

- ☐ Check the burner adjuster controls for complete and free movement. If the burner adjuster needs lubrication, use Molykote 321 or mineral-based molybdenum disulphide grease.
- ☐ Run SVD tests to exercise all motor drives over the full range of their travel:
 - ☐ Monochromator drive
 - ☐ Slit drive
 - ☐ Lamp selector
 - ☐ ABA

Optics components

- ☐ Check that external optical surfaces are clean – Clean or replace as required.
- ☐ Use SVD and perform **Mono Wavelength Correction**.
- ☐ Use SVD and perform **Slit Calibration**.
- ☐ Use SVD and perform **Grating Squareness Diagnostic**.
- ☐ Use SVD and perform **Zero Order Offset/Mono Correction**.
- ☐ Use SVD and perform **Wavelength Repeatability**.
- ☐ Physically inspect selected HC lamps (customer to supply per their choice) and measure the % Gain for each lamp. Advise customer if lamps are showing emission degradation due to age.
- ☐ Check that the signal energy of the D2 and HC lamps track properly. Advise customer if their D2 lamp is showing emission degradation due to age.

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Sample Introduction and Atomization

- ☐ Inspect the burner interlock plate to ensure that the interlock pin is secure and correct for the burner type.
- ☐ Clean the burner slot with a clean white card.
- ☐ Check the uniformity of the slot width.
- ☐ Clean the burner if required.
- ☐ Change the burner o-ring.
- ☐ Clean the nebulizer, spray chamber and liquid trap.
- ☐ Change all o-rings and seals in the nebulizer, nebulizer block and spray chamber.
- ☐ Check that the pressure relief bung releases readily.
- ☐ Change o-rings on the fuel and oxidant delivery bars
- ☐ Leave the liquid trap EMPTY and verify the flame will not ignite in this state.
- ☐ Refill liquid trap and check that overflow drains freely into the drain/waste tube.
- ☐ Check the drain/waste tube for good drainage. It should not have tight bends, kinks or loops and the lower end must be above the liquid level in the waste vessel
- ☐ Check and clean the Igniter electrode

Gas handling components and safety interlocks

- ☐ Pressure test for leaks
- ☐ Leak test gasbox internal components and connections
- ☐ Check safety interlock status and operation using the **SVD interlock monitoring diagnostic**.

Analytical performance for Flame systems

- ☐ Ignite a flame.
- ☐ Check that you can adjust the nebulizer uptake rate from 4 to 6.5 mL per minute.
- ☐ Optimize the instrument ready to perform Cu sensitivity test.
- ☐ Create a manual method to perform a Basic Cu ABS test - "Final Performance Testing"
- ☐ Run a PM completed sensitivity test for a 5 ppm copper sample and record the results in the AA PM Performance test results and measurements table.

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FURNACE SYSTEM section

- ☒ Section not applicable

Electronic components

- ☒ Review and confirm instrument configuration data in SVD
- ☒ Confirm power supply voltages using the **SVD Power Supply diagnostic**.

Mechanical components

- ☒ Run SVD tests to exercise all motor drives over the full range of their travel:
 - ☒ Monochromator drive
 - ☒ Slit drive
 - ☒ Lamp selector

Optics components

- ☒ Check that external optical surfaces are clean – Clean or replace as required.
- ☒ Use SVD and perform **Mono Wavelength Correction**.
- ☒ Use SVD and perform **Slit Calibration**.
- ☒ Use SVD and perform **Grating Squareness Diagnostic**.
- ☒ Use SVD and perform **Zero Order Offset/Mono Correction**.
- ☒ Use SVD and perform **Wavelength Repeatability**.
- ☒ Physically inspect selected HC lamps (customer to supply per their choice) and measure the % Gain for each lamp. Advise customer if lamps are showing emission degradation due to age.

Gas handling, water system and workhead component checks

- ☒ Inspect the GTA workhead gas hoses and connections for leaks.
- ☒ Pressure test for gas leaks
- ☒ If the cooler system is accessible (stand-alone) check for correct operation and coolant/water level – this includes any temperature and pressure settings plus filter cleaning (air flow and water).
- ☒ Inspect the GTA workhead water hoses and connections for leaks.
- ☒ Check all graphite components and replace if necessary.

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- ☐ Tube
- ☐ Electrodes
- ☐ Shroud

- ☒ Check and clean the end windows on the workhead.
- ☒ Check safety interlock operation.

Analytical performance for Furnace systems

- ☒ Optimize the instrument ready to perform Cu sensitivity test.
- ☒ Run the sensitivity test for a 25 ppb copper sample and record the results in the results table.

PSD autosampler accessory for Furnace systems

- ☐ Section NOT Applicable
- ☒ Check condition of the PSD capillary – replace if necessary
- ☒ Check condition and operation of PSD syringe – ensure it does not have air locks and bubbles.
- ☒ Change PSD rinse bottle o-ring.
- ☒ Check and clean the rinse vessel.
- ☒ Check the drain tube for good drainage. It should not have tight bends, kinks or loops and the lower end must be above the liquid level in the waste vessel.
- ☒ Ensure that the waste vessel is suitable for use with the furnace system.

Sample introduction pump system (SIPS) accessory

- ☒ Section NOT Applicable
- ☐ Re-torque screws securing the hubs, presser arms and pump rotors.
- ☐ Adjust each roller so that it rotates freely.
- ☐ Wipe clean the pump rotor rollers and pump bands with a dry clean cloth.
- ☐ Ensure that the presser arms and the surfaces near the pump are free from dirt and spills.
- ☐ Remove the pump module rear cover and check for the incursion of liquids and any signs of corrosion.
- ☐ Re-torque the nuts that fasten the motor mounting plates to the chassis.
- ☐ Check clips securing the diluents holder and replace if necessary.
- ☐ Disconnect, clean T-piece, and reassemble the tubing using the following steps.

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- ☐ Remove the T-piece by disconnecting the pump tubes, the pump bands and all other tubing.
- ☐ Place the T-piece in an ultrasonic bath containing strong detergent 1-5% Decon 30 or similar, for approximately 5-10 minutes.
- ☐ Wash the T-piece under a tap with a strong flow of water.
- ☐ Rinse with distilled water through all of the inlets in the reverse direction to normal sample flow.
- ☐ Reassemble.

Sample preparation system (SPS 4) accessory

- ☒ Section NOT Applicable

The Agilent SPS 4 autosampler is designed to need minimal maintenance.

The following maintenance requirements are suggested to maintain the performance of the autosampler.

- ☐ Cleaning the spill tray, rack location mat, end frames and chassis accessories with a damp soft cloth and diluted mild detergent.
- ☐ Cleaning the autosampler cover panels with domestic window cleaner.
- ☐ Checking the X- axis and Z- axis drive belts for cracks, splits, damaged teeth, excessive fraying, color changes or degradation from fumes.
- ☐ Check the X- axis, Theta- axis and Z- axis FFC cables for cracks, incorrect positioning, damaged edge or damaged connectors.

NOTE: The autosampler requires no extra lubrication throughout its lifetime.

For further details refer to the SPS 4 service manual G8410-90050.

Sample preparation system (SPS 3) accessory

- ☒ Section NOT Applicable

- ☐ Check the x-axis and z-axis timing belts – Replace if there is any cracks, splits or color deterioration and belt tension.
- ☐ Check belt tensions - adjust if required
- ☐ Check the lubrication pad for single x-axis shaft. If pad is dry or customer has observed any vibration or erratic movements of the x-axis carriage, add 1 mL of Dow Corning 200 @ Fluid, 200 CS into the well.
- ☐ Check the auto-sampler ability to find tube positions - Calibrate if required.
- ☐ Clean the exterior surfaces of the accessory with soft lint free cloth. This cloth can be dampened with warm water or a mild detergent. Do not use organic solvents or abrasive cleaning agents.

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Vapor generation accessory VGA (hydride generator)

- ☒ Section NOT Applicable
- ☐ Inspect VGA gas supply hose.
- ☐ Inspect/replace VGA pump tubing.
- ☐ Check low gas pressure interlock setting – adjust if required.
- ☐ Check precision orifice gas flow setting – adjust if required.
- ☐ Check gas regulator pressure to 46 psi (325 kPa) – adjust if required.
- ☐ Clean the exterior surfaces of the accessory with soft lint free cloth. This cloth can be dampened with warm water or a mild detergent. Do not use organic solvents or abrasive cleaning agents.

UltrAA lamp accessory (external)

- ☐ Section NOT Applicable
- ☒ Check the condition of the power cable.
- ☒ Clean the exterior surfaces of the accessory with soft lint free cloth. This cloth can be dampened with warm water or a mild detergent. Do not use organic solvents or abrasive cleaning agents.

Restore System

- ☒ If you have altered the customer's instrumentation during the course of PM, restore to the original status to allow the customer to conduct their normal activities (e.g., reload the customer's method.)

Guidance

If the PM service is performed prior to a qualification service, then use the qualification procedure as a guide for final instrument set up and checkout.

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Signature Page

Service Review

- ☒ Attach available reports/printouts of all tests to this documentation.
- ☒ Record the Preventive Maintenance service activity in the customer's records/logbook.
- ☒ Update/reset instrument maintenance counters as appropriate.
- ☒ Affix the PM sticker to the system or instrument logbook based on the customer's request.
- ☒ Complete the Service Engineer Comments section if there are additional comments.
- ☒ Review this service, parts replaced, and test results obtained with the customer.
- ☒ If the instrument firmware was updated, record the details of the change in the Service Engineer's Comments box or if necessary, in the customer's IQ records.

Test Results

Test Description	Expected Test Result	Actual Test Result
Flame optics PMT Gain test		
For copper at 324.8 nm, 4 mA, 0.5 nm slit width	< 55 %	–
Flame performance test with 5 ppm copper sample		
Air /acetylene, mixing paddle removed	Abs value > 0.5	~
Air /acetylene, mixing paddle installed. 10 replicates	%RSD < 1.0	–
Deuterium furnace optics PMT Gain test		
For copper at 324.8 nm, 4 mA, 0.5 nm slit width	< 55 %	–
Deuterium furnace performance test with 25 ppb copper sample (324.8 nm)		
Precision %RSD	≤ 4.0%	–
Abs value	≥ 0.15	–
Zeeman furnace analytical performance: 25 ppb copper sample (327.4 nm)		
Precision %RSD	≤ 4.0%	1.37
Abs value	≥ 0.10	0.14915
MSR%	≥ 70 %	75.154

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AA consumable and parts list table

Part Description	Part Number	Product/Model # where used	PM supplied or Consumable	Instrument Type
Test Solution - Cu 5ppm solution	6610030100	50 55 140 240 280	PM supplied	Common
Test Solution - Blank solution	5190-7001	50 55 140 240 280	PM supplied	Common
Copper, 1000 ug/ml, 100ml	5190-8279	50 55 140 240 280	*	Common
Kit, Mk 7 O-rings, aqueous, complete set	9910093400	50 55 140 240 280	PM supplied	Flame
Organic Kit	9910093500	50 55 140 240 280	PM supplied	Flame
Wire Nebulizer Cleaning	9910024700	50 55 140 240 280	consumable	Flame
Tubing-Capillary Std Nebs	9910024800	50 55 140 240 280	consumable	Flame
Capillary Tube Hvac Neb (3) (organics only)	9910044000	50 55 140 240 280	consumable	Flame
Glass impact beads (5/pk)	9910025700	50 55 140 240 280	consumable	Flame
Teflon impact beads (5/pk) (organics only)	9910053300	50 55 140 240 280	consumable	Flame
Burner cleaning strip (100/pk)	9910053900	50 55 140 240 280	consumable	Flame
Window UV silica - round (right side)	2010082600	50 55 140 240 280	PM supplied	Common
Window UV silica - rectangular (left side)	2010082500	50 55 140 240 280	PM supplied	Common
Pad adhesive window (round)	4910012700	50 55 140 240 280	PM supplied	Common
Pad adhesive window (rectangular)	4910012800	50 55 140 240 280	PM supplied	Common
Electrode kit (1 pr) (D2)	6310003400	GTA120	PM supplied	Furnace
Shroud (D2)	6310003100	GTA120	PM supplied	Furnace
Zeeman electrode kit (1 pr)	6310003500	GTA120	PM supplied	Furnace
Zeeman shroud	6310003600	GTA120	PM supplied	Furnace
O-ring PSD rinse bottle	6910025900	PSD120	PM supplied	Furnace

* For engineers who only service AA instruments 5190-8279 can be used as a cheaper alternative for 6610030100.

Items classified as PM supplied in the above table are included in the standard PM
Those classified as consumable should be provided by the customer or charged to the customer if supplied by the Agilent service engineer.

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Service Engineer Comments (optional)

If there are any specific points you wish to note as part of performing the installation or other items of interest for the customer, please write in this box.

Service Completion

Service request number 6007172509 Date service completed Oct 15, 2024
Agilent signature Nukoon L. Customer signature Chomthanan
Total number of pages in this document 13

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SVD Results Report



Report ID: 26 Diagnostic Start Time: 10/15/2024 8:22:03 AM Diagnostic End Time: 10/15/2024 9:02:11 AM

Customer: United Analyst And Engineering Consultant Co., Ltd. Engineer: Nukoon Lueangsangwan
Address: 3 Soi Udomsuk 41 Sukhumvit Bangkok 10260 Contact Details: 02-637-6363

Instrument Configuration

Configuration:

Serial Number: MY18130003 Turret Type: Automatic
Instrument Model: Varian AA140/240/280 Number Of Lamps: 4
Flame Instrument: False Mono Type: Automatic
Furnace Instrument: True Gasbox Type: No Gas Box
Zeeman Present: True Auto Burner Adjuster: False
Internal Zeeman: True Mains Frequency: 50
Internal UltraAA: True Firmware Version: 2.12
Optics Type: Single Beam Photomultiplier Type: Normal(900nm)
D2 BG Correction Fitted: False PWB Version: 181
Boot Block Version: 2.02

EEPROM Data:

Instrument Run Hours: 16857.566 D2 Run Hours: 0.000
Zero Wavelength Offset: -1.340 D2 Serial Number: not set !
Mono Correction: -0.145 D2 Install Date: 1/1/1970
Flame Hours: 0.000 D2 Original Intensity: 1.000
D2 Last Intensity: 1.000

Frequency:

Averaging Period: 30.0
Datapoint Count: 20

Upper Limit: 51.00 Highest Measured Frequency: 50.00
Average Frequency: 50.00
Lower Limit: 49.00 Lowest Measured Frequency: 50.00

Result: **Passed**

Power Supply:

Averaging Period: 30.0
Datapoint Count: 20

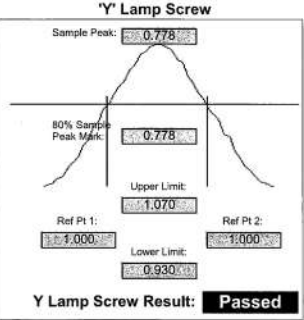
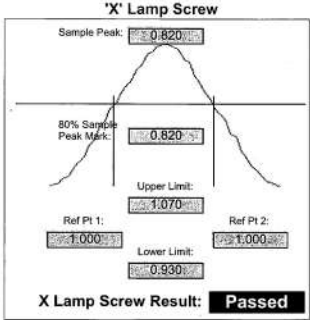
	Lower Limit (V)	Actual (V)	Upper Limit (V)	Result:
12.00 V Rail	10.80	12.10	13.20	Passed
-12.00 V Rail	-13.20	-11.80	-10.80	Passed
5.00 V Rail	4.50	5.00	5.50	Passed
310.00 V Rail	279.00	318.00	341.00	Passed

Optics

Beam Balance:

Lamp Type:
Lamp Socket Used:

Peak Selected:
Lamp Alignment: **Performed**



Grating Squareness:

Lamp Element(s): Copper
Lamp Turret Position: 3
Lamp Current(mA): 4.00
Slit Width(nm): 0.5
1st Order Wavelength(nm): 324.80
Lamp Alignment: **Performed**

	Lower Limit (nm)	Actual (nm)	Upper Limit (nm)	Result:
Zero Order	-0.10	0.00	0.10	Passed
First Order	324.45	324.65	325.15	Passed
Second Order	649.23	649.45	649.97	Passed

Wavelength Repeatability:

Lamp Used: Copper
Peak Used(nm): 324.750
Connected to Socket: 3
Lamp Current(mA): 4
Slit Width(nm): 0.2
Slit Height: Normal
Lamp Alignment: **Performed**
Lower Limit(nm) 324.608 324.728 Upper Limit(nm)
(Approach from Zero Order) (Approach from end)
Sample 1: 324.668 Sample 2: 324.672
Sample 3: 324.672 Sample 4: 324.672
Sample 5: 324.672 Sample 6: 324.668
Sample 7: 324.664 Sample 8: 324.672
Sample 9: 324.672 Sample 10: 324.672
Mean: 324.671 Standard Deviation: 0.003

Result: **Passed**

Mechanical

Wavelength Drive:

Passed

Slit Drive:

Passed

Turret Drive:

Passed

Auto Burner Adjuster Drive:

Untested

Miscellaneous

Signal Processing Linearity:

Calculate Mode: New Calc Mode

	Lower Limit	Actual	Upper Limit	Result:
S0	114	199	297	Passed
S1	156	166	191	Passed
S2	271	300	332	Passed
S3	474	514	579	Passed
S4	825	931	1008	Passed
S5	1435	1549	1754	Passed
S6	2498	2787	3053	Passed
S7	4347	4754	5313	Passed

Interlocks:

Burner Fitted: **Untested** Flame Detect: **Untested**
N2O Burner Fitted: **Untested** GCU Active: **Untested**
Flame Shield Closed: **Untested** Oxidant Pressure: **Untested**
Gas Control Fitted: **Untested** Oxidant Changeover: **Untested**
Pressure Release Bung Fitted: **Untested** Ignition: **Untested**
Liquid Trap Fitted: **Untested**

Auto Lamp Recognition:

Lamp 1: Uncoded Lamp/Not Connected
Lamp 2: 68 - Zinc (Zn)
Lamp 3: 14 - Copper (Cu)
Lamp 4: 87 - Silver/Cadmium/Lead/Zinc(UltrAA) (Ag/C
Lamp 5: Not Supported
Lamp 6: Not Supported
Lamp 7: Not Supported
Lamp 8: Not Supported

Result: **Passed**

GTA Temperature Monitoring:

Not Performed

Notes:

Signatures:

United Analyst And Engineering Data Consultant Co., Ltd Nukoon Lueangsangwan Date

Agilent AA Validate Test Report

Report Time: Tue 15 Oct 09:52:19 AM 2024 GMT: 10-15-2024 2:52:19 AM
Worksheet: C:\ProgramData\AGILENT\SP100\Zn_15-10-2024 09:52:19 AM.AAAWS
SpectraAA Software Version: 5.4
SpectraAA Build Number: 6
Computer Name: DESKTOP-LUNGCJE
User: DESKTOP-LUNGCJE\HMAU212
Software version: 1.0.0.81

Instrument / Accessory Information

Instrument A
Inst. Model AA 240 Series
Inst. Type FurnaceZeeman
FWD Long Range Tube
Gas Box No Gas Box
D2 BC Lamp Not Filled
Turret Type Automatic
Mono/Slits Auto Mono, Auto Slits
Lamp Positions 4
Mains Frequency 50Hz
Serial Number MY18130003
Firmware Version 2.12

Accessory Serial no Firmware Version
GTA 0000000000 8.04
SIPS 0000000000
VGA 0000000000
ETC-60 0000000000
Diluter 0000000000
SPS4 0000000000
UltraAA lamp Supply 0000000000

Test equipment Certification Date Serial no
Arsenic lamp 10-10-2022 0000000000
Copper lamp 10-10-2022 0000000000
Sodium/Potassium lamp 10-10-2022 0000000000
Gold lamp 10-10-2022 0000000000
Neutral density filter 10-10-2022 0000000000

TEST DESCRIPTION	SPECIFICATION	RESULTS	STATUS
Zeeman Magnetic Sensitivity Ratio			
Absorbance (BC OFF)		0.183	
Absorbance (BC ON)		0.138	
MSR	[70..99]	75.254	PASS

Meaning of signature*	Name	Signature	Date

*For example: "Tested by", "Reviewed by", etc.

Analyst
Date Started 9:16 AM 10/15/2024 GMT: 2:18 AM 10/15/2024
Worksheet Cu 25 ppb
Comment
Methods Cu
Computer name DESKTOP-LUNGCJE
Serial Number: MY18130003

Method: Cu (Zeeman)

Sample ID	Conc. ug/L	%RSD	Mean Abs	BG Abs
Cu 25 ppb	UNCAL	1.3	0.1495	0.0557
Readings				
	0.1518	0.1487	0.1482	

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม



Certificate of Calibration

Cert.No.: 24CH1115
Page: 1 of 2

Equipment : Turbidity Meter
Manufacturer : Oakton
Model : T100IR
Serial No. : 1120501017
ID. No. : UAE.WAT.056/2563
Condition As-Received: Used Item
Received Date : 05 September 2024
Calibration Date : 06 September 2024
Reference : 2409-0177DSC-1
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong, Bangkok 10260
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 20) %
Calibration Procedure : In - house method : CP-CH11
Direct measurement by
using Formazin standard solution
Calibrated by : Walalak Sirithean
Approved by :
() Unnopphol Harachai
() Ponpan Paipim
(✓) Salthip Meangmai
Issue Date : 9 September 2024

The Uncertainties are for a confidence probability of approximately 95%

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

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ศูนย์บริการการสอบเทียบและการตรวจสอบ
Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center



Calibration Certificate

Certificate No.: 2502226-002-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road,
Bangchack, Prakhonong, Bangkok 10260

Page 1 of 4

Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: XSR205DU
Serial No.: C210685394
ID No.: UAE.WAO.010/2565
Order No.: 2502226
Operation No.: 2502226-002
Date of Receipt: 19 March 2025
Date of Calibration: 20 March 2025

Calibrated by Mr.Yothin Charoensuk
Scientist
Approved by
(Mr.Pheraphat Tuanjit)
Manager, Division of Calibration Laboratory
Responsible for the Technical Management Team
Date of Issue: 25 March 2025

The uncertainties are for a confidence probability of approximately 95%

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full, except with the prior written approval of the National Food Institute.

FCS-009 Revision: 01 Date: 20-04-65

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Cert.No.: 24CH1115
Page: 2 of 2

Condition of this calibration result

1. Reference Standard Instruments :

Instruments	Serial No.	ID No.	Certificate No.	Due date
1) Thermo-Hygraph	1103328	130EC010	24H1372	12 July 2025
2) Electronic Balance	1126143764	140RC004	22MM22	20 Feb 2025

- This Certification is traceable to SI Through Technology Promotion Association (Thailand - Japan)

2. Standard Material : The Formazin suspension has been prepared gravimetric from

Material	Manufacturer	Lot No.	Assay
1) Hexamethylenetetramine	HIMEDIA	0000493947	99.65%
2) Hydrazinium Sulfate	HIMEDIA	0000522014	99.40%

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

Calibration result

Performing five - Formazin suspension standard curve by using 0,20,100,400,800 NTU
Turbidity Meter Serial Number : 1120501017

Standard Formazine suspension (NTU)	UUC* Reading (NTU)	Uncertainty of Measurement (± NTU)	Coverage Factor k
0	0.00	0.0081	2.06
20	20.2	0.39	2.00
100	100	0.75	2.00
400	401	1.5	2.06
800	801	2.1	2.17

Remark - UUC* = Unit Under Calibration
- NTU = Nephelometric Turbidity Units

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

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Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center



Calibration Report

Certificate No.: 2502226-002-01
Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: XSR205DU
Serial No.: C210685394
Capacity: 82 g / 220 g
Resolution: 0.00001 g / 0.0001 g
ID No.: UAE.WAO.010/2565

Page 2 of 4

Date of Calibration: 20 March 2025

Environment Condition: Ambient Temperature: 21.2 ± 0.6 °C Relative Humidity: 48 ± 3.5 %

Place of Calibration: 208 Balance Room, UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.

Condition of Equipment: Good Condition

Condition of This Results of Calibration:

1. Calibration Method: NFI Method W-MA-001 In-House Method based on UKAS Lab 14 : 2019

2. Reference Standards:

Reference Standard	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Standard Weight Class E2	1mg to 200g	8505567572	TCS	M24041005	19 April 2025
Instrument	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Thermo-Hygro Meter	608-H1	NF18TH 017/23	Quality Reborn	QR25-0542	10 February 2026

3. This certification is traceable to SI UNIT

4. This certificate was certified only for the instrument we calibrated.

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

Calibration Results:

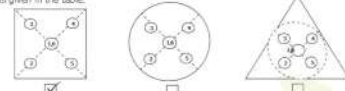
1. Repeatability of Reading:

Nominal Value (g)	Standard Deviation of Reading (g)
40	0.0000042
80	0.0000042
100	0.000000
200	0.000000

2. Off-Center Error:

A mass of 100 g was placed and moved to various position on pan.

The balance reading obtained is given in the table.



1	2	3	4	5	6	(Maximum Difference)
(g)	(g)	(g)	(g)	(g)	(g)	(g)
100.0001	100.0001	100.0001	100.0001	100.0001	100.0001	0.0000

FCS-012 Revision: 01 Date: 20-04-65

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Calibration Report

Certificate No.: 2502226-002-01
Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: XSR205DU
Resolution: 0.00001 g / 0.0001 g
Serial No.: C210685394
ID No.: UAE.WAO.010/2565
Capacity: 82 g / 220 g

Date of Calibration: 20 March 2025 **Page 3 of 4**

Calibration Results: (Continued)

Calibration Range: 0-80 g

Calibration Adjustment: Internal Calibration

3. Departure from Nominal Value: (Range: 0 - 82 g ; Resolution: 0.00001 g)

Nominal Value (g)	Standard Value (g)	Average Reading (g)	Correction (g)	Uncertainty (± g)	Coverage Factor k
Unloaded	0.000000	0.00000	0.00000	0.0000087	2.00
0.001	0.001003	0.00100	0.00000	0.0000090	2.00
0.005	0.005002	0.00501	-0.00001	0.0000092	2.00
0.01	0.010003	0.01002	-0.00002	0.0000089	2.00
0.05	0.049996	0.05001	-0.00001	0.0000096	2.00
0.1	0.100011	0.10002	-0.00001	0.000011	2.00
0.5	0.500016	0.50004	-0.00002	0.000014	2.00
1	1.000003	1.00005	-0.00005	0.000016	2.00
2	2.000023	2.00006	-0.00004	0.000017	2.00
5	5.000015	5.00006	-0.00005	0.000020	2.00
10	10.000009	10.00005	-0.00004	0.000026	2.00
20	20.000030	20.00007	-0.00004	0.000037	2.00
30	30.000039	30.00009	-0.00005	0.000050	2.00
50	50.000028	50.00008	-0.00005	0.000068	2.00
80	80.000067	80.00013	-0.00006	0.00011	2.00

F-CS-012 Revision: 01 Date: 20-04-65

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Calibration Report

Certificate No.: 2502226-002-01
Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: XSR205DU
Resolution: 0.00001 g / 0.0001 g
Serial No.: C210685394
ID No.: UAE.WAO.010/2565
Capacity: 82 g / 220 g

Date of Calibration: 20 March 2025 **Page 4 of 4**

Calibration Results: (Continued)

Calibration Range: >80-200 g

Calibration Adjustment: Internal Calibration

3. Departure from Nominal Value: (Range: >80 - 200 g ; Resolution: 0.0001 g)

Nominal Value (g)	Standard Value (g)	Average Reading (g)	Correction (g)	Uncertainty (± g)	Coverage Factor k
90	90.00010	90.0002	-0.0001	0.00015	2.00
100	100.00006	100.0001	0.0000	0.00016	2.00
110	110.00007	110.0002	-0.0001	0.00017	2.00
120	120.00009	120.0002	-0.0001	0.00018	2.00
130	130.00019	130.0002	-0.0001	0.00019	2.00
140	140.00013	140.0002	-0.0001	0.00019	2.00
150	150.00009	150.0002	-0.0001	0.00021	2.00
160	160.00019	160.0002	-0.0001	0.00022	2.00
170	170.00012	170.0002	-0.0001	0.00023	2.00
200	200.00013	200.0002	-0.0001	0.00028	2.00

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

----- End -----

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Agilent 55 240 280 Series Atomic Absorption Spectroscopy Systems

Preventive Maintenance Checklist

Agilent Preventive Maintenance provides factory recommended service for your analytical systems to assure reliable operation and the accuracy of your results.

Delivered by highly trained and certified service engineers using genuine Agilent parts and supplies, Agilent Preventive Maintenance provides everything you need to reduce unplanned downtime and keep your systems operating at their peak. This checklist will be completed at the end of the service and provided to you as a record of the installation.

Note: While non-current production AA instrument and/or accessory models are not covered specifically in this document it can be used as a basic reference.

For more information about Agilent Technologies services please visit our web site using the following URL: <http://www.agilent.com/en-us/services>

Introduction

Customer Information

- Customers should provide all necessary operating supplies upon request of the engineer.
- A customer representative should be available to the engineer while performing the preventive maintenance procedures.
- Any parts, not included in the Parts Lists section of this document, are not part of the recommended Preventive Maintenance service, nor are they included in the price of this service.
- If a system requires the use of extra or special procedures and/or parts for the maintenance service, then these must be ordered separately and charged as a repair, which may incur additional costs.

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Instrument Preventive Maintenance Checklist

Important Customer Web Links

- For more information about *Agilent Technologies services*, please visit our website using the following URL: <http://www.agilent.com/en-us/products/crosslab-instrument-services/service-repair>
- To access *Agilent University*, visit <http://www.agilent.com/crosslab/university/> to learn about training options, which include online, classroom and onsite delivery. A training specialist can work directly with you to help determine your best options.
- A useful *Agilent Resource Center* web page is available, which includes short videos on maintenance, quick lists of consumables for new instruments, and other valuable information. Check out the Resource Page here: <https://www.agilent.com/en-us/agilentresources>
- Need technical support, FAQs, supplies? – visit our *Support Home page* at <http://www.agilent.com/search/support>
- Get answers. Share insights. Build connections. Join the *Agilent Community* at <https://community.agilent.com/welcome>

Service Engineer's Responsibilities

- Contact the customer and ensure that all necessary supplies are available before the preventive maintenance visit.
- Confirm the ability of the instrument to deliver continued safe operation as established via the Agilent AA safe operation flow chart. (Refer directly to the AA 55/240/280 Preventive Maintenance Scope of Work to make this decision.)
- Only select those pages that relate to the system or module being serviced.
- Complete empty fields with the relevant information.
- Complete the relevant checkboxes in the checklist using either a "X" or tick mark "✓".
- Check "Section not applicable" check boxes to indicate services/tasks not delivered, as appropriate.
- Complete the Preventive Maintenance service in the order of the tasks listed.
- Complete the Service Review section together with the customer.
- Complete the fields for page numbers at the foot of each selected page
- Complete the total number of pages field in the Service Completion section
- Ask the customer to sign the Service Completion section including the customer's and your signature.

This information is subject to change without notice.

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Instrument Maintenance

System Information

- ☐ Check this box if an instrument configuration report is attached instead of completing the table.

Instrument System Name and ID	240 FS AAS
Instrument System Site and Location	United Analyst and Engineering Consultant

List System Component Product Numbers	List the Serial Numbers of each Component
1. G 9432 A	M1 13160001
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	

Preparation, Safe operation and Initial performance checks

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- ☐ Agilent AA safe operation flow chart inspections (to determine if the PM can be performed).

NOTE: If by following the flow chart the instrument is deemed to be unsafe for continued use you MUST NOT continue PM work. Inform the customer immediately of the Agilent recommendation that use of the instrument be discontinued.

- ☒ Discuss any specific issues with the customer before starting.
- ☐ For HF application systems, if standard sample introduction system was not installed, ask the customer to install it. ~~NA~~
- ☒ Review the instrument logbook for recorded problems and comments.
- ☒ Save instrument control settings before starting the procedure.
- ☒ Perform a general inspection of the system for cleanliness.
- ☒ Check for proper installation of parts, assemblies, sensors etc.
- ☒ Check system for required installation of components, settings as defined by current Service Notes
- ☒ Check for required firmware updates and verify with customers if they would like them installed.
- ☒ Use SVD to perform a Full Wavelength Scan for Cu HCL - "As found test_1"
- ☒ Perform a Basic Cu ABS test - "As found test_2"
- ☒ Print the Details page or screen captures of the test results and attach to the end of this checklist.

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Preventive Maintenance Procedures

FLAME SYSTEM section

- ☐ Section not applicable

Electronic components

- ☒ Review and confirm instrument configuration data in SVD
- ☒ Confirm power supply voltages using the *SVD Power Supply diagnostic*.
- ☒ For Dual Beam Instruments - Confirm RBC frequency using the *SVD RBC frequency diagnostic*.

Mechanical components

- ☒ Check the burner adjuster controls for complete and free movement. If the burner adjuster needs lubrication, use Molykote 321 or mineral-based molybdenum disulphide grease.
- ☒ Run SVD tests to exercise all motor drives over the full range of their travel:
 - ☒ Monochromator drive
 - ☒ Slit drive
 - ☒ Lamp selector
 - ☐ ABA

Optics components

- ☒ Check that external optical surfaces are clean - Clean or replace as required.
- ☒ Use SVD and perform *Mono Wavelength Correction*.
- ☒ Use SVD and perform *Slit Calibration*.
- ☒ Use SVD and perform *Grating Squareness Diagnostic*.
- ☒ Use SVD and perform *Zero Order Offset/Mono Correction*.
- ☒ Use SVD and perform *Wavelength Repeatability*.
- ☒ Physically inspect selected HC lamps (customer to supply per their choice) and measure the % Gain for each lamp. Advise customer if lamps are showing emission degradation due to age.
- ☒ Check that the signal energy of the D2 and HC lamps track properly. Advise customer if their D2 lamp is showing emission degradation due to age.

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Sample Introduction and Atomization

- ☒ Inspect the burner interlock plate to ensure that the interlock pin is secure and correct for the burner type.
- ☒ Clean the burner slot with a clean white card.
- ☒ Check the uniformity of the slot width.
- ☒ Clean the burner if required.
- ☒ Change the burner o-ring.
- ☒ Clean the nebulizer, spray chamber and liquid trap.
- ☒ Change all o-rings and seals in the nebulizer, nebulizer block and spray chamber.
- ☒ Check that the pressure relief bung releases readily.
- ☒ Change o-rings on the fuel and oxidant delivery bars.
- ☒ Leave the liquid trap EMPTY and verify the flame will not ignite in this state.
- ☒ Refill liquid trap and check that overflow drains freely into the drain/waste tube.
- ☒ Check the drain/waste tube for good drainage. It should not have tight bends, kinks or loops and the lower end must be above the liquid level in the waste vessel
- ☒ Check and clean the igniter electrode

Gas handling components and safety interlocks

- ☒ Pressure test for leaks
- ☒ Leak test gasbox internal components and connections
- ☒ Check safety interlock status and operation using the *SVD Interlock monitoring diagnostic*.

Analytical performance for Flame systems

- ☒ Ignite a flame.
- ☒ Check that you can adjust the nebulizer uptake rate from 4 to 6.5 mL per minute.
- ☒ Optimize the instrument ready to perform Cu sensitivity test.
- ☒ Create a manual method to perform a Basic Cu ABS test - "Final Performance Testing"
- ☒ Run a PM completed sensitivity test for a 5 ppm copper sample and record the results in the AA PM Performance test results and measurements table.

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FURNACE SYSTEM section

☒ Section not applicable

Electronic components

- ☐ Review and confirm instrument configuration data in SVD
- ☐ Confirm power supply voltages using the *SVD Power Supply diagnostic*.

Mechanical components

- ☐ Run SVD tests to exercise all motor drives over the full range of their travel:
 - ☐ Monochromator drive
 - ☐ Slit drive
 - ☐ Lamp selector

Optics components

- ☐ Check that external optical surfaces are clean – Clean or replace as required.
- ☐ Use SVD and perform *Mono Wavelength Correction*.
- ☐ Use SVD and perform *Slit Calibration*.
- ☐ Use SVD and perform *Grating Squareness Diagnostic*.
- ☐ Use SVD and perform *Zero Order Offset/Mono Correction*.
- ☐ Use SVD and perform *Wavelength Repeatability*.
- ☐ Physically inspect selected HC lamps (customer to supply per their choice) and measure the % Gain for each lamp. Advise customer if lamps are showing emission degradation due to age.

Gas handling, water system and workhead component checks

- ☐ Inspect the GTA workhead gas hoses and connections for leaks.
- ☐ Pressure test for gas leaks
- ☐ If the cooler system is accessible (stand-alone) check for correct operation and coolant/water level – this includes any temperature and pressure settings plus filter cleaning (air flow and water).
- ☐ Inspect the GTA workhead water hoses and connections for leaks.
- ☐ Check all graphite components and replace if necessary.

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- ☐ Tube
- ☐ Electrodes
- ☐ Shroud

- ☐ Check and clean the end windows on the workhead.
- ☐ Check safety interlock operation.

Analytical performance for Furnace systems

- ☐ Optimize the instrument ready to perform Cu sensitivity test.
- ☐ Run the sensitivity test for a 25 ppb copper sample and record the results in the results table.

PSD autosampler accessory for Furnace systems

☒ Section NOT Applicable

- ☐ Check condition of the PSD capillary – replace if necessary
- ☐ Check condition and operation of PSD syringe – ensure it does not have air locks and bubbles.
- ☐ Change PSD rinse bottle o-ring.
- ☐ Check and clean the rinse vessel.
- ☐ Check the drain tube for good drainage. It should not have tight bends, kinks or loops and the lower end must be above the liquid level in the waste vessel.
- ☐ Ensure that the waste vessel is suitable for use with the furnace system.

Sample introduction pump system (SIPS) accessory

☒ Section NOT Applicable

- ☐ Re-torque screws securing the hubs, presser arms and pump rotors.
- ☐ Adjust each roller so that it rotates freely.
- ☐ Wipe clean the pump rotor rollers and pump bands with a dry clean cloth.
- ☐ Ensure that the presser arms and the surfaces near the pump are free from dirt and spills.
- ☐ Remove the pump module rear cover and check for the incursion of liquids and any signs of corrosion.
- ☐ Re-torque the nuts that fasten the motor mounting plates to the chassis.
- ☐ Check clips securing the diluents holder and replace if necessary.
- ☐ Disconnect, clean T-piece, and reassemble the tubing using the following steps.

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- ☐ Remove the T-piece by disconnecting the pump tubes, the pump bands and all other tubing.
- ☐ Place the T-piece in an ultrasonic bath containing strong detergent 1-5% Decon 30 or similar, for approximately 5-10 minutes.
- ☐ Wash the T-piece under a tap with a strong flow of water.
- ☐ Rinse with distilled water through all of the inlets in the reverse direction to normal sample flow.
- ☐ Reassemble.

Sample preparation system (SPS 4) accessory

☒ Section NOT Applicable

The Agilent SPS 4 autosampler is designed to need minimal maintenance.

The following maintenance requirements are suggested to maintain the performance of the autosampler.

- ☐ Cleaning the spill tray, rack location mat, end frames and chassis accessories with a damp soft cloth and diluted mild detergent.
- ☐ Cleaning the autosampler cover panels with domestic window cleaner.
- ☐ Checking the X- axis and Z- axis drive belts for cracks, splits, damaged teeth, excessive fraying, color changes or degradation from fumes.
- ☐ Check the X- axis, Theta- axis and Z- axis FFC cables for cracks, incorrect positioning, damaged edge or damaged connectors.

NOTE: The autosampler requires no extra lubrication throughout its lifetime.

For further details refer to the SPS 4 service manual G8410-90050.

Sample preparation system (SPS 3) accessory

☒ Section NOT Applicable

- ☐ Check the x-axis and z-axis timing belts – Replace if there is any cracks, splits or color deterioration and belt tension.
- ☐ Check belt tensions - adjust if required
- ☐ Check the lubrication pad for single x-axis shaft. If pad is dry or customer has observed any vibration or erratic movements of the x-axis carriage, add 1 mL of Dow Corning 200 @ Fluid, 200 CS into the well.
- ☐ Check the auto-sampler ability to find tube positions - Calibrate if required.
- ☐ Clean the exterior surfaces of the accessory with soft lint free cloth. This cloth can be dampened with warm water or a mild detergent. Do not use organic solvents or abrasive cleaning agents.

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Vapor generation accessory VGA (hydride generator)

☒ Section NOT Applicable

- ☐ Inspect VGA gas supply hose.
- ☐ Inspect/replace VGA pump tubing.
- ☐ Check low gas pressure interlock setting – adjust if required.
- ☐ Check precision orifice gas flow setting – adjust if required.
- ☐ Check gas regulator pressure to 46 psi (325 kPa) – adjust if required.
- ☐ Clean the exterior surfaces of the accessory with soft lint free cloth. This cloth can be dampened with warm water or a mild detergent. Do not use organic solvents or abrasive cleaning agents.

UltraAA lamp accessory (external)

☒ Section NOT Applicable

- ☐ Check the condition of the power cable.
- ☐ Clean the exterior surfaces of the accessory with soft lint free cloth. This cloth can be dampened with warm water or a mild detergent. Do not use organic solvents or abrasive cleaning agents.

Restore System

- ☐ If you have altered the customer's instrumentation during the course of PM, restore to the original status to allow the customer to conduct their normal activities (e.g., reload the customer's method.)

Guidance

If the PM service is performed prior to a qualification service, then use the qualification procedure as a guide for final instrument set up and checkout.

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Signature Page

Service Review

- ☒ Attach available reports/printouts of all tests to this documentation.
- ☒ Record the Preventive Maintenance service activity in the customer's records/logbook.
- ☒ Update/reset instrument maintenance counters as appropriate.
- ☒ Affix the PM sticker to the system or instrument logbook based on the customer's request.
- ☒ Complete the Service Engineer Comments section if there are additional comments.
- ☒ Review this service, parts replaced, and test results obtained with the customer.
- ☒ If the instrument firmware was updated, record the details of the change in the Service Engineer's Comments box or if necessary, in the customer's IQ records.

Test Results

Test Description	Expected Test Result	Actual Test Result
Flame optics PMT Gain test		
For copper at 324.8 nm, 4 mA, 0.5 nm slit width	< 55 %	49 %
Flame performance test with 5 ppm copper sample		
Air /acetylene, mixing paddle removed	Abs value > 0.5	0.5599
Air /acetylene, mixing paddle installed, 10 replicates	%RSD < 1.0	0.2 %
Deuterium furnace optics PMT Gain test		
For copper at 324.8 nm, 4 mA, 0.5 nm slit width	< 55 %	-
Deuterium furnace performance test with 25 ppb copper sample (324.8 nm)		
Precision %RSD	≤ 4.0%	-
Abs value	≥ 0.15	-
Zeeman furnace analytical performance: 25 ppb copper sample (327.4 nm)		
Precision %RSD	≤ 4.0%	-
Abs value	≥ 0.10	-
MSPR%	≥ 70 %	-

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AA consumable and parts list table

Part Description	Part Number	Product/Model # where used	PM supplied or Consumable	Instrument-Type
Test Solution - Cu 5ppm solution	6610030100	50 55 140 240 280	PM supplied	Common
Test Solution - Blank solution	5190-7001	50 55 140 240 280	PM supplied	Common
Copper, 1000 ug/ml, 100ml	5190-8279	50 55 140 240 280	*	Common
Kit, Mk 7 O-rings, aqueous, complete set	9910093400	50 55 140 240 280	PM supplied	Flame
Organic Kit	9910093500	50 55 140 240 280	PM supplied	Flame
Wire Nebulizer Cleaning	9910024700	50 55 140 240 280	consumable	Flame
Tubing-Capillary Std Nebs	9910024800	50 55 140 240 280	consumable	Flame
Capillary Tube Hvac Neb (3) (organics only)	9910044000	50 55 140 240 280	consumable	Flame
Glass impact beads (5/pk)	9910025700	50 55 140 240 280	consumable	Flame
Teflon impact beads (5/pk): (organics only)	9910053300	50 55 140 240 280	consumable	Flame
Burner cleaning strip (100/pk)	9910053900	50 55 140 240 280	consumable	Flame
Window UV silica - round (right side)	2010082600	50 55 140 240 280	PM supplied	Common
Window UV silica - rectangular (left side)	2010082500	50 55 140 240 280	PM supplied	Common
Pad adhesive window (round)	4910012700	50 55 140 240 280	PM supplied	Common
Pad adhesive window (rectangular)	4910012800	50 55 140 240 280	PM supplied	Common
Electrode kit (1 pr) (D2)	6310003400	GTA120	PM supplied	Furnace
Shroud (D2)	6310003100	GTA120	PM supplied	Furnace
Zeeman electrode kit (1 pr)	6310003500	GTA120	PM supplied	Furnace
Zeeman shroud	6310003600	GTA120	PM supplied	Furnace
O-ring PSD rinse bottle	6910025900	PSD120	PM supplied	Furnace

* For engineers who only service AA instruments 5190-8279 can be used as a cheaper alternative for 6610030100.

Items classified as PM supplied in the above table are included in the standard PM. Those classified as consumable should be provided by the customer or charged to the customer if supplied by the Agilent service engineer.

Revision: 10.00, Issued: November 2021
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SVD Results Report



Report ID: 2	Diagnostic Start Time: 1/30/2025 9:14:28 AM	Diagnostic End Time: 1/30/2025 9:46:08 AM
Customer: UAE	Service Engineer: Kanyakorn S.	
Address: Soi Udomsuk 41, Sukhumvit Rd, Bangkok	Contact Details: 02637636381	

Configuration:

Serial Number: MY13160001	Turret Type: Automatic
Instrument Model: Varian AA140/240/280	Number Of Lamps: 4
Flame Instrument: True	Mono Type: Automatic
Furnace Instrument: True	Gasbox Type: "Y" Gas Box
Zeeman Present: False	Auto Burner Adjuster: False
Internal Zeeman: False	Mains Frequency: 50
Internal UltraAA: False	Firmware Version: 2.11
Optics Type: Double Beam	Photomultiplier Type: Normal(900nm)
D2 EG Connection Filled: True	PWB Version: 45
Boot Block Version: 1.00	

EEPROM Data:

Instrument Run Hours: 62818.180	D2 Run Hours: 63398.500
Zero Wavelength Offset: 00.133	D2 Serial Number: not set!
Mono Correction: 0.770	D2 Install Date: 1/1/1970
Flame Hours: 32441.834	D2 Original Intensity: 1.000
	D2 Last Intensity: 475.000

Service Engineer Comments (optional)

If there are any specific points you wish to note as part of performing the installation or other items of interest for the customer, please write in this box.

Service Completion

Service request number: 6007549143
Date service completed: 30 Jan 2025
Agilent signature: Kanyakorn S.
Customer signature: Janda Y.
Total number of pages in this document: 13

Revision: 10.00, Issued: November 2021
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Frequency:

Averaging Period: 30.0

Datapoint Count: 20

Upper Limit:
51.00

Average Frequency:

50.00

Highest Measured Frequency:

50.00

Lower Limit:
49.00

Lowest Measured Frequency:

50.00

Result: **Passed**

Power Supply:

Averaging Period: 30.0

Datapoint Count: 20

Lower Limit (V)

Actual (V)

Upper Limit (V)

Result:

12.00 V Rail

10.80

12.12

13.20

Passed

-12.00 V Rail

-13.20

-11.90

-10.80

Passed

5.00 V Rail

4.50

5.04

5.50

Passed

310.00 V Rail

279.00

320.00

341.00

Passed

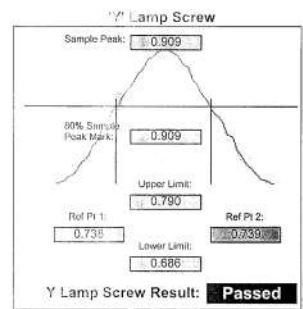
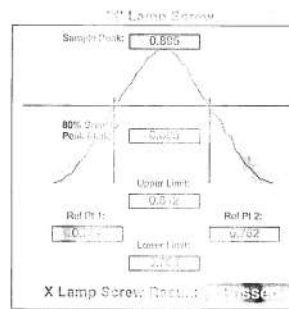
Optics

Beam Balance:

Lamp Type: Copper

Lamp Socket Used: 3

Peak Selected: 324.80

Lamp Alignment: **Performed**

Grating Spectrometer

Lamp Element(s): Copper

Lamp Turret Position: 3

Lamp Current(mA): 4.00

Slit Width(nm): 0.5

1st Order Wavelength(nm): 324.80

Lamp Alignment: **Performed**

	Lower Limit (nm)	Actual (nm)	Upper Limit (nm)	Result:
Zero Order	-0.10	0.00	0.10	Passed
First Order	324.05	324.75	325.15	Passed
Second Order	648.09	649.51	649.97	Passed

Report Generated At: 1/30/2025 9:47:25 AM

2

SVD Results Report **SVD**

เอกสารไม่ควบคุม

Wavelength Repeatability:

Lamp Used: Copper

Lamp Current(mA): 4

Peak Used(nm): 324.759

Slit Width(nm): 0.2

Connected to Socket: 3

Slit Height: Normal

Lamp Alignment: **Performed**

Lower Limit(nm) 324.779

324.888

Upper Limit(nm)

(High end from Zero Drive)

(Low end from end)

Sample 1: 324.823

Sample 2: 324.823

Sample 3: 324.823

Sample 4: 324.823

Sample 5: 324.823

Sample 6: 324.819

Sample 7: 324.819

Sample 8: 324.819

Sample 9: 324.823

Sample 10: 324.819

Mean: 324.823

Standard Deviation: 0.003

Result: **Passed**

Mechanics

Wavelength Drive:

Slit Drive:

Turret Drive:

Auto Burner/Wireless Control:

Micro-Alignment:

Signal Processing Linking:

Signal Data Mode: New Data Mode

	Lower Limit	Actual	Upper Limit	Result:
S0	114	114	297	Passed
S1	118	118	191	Passed
S2	271	271	332	Passed
C0	474	474	579	Passed
S3	936	936	1008	Passed
S4	1455	1455	1754	Passed
S5	2108	2108	3053	Passed
S6	4547	4547	5313	Passed

Interface:

Burner Flame: **Working**
H2O Burner Flame: **Working**
Flame Shield Closed: **Working**
Gas Control Valve: **Working**
Pressure Release Valve: **Working**
Liquid Trap Valve: **Working**

Flame Detect: **Working**
SCU Active: **Working**
Oxidant Pressure: **Working**
Oxidant Changeover: **Untested**
Ignition: **Working**

Report Generated At: 1/30/2025 9:47:35 PM

4

SVD Results Report **SVD**

เอกสารไม่ควบคุม

Report Generated At: 1/30/2025 9:47:35 PM

5

SVD Results Report **SVD**

เอกสารไม่ควบคุม

Auto Lamp Recognition:

Lamp 1: Uncoded Lamp/Not Connected
Lamp 2: 87 - Silver Cadmium Lamp (S/Cd) (Ap/C) Lamp 5: Not Supported
Lamp 3: 14 - Copper (Cu) Lamp 7: Not Supported
Lamp 4: Uncoded Lamp/Not Connected Lamp 8: Not Supported

Result: **Passed**

GTA Temperature Monitoring:

Notes:

Signatures:

Signature: Kanyakorn S. 30 Jan 2025
Date: 30 Jan 2025

Sequential by time report

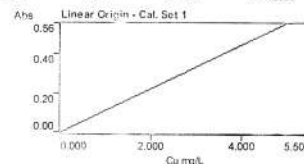
1/30/2025 10:53 AM
Page 1 of 1

SpectRAA

Analyst
Date Started 1/30/2025 10:33 AM GMT: 1/30/2025 3:33 AM
Worksheet Sensitivity Test 01
Comment
Methods Cu
Computer name DESKTOP-R3UFRS
Serial Number: MY13160001

Method: Cu (Flame)

Sample ID	Conc. mg/L	%RSD	Mean Abs		
CAL ZERO	0.000	38.8	0.0002		
Readings	0.0002	0.0003	0.0001	1/30/2025	10:51:46 AM
STANDARD 1	5.000	0.1	0.5571		
Readings	0.5574	0.5563	0.5575	1/30/2025	10:52:22 AM



Curve Fit = Linear Origin
Characteristic Conc = 0.030 mg/L
r = 1.0000
Calculated Conc = 0.002 5.000
Residuals = -0.007 0.000

Abs = 0.11141 x C					
5 ppm Cu	5.025	0.3	0.5568		
Readings	0.5582	0.5596	0.5615	1/30/2025	10:52:54 AM

Report Generated At: 1/30/2025 9:47:25 AM

5

SVD Results Report SVD

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม

Sequential by time report

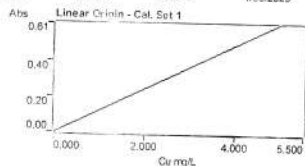
1/30/2025 10:48 AM
Page 1 of 1

SpectRAA

Analyst
Date Started 1/30/2025 10:33 AM GMT: 1/30/2025 3:33 AM
Worksheet Precision Test
Comment
Methods Cu
Computer name DESKTOP-R3UFRS
Serial Number: MY13160001

Method: Cu (Flame)

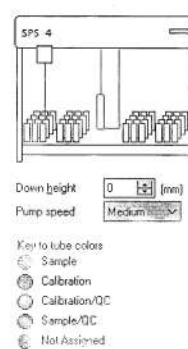
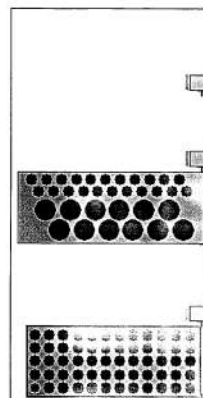
Sample ID	Conc. mg/L	%RSD	Mean Abs		
CAL ZERO	0.000	64.1	-0.0002		
Readings	-0.0003	-0.0003	-0.0001	1/30/2025	10:46:52 AM
STANDARD 1	5.000	0.3	0.6052		
Readings	0.6036	0.6073	0.6047	1/30/2025	10:47:24 AM



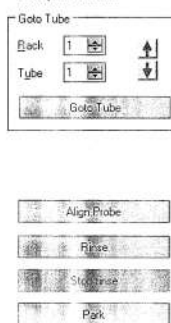
Curve Fit = Linear Origin
Characteristic Conc = 0.030 mg/L
r = 1.0000
Calculated Conc = -0.002 5.000
Residuals = 0.002 0.000

Abs = 0.12105 x C					
5 ppm Cu	5.007	0.2	0.6051		
Readings	0.6055	0.5952	0.6047	0.6042	0.6079
	0.6055	0.6076	0.6064	0.6079	1/30/2025 10:48:32 AM

Flame Optimization



Sampler Offline



Optimization: Lamp



0.917

Optimize Lamp

Optimize Sign

Rescale

Inst Zero

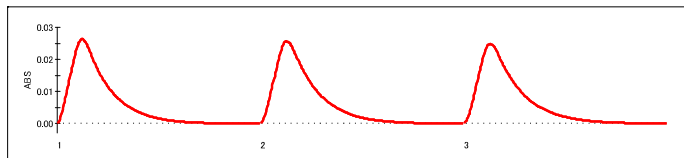
Gain 49 %

Ok

Sensitivity Check 1.5 mg/L gives about 0.2 Abs at 324.8 nm, A/A burner

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม



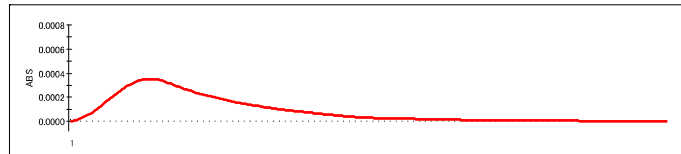
Self Check

Heat check: PASS!! (26.3degC[05:00] -> 30.3degC[02:29])
 Sensor check: PASS!! (53-10= 43)
 Leak check: PASS!! (0.19L/min)
 Sig/Ref check: PASS!! (Sig: 4.00V, Ref: 4.02V)
 Drift check: PASS!! (0.000061 - -0.0000179 = 0.0000240)

Title : Preventive Maintenance RA-4500 sn:17780278
 Date : 2024-07-09
 Name : Coax Group
 Memo : Blank

SMP

No.	NAME	SVOL [mL]	CVOL [mL]	DVOL [mL]	AREA [ON]	MEAS [ng]	CONC [ug/L]	Note
1	Blank DI				0.1002	0.0385		



-2-

เอกสารไม่ควบคุม



-3-

เอกสารไม่ควบคุม



DQE Services Co.,Ltd.
32 Soi Ladprao-Wanghin 55, Ladprao-Wanghin Rd., Ladprao, Bangkok 10230
Phone : +66 (0)2 538 2054, Email : dqeservicesinfo@gmail.com

CERTIFICATE OF CALIBRATION

Certificate No. : SP25-001 Page 1 of 5

Customer : United Analyst and Engineering Consultant Co.,Ltd. (Head Office)

Address : 3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260

Location of calibration : Laboratory 213

Equipment : UV-Vis Spectrophotometer

Manufacturer : Hitachi

Model : U-2900

Serial No. : 21E22-009

ID No. : UAE.WAT.051/2564

Received Date : 3 January 2025

Calibration Date : 3 January 2025

Issue Date : 8 January 2025

Condition Instrument : Good

Calibrated by : ทินันท์ (Mr.Tanawat Rittidach) Technical Manager

Approved by : ชลธิชา (Ms. Chonthicha Sangngern) Quality Manager

The calibration result is applied only to the above calibrated item and was found accurate as shown on date and place of calibration only.

The measurement capability of the laboratory and its traceability to recognized national standards and to the unit of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of DQE Services Co., Ltd.

เอกสารไม่ควบคุม

FM-708-02 R01 1/11/2021

DQE Services Co.,Ltd.
32 Soi Ladprao-Wanghin 55, Ladprao-Wanghin Rd., Ladprao, Bangkok 10230
Phone : +66 (0)2 538 2054, Email : dqeservicesinfo@gmail.com

REPORT OF CALIBRATION

Certificate No. : SP25-001 Page 2 of 5

Environment Condition : Ambient Temperature 25 ± 5 °C

Relative humidity 55 ± 20 %RH

Calibration method : In-house method CP-01 Based on ASTM E275-08

Certified Reference Materials :

Material	Serial No.	Certificate No.	Due date
Absorbance Standard set	25760	115663	25 October 2025
Absorbance Standard set	25757	115638	25 October 2025
Wavelength Standard set	25806	115657	25 October 2025
Wavelength Standard set	25758	115665	25 October 2025

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

Institute of Standards and Technology (NIST) through Starna Scientific Limited

Spectral Band Width of UUC : 1.5 nm.

Scan Speed of UUC : 200 nm/min

Scan Interval of UUC : 0.1 nm.

Resolution of UUC : Photometric 0.001 Abs.

Wavelength 0.1 nm.

เอกสารไม่ควบคุม

FM-708-02 R01 1/11/2021

DQEServicesDQEServices Co.,Ltd.32 Soi Ladprao-Wanghin 55, Ladprao-Wanghin Rd., Ladprao, Ladprao, Bangkok 10230Phone : +66 (0)2 538 2054, Email : dqeservicesinfo@gmail.com

REPORT OF CALIBRATION

Certificate No. : SP25-001Page 3 of 5

Calibration Results : Without adjustment

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
420	0.0000	0.000	0.0000	0.0028	2.00
	0.5780	0.578	0.0000	0.0031	2.00
	1.0484	1.045	0.0034	0.0029	2.00
	2.1876	2.192	-0.0044	0.0075	2.00
440	0.0000	0.000	0.0000	0.0028	2.00
	0.5595	0.560	-0.0005	0.0034	2.00
	1.0239	1.023	0.0009	0.0035	2.00
	2.1230	2.125	-0.0020	0.0079	2.00
465	0.0000	0.000	0.0000	0.0028	2.00
	0.5230	0.521	0.0020	0.0030	2.00
	0.9633	0.961	0.0023	0.0029	2.00
	1.9753	1.977	-0.0017	0.0070	2.00
546.1	0.0000	0.000	0.0000	0.0028	2.00
	0.5181	0.518	0.0001	0.0031	2.00
	1.0002	0.998	0.0022	0.0033	2.00
	1.9973	1.993	0.0043	0.0084	2.00
590	0.0000	0.000	0.0000	0.0028	2.00
	0.5517	0.552	-0.0003	0.0030	2.00
	1.0803	1.079	0.0013	0.0030	2.00
	2.0373	2.032	0.0053	0.0079	2.00
635	0.0000	0.000	0.0000	0.0028	2.00
	0.5591	0.559	0.0001	0.0031	2.00
	1.0518	1.050	0.0018	0.0030	2.00
	1.9274	1.923	0.0044	0.0079	2.00

เอกสารไม่ควบคุม

DQEServicesDQEServices Co.,Ltd.32 Soi Ladprao-Wanghin 55, Ladprao-Wanghin Rd., Ladprao, Ladprao, Bangkok 10230Phone : +66 (0)2 538 2054, Email : dqeservicesinfo@gmail.com

REPORT OF CALIBRATION

Certificate No. : SP25-001Page 4 of 5

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
235	0.0000	0.000	0.0000	0.0050	2.00
	0.7469	0.744	0.0029	0.0057	2.00
257	0.0000	0.000	0.0000	0.0050	2.00
	0.8674	0.863	0.0044	0.0059	2.00
313	0.0000	0.000	0.0000	0.0050	2.00
	0.2919	0.290	0.0019	0.0051	2.00
350	0.0000	0.000	0.0000	0.0050	2.00
	0.6430	0.640	0.0030	0.0055	2.00

เอกสารไม่ควบคุม

DQEServicesDQEServices Co.,Ltd.32 Soi Ladprao-Wanghin 55, Ladprao-Wanghin Rd., Ladprao, Ladprao, Bangkok 10230Phone : +66 (0)2 538 2054, Email : dqeservicesinfo@gmail.com

REPORT OF CALIBRATION

Certificate No. : SP25-001Page 5 of 5

Wavelength Accuracy :

CRMs Values (nm.)	UUC Reading (nm.)	Correction (nm.)	Uncertainty (nm.)	Coverage factor k
241.72	241.1	0.62	0.18	2.00
279.45	279.0	0.45	0.18	2.00
287.81	287.3	0.51	0.18	2.00
334.06	333.8	0.26	0.18	2.00
360.93	360.6	0.33	0.18	2.00
418.59	418.2	0.39	0.18	2.00
445.94	445.5	0.44	0.18	2.00
453.66	453.4	0.26	0.18	2.00
460.02	459.8	0.22	0.18	2.00
536.59	536.6	-0.01	0.18	2.00
637.98	637.7	0.28	0.18	2.00
431.38	431.1	0.28	0.18	2.00
472.50	472.3	0.20	0.18	2.00
513.47	513.4	0.07	0.18	2.00
528.88	528.9	-0.02	0.18	2.00
573.17	573.3	-0.13	0.18	2.00
585.35	585.1	0.25	0.20	2.00
684.40	684.5	-0.10	0.18	2.00
740.72	741.0	-0.28	0.20	2.00
748.55	748.8	-0.25	0.18	2.00
807.03	807.3	-0.27	0.18	2.00
879.28	879.6	-0.32	0.18	2.00

เอกสารไม่ควบคุม

Remark : - UUC = Unit Under Calibration

- N/A = Not Available

- The result expanded uncertainty of measurement U is stated as the standard uncertainty of measurement multiplied by the coverage factor k ,

which for a normal distribution corresponds to a coverage probability of approximately 95%

- End of Certificate -

เอกสารไม่ควบคุม



Certificate of Calibration

Cert. No.: 24TM938
Page : 1 of 3

Equipment : Incubator
Manufacturer : Binder
Model : KB 400 E6
Serial No. : 2022000022479
ID No. : UAE.MIC.028/2566
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : Microbiology Laboratory
Received Order : 09 July 2024
Calibration Date : 09 July 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Khit Rutanaprapachai
Approved by :
() Ponpan Paipim
(✓) Suwit Imjai
() Kunchit Promprat

Issue Date : 19 July 2024

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

เอกสารไม่ควบคุม



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2407-0153OC-4
Procedure Used :-

Cert. No.: 24TM938
Page : 2 of 3

Calibration were conducted using calibration procedure CP-OT02 based on TLAS G-20 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD).
The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

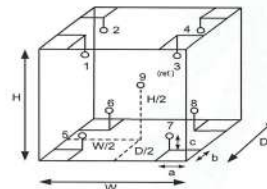
Instrument	Serial No.	Cert. No.	Traceable	Due Date
1.) Data Acquisition	MY49001451	24LM44	TPA	17 Mar 2025

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Not Available

Environment during calibration		
	Beginning	Finished
Temp. (°C)	23	24
REL.Humid. (%)	52	54
AC Supply (Volt)	221	222



Probe Installation Details :

a = 10 cm
b = 10 cm
c = 10 cm

Dimension of Chamber :

D = 0.47 m
W = 0.65 m
H = 1.2 m
Capacity = 0.37 m³

Position :	Ref. Std. ID No.:
1	19RTD-2/1
2	19RTD-2/2
3	19RTD-2/3
4	19RTD-2/4
5	19RTD-2/5
6	24-19RTD-2/6
7	19RTD-2/7
8	19RTD-2/8
9 (ref.)	19RTD-2/9

เอกสารไม่ควบคุม



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2407-0153OC-4
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Not Available

Cert. No.: 24TM938
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
35.0	35.0	35.0	0.030	0.31	0.33	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
35.0	35.093	35.011	35.081	35.118	34.840	35.054	34.924	34.978	34.824	0.30

Average* : The average of 30 values in each position.

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.

Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.

UUC* : Unit Under Calibration

Note : The reported uncertainty of measurement was included stability and excluded uniformity .

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

-o0o-

เอกสารไม่ควบคุม



Certificate of Calibration

Cert. No.: 24TM1016/1
Page : 1 of 3

This Certificate was issued to replace to the Certificate No. 24TM1016

Equipment : Water Bath

Manufacturer : Memmert

Model : WNB 14

Serial No. : L407.0756

ID No. : UAE.MIC.024/2550

Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260

Location : Microbiology Laboratory

Received Order : 09 July 2024
Calibration Date : 09 - 10 July 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : Preecha Hahib

Approved by :
Approved Signatory

() Ponpan Paipim
(✓) Suwit Imjai
() Kunchit Promprat

Issue Date : 5 August 2024

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

เอกสารไม่ควบคุม



Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2407-0153OC-6
Procedure Used :-

Cert. No.: 24TM1016/1
Page : 2 of 3

Calibration were conducted using in-house calibration procedure CP-OT04 Based on ASTM E715 according to direct measurement method with Data Acquisition which connected with Industrial Platinum Resistance Thermometer (IPRT).

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY59003411	23LM208	TPA	27 Dec 2024

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

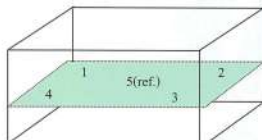
Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Heat transfer medium used : Water

	Environmental		AC Voltage Supply
	(°C)	(%R.H.)	
Beginning of Calibration	26	67	221
Finished of Calibration	27	66	222



Front

Position :	Ref. Std. ID No.:
1	4804539-001
2	4804539-002
3	4804539-003
4	4804539-004
5(ref.)	4804539-005

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Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2407-0153OC-6
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source

Cert. No.: 24TM1016/1
Page : 3 of 3

Calibration point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Average* Standard Reading (°C)					Uncertainty (± °C)
			1	2	3	4	5 (ref.)	
41.0	41.8	41.8	41.004	40.968	41.027	40.988	41.000	0.15
44.5	45.2	45.2	44.498	44.461	44.468	44.449	44.496	0.15
45.0	45.7	45.7	44.969	44.927	44.931	44.914	44.960	0.15

Calibration point (°C)	Uniformity (°C)	Stability (± °C)	Coverage Factor k
41.0	0.085	0.041	2
44.5	0.089	0.038	2
45.0	0.095	0.036	2

Average* : The average of 30 values in each position.

Uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

Stability : One-half of the greatest maximum difference of measured temperature at any one probe.

UUC* : Unit Under Calibration

Note : The reported uncertainty of measurement was included stability and excluded uniformity.

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

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

Certificate of Testing

Cert.No.: 25TW111
Page.: 1 of 2

Equipment : DO Meter
Manufacturer : Horiba
Model : LAQUA-DO210
Serial No. : HE9M0011
ID No. : UAE.EFM.017/2563 (EFM.DO.06/63)
Received Date : 26 May 2025
Test Date : 27 May 2025
Reference : 2505-0798WSC-1
Submitted by : United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Laboratory Condition : Temperature (25 ± 5) °C
Humidity (50 ± 20) %
Test Procedure : In - house method : CP-CH9
by Comparison Technique with Azide Modification Method

Tested by : Walalak Sirithean

Approved by : 
Approved Signatory

() Chakrit Waewwanjua
() Ponpan Paipim
(✓) Saitip Meangmai

Issue Date : 28 May 2025



Cert.No.: 25TW111
Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :

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

Instruments	Serial No.	ID No.	Certificate No.	Due Date
1. Burette	-	130BU10	25CG1126	18 Mar 2027
2. Balance	14233821	110RC001	24MM131	04 July 2025

2. Standard Material :-

Material	Manufacturer	Lot.No.	Assay
Sodium Thiosulfate 5-Hydrate AR	KEMAUS	2203162447	99.6%

Result : Dissolved Oxygen Meter Adjustment With Air 100 %
Dissolved Oxygen Probe No.: 9K0H0035

Titration Method (Azide Modification Method)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.20	8.20	0.0071

This report was certified only for the instrument we tested. It is allowable to use for study
Intend to use for advertising and referral purpose is prohibited. This report may not be reproduced
other in full, without written approval of the Laboratory

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Certificate of Calibration

Cert. No.: 25LM92
Page.: 1 of 2

Equipment : DO Meter with Sensor
Manufacturer : Horiba
Model : LAQUA-DO210
Serial No. : HE9M0011
ID No. : UAE.EFM.017/2563 (EFM.DO.06/63)
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : TPA On Site Calibration Laboratory
Received Order : 26 May 2025
Calibrated Date : 26 - 27 May 2025
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V
Calibrated by : Warakorn Lernagatrakul

Approved by : 
() Chakrit Waewwanjua
() Suwit Imjai
(✓) Kunchit Promprat
Issue Date : 28 May 2025

The Uncertainties are for a confidence probability of approximately 95%

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Equipment : DO Meter with Sensor
Condition As-Received : Used Item
Reference : 2505-0798WSC-2

Cert. No.: 25LM92
Page.: 2 of 2

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.
The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

- | Instrument | Serial No. | Cert. No. | Traceable | Due Date |
|------------------------|------------|-----------|-----------|-------------|
| 1) Digital Thermometer | 2188080 | 2411022 | TPA | 17 Sep 2025 |
2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :-

(*) Without Adjustment

Function :

Temperature measurement.

This instrument was connected with temperature sensor, S/N: 9K0H0035

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
15.0	80	15.005	15.0	-0.005	0.16	2.00
30.0	80	30.004	30.0	-0.004	0.16	2.00
45.0	80	45.001	45.0	-0.001	0.16	2.00

UUC* : Unit Under Calibration

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

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Agilent 55 240 280 Series Atomic Absorption Spectroscopy Systems

Preventive Maintenance Checklist

Agilent Preventive Maintenance provides factory recommended service for your analytical systems to assure reliable operation and the accuracy of your results.

Delivered by highly trained and certified service engineers using genuine Agilent parts and supplies, Agilent Preventive Maintenance provides everything you need to reduce unplanned downtime and keep your systems operating at their peak. This checklist will be completed at the end of the service and provided to you as a record of the installation.

Note: While non-current production AA instrument and/or accessory models are not covered specifically in this document it can be used as a basic reference.

For more information about Agilent Technologies services please visit our web site using the following URL: <http://www.agilent.com/en-us/services>

Introduction

Customer Information

- Customers should provide all necessary operating supplies upon request of the engineer.
- A customer representative should be available to the engineer while performing the preventive maintenance procedures.
- Any parts, not included in the Parts Lists section of this document, are not part of the recommended Preventive Maintenance service, nor are they included in the price of this service.
- If a system requires the use of extra or special procedures and/or parts for the maintenance service, then these must be ordered separately and charged as a repair, which may incur additional costs.



Instrument Preventive Maintenance Checklist

Important Customer Web Links

- For more information about *Agilent Technologies services*, please visit our website using the following URL: <http://www.agilent.com/en-us/products/crosslab-instrument-services/service-repair>
- To access *Agilent University*, visit <http://www.agilent.com/crosslab/university/> to learn about training options, which include online, classroom and onsite delivery. A training specialist can work directly with you to help determine your best options.
- A useful *Agilent Resource Center* web page is available, which includes short videos on maintenance, quick lists of consumables for new instruments, and other valuable information. Check out the Resource Page here: <https://www.agilent.com/en-us/agilentresources>
- Need technical support, FAQs, supplies? – visit our *Support Home page* at <http://www.agilent.com/search/support>
- Get answers. Share insights. Build connections. Join the *Agilent Community* at <https://community.agilent.com/welcome>

Service Engineer's Responsibilities

- Contact the customer and ensure that all necessary supplies are available before the preventive maintenance visit.
 - Confirm the ability of the instrument to deliver continued safe operation as established via the Agilent AA safe operation flow chart. (Refer directly to the AA 55/240/280 Preventive Maintenance Scope of Work to make this decision.)
 - Only select those pages that relate to the system or module being serviced.
 - Complete empty fields with the relevant information.
 - Complete the relevant checkboxes in the checklist using either a "X" or tick mark "✓".
 - Check "Section not applicable" check boxes to indicate services/tasks not delivered, as appropriate.
 - Complete the Preventive Maintenance service in the order of the tasks listed.
 - Complete the Service Review section together with the customer.
 - Complete the fields for page numbers at the foot of each selected page.
 - Complete the total number of pages field in the Service Completion section.
 - Ask the customer to sign the Service Completion section including the customer's and your signature.
- This information is subject to change without notice.



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Instrument Maintenance

System Information

- ☐ Check this box if an instrument configuration report is attached instead of completing the table.

Instrument System Name and ID	240 FS AAS
Instrument System Site and Location	United Analyst and Engineering Consultant

List System Component Product Numbers	List the Serial Numbers of each Component
1. G 9432 A	M1 13160001
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	

Preparation, Safe operation and Initial performance checks

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- ☐ Agilent AA safe operation flow chart inspections (to determine if the PM can be performed).

NOTE: If by following the flow chart the instrument is deemed to be unsafe for continued use you MUST NOT continue PM work. Inform the customer immediately of the Agilent recommendation that use of the instrument be discontinued.

- ☒ Discuss any specific issues with the customer before starting.
- ☐ For HF application systems, if standard sample introduction system was not installed, ask the customer to install it. **NA**
- ☒ Review the instrument logbook for recorded problems and comments.
- ☒ Save instrument control settings before starting the procedure.
- ☒ Perform a general inspection of the system for cleanliness.
- ☒ Check for proper installation of parts, assemblies, sensors etc.
- ☒ Check system for required installation of components, settings as defined by current Service Notes
- ☒ Check for required firmware updates and verify with customers if they would like them installed.
- ☒ Use SVD to perform a Full Wavelength Scan for Cu HCL - "As found test_1"
- ☒ Perform a Basic Cu ABS test - "As found test_2"
- ☒ Print the Details page or screen captures of the test results and attach to the end of this checklist.

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Preventive Maintenance Procedures

FLAME SYSTEM section

- ☐ Section not applicable

Electronic components

- ☒ Review and confirm instrument configuration data in SVD
- ☒ Confirm power supply voltages using the **SVD Power Supply diagnostic**.
- ☒ For Dual Beam Instruments - Confirm RBC frequency using the **SVD RBC frequency diagnostic**.

Mechanical components

- ☒ Check the burner adjuster controls for complete and free movement. If the burner adjuster needs lubrication, use Molykote 321 or mineral-based molybdenum disulphide grease.
- ☒ Run SVD tests to exercise all motor drives over the full range of their travel:
 - ☒ Monochromator drive
 - ☒ Slit drive
 - ☒ Lamp selector
 - ☐ ABA

Optics components

- ☒ Check that external optical surfaces are clean - Clean or replace as required.
- ☒ Use SVD and perform **Mono Wavelength Correction**.
- ☒ Use SVD and perform **Slit Calibration**.
- ☒ Use SVD and perform **Grating Squareness Diagnostic**.
- ☒ Use SVD and perform **Zero Order Offset/Mono Correction**.
- ☒ Use SVD and perform **Wavelength Repeatability**.
- ☒ Physically inspect selected HC lamps (customer to supply per their choice) and measure the % Gain for each lamp. Advise customer if lamps are showing emission degradation due to age.
- ☒ Check that the signal energy of the D2 and HC lamps track properly. Advise customer if their D2 lamp is showing emission degradation due to age.

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Sample Introduction and Atomization

- ☒ Inspect the burner interlock plate to ensure that the interlock pin is secure and correct for the burner type.
- ☒ Clean the burner slot with a clean white card.
- ☒ Check the uniformity of the slot width.
- ☒ Clean the burner if required.
- ☒ Change the burner o-ring.
- ☒ Clean the nebulizer, spray chamber and liquid trap.
- ☒ Change all o-rings and seals in the nebulizer, nebulizer block and spray chamber.
- ☒ Check that the pressure relief bung releases readily.
- ☒ Change o-rings on the fuel and oxidant delivery bars.
- ☒ Leave the liquid trap EMPTY and verify the flame will not ignite in this state.
- ☒ Refill liquid trap and check that overflow drains freely into the drain/waste tube.
- ☒ Check the drain/waste tube for good drainage. It should not have tight bends, kinks or loops and the lower end must be above the liquid level in the waste vessel
- ☒ Check and clean the igniter electrode

Gas handling components and safety interlocks

- ☒ Pressure test for leaks
- ☒ Leak test gasbox internal components and connections
- ☒ Check safety interlock status and operation using the **SVD Interlock monitoring diagnostic**.

Analytical performance for Flame systems

- ☒ Ignite a flame.
- ☒ Check that you can adjust the nebulizer uptake rate from 4 to 6.5 mL per minute.
- ☒ Optimize the instrument ready to perform Cu sensitivity test.
- ☒ Create a manual method to perform a Basic Cu ABS test - "Final Performance Testing"
- ☒ Run a PM completed sensitivity test for a 5 ppm copper sample and record the results in the AA PM Performance test results and measurements table.

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FURNACE SYSTEM section

☒ Section not applicable

Electronic components

- ☐ Review and confirm instrument configuration data in SVD
- ☐ Confirm power supply voltages using the *SVD Power Supply diagnostic*.

Mechanical components

- ☐ Run SVD tests to exercise all motor drives over the full range of their travel:
 - ☐ Monochromator drive
 - ☐ Slit drive
 - ☐ Lamp selector

Optics components

- ☐ Check that external optical surfaces are clean – Clean or replace as required.
- ☐ Use SVD and perform *Mono Wavelength Correction*.
- ☐ Use SVD and perform *Slit Calibration*.
- ☐ Use SVD and perform *Grating Squareness Diagnostic*.
- ☐ Use SVD and perform *Zero Order Offset/Mono Correction*.
- ☐ Use SVD and perform *Wavelength Repeatability*.
- ☐ Physically inspect selected HC lamps (customer to supply per their choice) and measure the % Gain for each lamp. Advise customer if lamps are showing emission degradation due to age.

Gas handling, water system and workhead component checks

- ☐ Inspect the GTA workhead gas hoses and connections for leaks.
- ☐ Pressure test for gas leaks
- ☐ If the cooler system is accessible (stand-alone) check for correct operation and coolant/water level – this includes any temperature and pressure settings plus filter cleaning (air flow and water).
- ☐ Inspect the GTA workhead water hoses and connections for leaks.
- ☐ Check all graphite components and replace if necessary.

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- ☐ Tube
- ☐ Electrodes
- ☐ Shroud

- ☐ Check and clean the end windows on the workhead.
- ☐ Check safety interlock operation.

Analytical performance for Furnace systems

- ☐ Optimize the instrument ready to perform Cu sensitivity test.
- ☐ Run the sensitivity test for a 25 ppb copper sample and record the results in the results table.

PSD autosampler accessory for Furnace systems

☒ Section NOT Applicable

- ☐ Check condition of the PSD capillary – replace if necessary
- ☐ Check condition and operation of PSD syringe – ensure it does not have air locks and bubbles.
- ☐ Change PSD rinse bottle o-ring.
- ☐ Check and clean the rinse vessel.
- ☐ Check the drain tube for good drainage. It should not have tight bends, kinks or loops and the lower end must be above the liquid level in the waste vessel.
- ☐ Ensure that the waste vessel is suitable for use with the furnace system.

Sample introduction pump system (SIPS) accessory

☒ Section NOT Applicable

- ☐ Re-torque screws securing the hubs, presser arms and pump rotors.
- ☐ Adjust each roller so that it rotates freely.
- ☐ Wipe clean the pump rotor rollers and pump bands with a dry clean cloth.
- ☐ Ensure that the presser arms and the surfaces near the pump are free from dirt and spills.
- ☐ Remove the pump module rear cover and check for the incursion of liquids and any signs of corrosion.
- ☐ Re-torque the nuts that fasten the motor mounting plates to the chassis.
- ☐ Check clips securing the diluents holder and replace if necessary.
- ☐ Disconnect, clean T-piece, and reassemble the tubing using the following steps.

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- ☐ Remove the T-piece by disconnecting the pump tubes, the pump bands and all other tubing.
- ☐ Place the T-piece in an ultrasonic bath containing strong detergent 1-5% Decon 30 or similar, for approximately 5-10 minutes.
- ☐ Wash the T-piece under a tap with a strong flow of water.
- ☐ Rinse with distilled water through all of the inlets in the reverse direction to normal sample flow.
- ☐ Reassemble.

Sample preparation system (SPS 4) accessory

☒ Section NOT Applicable

The Agilent SPS 4 autosampler is designed to need minimal maintenance.

The following maintenance requirements are suggested to maintain the performance of the autosampler.

- ☐ Cleaning the spill tray, rack location mat, end frames and chassis accessories with a damp soft cloth and diluted mild detergent.
- ☐ Cleaning the autosampler cover panels with domestic window cleaner.
- ☐ Checking the X- axis and Z- axis drive belts for cracks, splits, damaged teeth, excessive fraying, color changes or degradation from fumes.
- ☐ Check the X- axis, Theta- axis and Z- axis FFC cables for cracks, incorrect positioning, damaged edge or damaged connectors.

NOTE: The autosampler requires no extra lubrication throughout its lifetime.

For further details refer to the SPS 4 service manual G8410-90050.

Sample preparation system (SPS 3) accessory

☒ Section NOT Applicable

- ☐ Check the x-axis and z-axis timing belts – Replace if there is any cracks, splits or color deterioration and belt tension.
- ☐ Check belt tensions - adjust if required
- ☐ Check the lubrication pad for single x-axis shaft. If pad is dry or customer has observed any vibration or erratic movements of the x-axis carriage, add 1 mL of Dow Corning 200 @ Fluid, 200 CS into the well.
- ☐ Check the auto-sampler ability to find tube positions - Calibrate if required.
- ☐ Clean the exterior surfaces of the accessory with soft lint free cloth. This cloth can be dampened with warm water or a mild detergent. Do not use organic solvents or abrasive cleaning agents.

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Vapor generation accessory VGA (hydride generator)

☒ Section NOT Applicable

- ☐ Inspect VGA gas supply hose.
- ☐ Inspect/replace VGA pump tubing.
- ☐ Check low gas pressure interlock setting – adjust if required.
- ☐ Check precision orifice gas flow setting – adjust if required.
- ☐ Check gas regulator pressure to 46 psi (325 kPa) – adjust if required.
- ☐ Clean the exterior surfaces of the accessory with soft lint free cloth. This cloth can be dampened with warm water or a mild detergent. Do not use organic solvents or abrasive cleaning agents.

UltraAA lamp accessory (external)

☒ Section NOT Applicable

- ☐ Check the condition of the power cable.
- ☐ Clean the exterior surfaces of the accessory with soft lint free cloth. This cloth can be dampened with warm water or a mild detergent. Do not use organic solvents or abrasive cleaning agents.

Restore System

- ☐ If you have altered the customer's instrumentation during the course of PM, restore to the original status to allow the customer to conduct their normal activities (e.g., reload the customer's method.)

Guidance

If the PM service is performed prior to a qualification service, then use the qualification procedure as a guide for final instrument set up and checkout.

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Signature Page

Service Review

- ☒ Attach available reports/printouts of all tests to this documentation.
- ☒ Record the Preventive Maintenance service activity in the customer's records/logbook.
- ☒ Update/reset instrument maintenance counters as appropriate.
- ☒ Affix the PM sticker to the system or instrument logbook based on the customer's request.
- ☒ Complete the Service Engineer Comments section if there are additional comments.
- ☒ Review this service, parts replaced, and test results obtained with the customer.
- ☒ If the instrument firmware was updated, record the details of the change in the Service Engineer's Comments box or if necessary, in the customer's IQ records.

Test Results

Test Description	Expected Test Result	Actual Test Result
Flame optics PMT Gain test		
For copper at 324.8 nm, 4 mA, 0.5 nm slit width	< 55 %	49 %
Flame performance test with 5 ppm copper sample		
Air /acetylene, mixing paddle removed	Abs value > 0.5	0.5599
Air /acetylene, mixing paddle installed, 10 replicates	%RSD < 1.0	0.2 %
Deuterium furnace optics PMT Gain test		
For copper at 324.8 nm, 4 mA, 0.5 nm slit width	< 55 %	-
Deuterium furnace performance test with 25 ppb copper sample (324.8 nm)		
Precision %RSD	≤ 4.0%	-
Abs value	≥ 0.15	-
Zeeman furnace analytical performance: 25 ppb copper sample (327.4 nm)		
Precision %RSD	≤ 4.0%	-
Abs value	≥ 0.10	-
MSPR%	≥ 70 %	-

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AA consumable and parts list table

Part Description	Part Number	Product/Model # where used	PM supplied or Consumable	Instrument-Type
Test Solution - Cu 5ppm solution	6610030100	50 55 140 240 280	PM supplied	Common
Test Solution - Blank solution	5190-7001	50 55 140 240 280	PM supplied	Common
Copper, 1000 ug/ml, 100ml	5190-8279	50 55 140 240 280	*	Common
Kit, Mk 7 O-rings, aqueous, complete set	9910093400	50 55 140 240 280	PM supplied	Flame
Organic Kit	9910093500	50 55 140 240 280	PM supplied	Flame
Wire Nebulizer Cleaning	9910024700	50 55 140 240 280	consumable	Flame
Tubing-Capillary Std Nebs	9910024800	50 55 140 240 280	consumable	Flame
Capillary Tube Hvac Neb (3) (organics only)	9910044000	50 55 140 240 280	consumable	Flame
Glass impact beads (5/pk)	9910025700	50 55 140 240 280	consumable	Flame
Teflon impact beads (5/pk): (organics only)	9910053300	50 55 140 240 280	consumable	Flame
Burner cleaning strip (100/pk)	9910053900	50 55 140 240 280	consumable	Flame
Window UV silica - round (right side)	2010082600	50 55 140 240 280	PM supplied	Common
Window UV silica - rectangular (left side)	2010082500	50 55 140 240 280	PM supplied	Common
Pad adhesive window (round)	4910012700	50 55 140 240 280	PM supplied	Common
Pad adhesive window (rectangular)	4910012800	50 55 140 240 280	PM supplied	Common
Electrode kit (1 pr) (D2)	6310003400	GTA120	PM supplied	Furnace
Shroud (D2)	6310003100	GTA120	PM supplied	Furnace
Zeeman electrode kit (1 pr)	6310003500	GTA120	PM supplied	Furnace
Zeeman shroud	6310003600	GTA120	PM supplied	Furnace
O-ring PSD rinse bottle	6910025900	PSD120	PM supplied	Furnace

* For engineers who only service AA instruments 5190-8279 can be used as a cheaper alternative for 6610030100.

Items classified as PM supplied in the above table are included in the standard PM. Those classified as consumable should be provided by the customer or charged to the customer if supplied by the Agilent service engineer.

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SVD Results Report



Report ID: 2	Diagnostic Start Time: 1/30/2025 9:14:28 AM	Diagnostic End Time: 1/30/2025 9:46:28 AM
Customer: UAE	Service Engineer: Kanyakorn S.	
Address: Soi Udomsuk 41, Sukhumvit Rd, Bangkok	Contact Details: 02637636381	

Configuration:

Serial Number: MY13160001	Turret Type: Automatic
Instrument Model: Varian AA140/240/280	Number Of Lamps: 4
Flame Instrument: True	Mono Type: Automatic
Furnace Instrument: True	Gasbox Type: Y Gas Box
Zeeman Present: False	Auto Burner Adjuster: False
Internal Zeeman: False	Mains Frequency: 50
Internal UltraAA: False	Firmware Version: 2.11
Optics Type: Double Beam	Photomultiplier Type: Normal(900nm)
D2 EG Connection Filled: True	PWB Version: 45
Boot Block Version: 1.00	

EEPROM Data:

Instrument Run Hours: 62818.180	D2 Run Hours: 63398.500
Zero Wavelength Offset: 00.133	D2 Serial Number: not set!
Mono Correction: 0.770	D2 Install Date: 1/1/1970
Flame Hours: 32441.834	D2 Original Intensity: 1.000
	D2 Last Intensity: 475.000

Service Engineer Comments (optional)

If there are any specific points you wish to note as part of performing the installation or other items of interest for the customer, please write in this box.

Service Completion

Service request number: 6007549143 Date service completed: 30 Jan 2025
Agilent signature: Kanyakorn S. Customer signature: Janda Y.
Total number of pages in this document: 13

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Frequency:

Averaging Period: 30.0

Datapoint Count: 20

Upper Limit:

51.00

Average Frequency:

50.00

Highest Measured Frequency:

50.00

Lower Limit:

49.00

Lowest Measured Frequency:

50.00

Result: **Passed**

Power Supply:

Averaging Period: 30.0

Datapoint Count: 20

	Lower Limit (V)	Actual (V)	Upper Limit (V)	Result:
12.00 V Rail	10.80	12.12	13.20	Passed
-12.00 V Rail	-13.20	-11.90	-10.80	Passed
5.00 V Rail	4.50	5.04	5.50	Passed
310.00 V Rail	279.00	320.00	341.00	Passed

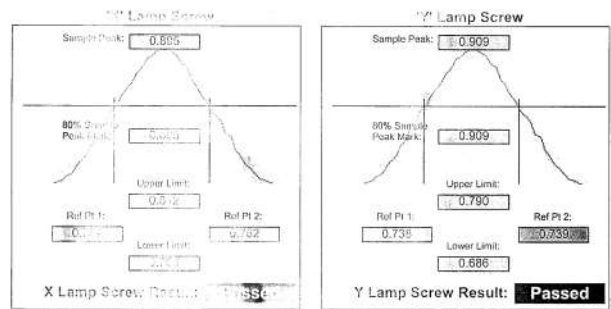
Optics

Beam Balance:

Lamp Type: Copper

Lamp Socket Used: 3

Peak Selected: 324.80

Lamp Alignment: **Performed**

Grating Spectrometer

Lamp Element(s): Copper

Lamp Turret Position: 3

Lamp Current(mA): 4.00

Slit Width(nm): 0.5

1st Order Wavelength(nm): 324.80

Lamp Alignment: **Performed**

	Lower Limit (nm)	Actual (nm)	Upper Limit (nm)	Result:
Zero Order	-0.10	0.00	0.10	Passed
First Order	324.05	324.75	325.15	Passed
Second Order	648.00	649.50	649.97	Passed

Report Generated At: 1/30/2025 9:47:25 AM

2

SVD Results Report **SVD**

เอกสารไม่ควบคุม

Wavelength Repeatability:

Lamp Used: Copper

Lamp Current(mA): 4

Peak Used(nm): 324.759

Slit Width(nm): 0.2

Connected to Socket: 3

Slit Height: Normal

Lamp Alignment: **Performed**

Lower Limit(nm) 324.779 Upper Limit(nm) 324.888

(Measured from Zero Drive)

(Measured from end)

Sample 1: 324.823

Sample 2: 324.823

Sample 3: 324.823

Sample 4: 324.823

Sample 5: 324.823

Sample 6: 324.819

Sample 7: 324.819

Sample 8: 324.819

Sample 9: 324.823

Sample 10: 324.819

Mean: 324.823

Standard Deviation: 0.003

Result: **Passed**

Mechanics

Wavelength Drive:

Slit Drive:

Turret Drive:

Auto Burn-in/Wireless Control:

Micro-Alignment:

Signal Processing Linking:

SVD Data Mode: New Data Mode

	Lower Limit	Actual	Upper Limit	Result:
S0	114	114	297	Passed
S1	118	118	191	Passed
S2	271	271	332	Passed
C0	474	474	579	Passed
S3	936	936	1008	Passed
S4	1455	1455	1754	Passed
S5	2108	2108	3053	Passed
S6	4547	4547	5313	Passed

Interface:

Burner FID(s)	Working	Flame Detect:	Working
H2O Burner FID(s)	Working	SCU Active:	Working
Flame Shield Closed:	Working	Oxidant Pressure:	Working
Gas Control FID(s)	Working	Oxidant Changeover:	Untested
Pressure Release Bump FID(s)	Working	Ignition:	Working
Liquid Trap FID(s)	Working		

Report Generated At: 1/30/2025 9:47:35 PM

4

SVD Results Report **SVD**

เอกสารไม่ควบคุม

Report Generated At: 1/30/2025 9:47:35 PM

5

SVD Results Report **SVD**

เอกสารไม่ควบคุม

Auto Lamp Recognition:

Lamp 1: Uncoded Lamp/Not Connected
Lamp 2: 87 - Silver Cadmium Lamp (S/Cd) (Ag/Cd) Lamp 6: Not Supported
Lamp 3: 14 - Copper (Cu) Lamp 7: Not Supported
Lamp 4: Uncoded Lamp/Not Connected Lamp 8: Not Supported

Result: **Passed**

GTA Temperature Monitoring:

Notes:

Signatures:

Date
Kanyakorn S. 30 Jan 2025
Kanyakorn S. Date

Sequential by time report

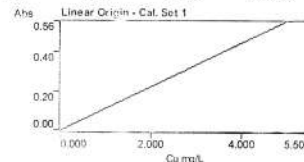
1/30/2025 10:53 AM
Page 1 of 1

SpectraA

Analyst
Date Started 1/30/2025 10:33 AM GMT: 1/30/2025 3:33 AM
Worksheet Sensitivity Test 01
Comment
Methods Cu
Computer name DESKTOP-R3UFRS
Serial Number: MY13160001

Method: Cu (Flame)

Sample ID	Conc. mg/L	%RSD	Mean Abs		
CAL ZERO	0.000	38.8	0.0002		
Readings	0.0002	0.0003	0.0001	1/30/2025	10:51:46 AM
STANDARD 1	5.000	0.1	0.5571		
Readings	0.5574	0.5563	0.5575	1/30/2025	10:52:22 AM



Curve Fit = Linear Origin
Characteristic Conc = 0.030 mg/L
r = 1.0000
Calculated Conc = 0.002 5.000
Residuals = -0.007 0.000

Abs = 0.11141 x C

5 ppm Cu	5.025	0.3	0.5568		
Readings	0.5582	0.5596	0.5615	1/30/2025	10:52:54 AM

Report Generated At: 1/30/2025 9:47:25 AM

5

SVD Results Report SVD

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม

Sequential by time report

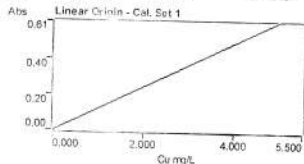
1/30/2025 10:48 AM
Page 1 of 1

SpectraA

Analyst
Date Started 1/30/2025 10:33 AM GMT: 1/30/2025 3:33 AM
Worksheet Precision Test
Comment
Methods Cu
Computer name DESKTOP-R3UFRS
Serial Number: MY13160001

Method: Cu (Flame)

Sample ID	Conc. mg/L	%RSD	Mean Abs		
CAL ZERO	0.000	64.1	-0.0002		
Readings	-0.0003	-0.0003	-0.0001	1/30/2025	10:46:52 AM
STANDARD 1	5.000	0.3	0.6052		
Readings	0.6036	0.6073	0.6047	1/30/2025	10:47:24 AM

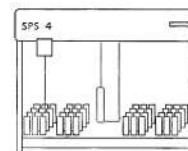
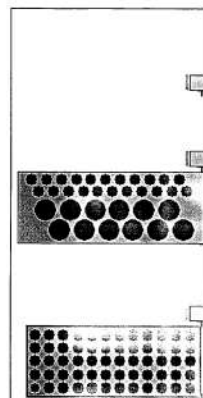


Curve Fit = Linear Origin
Characteristic Conc = 0.030 mg/L
r = 1.0000
Calculated Conc = -0.002 5.000
Residuals = 0.002 0.000

Abs = 0.12105 x C

5 ppm Cu	5.007	0.2	0.6051		
Readings	0.6055	0.5952	0.6047	0.6042	0.6079
	0.6055	0.6076	0.6064	0.6079	1/30/2025 10:48:32 AM

Flame Optimization



Down height 0 (mm)
Pump speed Medium

Key to tube colors
Sample
Calibration
Calibration/QC
Sample/QC
Not Assigned

Sampler Offline

Goto Tube
Back 1
Tube 1
Goto Tube

Align Probe
Rinse
Stop Rinse
Park

Optimization: Lamp

HC Lamp 1.30
1.00
0.50
0.00

0.917

Optimize Lamp
Optimize Sign

Rescale

Inst Zero

Gain 49 %


Ok

Sensitivity Check 1.5 mg/L gives about 0.2 Abs at 324.8 nm, A/A burner

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม

DQE Services Co.,Ltd.
32 Soi Ladprao-Wanghin 55, Ladprao-Wanghin Rd., Ladprao, Bangkok 10230
Phone : +66 (0)2 538 2054, Email : dqeservicesinfo@gmail.com


ISO 9001:2015
CALIBRATION DATA

CERTIFICATE OF CALIBRATION

Certificate No. : SP25-001

Page 1 of 5

Customer : United Analyst and Engineering Consultant Co.,Ltd. (Head Office)

Address : 3 Soi Udumsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260

Location of calibration : Laboratory 213

Equipment : UV-Vis Spectrophotometer

Manufacturer : Hitachi

Model : U-2900

Serial No. : 21E22-009


ID No. : UAE.WAT.051/2564


Received Date : 3 January 2025

Calibration Date : 3 January 2025

Issue Date : 8 January 2025

Condition Instrument : Good

Calibrated by : 
(Mr.Tanawat Rittidach)
Technical Manager

Approved by : 
(Ms. Chonthicha Sangnern)
Quality Manager

The calibration result is applied only to the above calibrated item and was found accurate as shown on date and place of calibration only.

The measurement capability of the laboratory and its traceability to recognized national standards and to the unit of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written consent of DQE Services Co., Ltd.

เอกสารไม่ควบคุม

FM-708-02 R01 1/11/2021

DQE Services Co.,Ltd.
32 Soi Ladprao-Wanghin 55, Ladprao-Wanghin Rd., Ladprao, Bangkok 10230
Phone : +66 (0)2 538 2054, Email : dqeservicesinfo@gmail.com


ISO 9001:2015
CALIBRATION DATA

REPORT OF CALIBRATION

Certificate No. : SP25-001

Page 2 of 5

Environment Condition : Ambient Temperature 25 ± 5 °C

Relative humidity 55 ± 20 %RH

Calibration method : In-house method CP-01 Based on ASTM E275-08

Certified Reference Materials :

Material	Serial No.	Certificate No.	Due date
Absorbance Standard set	25760	115663	25 October 2025
Absorbance Standard set	25757	115638	25 October 2025
Wavelength Standard set	25806	115657	25 October 2025
Wavelength Standard set	25758	115665	25 October 2025

Traceability : This certification is traceable to the International System of Unit maintained at National -
Institute of Standards and Technology (NIST) through Starna Scientific Limited

Spectral Band Width of UUC : 1.5 nm.

Scan Speed of UUC : 200 nm/min

Scan Interval of UUC : 0.1 nm.

Resolution of UUC : Photometric 0.001 Abs.
Wavelength 0.1 nm.

เอกสารไม่ควบคุม

FM-708-02 R01 1/11/2021

DQE Services Co.,Ltd.
32 Soi Ladprao-Wanghin 55, Ladprao-Wanghin Rd., Ladprao, Bangkok 10230
Phone : +66 (0)2 538 2054, Email : dqeservicesinfo@gmail.com


ISO 9001:2015
CALIBRATION DATA

REPORT OF CALIBRATION

Certificate No. : SP25-001

Page 3 of 5

Calibration Results : Without adjustment


Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
420	0.0000	0.000	0.0000	0.0028	2.00
	0.5780	0.578	0.0000	0.0031	2.00
	1.0484	1.045	0.0034	0.0029	2.00
	2.1876	2.192	-0.0044	0.0075	2.00
440	0.0000	0.000	0.0000	0.0028	2.00
	0.5595	0.560	-0.0005	0.0034	2.00
	1.0239	1.023	0.0009	0.0035	2.00
	2.1230	2.125	-0.0020	0.0079	2.00
465	0.0000	0.000	0.0000	0.0028	2.00
	0.5230	0.521	0.0020	0.0030	2.00
	0.9633	0.961	0.0023	0.0029	2.00
	1.9753	1.977	-0.0017	0.0070	2.00
546.1	0.0000	0.000	0.0000	0.0028	2.00
	0.5181	0.518	0.0001	0.0031	2.00
	1.0002	0.998	0.0022	0.0033	2.00
	1.9973	1.993	0.0043	0.0084	2.00
590	0.0000	0.000	0.0000	0.0028	2.00
	0.5517	0.552	-0.0003	0.0030	2.00
	1.0803	1.079	0.0013	0.0030	2.00
	2.0373	2.032	0.0053	0.0079	2.00
635	0.0000	0.000	0.0000	0.0028	2.00
	0.5591	0.559	0.0001	0.0031	2.00
	1.0518	1.050	0.0018	0.0030	2.00
	1.9274	1.923	0.0044	0.0079	2.00

เอกสารไม่ควบคุม

FM-708-02 R01 1/11/2021

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ISO 9001:2015
CALIBRATION DATA

REPORT OF CALIBRATION

Certificate No. : SP25-001

Page 4 of 5

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
235	0.0000	0.000	0.0000	0.0050	2.00
	0.7469	0.744	0.0029	0.0057	2.00
257	0.0000	0.000	0.0000	0.0050	2.00
	0.8674	0.863	0.0044	0.0059	2.00
313	0.0000	0.000	0.0000	0.0050	2.00
	0.2919	0.290	0.0019	0.0051	2.00
350	0.0000	0.000	0.0000	0.0050	2.00
	0.6430	0.640	0.0030	0.0055	2.00

เอกสารไม่ควบคุม

FM-708-02 R01 1/11/2021

REPORT OF CALIBRATION

Certificate No. : SP25-001

Page 5 of 5

Wavelength Accuracy :

CRMs Values (nm.)	UUC Reading (nm.)	Correction (nm.)	Uncertainty (nm.)	Coverage factor <i>k</i>
241.72	241.1	0.62	0.18	2.00
279.45	279.0	0.45	0.18	2.00
287.81	287.3	0.51	0.18	2.00
334.06	333.8	0.26	0.18	2.00
360.93	360.6	0.33	0.18	2.00
418.59	418.2	0.39	0.18	2.00
445.94	445.5	0.44	0.18	2.00
453.66	453.4	0.26	0.18	2.00
460.02	459.8	0.22	0.18	2.00
536.59	536.6	-0.01	0.18	2.00
637.98	637.7	0.28	0.18	2.00
431.38	431.1	0.28	0.18	2.00
472.50	472.3	0.20	0.18	2.00
513.47	513.4	0.07	0.18	2.00
528.88	528.9	-0.02	0.18	2.00
573.17	573.3	-0.13	0.18	2.00
585.35	585.1	0.25	0.20	2.00
684.40	684.5	-0.10	0.18	2.00
740.72	741.0	-0.28	0.20	2.00
748.55	748.8	-0.25	0.18	2.00
807.03	807.3	-0.27	0.18	2.00
879.28	879.6	-0.32	0.18	2.00

Remark : - UUC = Unit Under Calibration

- N/A = Not Available

- The result expanded uncertainty of measurement *U* is stated as the standard uncertainty of measurement multiplied by the coverage factor *k*.

which for a normal distribution corresponds to a coverage probability of approximately 95%

- End of Certificate -

เอกสารไม่ควบคุม

FM-708-02 R01 1/11/2021

บริษัท อินทิเกรตเต็ด รีเสิร์ช เซ็นเตอร์ จำกัด



Certificate of Calibration

Certificate No.: C01243398

Page: 2 of 2

Equipment: Balance
Model: BSA224S-CW
Serial No. (or ID.): 34490341
Manufacturer: Sartorius
Condition: In condition

Certificate No.: C01243398
Issued Date: 06 November 2024
Job No.: WO-00047130
Page: 1 of 2

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

Environment Condition: Temperature 24 °C ± 0.4 °C
Humidity 60 %RH ± 3.3 %RH

Calibration Place: Double A (1991) Public Company Limited.
(Water Laboratory IP1 (Balance Room))
1 Moo 2, Thatoom, Srimahaphot,
Prachinburi 25140 Thailand.

Calibration By: Mr. Piypat Saidoung

Calibration Date: 30 October 2024

The Method used: In-house method, CAL-WI-47, based on UKAS Lab 14

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Co., Ltd. Certificate No. C02231944

Calibration Results:

Without Adjustment

Eccentric Error: Weight to be 1/3 or 1/2 of Maximum capacity, taken from the center of the pan as a zero reference.

Nominal Test Value		100 (g)				
		Reference Points (g)				
A	B	C	D	E		
-	0.0001	0.0001	-0.0001	-0.0001		

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

Nominal test value (g)	Standard Deviation
20	0.00004
200	0.00006

Error of indication from nominal or conventional mass value., Readability 0.0001 (g)

Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Error of indication (g)	Uncertainty (g)	k
0.1	0.10001	0.1000	0.0000	0.00011	2.04
0.2	0.20001	0.2000	0.0000	0.00011	2.04
0.5	0.50001	0.5000	0.0000	0.00011	2.04
1	1.00001	1.0000	0.0000	0.00011	2.04
2	2.00002	2.0000	0.0000	0.00011	2.04
5	5.00002	5.0000	0.0000	0.00011	2.04
10	10.00001	10.0000	0.0000	0.00011	2.04
20	20.00001	20.0000	0.0000	0.00012	2.03
50	50.00001	50.0000	0.0000	0.00013	2.02
100	100.00003	100.0000	0.0000	0.00017	2.01
200	200.00000	200.0000	0.0000	0.00030	2.00

The End of Certificate

(Mr. Piypat Saidoung)
Person in charge

(Mr. Adisai Maknoi)
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 DKSH Technology Limited.

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DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Prachinburi, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

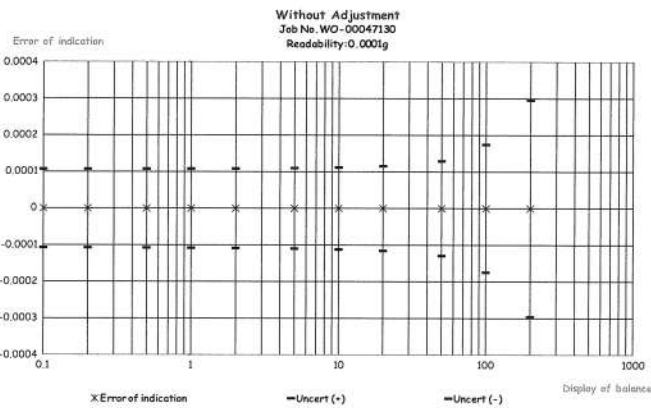
Delivering Growth - in Asia and Beyond.

CAL-FM-C01-14: 12 Sep 2022

บริษัท ดีเคเอส เทคโนโลยี จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Prachinburi, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

Delivering Growth - in Asia and Beyond.

CAL-FM-C01-14: 12 Sep 2022



ใบตรวจสอบสภาพเครื่องชั่ง

เลขที่ใบงาน: WO-00047130

ชนิดเครื่องมือ: Balance

รุ่น: BSA224S-CW

หมายเลขเครื่อง: 34490341

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
30 Oct 2024			30 Oct 2024		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		General			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. สายไฟ/Adapter, power supply 220/110V	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. ความสมบูรณ์ชุดกระถางกันลม (Cover)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. ความสมบูรณ์ชุดของระดับน้ำ	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. การปรับระดับของขาตั้งเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. การตอบสนองของไมกด	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	6. ความสมบูรณ์ของ Display	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	7. การแสดงผลของ Display หลังวางน้ำหนัก	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. ชุดรองจานชั่ง (Stopper) / pan support	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	9. การทำงานของ Function Internal / External	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	10. ความสะอาดของตัวเครื่องภายนอกและแผ่น load cell	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	11. สภาพแวดล้อม ณ สถานที่ตั้งเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

หมายเหตุเพิ่มเติมอื่น ๆ :

Mr. Piypat Saidoung
Service Engineer

บริษัท ดีเคเอส เทคโนโลยี จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Prachinburi, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

Delivering Growth - in Asia and Beyond.

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

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

Request No.23-68/0221

MTC.No.23-68/0221

Number of page(s) 2

CALIBRATION CERTIFICATE

Nomenclature : PERSONAL AIR PUMP SAMPLING PUMP CALIBRATION

Manufacturer : MesaLabs

Serial No.: 210155

Model : Defender 510

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

Subdivision : (0.00001, 0.0001) l/min

Submitted by : INTEGRATED RESEARCH CENTER COMPANY LIMITED.

122 T.Thatoom A.Srimahaphote,

Prachinburi 25140, Thailand.

Received date : 15 January 2025 Condition of measured item : Normal

Calibration date : 3 February 2025

Standard :

Standard	Certificate No.	Date due	Traceability
RTD Thermometer	PSL-T 0811/67	3-Jul-26	TISTR
Molbox/Pressure/Transducer/UpStream	MP-0076-23	2-Apr-25	NIMT
Primary Flow Calibrator S/N 119521	MW-0033-23	6-Jun-25	NIMT

Calibrated by : Terasak Panna

(Mr.Terasak Panna)

Approved by :

(Ms.Kirana Luangnirun)

Director

Mechanical Engineering Standards Laboratory

Ref. 2013268011500202001

Issued Date 5 February 2025

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FM.BLMTC.002 Rev.5

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JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd.
63/14-15, 67/35-36
Pattanaum 7/71, Rd. Wattana, Bangkokkai,
Bangkok 10600(Thailand)
Tel. +(66)06680332
Mobile: +(66)83999453
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.comAccredited calibration laboratory
ISO/IEC 17025:2017
NSC-TISI-TIS 17025
CALIBRATION 0367Flow measurement laboratory
Calibration services department.NSC - TISI - TIS 17025
CALIBRATION 0367

JIRANATEE ASSOCIATES CO.,LTD.

Continuation of Certificate of Calibration Number COF-013-67

Page 2 of 2 Pages

CERTIFICATE OF CALIBRATION

Certificate No. : COF-013-67

Page 1 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER
MODEL/TYPE
SERIAL NUMBER
ID NUMBER
CONDITION AS-RECEIVED
CUSTOMER: Top Load Orifice
: TISO4
: TE-5028A
: 2926
: -
: Used Item: Integrated Research Center Company Limited.
122 Moo 2, Thatoom, Srimahaphote,
Prachinburi 25140, Thailand.RECEIVED DATE
MEASUREMENT DATE
ISSUE DATE: 10 May 2024
: 05 Jun 2024
: 06 Jun 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

CALIBRATION CONDITION:

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are 22.9 °C and 53.2 %RH.

NOTED: The certificate is valid only to the item calibrated on date and place of calibration.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibration procedure:

The Orifice gas flow device was calibrated against
Standard Rotary Displacement Meter (Roots
Meter) Model G65/IMC/W2-40. The MP-CL-004
was used as a calibration guideline.

Traceability:

This certificate provides a traceability of the
measurement to recognized the national
standards and to realization of the international
system of units (SI) through the NMV (National
Metrology Institute of Thailand) via Certificate
number: MW-0063-23.

Uncertainty of Measurement:

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

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

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

Atmospheric pressure (1010±13) hPa

Calibration method : The flowmeter (UUC) was calibrated by comparison method with
standard flowmeter according to CP-370.01.The reported value is the value that converted to value at reference condition
within pressure and temperature of the actual gas entering the UUC

Measurement data :

UUC Value (l/min)	Standard Value (l/min)	Temperature (°C)	Pressure (hPa)	Deviation (%)	Uncertainty (%)
0.05043	0.049841	24.718	1007.90	+1.19	1.4
0.50136	0.49651	24.716	1008.19	+0.98	0.90
1.0045	0.9973	24.693	1008.53	+0.73	0.89
1.5020	1.5012	24.688	1009.04	+0.06	0.89
1.9995	2.0036	24.668	1009.48	-0.20	0.89

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

The end of calibration certificate.

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.



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0159

MTC No. EEL. BP. 80/0168

CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.

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

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

Instrument Calibrated :

Description : Sound Calibrator

Manufacturer : ACO

Model : 2127

Serial No. : 100012

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.500) kPa

- Standards used :
1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
 2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.
 3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.
 4. Digital Multimeter Agilent 34401A S/N MY44005560.
 5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.
 6. Audio Analyzer Panasonic VP-7722A S/N 041477D122.
 7. Condenser Microphone B&K 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 : 14 Jan. 2025

Date of Calibration : 21 Jan. 2025

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.

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0159

MTC No. EEL. BP. 82/0168

CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.

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

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

Instrument Calibrated :

Description : Sound Calibrator

Manufacturer : Delta Ohm

Model : HD9102

Serial No. : 10038483

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.500) kPa

- Standards used :
1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
 2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.
 3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.
 4. Digital Multimeter Agilent 34401A S/N MY44005560.
 5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.
 6. Audio Analyzer Panasonic VP-7722A S/N 041477D122.
 7. Condenser Microphone B&K 4180 S/N 2889871.

Calibration Procedure: CP-102-04 based on IEC 60942-2003. The sound pressure level of instrument was measured by standard microphone using an insert voltage technique.

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

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

Date of Receipt : 14 Jan. 2025

Date of Calibration : 22 Jan. 2025

1/3

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0159

MTC No. EEL. BP. 80/0168

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

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

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

1. Sound Pressure Level

Standard Microphone	Measured Sound Pressure	Deviated value	Uncertainty	Tolerance limit
Type	Level (dB)	(dB)	(dB)	IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	93.91	-0.09	± 0.10	±0.40 dB

2. Frequency

Standard Microphone	Measured Frequency	Deviated value	Uncertainty	Tolerance limit
Type	(Hz)	(Hz)	(Hz)	IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	1000.0	0.0	± 1.5	±1.0%

3. Total Distortion

Standard Microphone	Measured Total Distortion	Uncertainty	Tolerance limit
Type	(%)	(%)	IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	1.50	± 0.50	±3.0%

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :

(Signature)
(Mr.Weerachai Decchaiyae)

Approved by :

(Signature)
(Mr.Prinyakorn Klaiyapa)

Director
Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 21 Jan. 2025

Date of Issue : 23 Jan. 2025

Ref : 2011268011400184001

End of Certificate

2/2

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0159

MTC No. EEL. BP. 82/0168

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

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

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

1. Sound Pressure Level

Standard Microphone	Measured Sound Pressure	Deviated value	Uncertainty	Tolerance limit
Type	Level (dB)	(dB)	(dB)	IEC60942:2003 Class 2
1/2 inch Bruel&Kjaer 4180	93.88	-0.12	± 0.10	±0.75 dB

2. Frequency

Standard Microphone	Measured Frequency	Deviated value	Uncertainty	Tolerance limit
Type	(Hz)	(Hz)	(Hz)	IEC60942:2003 Class 2
1/2 inch Bruel&Kjaer 4180	988.3	-11.7	± 1.5	±2.0%

3. Total distortion

Standard Microphone	Measured Total distortion	Uncertainty	Tolerance limit
Type	(%)	(%)	IEC60942:2003 Class 2
1/2 inch Bruel&Kjaer 4180	1.00	± 0.50	±4.0%

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Date of Calibration : 22 Jan. 2025

2/3

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0159

MTC No. EEL. BP. 82/0168

Nominal Output of Unit Under Test = 114 dB re 20µPa at 1000 Hz

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Brüel&Kjaer 4180	113.86	-0.14	± 0.10	±0.75 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Brüel&Kjaer 4180	988.4	-11.6	± 1.5	±2.0%

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Brüel&Kjaer 4180	0.21	± 0.50	±4.0%

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :

(Mr. Weerachai Deechaiyae)

Approved by :

(Mr. Prawate Khuaypa)

Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 22 Jan. 2025

Date of Issue : 23 Jan. 2025

Ref: 2011268011400184003

End of Certificate

3 / 3

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0159

MTC No. EEL. BP. 81/0168

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

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

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjaer 4180	93.91	-0.09	± 0.10	±0.40 dB

2. Frequency

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

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjaer 4180	1.35	± 0.50	±3.0%

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

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

Calibrated by :

(Mr. Weerachai Deechaiyae)

Approved by :

(Mr. Prawate Khuaypa)

Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 22 Jan. 2025

Date of Issue : 23 Jan. 2025

Ref: 2011268011400184002

End of Certificate

2 / 2

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0159

MTC No. EEL. BP. 81/0168

CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.

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

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.

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

Instrument Calibrated :

Description : Sound Calibrator

Manufacturer : Rion

Model : NC-74

Serial No. : 35046798

Standards used : 1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.

2. Measuring Amplifier Brüel&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 Panasonic VP-7722A S/N 041477D122.

7. Condenser Microphone B&K 4180 S/N 2633526.

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.500) kPa

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 : 14 Jan. 2025

Date of Calibration : 22 Jan. 2025

1 / 2

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0160

MTC No. EEL. BP. 89/0168

CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.

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

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.

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

Instrument Calibrated :

Description : Integrating Sound Level Meter

Manufacturer : ACO

Model : 6226

Serial No. : 100144

Microphone : Type 7052 No.79844

Preamplifier : -

Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.

2. Condenser Microphone Brüel&Kjaer 4180 S/N 2889871.

3. Decade Attenuator Ando AL-205 S/N 00464602.

4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.

5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.

6. Sound Calibrator Brüel&Kjaer 4231 S/N 3015154.

7. Measuring Amplifier Brüel&Kjaer 2636 S/N 1537484.

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.5) kPa

Date of Receipt : 14 Jan. 2025

Date of Calibration : 17-18 Feb. 2025

1 / 9

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FMBL.MTC.002 Rev.5

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(66) 08 1889 6827

8. Power Amplifier Brüel&Kjær 2706 S/N 1517650.
9. Speaker Tannoy Limited, Great Britain British Patent No. 215300.
10. Digital Multimeter Agilent 34401A S/N MY44005560.
11. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

Date of Calibration : 17-18 Feb. 2025

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
	A-weight	C-weight	Flat			
125	-0.3	0.2	0.1	1.5	0.45	0.6
1 000	-0.1	-0.1	0.0	1.0	0.45	0.6
8 000	-4.8	-4.7	-4.8	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

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

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1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
	Before adjust	After adjust				
93.99	93.7	94.0	0.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 115.1 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
18.5	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
A-Weight	16.3	0.10	N/A
C-Weight	24.7	0.10	N/A
Flat	26.7	0.10	N/A

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5. Long-term stability

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

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

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

6.2 Time weightings at 1 kHz

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

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
122	122.0	0.0	1.1	0.30	0.3
121	121.1	0.1	1.1	0.30	0.3
120	120.0	0.0	1.1	0.30	0.3
119	119.1	0.1	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.1	0.1	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.1	0.1	1.1	0.30	0.3
79	79.1	0.1	1.1	0.30	0.3
74	74.1	0.1	1.1	0.30	0.3
69	69.1	0.1	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3
54	54.0	0.0	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.1	0.1	1.1	0.30	0.3
39	39.0	0.0	1.1	0.30	0.3
34	34.1	0.1	1.1	0.30	0.3
33	33.1	0.1	1.1	0.30	0.3

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8. Level linearity including the level range control

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

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	45	45.0	0.0	1.1	0.30	0.3
30-120	35	35.0	0.0	1.1	0.30	0.3
20-110	25	25.5	0.5	1.1	0.30	0.3
20-100	25	25.5	0.5	1.1	0.30	0.3
20-90	25	25.4	0.4	1.1	0.30	0.3
20-80	25	25.4	0.4	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	115.8	-0.2	±1.0	0.20	0.3
	2	98.8	-0.2	+1.0; -2.5	0.20	0.3
	0.25	89.6	-0.4	+1.5; -5.0	0.20	0.3
Slow	200	109.4	-0.2	±1.0	0.20	0.3
	2	89.8	-0.2	+1.0; -5.0	0.20	0.3
SEL	200	109.9	-0.1	±1.0	0.20	0.3
	2	90.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
32	32.1	0.1	1.1	0.30	0.3
31	31.3	0.3	1.1	0.30	0.3
30	30.3	0.3	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

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

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10. Peak C sound level


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

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
131.1	131.1	0.0	1.5	0.20	0.25

12. High-level stability

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

Calibrated by : 
(Mr. Pannasit Phasingsri)

Approved by : 
(Mr. Prawate Klusanya)
Director

Electrical and Electronic Standards Laboratory

Date of Calibration : 17-18 Feb. 2025

Industrial Metrology and Testing Service Centre

Date of Issue : 24 Feb. 2025

Ref : 2011268011400185007

End of Certificate

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CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.

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

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.

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

Instrument Calibrated :

Description : Integrating Sound Level Meter

Manufacturer : ACO

Model : 6226

Serial No. : 100145

Microphone : Type 7052NR No.78402

Preamplifier : *

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.5) kPa

Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Sound Calibrator Brüel&Kjær 4231 S/N 3015154.
7. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 14 Jan. 2025

Date of Calibration : 17-18 Feb. 2025

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1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
93.99	92.9	94.0	0.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment

was then completed at the display of 117.0 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
25.3	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	24.5	0.10	N/A
C-Weight	26.7	0.10	N/A
Flat	31.3	0.10	N/A

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

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

Calibration Procedure :

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

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

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

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.4	0.1	-0.1	1.5	0.45	0.6
1 000	0.1	0.2	0.2	1.0	0.45	0.6
8 000	-4.2	-3.6	-4.4	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

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

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5. Long-term stability

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

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

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

6.2 Time weightings at 1 kHz

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

Date of Calibration : 17-18 Feb. 2025

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
32	32.2	0.2	1.1	0.30	0.3
31	31.2	0.2	1.1	0.30	0.3
30	30.3	0.3	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

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

Date of Calibration : 17-18 Feb. 2025

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
122	121.9	-0.1	1.1	0.30	0.3
121	120.9	-0.1	1.1	0.30	0.3
120	119.9	-0.1	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	113.9	-0.1	1.1	0.30	0.3
109	108.9	-0.1	1.1	0.30	0.3
104	103.9	-0.1	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	88.9	-0.1	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3
64	63.9	-0.1	1.1	0.30	0.3
59	58.9	-0.1	1.1	0.30	0.3
54	53.9	-0.1	1.1	0.30	0.3
49	48.9	-0.1	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	38.9	-0.1	1.1	0.30	0.3
34	34.0	0.0	1.1	0.30	0.3
33	33.1	0.1	1.1	0.30	0.3

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8. Level linearity including the level range control

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

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	45	45.0	0.0	1.1	0.30	0.3
30-120	35	35.0	0.0	1.1	0.30	0.3
20-110	25	25.4	0.4	1.1	0.30	0.3
20-100	25	25.5	0.5	1.1	0.30	0.3
20-90	25	25.6	0.6	1.1	0.30	0.3
20-80	25	25.5	0.5	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	115.8	-0.2	±1.0	0.20	0.3
	2	98.8	-0.2	+1.0; -2.5	0.20	0.3
	0.25	89.6	-0.4	+1.5; -5.0	0.20	0.3
Slow	200	109.4	-0.2	±1.0	0.20	0.3
	2	89.8	-0.2	+1.0; -5.0	0.20	0.3
SEL	200	109.9	-0.1	±1.0	0.20	0.3
	2	90.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

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10. Peak C sound level


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

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
131.1	131.1	0.0	1.5	0.20	0.25

12. High-level stability

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

Calibrated by: 
(Mr. Pannasit Phasingsri)

Approved by: 
(Mr. Prawate Klunnya)
Director
Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 17-18 Feb. 2025

Date of Issue : 24 Feb. 2025

Ref: 2011268011400185008

End of Certificate

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- Power Amplifier Brüel&Kjær 2706 S/N 1517650.
- Speaker Tannoy Limited, Great Britain British Patent No. 215300.
- Digital Multimeter Agilent 34401A S/N MY44005560.
- Programmable Attenuator Tamagawa TPA-303A S/N 2212.

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

Date of Calibration : 17-18 Feb. 2025

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CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.

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

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.

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

Instrument Calibrated :

Description : Integrating Sound Level Meter

Manufacturer : ACO

Model : 6226

Serial No. : 100146

Microphone : Type 7052NR No.78402

Preamplifier : -

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.5) kPa

Standards used :

- Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
- Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
- Decade Attenuator Ando AL-205 S/N 00464602.
- Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
- Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
- Sound Calibrator Brüel&Kjær 4231 S/N 3015154.
- Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 14 Jan. 2025

Date of Calibration : 17-18 Feb. 2025

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1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
93.99	92.7	94.0	0.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 95.1 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
23.1	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	22.5	0.10	N/A
C-Weight	27.6	0.10	N/A
Flat	30.1	0.10	N/A

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.7	0.5	0.0	1.5	0.45	0.6
1 000	0.2	0.1	0.1	1.0	0.45	0.6
8 000	-4.4	-4.2	-4.4	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	0.3	0.1	0.1	2.0	0.20	0.6
125	0.1	0.1	1.3	1.5	0.20	0.6
250	0.1	0.1	0.1	1.5	0.20	0.6
500	0.1	0.0	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	-0.1	0.0	0.1	2.0	0.20	0.6
4 000	-0.4	-0.2	0.0	3.0	0.20	0.6
8 000	-0.3	-0.2	-0.1	5.0	0.20	0.7

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
122	121.8	-0.2	1.1	0.30	0.3
121	120.9	-0.1	1.1	0.30	0.3
120	119.9	-0.1	1.1	0.30	0.3
119	118.9	-0.1	1.1	0.30	0.3
114	113.9	-0.1	1.1	0.30	0.3
109	108.9	-0.1	1.1	0.30	0.3
104	103.9	-0.1	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	88.9	-0.1	1.1	0.30	0.3
84	84.1	0.1	1.1	0.30	0.3
79	78.9	-0.1	1.1	0.30	0.3
74	73.9	-0.1	1.1	0.30	0.3
69	68.9	-0.1	1.1	0.30	0.3
64	63.9	-0.1	1.1	0.30	0.3
59	58.8	-0.2	1.1	0.30	0.3
54	53.9	-0.1	1.1	0.30	0.3
49	48.9	-0.1	1.1	0.30	0.3
44	44.2	0.2	1.1	0.30	0.3
39	39.0	0.0	1.1	0.30	0.3
34	34.1	0.1	1.1	0.30	0.3
33	33.2	0.2	1.1	0.30	0.3

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5. Long-term stability

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

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

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

6.2 Time weightings at 1 kHz

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

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
32	32.3	0.3	1.1	0.30	0.3
31	31.4	0.4	1.1	0.30	0.3
30	30.4	0.4	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

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

Date of Calibration : 17-18 Feb. 2025

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8. Level linearity including the level range control

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

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	45	45.0	0.0	1.1	0.30	0.3
30-120	35	35.0	0.0	1.1	0.30	0.3
20-110	25	25.8	0.8	1.1	0.30	0.3
20-100	25	25.8	0.8	1.1	0.30	0.3
20-90	25	25.6	0.6	1.1	0.30	0.3
20-80	25	25.7	0.7	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	115.8	-0.2	±1.0	0.20	0.3
	2	98.8	-0.2	+1.0; -2.5	0.20	0.3
	0.25	89.6	-0.4	+1.5; -5.0	0.20	0.3
Slow	200	109.4	-0.2	±1.0	0.20	0.3
	2	89.8	-0.2	+1.0; -5.0	0.20	0.3
SEL	200	109.9	-0.1	±1.0	0.20	0.3
	2	90.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

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CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.

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

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.

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

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Delta OHM

Model : HD 2010UC

Serial No. : 11040842479

Microphone : Type UC-52 No.114674

Preamplifier : Delta Type HD2010PNE2 No.11001018

Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Sound Calibrator Brüel&Kjær 4231 S/N 3015154.
7. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.5) kPa

Date of Receipt : 14 Jan. 2025

Date of Calibration : 17-18 Feb. 2025

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10. Peak C sound level


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

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle	value (dB)	class 2 (±dB)	(±dB)	of measurement (±dB)
131.1	131.1	0.0	1.5	0.20	0.25

12. High-level stability

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

Calibrated by : 
(Mr. Pannasit Phasingsri)

Approved by : 
(Mr. Pravee Klunypa)
Director
Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre
Ref : 2011268011400185009

End of Certificate

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8. Power Amplifier Brüel&Kjær 2706 S/N 1517650.
9. Speaker Tannoy Limited, Great Britain British Patent No. 215300.
10. Digital Multimeter Agilent 34401A S/N MY44005560.
11. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

Date of Calibration : 17-18 Feb. 2025

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1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
93.95	93.3	94.0	0.1	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 94.0 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
19.6	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	18.3	0.10	N/A
C-Weight	24.5	0.20	N/A
Flat	26.9	0.30	N/A

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5. Long-term stability

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

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

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

6.2 Time weightings at 1 kHz

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

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.4	0.3	0.2	1.5	0.45	0.6
1 000	-0.5	-0.5	-0.5	1.0	0.45	0.6
8 000	-4.0	-3.9	-4.0	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

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

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
120	120.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3
54	54.0	0.0	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
43	43.0	0.0	1.1	0.30	0.3
42	42.1	0.1	1.1	0.30	0.3

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
41	41.1	0.1	1.1	0.30	0.3
40	40.1	0.1	1.1	0.30	0.3
39	39.1	0.1	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
60-140	94.0	94.0	0.0	1.1	0.30	0.3
50-130	94.0	94.0	0.0	1.1	0.30	0.3
40-120	94.0	94.0	0.0	1.1	0.30	0.3
30-110	94.0	94.0	0.0	1.1	0.30	0.3
20-100	94.0	94.0	0.0	1.1	0.30	0.3

Date of Calibration : 17-18 Feb. 2025

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10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	135.4	135.3	-0.1	3.0	0.20	0.35
Positive half cycle	134.4	134.2	-0.2	2.0	0.20	0.35
Negative half cycle	134.4	134.2	-0.2	2.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
140.5	140.5	0.0	1.5	0.20	0.25

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	139.0	0.0	0.3	0.10	0.1
End	139.0				

Calibrated by : 
(Mr. Pannasit Phasingsri)

Approved by : 
(Mr. Pravee Klunypa)
Director
Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 17-18 Feb. 2025

Date of Issue : 24 Feb. 2025

Ref : 2011268011400185012

End of Certificate

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8. Level linearity including the level range control

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

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
60-140	65	65.0	0.0	1.1	0.30	0.3
50-130	55	55.0	0.0	1.1	0.30	0.3
40-120	45	45.0	0.0	1.1	0.30	0.3
30-110	35	35.2	0.2	1.1	0.30	0.3
20-100	25	25.3	0.3	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	115.8	-0.2	±1.0	0.20	0.3
	2	98.8	-0.2	+1.0; -2.5	0.20	0.3
	0.25	89.6	-0.4	+1.5; -5.0	0.20	0.3
Slow	200	109.4	-0.2	±1.0	0.20	0.3
	2	89.8	-0.2	+1.0; -5.0	0.20	0.3
SEL	200	109.9	-0.1	±1.0	0.20	0.3
	2	90.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

Date of Calibration : 17-18 Feb. 2025

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Bangkok 10900, Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
(66) 08 1889 6827

CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.

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

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.

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

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Rion

Model : NL-42

Serial No. : 00433730

Microphone : Type UC-52 No.144953

Preamplifier : Type NH-24 No.33780

Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Sound Calibrator Brüel&Kjær 4231 S/N 3015154.
7. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.5) kPa

Date of Receipt : 14 Jan. 2025

Date of Calibration : 17-18 Feb. 2025

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8. Power Amplifier Brüel&Kjær 2706 S/N 1517650.
9. Speaker Tannoy Limited, Great Britain British Patent No. 215300.
10. Digital Multimeter Agilent 34401A S/N MY44005560.
11. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

Date of Calibration : 17-18 Feb. 2025

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
	A-weight	C-weight	Flat			
125	0.1	0.3	0.0	1.5	0.45	0.6
1 000	0.1	0.0	0.1	1.0	0.45	0.6
8 000	-4.6	-4.4	-4.7	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

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

Date of Calibration : 17-18 Feb. 2025

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1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
	Before adjust	After adjust				
93.95	93.8	113.9	20.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 124.0 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
17.9	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
A-Weight	14.3	0.70	N/A
C-Weight	19.4	0.70	N/A
Flat	25.1	0.30	N/A

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5. Long-term stability

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

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

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

6.2 Time weightings at 1 kHz

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

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
137	137.1	0.1	1.1	0.64	0.3
136	136.1	0.1	1.1	0.69	0.3
135	135.0	0.0	1.1	0.58	0.3
133	133.0	0.0	1.1	0.64	0.3
132	132.0	0.0	1.1	0.64	0.3
131	131.0	0.0	1.1	0.64	0.3
130	130.0	0.0	1.1	0.64	0.3
129	129.0	0.0	1.1	2.90	0.3
124	124.0	0.0	1.1	2.90	0.3
119	119.0	0.0	1.1	2.90	0.3
114	114.0	0.0	1.1	2.90	0.3
109	109.0	0.0	1.1	2.90	0.3
104	104.0	0.0	1.1	2.90	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.1	0.1	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	58.9	-0.1	1.1	0.30	0.3

Date of Calibration : 17-18 Feb. 2025

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8. Level linearity including the level range control

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

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	25	25.0	0.0	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	126.0	0.0	±1.0	0.20	0.3
	2	108.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	100.0	0.0	+1.5; -5.0	0.20	0.3
Slow	200	119.5	-0.1	±1.0	0.20	0.3
	2	100.0	0.0	+1.0; -5.0	0.20	0.3

Date of Calibration : 17-18 Feb. 2025

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

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
54	53.9	-0.1	1.1	0.30	0.3
49	48.9	-0.1	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	38.9	-0.1	1.1	0.30	0.3
34	33.9	-0.1	1.1	0.30	0.3
29	29.0	0.0	1.1	0.30	0.3
28	27.9	-0.1	1.1	0.30	0.3
27	26.9	-0.1	1.1	0.30	0.3
26	25.9	-0.1	1.1	0.30	0.3
25	24.9	-0.1	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	94.0	94.0	0.0	1.1	0.30	0.3

Date of Calibration : 17-18 Feb. 2025

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10. Peak C sound level


Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.5	0.1	3.0	0.20	0.35
Positive half cycle	124.4	124.1	-0.3	2.0	0.20	0.35
Negative half cycle	124.4	124.1	-0.3	2.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
135.4	135.4	0.0	1.5	0.55	0.25

12. High-level stability

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

Calibrated by : 
(Mr. Pannasit Phasingari)

Approved by : 
(Mr. Prawate Khaypa)
Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 17-18 Feb. 2025

Date of Issue : 24 Feb. 2025

Ref : 2011268011400185010

End of Certificate

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Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.

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

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Rion

Model : NL-42

Serial No. : 00646442

Microphone : Type UC-52 No.142301

Preamplifier : Type NH-24 No.22410

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.5) kPa

Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
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1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
93.95	93.6	113.9	20.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 124.3 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
16.9	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	13.1	0.10	N/A
C-Weight	18.5	0.10	N/A
Flat	24.4	0.10	N/A

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

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

Calibration Procedure :

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.8	0.2	0.0	1.5	0.45	0.6
1 000	0.0	0.0	0.0	1.0	0.45	0.6
8 000	-2.0	-2.0	-2.1	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

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

Date of Calibration : 17-18 Feb. 2025

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5. Long-term stability

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

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

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

6.2 Time weightings at 1 kHz

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

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

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
54	54.0	0.0	1.1	0.30	0.3
49	48.9	-0.1	1.1	0.30	0.3
44	43.9	-0.1	1.1	0.30	0.3
39	38.9	-0.1	1.1	0.30	0.3
34	34.0	0.0	1.1	0.30	0.3
29	28.9	-0.1	1.1	0.30	0.3
28	27.9	-0.1	1.1	0.30	0.3
27	26.9	-0.1	1.1	0.30	0.3
26	25.9	-0.1	1.1	0.30	0.3
25	24.9	-0.1	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	94.0	94.0	0.0	1.1	0.30	0.3

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
137	136.6	-0.4	1.1	0.30	0.3
136	135.6	-0.4	1.1	0.30	0.3
135	134.7	-0.3	1.1	0.30	0.3
133	132.8	-0.2	1.1	0.30	0.3
132	131.8	-0.2	1.1	0.30	0.3
131	130.9	-0.1	1.1	0.30	0.3
130	129.9	-0.1	1.1	0.30	0.3
129	128.9	-0.1	1.1	0.30	0.3
124	124.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	78.9	-0.1	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	68.9	-0.1	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	58.9	-0.1	1.1	0.30	0.3

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8. Level linearity including the level range control

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

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
30-130	25	25.0	0.0	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	126.0	0.0	±1.0	0.20	0.3
	2	108.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	100.0	0.0	+1.5; -5.0	0.20	0.3
Slow	200	119.5	-0.1	±1.0	0.20	0.3
	2	100.0	0.0	+1.0; -5.0	0.20	0.3

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10. Peak C sound level


Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.5	0.1	3.0	0.20	0.35
Positive half cycle	124.4	124.1	-0.3	2.0	0.20	0.35
Negative half cycle	124.4	124.1	-0.3	2.0	0.20	0.35

11. Overload indication

Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle			
135.4	135.4	0.0	1.5	0.55

12. High-level stability

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

Calibrated by: 
(Mr. Pannasit Phasingsri)

Approved by: 
(Mr. Pravat Kluaypa)
Director
Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre
Ref: 2011268011400185011

Date of Calibration : 17-18 Feb. 2025
Date of Issue : 24 Feb. 2025

End of Certificate

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- Power Amplifier Brüel&Kjær 2706 S/N 1517650.
- Speaker Tannoy Limited, Great Britain British Patent No. 215300.
- Digital Multimeter Agilent 34401A S/N MY44005560.
- Programmable Attenuator Tamagawa TPA-303A S/N 2212.

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

Date of Calibration : 24-27 Feb.2025

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CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.

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

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

Instrument Calibrated :

Description : Sound Level Meter
Manufacturer : ACO
Model : 6236
Serial No. : 192014
Microphone : 7052NR No.73303
Preamplifier : -

Ambient Environment

Temperature : (23 ± 3) °C
Relative Humidity : (50 ± 15) %
Ambient Pressure : (101.325 ± 1.5) kPa

Standards used :

- Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
- Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
- Decade Attenuator Ando AL-205 S/N 00464602.
- Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
- Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
- Sound Calibrator Brüel&Kjær 4231 S/N 3015154.
- Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 14 Jan.2025

Date of Calibration : 24-27 Feb.2025

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1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)	Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
93.99	94.0	0.0	1.0	0.48	N/A

Note: No adjustment.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
20.8	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	13.3	0.10	N/A
C-Weight	18.4	0.10	N/A
Flat	22.4	0.10	N/A

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.2	0.3	0.2	1.5	0.45	0.6
1 000	0.1	0.1	0.2	1.0	0.45	0.6
8 000	-1.6	-1.5	-1.1	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

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

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
122	122.0	0.0	1.1	0.30	0.3
121	121.1	0.1	1.1	0.30	0.3
120	120.1	0.1	1.1	0.30	0.3
119	119.1	0.1	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.1	0.1	1.1	0.30	0.3
74	74.1	0.1	1.1	0.30	0.3
69	69.1	0.1	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3
54	54.0	0.0	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	39.0	0.0	1.1	0.30	0.3
34	34.1	0.1	1.1	0.30	0.3
33	33.1	0.1	1.1	0.30	0.3

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5. Long-term stability

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

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

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

6.2 Time weightings at 1 kHz

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

Date of Calibration : 24-27 Feb.2025

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
32	32.2	0.2	1.1	0.30	0.3
31	31.2	0.2	1.1	0.30	0.3
30	30.3	0.3	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

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

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8. Level linearity including the level range control

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

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

9. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	115.8	-0.2	±1.0	0.20	0.3
	2	98.3	-0.7	+1.0; -2.5	0.20	0.3
	0.25	89.2	-0.8	+1.5; -5.0	0.20	0.3
Slow	200	109.5	-0.1	±1.0	0.20	0.3
	2	89.7	-0.3	+1.0; -5.0	0.20	0.3
SEL	200	109.9	-0.1	±1.0	0.20	0.3
	2	89.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

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CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.

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

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

Instrument Calibrated :

Description : Sound Level Meter
Manufacturer : ACO
Model : 6236
Serial No. : 192015
Microphone : 7052NR No.73304
Preamplifier : -

Ambient Environment

Temperature : (23 ± 3) °C
Relative Humidity : (50 ± 15) %
Ambient Pressure : (101.325 ± 1.5) kPa

Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Sound Calibrator Brüel&Kjær 4231 S/N 3015154.
7. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 14 Jan.2025

Date of Calibration : 24-27 Feb.2025

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10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.7	0.3	3.0	0.20	0.35
Positive half cycle	124.4	124.2	-0.2	2.0	0.20	0.35
Negative half cycle	124.4	124.2	-0.2	2.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
132.5	132.5	0.0	1.5	0.20	0.25

12. High-level stability

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

Calibrated by :

(Signature)
(Mr. Tawikiat Iamsamran)

Approved by :

(Signature)
(Mr. Prawate Klusanya)
Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 24-27 Feb.2025

Date of Issue : 28 Feb.2025

Ref : 2011268011400185003

End of Certificate

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8. Power Amplifier Brüel&Kjær 2706 S/N 1517650.
9. Speaker Tannoy Limited, Great Britain British Patent No. 215300.
10. Digital Multimeter Agilent 34401A S/N MY44005560.
11. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

Date of Calibration : 24-27 Feb.2025

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1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)	Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
93.99	93.9	-0.1	1.0	0.48	N/A

Note: No adjustment.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
22.0	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	15.7	0.10	N/A
C-Weight	21.5	0.10	N/A
Flat	26.0	0.10	N/A

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5. Long-term stability

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

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

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

6.2 Time weightings at 1 kHz

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

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
125	0.4	1.5	0.45	0.6
1 000	-0.4	1.0	0.45	0.6
8 000	-0.8	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

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

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
122	122.1	0.1	1.1	0.30	0.3
121	121.1	0.1	1.1	0.30	0.3
120	120.1	0.1	1.1	0.30	0.3
119	119.1	0.1	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.1	0.1	1.1	0.30	0.3
74	74.2	0.2	1.1	0.30	0.3
69	69.2	0.2	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	59.1	0.1	1.1	0.30	0.3
54	54.1	0.1	1.1	0.30	0.3
49	49.1	0.1	1.1	0.30	0.3
44	44.1	0.1	1.1	0.30	0.3
39	39.1	0.1	1.1	0.30	0.3
34	34.2	0.2	1.1	0.30	0.3
33	33.3	0.3	1.1	0.30	0.3

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
32	32.3	0.3	1.1	0.30	0.3
31	31.4	0.4	1.1	0.30	0.3
30	30.4	0.4	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

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

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10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.5	0.1	3.0	0.20	0.35
Positive half cycle	124.4	124.3	-0.1	2.0	0.20	0.35
Negative half cycle	124.4	124.3	-0.1	2.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
132.5	132.5	0.0	1.5	0.20	0.25

12. High-level stability

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

Calibrated by :

Approved by :

(Mr. Tawikiat Jamsamran)

(Mr. Prawate Klaiyapa)

Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 24-27 Feb.2025

Date of Issue : 28 Feb.2025

Ref : 2011268011400185002

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8. Level linearity including the level range control

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

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	45.0	45.0	0.0	1.1	0.30	0.3
30-120	35.0	35.0	0.0	1.1	0.30	0.3
20-110	25.0	25.5	0.5	1.1	0.30	0.3
20-100	25.0	25.4	0.4	1.1	0.30	0.3
20-90	25.0	25.4	0.4	1.1	0.30	0.3
20-80	25.0	25.2	0.2	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	115.8	-0.2	±1.0	0.20	0.3
	2	98.6	-0.4	+1.0; -2.5	0.20	0.3
	0.25	89.0	-1.0	+1.5; -5.0	0.20	0.3
Slow	200	109.4	-0.2	±1.0	0.20	0.3
	2	89.8	-0.2	+1.0; -5.0	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3
SEL	200	109.9	-0.1	±1.0	0.20	0.3
	2	90.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

Date of Calibration : 24-27 Feb.2025

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(66) 08 1889 6827

CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.

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

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.

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

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : ACO

Model : 6236

Serial No. : 192016

Microphone : 7052NR No.73305

Preamplifier : -

Standards used :

- Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
- Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
- Decade Attenuator Ando AL-205 S/N 00464602.
- Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
- Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
- Sound Calibrator Brüel&Kjær 4231 S/N 3015154.
- Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325±1.5) kPa

Date of Receipt : 14 Jan.2025

Date of Calibration : 24-27 Feb.2025

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8. Power Amplifier Brüel&Kjær 2706 S/N 1517650.
9. Speaker Tannoy Limited, Great Britain British Patent No. 215300.
10. Digital Multimeter Agilent 34401A S/N MY44005560.
11. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

Date of Calibration : 24-27 Feb.2025

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.5	0.6	0.5	1.5	0.45	0.6
1 000	-0.9	-0.9	-0.8	1.0	0.45	0.6
8 000	-1.3	-1.1	-0.7	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

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

Date of Calibration : 24-27 Feb.2025

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1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)	Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
93.99	93.3	-0.7	1.0	0.48	N/A

Note: No adjustment.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
23.6	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	15.5	0.10	N/A
C-Weight	20.5	0.10	N/A
Flat	25.1	0.10	N/A

Date of Calibration : 24-27 Feb.2025

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5. Long-term stability

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

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

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

6.2 Time weightings at 1 kHz

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

Date of Calibration : 24-27 Feb.2025

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
122	121.9	-0.1	1.1	0.30	0.3
121	120.9	-0.1	1.1	0.30	0.3
120	119.9	-0.1	1.1	0.30	0.3
119	118.9	-0.1	1.1	0.30	0.3
114	113.9	-0.1	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.1	0.1	1.1	0.30	0.3
79	79.1	0.1	1.1	0.30	0.3
74	74.1	0.1	1.1	0.30	0.3
69	69.2	0.2	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	59.1	0.1	1.1	0.30	0.3
54	54.0	0.0	1.1	0.30	0.3
49	49.1	0.1	1.1	0.30	0.3
44	44.1	0.1	1.1	0.30	0.3
39	39.1	0.1	1.1	0.30	0.3
34	34.2	0.2	1.1	0.30	0.3
33	33.3	0.3	1.1	0.30	0.3

Date of Calibration : 24-27 Feb.2025

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8. Level linearity including the level range control

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

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	45.0	44.9	-0.1	1.1	0.30	0.3
30-120	35.0	35.0	0.0	1.1	0.30	0.3
20-110	25.0	25.7	0.7	1.1	0.30	0.3
20-100	25.0	25.6	0.6	1.1	0.30	0.3
20-90	25.0	25.5	0.5	1.1	0.30	0.3
20-80	25.0	25.4	0.4	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	116.0	0.0	±1.0	0.20	0.3
	2	98.6	-0.4	+1.0; -2.5	0.20	0.3
	0.25	89.5	-0.5	+1.5; -5.0	0.20	0.3
Slow	200	109.5	-0.1	±1.0	0.20	0.3
	2	89.8	-0.2	+1.0; -5.0	0.20	0.3
	200	109.9	-0.1	±1.0	0.20	0.3
SEL	2	89.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

Date of Calibration : 24-27 Feb.2025

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
32	32.4	0.4	1.1	0.30	0.3
31	31.5	0.5	1.1	0.30	0.3
30	30.6	0.6	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

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

Date of Calibration : 24-27 Feb.2025

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10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.1	-0.3	3.0	0.20	0.35
Positive half cycle	124.4	122.4	-2.0	2.0	0.20	0.35
Negative half cycle	124.4	124.6	0.2	2.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
132.5	132.5	0.0	1.5	0.20	0.25

12. High-level stability

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

Calibrated by :

(Mr. Tawikiat Iamsamran)

Approved by :



(Mr. Praveen Klayapa)
Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 24-27 Feb.2025

Date of Issue : 28 Feb.2025

Ref : 2011268011400185001

End of Certificate

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CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.

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

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.

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

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : ACO

Model : 6236

Serial No. : 212014

Microphone : 7052NR No.76235

Preamplifier :-

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.5) kPa

Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Sound Calibrator Brüel&Kjær 4231 S/N 3015154.
7. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 14 Jan.2025

Date of Calibration : 24-27 Feb.2025

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1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
93.99	94.2	94.0	0.0	1.0	0.48	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 114.7 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
20.7	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	13.7	0.10	N/A
C-Weight	19.0	0.10	N/A
Flat	23.9	0.10	N/A

Date of Calibration : 24-27 Feb.2025

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Office
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Bangkok 10900, Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
(66) 08 1889 6827

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

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

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

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

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

Date of Calibration : 24-27 Feb.2025

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.5	0.5	0.3	1.5	0.45	0.6
1 000	-0.1	-0.2	0.0	1.0	0.45	0.6
8 000	-1.3	-1.1	-0.8	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

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

Date of Calibration : 24-27 Feb.2025

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5. Long-term stability

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

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

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

6.2 Time weightings at 1 kHz

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

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
32	32.2	0.2	1.1	0.30	0.3
31	31.3	0.3	1.1	0.30	0.3
30	30.3	0.3	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

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

Date of Calibration : 24-27 Feb.2025

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
122	122.1	0.1	1.1	0.30	0.3
121	121.1	0.1	1.1	0.30	0.3
120	120.1	0.1	1.1	0.30	0.3
119	119.1	0.1	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.1	0.1	1.1	0.30	0.3
69	69.1	0.1	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3
54	54.0	0.0	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	39.0	0.0	1.1	0.30	0.3
34	34.1	0.1	1.1	0.30	0.3
33	33.2	0.2	1.1	0.30	0.3

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8. Level linearity including the level range control

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

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

9. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	115.8	-0.2	±1.0	0.20	0.3
	2	98.7	-0.3	+1.0; -2.5	0.20	0.3
	0.25	89.2	-0.8	+1.5; -5.0	0.20	0.3
Slow	200	109.5	-0.1	±1.0	0.20	0.3
	2	89.8	-0.2	+1.0; -5.0	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3
SEL	200	109.9	-0.1	±1.0	0.20	0.3
	2	89.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

Date of Calibration : 24-27 Feb.2025

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10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.0	-0.4	3.0	0.20	0.35
Positive half cycle	124.4	124.3	-0.1	2.0	0.20	0.35
Negative half cycle	124.4	124.3	-0.1	2.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
132.5	132.5	0.0	1.5	0.20	0.25

12. High-level stability

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

Calibrated by :

Approved by :

(Mr. Tawikiat Jamsamran)

(Mr. Prawate Khuyapa)

Director

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 24-27 Feb.2025

Date of Issue : 28 Feb.2025

Ref : 2011268011400185004

End of Certificate

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- Speaker Tannoy Limited, Great Britain British Patent No. 215300.
- Digital Multimeter Agilent 34401A S/N MY44005560.
- Programmable Attenuator Tamagawa TPA-303A S/N 2212.

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

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CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.

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

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.

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

Instrument Calibrated :

Ambient Environment

Description : Sound Level Meter

Temperature : (23 ± 3) °C

Manufacturer : ACO

Relative Humidity : (50 ± 15) %

Model : 6236

Ambient Pressure : (101.325 ± 1.5) kPa

Serial No. : 212015

Microphone : 7052NR No.76236

Preamplifier : -

Standards used :

- Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
- Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
- Decade Attenuator Ando AL-205 S/N 00464602.
- Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
- Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
- Sound Calibrator Brüel&Kjær 4231 S/N 3015154.
- Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 14 Jan.2025

Date of Calibration : 24-27 Feb.2025

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1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
93.99	94.4	94.0	0.0	1.0	0.48	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 115.0 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
20.7	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	15.1	0.10	N/A
C-Weight	19.9	0.10	N/A
Flat	24.7	0.10	N/A

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Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.4	0.6	0.4	1.5	0.45	0.6
1 000	-0.1	-0.1	0.1	1.0	0.45	0.6
8 000	-0.7	-0.7	-0.2	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

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

Date of Calibration : 24-27 Feb.2025

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
122	122.0	0.0	1.1	0.30	0.3
121	121.0	0.0	1.1	0.30	0.3
120	120.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.1	0.1	1.1	0.30	0.3
79	79.1	0.1	1.1	0.30	0.3
74	74.1	0.1	1.1	0.30	0.3
69	69.1	0.1	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3
54	54.0	0.0	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	39.0	0.0	1.1	0.30	0.3
34	34.1	0.1	1.1	0.30	0.3
33	33.1	0.1	1.1	0.30	0.3

Date of Calibration : 24-27 Feb.2025

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5. Long-term stability

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

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

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

6.2 Time weightings at 1 kHz

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

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
32	32.2	0.2	1.1	0.30	0.3
31	31.2	0.2	1.1	0.30	0.3
30	30.3	0.3	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

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

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8. Level linearity including the level range control

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

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	45.0	45.0	0.0	1.1	0.30	0.3
30-120	35.0	35.0	0.0	1.1	0.30	0.3
20-110	25.0	25.3	0.3	1.1	0.30	0.3
20-100	25.0	25.2	0.2	1.1	0.30	0.3
20-90	25.0	25.1	0.1	1.1	0.30	0.3
20-80	25.0	24.9	-0.1	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	115.8	-0.2	±1.0	0.20	0.3
	2	98.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	89.0	-1.0	+1.5; -5.0	0.20	0.3
Slow	200	109.3	-0.3	±1.0	0.20	0.3
	2	89.8	-0.2	+1.0; -5.0	0.20	0.3
SEL	200	109.9	-0.1	±1.0	0.20	0.3
	2	89.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

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CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.

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

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.

Sri IC, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Sound Level Meter
Manufacturer : ACO
Model : 6236
Serial No. : 212016
Microphone : 7052NR No.76237
Preamplifier : -

Ambient Environment

Temperature : (23 ± 3) °C
Relative Humidity : (50 ± 15) %
Ambient Pressure : (101.325 ± 1.5) kPa

Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
3. Decade Attenuator Ando AI-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Sound Calibrator Brüel&Kjær 4231 S/N 3015154.
7. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 14 Jan.2025

Date of Calibration : 24-27 Feb.2025

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10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.5	0.1	3.0	0.20	0.35
Positive half cycle	124.4	124.3	-0.1	2.0	0.20	0.35
Negative half cycle	124.4	124.3	-0.1	2.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
132.5	132.5	0.0	1.5	0.20	0.25

12. High-level stability

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

Calibrated by :

Approved by :

(Mr. Tawikiat Iamsamran)

(Mr. Prawate Khayapa)

Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 24-27 Feb.2025

Date of Issue : 28 Feb.2025

Ref : 2011268011400185005

End of Certificate

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

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

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

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

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

Date of Calibration : 24-27 Feb.2025

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1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)	Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
93.99	94.0	0.0	1.0	0.48	N/A

Note: No adjustment.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
21.3	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	14.4	0.10	N/A
C-Weight	19.1	0.10	N/A
Flat	23.5	0.10	N/A

Date of Calibration : 24-27 Feb.2025

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5. Long-term stability

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

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

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

6.2 Time weightings at 1 kHz

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

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3. Acoustical signal test of frequency weightings

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

4. Electrical signal test of frequency weightings

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

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
122	122.1	0.1	1.1	0.30	0.3
121	121.1	0.1	1.1	0.30	0.3
120	120.1	0.1	1.1	0.30	0.3
119	119.1	0.1	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	83.9	-0.1	1.1	0.30	0.3
79	78.9	-0.1	1.1	0.30	0.3
74	74.1	0.1	1.1	0.30	0.3
69	69.2	0.2	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3
54	54.0	0.0	1.1	0.30	0.3
49	49.1	0.1	1.1	0.30	0.3
44	44.1	0.1	1.1	0.30	0.3
39	39.0	0.0	1.1	0.30	0.3
34	34.2	0.2	1.1	0.30	0.3
33	33.2	0.2	1.1	0.30	0.3

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
32	32.2	0.2	1.1	0.30	0.3
31	31.2	0.2	1.1	0.30	0.3
30	30.3	0.3	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

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

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10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.3	-0.1	3.0	0.20	0.35
Positive half cycle	124.4	124.3	-0.1	2.0	0.20	0.35
Negative half cycle	124.4	124.2	-0.2	2.0	0.20	0.35

11. Overload indication

Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle			
132.5	132.5	0.0	1.5	0.20

12. High-level stability

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

Calibrated by :

Approved by :

(Mr. Tawikiat Jamsamran)

(Mr. Prawate Khlaya)

Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 24-27 Feb.2025

Date of Issue : 28 Feb.2025

Ref : 2011268011400185006

End of Certificate

9/9

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.

FMBL.MTC.002 Rev.5

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668 Mu 2 Tambon Bangpoimai, Amphoe Muang Samutprakan,
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Office
196 Phahonyothin Road, Ladysao, Chatuchak,
Bangkok 10900, Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
(66) 08 1889 6827

8. Level linearity including the level range control

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

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	45.0	45.0	0.0	1.1	0.30	0.3
30-120	35.0	35.0	0.0	1.1	0.30	0.3
20-110	25.0	25.5	0.5	1.1	0.30	0.3
20-100	25.0	25.4	0.4	1.1	0.30	0.3
20-90	25.0	25.3	0.3	1.1	0.30	0.3
20-80	25.0	25.2	0.2	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	115.9	-0.1	±1.0	0.20	0.3
	2	98.1	-0.9	+1.0; -2.5	0.20	0.3
	0.25	89.2	-0.8	+1.5; -5.0	0.20	0.3
Slow	200	109.5	-0.1	±1.0	0.20	0.3
	2	89.8	-0.2	+1.0; -5.0	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3
SEL	200	109.9	-0.1	±1.0	0.20	0.3
	2	90.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

Date of Calibration : 24-27 Feb.2025

8/9

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.

FMBL.MTC.002 Rev.5

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Office
196 Phahonyothin Road, Ladysao, Chatuchak,
Bangkok 10900, Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
(66) 08 1889 6827

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number: E03N199E80A0020 Reference Number: 82-401285019-1
Cylinder Number: LL193324 Cylinder Volume: 83.4 CF
Laboratory: 124 - Riverton (SAP) - NJ Cylinder Pressure: 2215 PSIG
PGVP Number: B52018 Valve Outlet: 660
Gas Code: NO,NOX,SO2,BALN Certification Date: Sep 05, 2018

Expiration Date: Sep 05, 2026

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

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

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	50.00 PPM	50.71 PPM	G1	±1.4% NIST Traceable	08/27/2018, 09/05/2018
NITRIC OXIDE	50.00 PPM	50.87 PPM	G1	±1.4% NIST Traceable	08/27/2018, 09/05/2018
SULFUR DIOXIDE	50.00 PPM	50.54 PPM	G1	±1.0% NIST Traceable	08/27/2018, 09/05/2018
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	16060625	CC442585	50.42 PPM NITRIC OXIDE/NITROGEN	±1.0%	Jun 27, 2020
PRM	12368	5604119	26.86 PPM NITROGEN DIOXIDE/AIR	±1.5%	Jun 02, 2017
GMIS	7042010104	CC503941	5.101 PPM NITROGEN DIOXIDE/NITROGEN	±1.5%	Jun 01, 2020
NTRM	14010327	KAL004378	49.08 PPM SULFUR DIOXIDE/NITROGEN	±1.0%	Apr 17, 2024

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

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 APW1100391 NO	FTIR	Aug 09, 2018
Nicolet 6700 APW1100391 NO2	FTIR	Aug 31, 2018
Nicolet 6700 APW1100391 SO2	FTIR	Aug 30, 2018

Triad Data Available Upon Request

NOTES: PO# 5218003935

Net weight: 2736 grams

Gross weight: 17393 grams

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



Approved for Release

CERTIFICATE OF ANALYSIS **Grade of Product: EPA Protocol**

Part Number: E03N199E80A0020 Reference Number: 82-401285019-1
Cylinder Number: LL193324 Cylinder Volume: 83.4 CF
Laboratory: 124 - Riverton (SAP) - NJ Cylinder Pressure: 2215 PSIG
PGVP Number: B52018 Valve Outlet: 660
Gas Code: NO,NOX,SO2,BALN Certification Date: Sep 05, 2018

Expiration Date: Sep 05, 2026

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

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

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	50.00 PPM	50.71 PPM	G1	+/- 1.4% NIST Traceable	08/27/2018, 09/05/2018
NITRIC OXIDE	50.00 PPM	50.67 PPM	G1	+/- 1.4% NIST Traceable	08/27/2018, 09/05/2018
SULFUR DIOXIDE	50.00 PPM	50.54 PPM	G1	+/- 1.0% NIST Traceable	08/27/2018, 09/05/2018
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	16060525	CC442585	50.42 PPM NITRIC OXIDE/NITROGEN	+/- 0.8%	Jun 27, 2020
PRM	12368	5604119	26.86 PPM NITROGEN DIOXIDE/AIR	+/- 1.5%	Jun 02, 2017
GMIS	7042010104	CC503941	5.101 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Jun 01, 2020
NTRM	14010327	KAL004376	49.08 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Apr 17, 2024

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

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 APW1100391 NO	FTIR	Aug 09, 2018
Nicolet 6700 APW1100391 NO2	FTIR	Aug 31, 2018
Nicolet 6700 APW1100391 SO2	FTIR	Aug 30, 2018

Triad Data Available Upon Request

NOTES:PO# 5218003935

Net weight: 2736 grams
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This calibration std. has been certified in accordance with the May 2012 EPA Traceability Protocol, Document EPA-600/R-12/531. All testing processes and measurements conform to the requirements of ISO/IEC 17025 and to Airgas ISO 9001:2008 and relate only to items identified on this certificate. Values are certified to be NIST Traceable with total uncertainty as detailed under Analytical Uncertainty. This document shall not be reproduced in full without written approval of the issuer.



TESTING CERT No. 3082.05

[Signature]
Approved for Release

Agilent CrossLab Start Up Services

Agilent 5100 5110 ICP-OES Preventive Maintenance

Agilent Preventive Maintenance provides factory recommended service for your analytical instruments to assure reliable operation and the accuracy of your results

Delivered by highly trained and certified service engineers using genuine Agilent parts and supplies, Agilent Preventive Maintenance provides what you need to reduce unplanned downtime and keep your systems operating at their peak performance.

This checklist is used as a guide for completing the preventive maintenance tasks. A signed copy of this checklist is provided for your records.

Introduction

Customer Information

- Customers should provide all necessary operating supplies upon request of the engineer.
- A customer representative should be available to the engineer while performing the preventive maintenance procedures. Customers are responsible for regular maintenance and are encouraged to observe the service representative.
- Any parts not included in the Parts Lists section of this document are not part of the recommended Preventive Maintenance service nor are they included in the price of this service.
- If a system requires the use of extra or special procedures and/or parts for the maintenance service, then these must be ordered separately and charged as a repair, which may incur additional costs.
- For customers using HF applications, the instrument should be returned to its standard sample introduction system.

Important Customer Web Links

- To access **Agilent University**, visit <http://www.agilent.com/crosslab/university/> to learn about training options, which include online, classroom and onsite delivery. A training specialist can work directly with you to help determine your best options.
- To access the **Agilent Resource Center** web page, visit <https://www.agilent.com/en-us/agilentresources>. The following information topics are available:
 - Sample Prep and Containment
 - Chemical Standards
 - Analysis
 - Service and Support
 - Application Workflows
- The **Agilent Community** is an excellent place to get answers, collaborate with others about applications and Agilent products, and find in-depth documents and videos relevant to Agilent technologies. Visit <https://community.agilent.com/welcome>
- Videos about specific preparation requirements for your instrument can be found by searching the **Agilent YouTube** channel at <https://www.youtube.com/user/agilent>
- **Need to place a service call?** Flexible Repair Options | Agilent

Service Engineer's Responsibilities

- Contact the customer and ensure that all necessary supplies are available before the preventive maintenance visit.
- Only select those pages that relate to the system or module being serviced.
- Complete empty fields with the relevant information.
- Complete the relevant checkboxes in the checklist using either a "X" or tick mark "✓".
- Check **"Service not applicable"** check boxes to indicate services/tasks not delivered, as appropriate.
- Complete the Preventive Maintenance services in the most logical order relevant to the individual system service in the order of the tasks listed.
- Complete the **Service Review** section together with the customer.
- Complete the fields for page numbers at the foot of each selected page
- Add relevant page numbers to selected pages and complete the total number of pages field in the Service Completion section
- **Ask the customer to sign the Service Verification section including the customer's and your signature.**

Instrument Maintenance

System Information

- ☐ Check this box if an instrument configuration report is attached instead of completing the table.

Instrument System Name and ID	5110 ICP-OES
Instrument System Site and Location	Integrated Research Center

List System Component Product Numbers	List the Serial Numbers of each Component
1. G 9015 A	M7 19351008
2. G 3212 A	1907 - 00426
3.	
4.	
5.	
6.	
7.	
8.	
9.	

ICP-OES Configuration Table	Circle the type or write in the type if other
Nebulizer Type	(SeaSpray) OneNeb Conikal Other
Spray Chamber	Cyclonic Single Pass (Cyclonic Double Pass) Other
Torch	Radial (Dual View) Other
Torch Type	One Piece (Semi Demountable) Fully Demountable Other
Injector Diameter	2.4mm (1.8mm) 1.4mm 0.8mm Other
Injector Material	(Quartz) Ceramic Other

Preparation

- ☒ Discuss any specific issues with the customer before starting.
 - ☒ Review the instrument logbook for recorded problems and comments.
 - ☒ Save instrument control settings before starting the procedure.
 - ☒ Perform a general inspection of the system for cleanliness.
 - ☒ Check for proper installation of parts, assemblies, sensors etc.
 - ☒ Check system for required installation of components and implementation of Service Notes
 - ☒ Check for required firmware/software updates and verify with customers if they would like them installed.
- (N/A) ☐ For HF application systems, if standard sample introduction system was not installed, ask the customer to install it.
- ☒ Ask the customer to remove any samples from the ICP-OES sample introduction area, auto sampler or around the ICP-OES.

Preventive Maintenance Procedures

Record Pre-PM instrument performance

- ☒ Run Instrument Performance test.
- ☒ Record results in Instrument Performance Test Results Table – Pre-PM.

Clean and inspect ICP-OES system

- ☒ Look for any obvious external damage or problems.
- ☒ Inspect water cooling hoses, gas lines and power cord for excessive wear or damage.
- ☒ Perform a general internal inspection of the system for excessive dust accumulation, clean if necessary.
- ☒ Inspect sample introduction components and record any required maintenance in the Service Engineer Comments and notify the customer as the required actions required.
- ☒ Record the instrument operating conditions in the ICP-OES Status Results Table.
- ☒ Replace the polychromator purge filter.
- ☒ Replace the radial pre-optics window
- ☒ Replace the axial pre-optics window for SVDV and VDV instruments.
- ☒ Check exhaust flow for the correct positive extraction at the exhaust duct to insure they meet minimum specifications.
- ☒ Replace air inlet dust filter.
- (N/A) ☐ Replace high capacity air inlet dust filter element if installed.
- ☒ Remove and clean instrument water inlet filter.

Agilent Water Recirculator

- ☐ Service not applicable
- ☒ Drain cooling fluid and remove any particles from the chiller reservoir
- ☒ Remove, clean and reinstall water inlet metal mesh filter if present.
- ☒ Re fill with Agilent Cool Clear cooling fluid.
- ☒ Clean the cooling system Air filter and the condenser.

SPS 3 Auto Sampler

- ☒ Service not applicable
- ☐ Power cycle the autosampler and verify successful initialization.
- ☐ Inspect X and Z axis belts for wear. Replace is necessary.
- ☐ Clean X and Z axis slide shafts.
- ☐ Using customer's racks and the Agilent software move the sample probe to the 4 outermost corners and rinse port, ensure that the probe is approximately centered in the vial.

SPS 4 Auto sampler

- ☒ Service not applicable
- ☐ Clean the spill tray, rack location mat, end frames and chassis with a damp soft cloth and diluted mild detergent.
- ☐ Clean the auto sampler cover panels, if cover kit is installed, with domestic window cleaner.
- ☐ Check the X-axis and Z-axis drive belts for cracks, splits, damaged teeth, excessive fraying, color changes or degradation from fumes.
- ☐ Check the X-axis, Theta-axis and Z-axis FFC cables for cracks, incorrect positioning, damaged edges or damaged connectors.
- ☐ Pump Tubing Replacement. Replace peristaltic pump tubing. Replace all tubing that goes from the rinse station to the pump and from the pump to the waste/rinse bottles
- ☐ Test using customer's tray and move the sample probe to the sample vial 1, wash vial and rinse port and ensure that the probe is centered in the vial. If not use calibration wizard and calibrate the position.

AVS 4, 6, 7 Advanced Valve System

- ☒ Service not applicable
- ☐ Replace valve rotor seal
- ☐ Check fittings for signs of leaks
- ☐ Check tubing including autosampler tubing for kinks or excessive wear
- ☐ Check high flow pump for signs of leaks

ICP-OES adjustment

- ☒ Check position of Zn peak, adjust if required.
- ☒ Check Argon Ratio, adjust to specified value if required.
- ☒ Perform Detector Calibration.
- ☒ Perform Instrument Calibration.

Record Post-PM instrument performance

- ☒ Run Instrument Performance test.
- ☒ Record results in Instrument Performance Test Results Table - Post PM.
- ☒ For systems using ICP Expert version 7.3 and above, run the following Instrument tests
 - ☒ Subsystem Communications Test
 - ☒ Air Flow
 - ☒ Water Flow
 - ☒ Gas Flows
 - ☒ RF Generator
 - ☒ Camera Test
 - ☒ Optics Test
 - ☒ Nebulizer Test

- ☒ Record the result in the Instrument Test Results Table

Restore Instrument

- (N/A) ☐ For HF applications, ask the customer to reinstall their sample introduction system.
- ☒ Leave system in an idle state: on and purging.
 - ☒ Guidance: If the PM service is performed prior to a qualification service, then use the qualification procedure as a guide for final instrument set up and checkout.

Service Review

- ☒ Attach available reports/printouts of all tests to this documentation.
- ☒ Record the Preventive Maintenance service activity in the customer's records/logbook.
- ☒ Record the PM event in the Smart Alerts logbook, if applicable.
- ☒ Update/reset instrument maintenance counters as appropriate.
- ☒ Affix the PM sticker to the system or instrument logbook based on the customer's request.
- ☒ Complete the Service Engineer Comments section if there are additional comments.
- ☒ Review this service, parts replaced, and test results obtained with the customer.
- ☒ If the instrument firmware was updated, record the details of the change in the Service Engineer's Comments box. Systems in a compliant environment may need additional documentation.
- ☒ Complete the Signature Page with both Service Engineer and Customer signatures.

Test Results

Instrument Performance Test Results Table

Note: These measurements do not form part of any specification and are for reference only.

	Pre PM Sensitivity Check		Post PM Sensitivity Check	
	Radial	Axial *	Radial	Axial*
Zn 213.857 nm SRBR	1503.1	4353.1	1878.3	6963.0
Mn 257.610 nm SRBR	7167.4	25078.8	8999.6	38366.4
Al 396.152 nm SBR	7.7	19.1	9.0	35.3
K 766.491 nm SBR	7.2	101.4	5.7	118.7

* Axial result is not applicable for G8016AA, G8012AA Radial View instruments.

Instrument Test Results Table

Note: The Instrument Test results are for systems using ICP Expert version 7.3 and above only.

Instrument Test	Result
Subsystem Communications Test	Pass
Air Flow	Pass
Water Flow	Pass
Gas Flows	Pass
RF Generator	Pass
Camera Test	Pass
Optics Test	Pass
Nebulizer test	Pass

ICP-OES Status Results Table

Note: These measurements do not form part of any specification and are for reference only.

Measurement	Standby Mode	Plasma On
Mains Voltage	231.221 VAC	228.146 VAC
Mains Current	0.083 A	0.108 A
Instrument Temperature	24.2 °C	24.4 °C
RF Air Flow (sensor speed)	15.0 Hz	17.0 Hz
Plasma Exhaust Temperature	No measurement	56.7 °C
Water Flow Oscillator	No measurement	1.48 L/min
Water Flow Detector	0.00 L/min	1.14 L/min
Water Inlet Temperature	21.8 °C	20.5 °C
Polychromator Temperature	35.6 °C	35.0 °C
CCD Temperature	26.7 °C	-39.5 °C
Thermal Stabilizer	35.0 °C	35.0 °C
Argon Supply Pressure	634.52 kPa	574.57 kPa
Purge Gas Supply Pressure*1	633.28 kPa	598.40 kPa
Option Gas Supply Pressure*1	— kPa	— kPa
Nebulizer Flow	No measurement	0.70 L/min
Nebulizer Back Pressure	No measurement	297.12 kPa
Plasma Gas Flow	No measurement	14.59 L/min
Auxiliary Gas Flow	No measurement	1.20 L/min
RF Power	No measurement	1196.4 W
RF Supply Current	No measurement	8.100 A
RF Supply Voltage	No measurement	198.796 V

*1 If option installed

Consumed PM Parts

Part Description	Part Number	Product or Model# where used	Quantity consumed
Axial Pre-Optic Window	G8010-68014	G8010A, G8011A, G8014A/G8015A	1
Radial Pre-Optic Window	G8010-68015	All	1
Agilent Cool Clear Coolant Fluid	S799-0037	Agilent Water Recirculator	1
Purge Gas Filter	G8010-60136	All	1
Air inlet filter	G8000-68002	All	1
High Capacity Air Filter	G8010-60189	Optional	
Rotor seal for 6-7 port valve for AVS6/7	G8494-60002	G8494A/G8495	
Rotor seal for 4 port valve for AVS4	G8493-60002	G8493A	
Rinse solution to rinse station 2.5mm id x 1m	G8410-80123	SPS 4	
Barb connector 2.5mm-1.5mm ID	G8410-80124	SPS 4	
PVC waste tubing, 8mm od x 5mm id, 2m	G8410-80122	SPS 4	
Additional Parts may be required from engineer's stock:			
X axis drive belt	5410047500	SPS 3	
Z axis drive belt	5410047400	SPS 3	
Peristaltic pump tubing, PVC SolvaFlex, 3 bridged,	3710049000	SPS 4	

Consumed Parts Reference
(Purchased by customer, not included as part of PM)☒ Section Not Applicable.

Part Description	Part Number	Product or Model# where used	Quantity consumed
------------------	-------------	------------------------------	-------------------

Revision: A.02, Issued: 21 January 2022
Document Number: G8014-90075
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Signature Page

Service Engineer Comments (optional)

If there are any specific points you wish to note as part of performing the installation or other items of interest for the customer, please write in this box.

- Replaced all PM parts.
- Test instrument all parameters >> Passed.
- Found some error of snout purge gas is not active but this part is not ~~never~~ necessary for current method run.

Service Verification

Service Request Number:

6007433960

Service Engineer Name:

Uthai Ngamlestinichai

Service Engineer Signature:

Uthai Ng.

Total number of pages in this document:

14

Date Service Completed:

31 Oct. 2024

Customer Name:

Chonluek Saensuk

Customer Signature:

Chonluek S.

Revision: A.02, Issued: 21 January 2022
Document Number: G8014-90075
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MICRO PRECISION CALIBRATION LABORATORY (THAILAND) CO., LTD.
413 BONDSTREET ROAD (JAMBOL SANGKHOOMPONG PARKWAY, NONTABURI)
NONTABURI 11120 THAILAND
88 2 543 9834

Certificate of Calibration

Date: Nov 11, 2024

Customer:

DOUBLE A (1991) PUBLIC COMPANY LIMITED
1 MOO2 KLONGRUNG-PRACHINBURI ROAD
THATOOM, SRIMAHAPHOT
PRACHINBURI PRACHINBURI 25140

Cert No. 5523631031362690

Work Order #: THAI-PT-00735

MPC Control #: EV3700
Asset ID: WL-056/11
Gage Type: PH METER
Manufacturer: METTLER TOLEDO
Model Number: SEVEN EASY
Size: N/A
Temp/RH: 25.0°C / 52.0%
Location: Calibration performed at Customer's facilitySerial Number: 1232025225
Department: N/A
Performed By: JAKRAPONG ARIYACHAT
Received Condition: IN TOLERANCE
Returned Condition: IN TOLERANCE
Cal. Date: October 31, 2024
Cal. Interval: 12 MONTHS
Cal. Due Date: October 31, 2025

Calibration Notes:

Please refer to the attached Calibration Report (1 page)

Standards Used to Calibrate Equipment

I.D.	Description	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
AW2318	PH BUFFER SOLUTION	PH 4.00	1040525C	REAGECON	Aug 28, 2026	4C23H1 / REAGECON
AW2319	PH BUFFER SOLUTION	PH 7.00	1070525C	REAGECON	Jul 28, 2025	725C23G1 / REAGECON
AW2320	PH BUFFER SOLUTION	PH 10.00	1100525C	REAGECON	May 28, 2025	1125C23E1 / REAGECON

Procedures Used in this Event

Procedure Name	Description
MPC-PHM-001 Rev. 06	pH Meters, General, Rev.06, May-24-2024

Calibrating Technician:

JAKRAPONG ARIYACHAT

QC Approval:

PADUNG SRASUAY

STATEMENTS OF PASS OR FAIL CONFORMANCE: The uncertainty of measurement has been taken into account when determining compliance with specifications. All measurements and test results passed stated within the accuracy of measurement has not stated PM in accordance with ISO/IEC 17025:2017.

THE CALIBRATION REPORT STATUS

PASS: Item used after compliance tolerance is given, and the measurement result is acceptable based on PM01.
FAIL: Item used after compliance tolerance is given, and the measurement result is not acceptable based on PM01.
RECEIVED: Item used after compliance tolerance is given, and the measurement result is not acceptable based on PM01.
RECEIVED: Item used after compliance tolerance is given, and the measurement result is not acceptable based on PM01.

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



Calibration Report of Mettler Toledo SEVEN EASY Ph Meter

MPC Control #: EV3700

Asset ID: WL-056/11

Serial Number: 1232025225

Calibration Date: October 31, 2024

Measurement Results

Buffer Solution

STD Test Point @ 25°C	Lower Limit	Measured Value		Upper Limit	Result	Uncertainty (±)
		AS Found	AS Left			
4.01 pH	3.91 pH	4.01 pH	4.01 pH	4.11 pH	PASS	0.013 pH
7.01 pH	6.91 pH	7.01 pH	7.01 pH	7.11 pH	PASS	0.013 pH
10.01 pH	9.91 pH	10.01 pH	10.01 pH	10.11 pH	PASS	0.013 pH

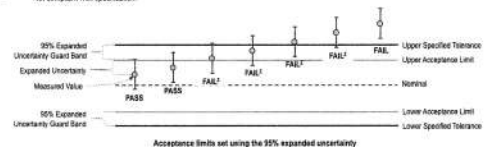
Note : Accuracy by Customer : ± 0.10 pH

Statements of Pass or Fail Conformance

The uncertainty of measurement has been taken into account when determining compliance with specification. All measurements and test results passed stated within the accuracy of measurement has not stated PM in accordance with ISO/IEC 17025:2017.

The status of compliance with the acceptance criteria is reported as:

- PASS — Compliant with specification.
- FAIL — The measured value is not within the acceptance limits. However, a portion of the expanded uncertainty of measurement at 95% is within the specified tolerance.
- FAIL — Not compliant with specification.



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

End of Calibration Report

Calibration Report of Memmert WNB22 Water Bath

MPC Control #:	EV3704	Serial Number:	L508.0973
Asset ID:	WL-WTB/01	Calibration Date:	October 31, 2024

Measurement Results

Section 1 : Temperature Distribution

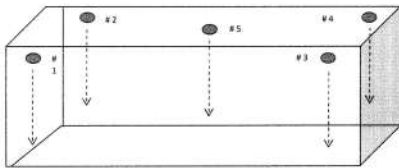
Temperature @ 85 °C

Sensor No.	UUC Setting (°C)	Lower Limit (°C)	STD Reading (°C)		Upper Limit (°C)	Result	Uncertainty (°C)
			As Found	As Left			
Sensor#1	85.00	84.00	85.01	85.01	86.00	PASS	± 0.35
Sensor#2	85.00	84.00	84.75	84.75	86.00	PASS	± 0.35
Sensor#3	85.00	84.00	85.02	85.02	86.00	PASS	± 0.35
Sensor#4	85.00	84.00	85.12	85.12	86.00	PASS	± 0.35
Sensor#5	85.00	84.00	85.21	85.21	86.00	PASS	± 0.35

Section 2 : Chamber Performance

Setting Temp (°C)	Indicating Temp (°C)	Measured Uniformity (°C)	Measured Stability (°C)	Overall Variation (°C)
85.0	85.0	1.62	0.7	1.9

Accuracy By : Customer Specification ± 1 °C



Page 1 of 2

Calibration Report of Memmert WNB22 Water Bath

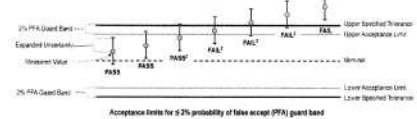
MPC Control #:	EV3704	Serial Number:	L508.0973
Asset ID:	WL-WTB/01	Calibration Date:	October 31, 2024

Statements of Pass or Fail Conformance

The uncertainty of measurement has been taken into account when determining compliance with specification.
All measurements and test results guard banded to ensure the probability of false accept does not exceed 2% in compliance with ANSI/ISO/IEC 17025.

The status of compliance with the acceptance criteria is reported as:

- PASS — Compliant with specification
PASS? — The measured value is within acceptance limits.
However, a portion of the expanded uncertainty of measurement at 95% exceeds the specified tolerance.
FAIL? — The measured value is not within the acceptance limits.
However, a portion of the expanded uncertainty of measurement at 95% is within the specified tolerance.
FAIL — Not compliant with specification.



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

The calibration report complies with ISO/IEC 17025:2017 and ANSI/ISO/IEC 17025:2005 Method 4 — Guard Bands Based on Test Uncertainty Ratio.

End of Calibration Report

Page 2 of 2

MICRO PRECISION CALIBRATION LABORATORY (THAILAND) CO., LTD.
413 BONGKISTREET ROAD, TAMBOL, BANGKOKDAMRUANG DISTRICT, NORTHEAST
NORTHAVURE 11123 THAILAND
86 2 580 8834

Certificate of Calibration

Date: Nov 11, 2024

Cert No. 5523631031362700

Customer:
DOUBLE A (1991) PUBLIC COMPANY LIMITED
1 MOO2 KLONGRUNG-PRACHINBURI ROAD
THATOOM, SRIRAMAPHOT
PRACHINBURI PRACHINBURI 25140

Work Order #: THAI-PT-00735

MPC Control #: EV3706
Asset ID: DARC-TE15028
Gage Type: COOL ROOM
Manufacturer: DIXELL
Model Number: XR06CX-5N0C2
Size: N/A
Temp/RH: 28.7 °C / 58.0%
Location: Calibration performed at Customer's facility

Serial Number: LIQ8XBX500
Department: N/A
Performed By: JAKRAPONG ARIYACHAT
Received Condition: IN TOLERANCE
Returned Condition: IN TOLERANCE
Cal. Date: October 31, 2024
Cal. Interval: 12 MONTHS
Cal. Due Date: October 31, 2025

Calibration Notes:

Please refer to the attached Calibration Report (2 pages)

Standards Used to Calibrate Equipment

I.D.	Description	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
EO6188	DATA ACQUISITION/SWITCH UNIT	34970A	MY345289	AGILENT	Mar 13, 2025	5523631030779308 / MP-TH

Procedures Used in this Event

Procedure Name	Description
THAI LAB ACC G-20	Guidelines for Calibration and Checks of Temperature Controlled Enclosures Publication Reference

Calibrating Technician:

JAKRAPONG ARIYACHAT

QC Approval:

PADUNG SRASUAY

STATEMENTS OF PASS OR FAIL CONFORMANCE: The uncertainty of measurement has been taken into account when determining compliance with specification. All measurements and test results guard banded to ensure the probability of false accept does not exceed 2% in compliance with ANSI/ISO/IEC 17025:2017.

FAIL CONFORMANCE STATEMENT: PASS? — The measured value is within acceptance limits.

However, a portion of the expanded uncertainty of measurement at 95% exceeds the specified tolerance.

FAIL? — The measured value is not within the acceptance limits.

However, a portion of the expanded uncertainty of measurement at 95% is within the specified tolerance.

FAIL — Not compliant with specification.

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

The calibration report complies with ISO/IEC 17025:2017 and ANSI/ISO/IEC 17025:2005 Method 4 — Guard Bands Based on Test Uncertainty Ratio.

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

The calibration report complies with ISO/IEC 17025:2017 and ANSI/ISO/IEC 17025:2005 Method 4 — Guard Bands Based on Test Uncertainty Ratio.

Page 1 of 1

(CERT. Rev 9)

Calibration Report of Dixell XR06CX-5N0C2 Cool Room

MPC Control #:	EV3706	Serial Number:	LIQ8XBX500
Asset ID:	DARC-TE15028	Calibration Date:	October 31, 2024

Measurement Results

Section 1 : Temperature Distribution

Temperature @ 4 °C

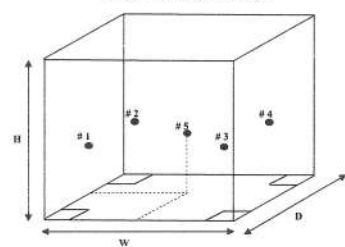
Sensor No.	UUC Setting (°C)	Lower Limit (°C)	STD Reading (°C)		Upper Limit (°C)	Result	Uncertainty (°C)
			As Found	As Left			
Sensor#1	4.00	2.00	4.53	4.53	6.00	PASS	± 0.35
Sensor#2	4.00	2.00	4.66	4.66	6.00	PASS	± 0.35
Sensor#3	4.00	2.00	4.61	4.61	6.00	PASS	± 0.35
Sensor#4	4.00	2.00	4.67	4.67	6.00	PASS	± 0.35
Sensor#5	4.00	2.00	4.62	4.62	6.00	PASS	± 0.35

Section 2 : Chamber Performance

Setting Temp (°C)	Indicating Temp (°C)	Measured Uniformity (°C)	Measured Stability (°C)	Overall Variation (°C)
4.0	4.0	0.29	1.2	2.5

Accuracy By : Customer Specification ± 2 °C

Sensor Installation Location



Page 1 of 2

Calibration Report of Dixell XR06CX-5N0C2 Cool Room

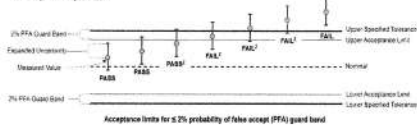
MPC Control #: EV3706 Serial Number: LIOGBXB500
Asset ID: DARC-TE15028 Calibration Date: October 31, 2024

Statements of Pass or Fail Conformance

The uncertainty of measurement has been taken into account when determining compliance with specification.
All measurements and test results passed to ensure the probability of false accept does not exceed 2% in compliance with ANSI/ISO 17025:2017.

The status of compliance with the acceptance criteria is reported as:

- PASS — Compliant with specification
PASS? — The measured value is within acceptance limits.
However, a portion of the expanded uncertainty of measurement at 95% exceeds the specified tolerance.
FAIL? — The measured value is not within the acceptance limits.
However, a portion of the expanded uncertainty of measurement at 95% is within the specified tolerance.
FAIL — Not compliant with specification.



The expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%, unless otherwise stated.
This calibration report complies with ISO/IEC 17025:2017 and ANSI/ISO 17025:2017, Method B — Guard Bands Based on Test Uncertainty Ratio.

End of Calibration Report

Certificate of Calibration

Date: Nov 11, 2024

Cert No. 5523631031362699

Customer:

DOUBLE A (1991) PUBLIC COMPANY LIMITED
1 MOO 2 KLONGRUNG-PRACHINBURI ROAD
THATOOM, SRIMAHAPHOT
PRACHINBURI PRACHINBURI 25140

Work Order #: THAI-PT-00735

MPC Control #: EV3705
Asset ID: WL-INC/02
Gage Type: INCUBATOR
Manufacturer: ACCUPLUS
Model Number: I250
Size: N/A
Temp/RH: 23.5°C / 55.0%
Location: Calibration performed at Customer's facility

Serial Number: 0213-0004
Department: N/A
Performed By: JAKRAPONG ARIYACHAT
Received Condition: IN TOLERANCE
Returned Condition: IN TOLERANCE
Cal. Date: October 31, 2024
Cal. Interval: 12 MONTHS
Cal. Due Date: October 31, 2025

Calibration Notes:

Please refer to the attached Calibration Report (3 pages)

Standards Used to Calibrate Equipment

I.D.	Description	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
E06187	DATA ACQUISITION/SWITCH UNIT	34970A	N/A	AGILENT	Mar 13, 2025	5523631030779300 / MP-TH

Procedures Used in this Event

Procedure Name	Description
THAI LAB ACC G-20	Guidelines for Calibration and Checks of Temperature Controlled Enclosures Publication Reference

Calibrating Technician:

JAKRAPONG ARIYACHAT

QC Approval:

PADJUNG SRASUAY

STATEMENT OF PASS OR FAIL CONFORMANCE: The conformity of measurement has been taken into account when determining compliance with specification. All measurements and test results passed to ensure the probability of false accept does not exceed 2% in compliance with ANSI/ISO 17025:2017.

THE CALIBRATION REPORT STATUS
PASS: Fully compliant with specification. The measured value is within the acceptance limits.
PASS?: Fully compliant with specification. The measured value is within the acceptance limits.
However, a portion of the expanded uncertainty of measurement at 95% exceeds the specified tolerance.
FAIL?: Fully compliant with specification. The measured value is within the acceptance limits.
However, a portion of the expanded uncertainty of measurement at 95% is within the specified tolerance.
FAIL: Not compliant with specification.

The expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%, unless otherwise stated.
This calibration report complies with ISO/IEC 17025:2017 and ANSI/ISO 17025:2017, Method B — Guard Bands Based on Test Uncertainty Ratio.
The expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%, unless otherwise stated.
This calibration report complies with ISO/IEC 17025:2017 and ANSI/ISO 17025:2017, Method B — Guard Bands Based on Test Uncertainty Ratio.

Calibration Report of Accuplus I250 Incubator

MPC Control #: EV3705 Serial Number: 0213-0004
Asset ID: WL-INC/02 Calibration Date: October 31, 2024

Measurement Results

Section 1 : Temperature Distribution

Temperature @ 20 °C

Sensor No.	UUC Setting (°C)	Lower Limit (°C)	STD Reading (°C)		Upper Limit (°C)	Result	Uncertainty (°C)
			As Found	As Left			
Sensor#1	20.00	19.00	19.71	19.71	21.00	PASS	± 0.35
Sensor#2	20.00	19.00	19.70	19.70	21.00	PASS	± 0.35
Sensor#3	20.00	19.00	19.75	19.75	21.00	PASS	± 0.35
Sensor#4	20.00	19.00	19.80	19.80	21.00	PASS	± 0.35
Sensor#5	20.00	19.00	19.82	19.82	21.00	PASS	± 0.35
Sensor#6	20.00	19.00	19.77	19.77	21.00	PASS	± 0.35
Sensor#7	20.00	19.00	19.73	19.73	21.00	PASS	± 0.35
Sensor#8	20.00	19.00	19.77	19.77	21.00	PASS	± 0.35
Sensor#9	20.00	19.00	19.71	19.71	21.00	PASS	± 0.35

Temperature @ 29 °C

Sensor No.	UUC Setting (°C)	Lower Limit (°C)	STD Reading (°C)		Upper Limit (°C)	Result	Uncertainty (°C)
			As Found	As Left			
Sensor#1	29.00	28.00	28.45	28.45	30.00	PASS	± 0.35
Sensor#2	29.00	28.00	28.50	28.50	30.00	PASS	± 0.35
Sensor#3	29.00	28.00	28.51	28.51	30.00	PASS	± 0.35
Sensor#4	29.00	28.00	28.52	28.52	30.00	PASS	± 0.35
Sensor#5	29.00	28.00	28.47	28.47	30.00	PASS	± 0.35
Sensor#6	29.00	28.00	28.45	28.45	30.00	PASS	± 0.35
Sensor#7	29.00	28.00	28.50	28.50	30.00	PASS	± 0.35
Sensor#8	29.00	28.00	28.42	28.42	30.00	PASS	± 0.35
Sensor#9	29.00	28.00	28.47	28.47	30.00	PASS	± 0.35

Calibration Report of Accuplus I250 Incubator

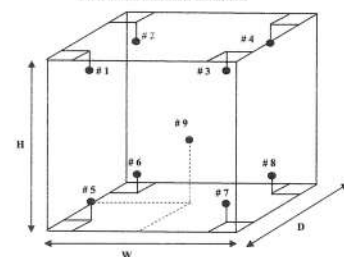
MPC Control #: EV3705 Serial Number: 0213-0004
Asset ID: WL-INC/02 Calibration Date: October 31, 2024

Section 2 : Chamber Performance

Setting Temp (°C)	Indicating Temp (°C)	Measured Uniformity (°C)	Measured Stability (°C)	Overall Variation (°C)
20.0	20.0	0.36	0.57	1.15
29.0	29.0	0.21	0.32	0.66

Accuracy By : Customer Specification $\pm 1^\circ\text{C}$

Sensor Installation Location



Calibration Report of Accuplus i250 Incubator

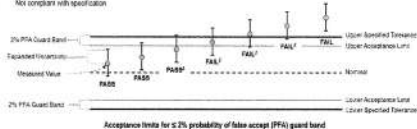
MPC Control #:	EV3705	Serial Number:	0213-0004
Asset ID:	WL-INC/02	Calibration Date:	October 31, 2024

Statements of Pass or Fail Conformance

The accuracy of measurement has been taken into account when determining compliance with specification. All measurements and test results must be within the probability of failure acceptance does not exceed 2% in compliance with ANSI/ISO 17025:2017.

The status of compliance with the acceptance criteria is reported as:

PASS	Compliant with specification
PASS ¹	The measured value is within acceptance limits. However, a portion of the expected uncertainty of measurement at 50% exceeds the specified tolerance.
FAIL	The measured value is not within the acceptance limits. However, a portion of the expected uncertainty of measurement at 50% is within the specified tolerance.
FAIL	Not compliant with specification



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

The calibration report complies with ISO/IEC 17025:2017 and ANSI/ISO 17025:2017, Method B - Guard Bands Based on Test Uncertainty Ratio.

End of Calibration Report

Certificate of Calibration

Date: Nov 7, 2024

Cert No. 5523631031354570

Customer:

DOUBLE A (1991) PUBLIC COMPANY LIMITED
1 MOOZ KLONGRUNG-PRACHINBURI ROAD
THATOOM, SRIMAHAPHOT
PRACHINBURI PRACHINBURI 25140

Work Order #: THAI-32268995

MPC Control #:	EV3398	Serial Number:	19009
Asset ID:	WL-TMM/01	Department:	N/A
Gage Type:	THERMOMETER	Performed By:	KHOMSAN SAENGKAEW
Manufacturer:	PRECISION	Received Condition:	OPERATIONAL
Model Number:	N/A	Returned Condition:	REPORT OF VALUE
Size:	N/A	Cal. Date:	November 06, 2024
Temp/RH:	23.0°C / 50.0%	Cal. Interval:	12 MONTHS
Location:	Calibration performed at MPC facility	Cal. Due Date:	November 06, 2025

Calibration Notes:

The user shall determine the suitability of the equipment for its intended use. The calibration status is defined as Report of Value. Please refer to the attached Calibration Report (1 page)

Standards Used to Calibrate Equipment

I.D.	Description	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
AS9541	PLATINUM RESISTANCE THERMOMETER	162C	957	ROSEMOUNT ANALYTICAL INC.	Jun 3, 2026	5523631031246251 / MP-GV

Procedures Used in this Event

Procedure Name	Description
MPC-TEM-001	Temperature Sensors, Indicators, and Controlled Unenclosed Temperature Devices, Rev.07, May-17-2024

Calibrating Technician:

Khomsan S.
KHOMSAN SAENGKAEW

QC Approval:

S. Praduan
PADUNG SRASUAY

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with EA's Publication and NIST Technical Note 1297, 1994 Edition. Services rendered comply with ISO/IEC 17025:2017, ANSI/ISO 17025:2017, ANSI/ISO 17025:2017, Method B - Guard Bands Based on Test Uncertainty Ratio.

Calibration cycles and resulting due dates were submitted/approved by the customer. Any number of factors may cause an instrument to drift out of tolerance before the next scheduled calibration. Recalibration cycles should be based on frequency of use, environmental conditions and customer's established systematic accuracy. The information on this report, pertains only to the instrument identified.

All standards are traceable to SI through the National Institute of Standards and Technology (NIST) and/or recognized national or international standards laboratories. Services rendered include proper manufacturer's service instruction and are warranted for no less than thirty (30) days. This report may not be reproduced in part or in a whole without the prior written approval of the issuing MPC lab.

Calibration Report of Precision Thermometer

MPC Control #:	EV3398	Serial Number:	19009
Asset ID:	WL-TMM/01	Calibration Date:	November 6, 2024

Measurement Results

STD Setting (°C)	UUC Reading (°C)		Correction (°C)	Uncertainty (°C)
	As Found	As Left		
0.00	0	0	0.00	± 0.047
50.00	50	50	0.00	± 0.049
100.00	100	100	0.00	± 0.048

UUC : Unit Under Calibration, Immersion Type : Total Immersion

The user shall determine the suitability of the equipment for its intended use. The calibration status is defined as Report of Value.

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

End of Calibration Report

Certificate of Calibration

Date: Nov 7, 2024

Cert No. 5523631031354527

Customer:

DOUBLE A (1991) PUBLIC COMPANY LIMITED
1 MOOZ KLONGRUNG-PRACHINBURI ROAD
THATOOM, SRIMAHAPHOT
PRACHINBURI PRACHINBURI 25140

Work Order #: THAI-32268995

MPC Control #:	EV3395	Serial Number:	N/A
Asset ID:	WL-DTH/01	Department:	N/A
Gage Type:	DIGITAL HYGRO - THERMOMETER	Performed By:	KHOMSAN SAENGKAEW
Manufacturer:	N/A	Received Condition:	IN TOLERANCE
Model Number:	N/A	Returned Condition:	IN TOLERANCE
Size:	N/A	Cal. Date:	November 06, 2024
Temp/RH:	23.0°C / 50.0%	Cal. Interval:	12 MONTHS
Location:	Calibration performed at MPC facility	Cal. Due Date:	November 06, 2025

Calibration Notes:

Please refer to the attached Calibration Report (1 page)

Standards Used to Calibrate Equipment

I.D.	Description	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
AS9541	PLATINUM RESISTANCE THERMOMETER	162C	957	ROSEMOUNT ANALYTICAL INC	Jun 3, 2026	5523631031246251 / MP-GV
EA0537	HYGROLOG	HL-NT2-DHC2A-S 612803746077948	6	ROTICRON	Mar 7, 2025	551220854608039 / MP-TH

Procedures Used in this Event

Procedure Name	Description
MPC-THD-001 Rev. 03	Temperature, Humidity and Dew Point Devices, General, Rev.03, Jul-15-2024

Calibrating Technician:

Khomsan S.
KHOMSAN SAENGKAEW

QC Approval:

S. Praduan
PADUNG SRASUAY

STATEMENTS OF PASS OR FAIL CONFORMANCE: The accuracy of measurement has been taken into account when determining compliance with specification. All measurements and test results must be within the probability of failure acceptance does not exceed 2% in compliance with ISO/IEC 17025:2017.

THE CALIBRATION REPORT STATUS:
PASS: Test used when compliance statement is given, and the measurement result is PASS.
PASS¹: Test used when compliance statement is given, and the measurement result is PASS.
FAIL: Test used when compliance statement is given, and the measurement result is FAIL.
FAIL¹: Test used when compliance statement is given, and the measurement result is FAIL.
RECAL: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL¹: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL²: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL³: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL⁴: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL⁵: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL⁶: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL⁷: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL⁸: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL⁹: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL¹⁰: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL¹¹: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL¹²: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL¹³: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL¹⁴: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL¹⁵: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL¹⁶: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL¹⁷: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL¹⁸: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL¹⁹: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL²⁰: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL²¹: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL²²: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL²³: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL²⁴: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL²⁵: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL²⁶: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL²⁷: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL²⁸: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL²⁹: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL³⁰: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL³¹: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL³²: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL³³: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL³⁴: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL³⁵: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL³⁶: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL³⁷: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL³⁸: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL³⁹: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL⁴⁰: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL⁴¹: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL⁴²: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL⁴³: Test used when compliance statement is given, and the measurement result is RECAL.
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RECAL⁹⁹: Test used when compliance statement is given, and the measurement result is RECAL.
RECAL¹⁰⁰: Test used when compliance statement is given, and the measurement result is RECAL.

Calibration Report of Digital Hygro - Thermometer

MPC Control #: EV3395 Serial Number: N/A
Asset ID: WL-DTH/01 Calibration Date: November 6, 2024

Measurement Results

Section 1 - Temperature Measurement

STD Reading (°C)	Lower Limit (°C)	UUC Reading (°C)		Upper Limit (°C)	Result	Uncertainty (°C)
		As Found	As Left			
20.00	19.00	19.8	19.8	21.00	PASS	± 0.051
25.00	24.00	24.6	24.6	26.00	PASS	± 0.055

Section 2 - Humidity Measurement

STD Reading (%RH)	Lower Limit (%RH)	UUC Reading (%RH)		Upper Limit (%RH)	Result	Uncertainty (%RH)
		As Found	As Left			
30.00	28.00	29	29	32.00	PASS	± 0.75
50.00	48.00	50	50	52.00	PASS	± 1.2
70.00	68.00	70	70	72.00	PASS	± 1.3

UUC : Unit Under Calibration, Temperature @ 25 °C

Accuracy By Manufacturer Specification , Temperature : ± 1 °C, Humidity : ± 2 %RH

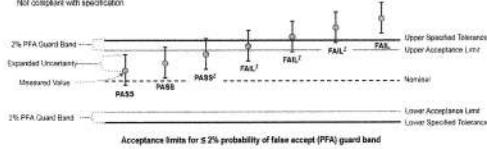
Statements of Pass or Fail Conformance

The uncertainty of measurement has been taken into account when determining compliance with specification.

All measurements and test results guard banded to ensure the probability of false-accept does not exceed 2% in compliance with ANSI/ISO/IEC 17025:2017.

The status of compliance with the acceptance criteria is reported as:

- PASS — Compliant with specification.
PASS? — The measured value is within acceptance limits.
However, a portion of the expanded uncertainty of measurement at 95% exceeds the specified tolerance.
FAIL? — The measured value is not within the acceptance limits.
However, a portion of the expanded uncertainty of measurement at 95% is within the specified tolerance.
FAIL — Not compliant with specification.



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

This calibration report complies with ISO/IEC 17025:2017 and ANSI/ISO/IEC 17025:2017, Method B — Guard Bands Based on Test Uncertainty Ratio.

End of Calibration Report

Page 1 of 1

Calibration Report of Digital Hygro - Thermometer

MPC Control #: EV3396 Serial Number: N/A
Asset ID: WL-DTH/02 Calibration Date: November 6, 2024

Measurement Results

Section 1 - Temperature Measurement

STD Reading (°C)	Lower Limit (°C)	UUC Reading (°C)		Upper Limit (°C)	Result	Uncertainty (°C)
		As Found	As Left			
20.00	19.00	20.0	20.0	21.00	PASS	± 0.051
25.00	24.00	25.1	25.1	26.00	PASS	± 0.055

Section 2 - Humidity Measurement

STD Reading (%RH)	Lower Limit (%RH)	UUC Reading (%RH)		Upper Limit (%RH)	Result	Uncertainty (%RH)
		As Found	As Left			
30.00	28.00	29	29	32.00	PASS	± 0.75
50.00	48.00	48	48	52.00	FAIL	± 1.2
70.00	68.00	69	69	72.00	FAIL	± 1.3

UUC : Unit Under Calibration, Temperature @ 25 °C

Accuracy By Manufacturer Specification , Temperature : ± 1 °C, Humidity : ± 2 %RH

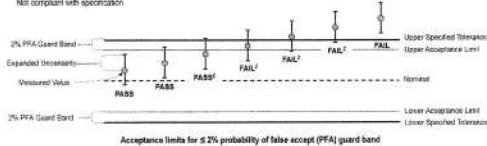
Statements of Pass or Fail Conformance

The uncertainty of measurement has been taken into account when determining compliance with specification.

All measurements and test results guard banded to ensure the probability of false-accept does not exceed 2% in compliance with ANSI/ISO/IEC 17025:2017.

The status of compliance with the acceptance criteria is reported as:

- PASS — Compliant with specification.
PASS? — The measured value is within acceptance limits.
However, a portion of the expanded uncertainty of measurement at 95% exceeds the specified tolerance.
FAIL? — The measured value is not within the acceptance limits.
However, a portion of the expanded uncertainty of measurement at 95% is within the specified tolerance.
FAIL — Not compliant with specification.



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

This calibration report complies with ISO/IEC 17025:2017 and ANSI/ISO/IEC 17025:2017, Method B — Guard Bands Based on Test Uncertainty Ratio.

End of Calibration Report

Page 1 of 1

Certificate of Calibration

Date: Nov 7, 2024

Cert No. 5523631031354528

Customer:

DOUBLE A (1991) PUBLIC COMPANY LIMITED
1 MOO2 KLONGRUNG-PRACHINBURI ROAD
THATOOM, SRIMAHAPHOT
PRACHINBURI PRACHINBURI 25140

Work Order #: THAI-32268995

MPC Control #: EV3396
Asset ID: WL-DTH/02
Gage Type: DIGITAL HYGRO - THERMOMETER
Manufacturer: N/A
Model Number: N/A
Size: N/A
Temp/RH: 23.0°C / 50.0%
Location: Calibration performed at MPC facility

Serial Number: N/A
Department: N/A
Performed By: KHOMSAN SAENGKAEW
Received Condition: IN TOLERANCE
Returned Condition: IN TOLERANCE
Cal. Date: November 06, 2024
Cal. Interval: 12 MONTHS
Cal. Due Date: November 06, 2025

Calibration Notes:

Please refer to the attached Calibration Report (1 page)

Standards Used to Calibrate Equipment

I.D.	Description	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
AS9541	PLATINUM RESISTANCE THERMOMETER	162C	957	ROSEMOUNT ANALYTICAL INC	Jun 3, 2026	5523631031246251 / MP-GV
EA0537	HYGROLOG	HL-NT2-DHCA-S 61290374/6077948	6	ROTTRONIC	Mar 7, 2025	551220085460939 / MP-TH

Procedures Used in this Event

Procedure Name	Description
MPC-THD-001 Rev. 03	Temperature, Humidity and Dew Point Devices, General, Rev.03, Jul-15-2024

Calibrating Technician:

Khom san. S.
KHOMSAN SAENGKAEW

QC Approval:

S. Pradyan
PADUNG SRASUAY

STATEMENTS OF PASS OR FAIL CONFORMANCE: The uncertainty of measurement has been taken into account when determining compliance with specification. All measurements and test results guard banded to ensure the probability of false-accept does not exceed 2% in compliance with ISO/IEC 17025:2017.

THE CALIBRATION REPORT STATUS:
PASS: Test used when compliance statement is given, and the measurement result is PASS.
PASS?: Test used when compliance statement is given, and the measurement result is PASS?
FAIL: Test used when compliance statement is given, and the measurement result is FAIL.
FAIL?: Test used when compliance statement is given, and the measurement result is FAIL?
REMARK: Other adjustments are made to all instruments which change the value of measurement from what was measured as found in new use as left.

THE expanded uncertainty of measurement is stated as the expanded uncertainty of measurement indicated by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%, unless otherwise stated.
This calibration report complies with ISO/IEC 17025:2017 and ANSI/ISO/IEC 17025:2017, Method B — Guard Bands Based on Test Uncertainty Ratio. Calibration system and resulting data were submitted to the customer. Any number of system may be measured in test and/or tolerance before the next scheduled calibration. Measurement system should be based on frequency of use, environmental conditions and customer's established tolerance. All measurements are traceable to the National Institute of Standards and Technology (NIST).
The expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%, unless otherwise stated.
This calibration report complies with ISO/IEC 17025:2017 and ANSI/ISO/IEC 17025:2017, Method B — Guard Bands Based on Test Uncertainty Ratio.

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(CERT, Rev B)

Certificate of Calibration

Date: Nov 7, 2024

Cert No. 5523631031354532

Customer:

DOUBLE A (1991) PUBLIC COMPANY LIMITED
1 MOO2 KLONGRUNG-PRACHINBURI ROAD
THATOOM, SRIMAHAPHOT
PRACHINBURI PRACHINBURI 25140

Work Order #: THAI-32268995

MPC Control #: EV3397
Asset ID: WL-DTH/03
Gage Type: DIGITAL HYGRO - THERMOMETER
Manufacturer: ELITECH
Model Number: BT-3
Size: N/A
Temp/RH: 23.0°C / 50.0%
Location: Calibration performed at MPC facility

Serial Number: N/A
Department: N/A
Performed By: KHOMSAN SAENGKAEW
Received Condition: IN TOLERANCE
Returned Condition: IN TOLERANCE
Cal. Date: November 06, 2024
Cal. Interval: 12 MONTHS
Cal. Due Date: November 06, 2025

Calibration Notes:

Please refer to the attached Calibration Report (1 page)

Standards Used to Calibrate Equipment

I.D.	Description	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
AS9541	PLATINUM RESISTANCE THERMOMETER	162C	957	ROSEMOUNT ANALYTICAL INC	Jun 3, 2026	5523631031246251 / MP-GV
EA0537	HYGROLOG	HL-NT2-DHCA-S 61290374/6077948	6	ROTTRONIC	Mar 7, 2025	551220085460939 / MP-TH

Procedures Used in this Event

Procedure Name	Description
MPC-THD-001 Rev. 03	Temperature, Humidity and Dew Point Devices, General, Rev.03, Jul-15-2024

Calibrating Technician:

Khom san. S.
KHOMSAN SAENGKAEW

QC Approval:

S. Pradyan
PADUNG SRASUAY

STATEMENTS OF PASS OR FAIL CONFORMANCE: The uncertainty of measurement has been taken into account when determining compliance with specification. All measurements and test results guard banded to ensure the probability of false-accept does not exceed 2% in compliance with ISO/IEC 17025:2017.

THE CALIBRATION REPORT STATUS:
PASS: Test used when compliance statement is given, and the measurement result is PASS.
PASS?: Test used when compliance statement is given, and the measurement result is PASS?
FAIL: Test used when compliance statement is given, and the measurement result is FAIL.
FAIL?: Test used when compliance statement is given, and the measurement result is FAIL?
REMARK: Other adjustments are made to all instruments which change the value of measurement from what was measured as found in new use as left.

THE expanded uncertainty of measurement is stated as the expanded uncertainty of measurement indicated by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%, unless otherwise stated.
This calibration report complies with ISO/IEC 17025:2017 and ANSI/ISO/IEC 17025:2017, Method B — Guard Bands Based on Test Uncertainty Ratio. Calibration system and resulting data were submitted to the customer. Any number of system may be measured in test and/or tolerance before the next scheduled calibration. Measurement system should be based on frequency of use, environmental conditions and customer's established tolerance. All measurements are traceable to the National Institute of Standards and Technology (NIST).
The expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%, unless otherwise stated.
This calibration report complies with ISO/IEC 17025:2017 and ANSI/ISO/IEC 17025:2017, Method B — Guard Bands Based on Test Uncertainty Ratio.

Page 1 of 1

(CERT, Rev B)

Calibration Report of Elitech BT-3 Digital Hygro - Thermometer

MPC Control #: EV3397 Serial Number: N/A
Asset ID: WL-DTH/03 Calibration Date: November 6, 2024

Measurement Results

Section 1 - Temperature Measurement

STD Reading (°C)	Lower Limit (°C)	UUC Reading (°C)		Upper Limit (°C)	Result	Uncertainty (°C)
		As Found	As Left			
20.00	19.50	19.8	19.8	20.50	PASS	± 0.051
25.00	24.50	24.7	24.7	25.50	PASS	± 0.055

Section 2 - Humidity Measurement

STD Reading (%RH)	Lower Limit (%RH)	UUC Reading (%RH)		Upper Limit (%RH)	Result	Uncertainty (%RH)
		As Found	As Left			
30.00	27.00	29	29	33.00	PASS	± 0.75
50.00	47.00	51	51	53.00	PASS	± 1.2
70.00	67.00	70	70	73.00	PASS	± 1.3

UUC : Unit Under Calibration, Temperature @ 25 °C

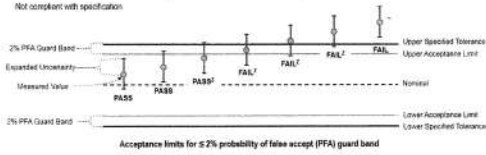
Accuracy By Manufacturer Specification , Temperature : ± 0.5 °C, Humidity : ± 3 %RH

Statements of Pass or Fail Conformance

The uncertainty of measurement has been taken into account when determining compliance with specification.
All measurements and test results guard banded to ensure the probability of false-accept does not exceed 2% in compliance with ANSI/ISO/IEC 17025:2017 and ANSI/ISO/IEC 17025:2017.

The status of compliance with the acceptance criteria is reported as:

- PASS** — Compliant with specification.
PASS? — The measured value is within acceptance limits.
However, a portion of the expanded uncertainty of measurement at 95% exceeds the specified tolerance.
FAIL? — The measured value is not within the acceptance limits.
However, a portion of the expanded uncertainty of measurement at 95% is within the specified tolerance.
FAIL — Not compliant with specification.



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

This calibration report complies with ISO/IEC 17025:2017 and ANSI/ISO/IEC 17025:2017. Method 6 — Guard Bands Based on Test Uncertainty Ratio.

End of Calibration Report