# เอกสารแนบ 9
## เอกสารอนุญาตห้องปฏิบัติการ

MM-N12

เอกสารแนบท้ายหนังสือรับต่ออายุขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน
บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด เลขทะเบียน ว-๒๐๔
ที่ อก ๐๓๑๐(๑)/ ลงวันที่ ๒๘ มกราคม ๒๕๖๕

ก. ผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์ จำนวน ๖ ราย

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ที่ อก ๐๓๑๐(๑)/ ๑๐๖๙

กรมโรงงานอุตสาหกรรม
ถนนพระรามที่ ๖ เขตราชเทวี
กรุงเทพมหานคร ๑๐๔๐๐

๒๘ มกราคม ๒๕๖๕

เรื่อง ต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน

เรียน กรรมการผู้จัดการ บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด

อ้างถึง คำขอขึ้นทะเบียน/ต่ออายุ/เปลี่ยนแปลงบุคลากร และชนิดสารมลพิษของห้องปฏิบัติการวิเคราะห์เอกชน ลงวันที่ ๓๐ กรกฎาคม ๒๕๖๓

สิ่งที่ส่งมาด้วย ๑. รายชื่อผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์ จำนวน ๑ แผ่น
๒. รายชื่อเจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๕ แผ่น
๓. ขอบข่ายสารมลพิษที่ได้รับขึ้นทะเบียนจากกรมโรงงานอุตสาหกรรม จำนวน ๓๑ แผ่น

ตามหนังสือที่อ้างถึง บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด ขอต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน เลขทะเบียน ว-๒๐๔ สถานที่ตั้งเลขที่ ๑๐๔ ซอยพัฒนาการ ๔๐ ถนนพัฒนาการ แขวงพัฒนาการ เขตสวนหลวง กรุงเทพมหานคร ต่อกรมโรงงานอุตสาหกรรม นั้น

กรมโรงงานอุตสาหกรรมพิจารณาแล้ว ให้บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด ต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน โดยมีองค์ประกอบดังนี้

ก. ผู้ควบคุมดูแลห้องปฏิบัติการวิเคราะห์ จำนวน ๖ ราย ตามสิ่งที่ส่งมาด้วย ๑
ข. เจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๑๖๒ ราย ตามสิ่งที่ส่งมาด้วย ๒
ค. ขอบข่ายสารมลพิษที่ได้รับขึ้นทะเบียนให้วิเคราะห์ในน้ำเสีย จำนวน ๕๙ รายการ น้ำใต้ดิน จำนวน ๑๒๖ รายการ อากาศเสีย ๑๖ รายการ สิ่งปฏิกูลหรือวัสดุที่ไม่ใช้แล้ว จำนวน ๓๕ รายการ และดิน จำนวน ๑๒๕ รายการ รวมทั้งสิ้นจำนวน ๓๖๑ รายการ ตามสิ่งที่ส่งมาด้วย ๓

หนังสือฉบับนี้จะหมดอายุในวันที่ ๒ กันยายน ๒๕๖๖ หากประสงค์จะต่ออายุหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน ให้ยื่นคำขอต่ออายุพร้อมเอกสารประกอบคำขอต่อกรมโรงงานอุตสาหกรรม ภายใน ๓๐ วัน ก่อนวันสิ้นอายุของหนังสือรับขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน ซึ่งคำขอต่ออายุดังกล่าวขอรับได้ที่กรมโรงงานอุตสาหกรรม

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ

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กองวิจัยและเตือนภัยมลพิษโรงงาน
กลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษและทะเบียนห้องปฏิบัติการ
โทร. ๐ ๒๒๐๒ ๔๑๔๖ ๐ ๒๒๐๒ ๔๐๐๒
โทรสาร ๐ ๒๓๕๔ ๓๒๐๘ ๐ ๒๓๕๔ ๓๔๑๕

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เอกสารแนบท้ายหนังสือรับต่ออายุขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน
บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด เลขทะเบียน ว-๒๐๔
ที่ อก ๐๓๑๐(๑)/ ๑๐๖๙ ลงวันที่ ๒๘ มกราคม ๒๕๖๕

ข. เจ้าหน้าที่ประจำห้องปฏิบัติการวิเคราะห์ จำนวน ๑๖๒ ราย

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เอกสารแนบท้ายหนังสือรับต่ออายุขึ้นทะเบียนห้องปฏิบัติการวิเคราะห์เอกชน
บริษัท เอแอลเอส แลบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด เลขทะเบียน ว-๒๐๔
ที่ อก ๐๓๑๐(๑)/ ๑๐๖๙ ลงวันที่ ๒๘ มกราคม ๒๕๖๕

ขอบข่ายสารมลพิษที่ได้รับขึ้นทะเบียนจากกรมโรงงานอุตสาหกรรม จำนวน ๓๖๑ รายการ

น้ำเสีย จำนวน 59 รายการ

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 1 | Aldicarb | High-Performance Liquid Chromatographic Method[4] |
| 2 | Aldicarb Sulfone | High-Performance Liquid Chromatographic Method[4] |
| 3 | Aldicarb Sulfoxide | High-Performance Liquid Chromatographic Method[4] |
| 4 | Aldrin | Liquid-Liquid Extraction, Gas Chromatographic Method[4] |
| 5 | Arsenic | 1) Digestion, Inductively Coupled Plasma Method[4]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4] |
| 6 | Barium | 1) Digestion, Inductively Coupled Plasma Method[4]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4] |
| 7 | α-BHC | Liquid-Liquid Extraction, Gas Chromatographic Method[4] |
| 8 | β-BHC | Liquid-Liquid Extraction, Gas Chromatographic Method[4] |
| 9 | δ-BHC | Liquid-Liquid Extraction, Gas Chromatographic Method[4] |
| 10 | γ-BHC | Liquid-Liquid Extraction, Gas Chromatographic Method[4] |
| 11 | Biochemical Oxygen Demand | 1) 5-Day BOD Test, Azide Modification Method[4]<br>2) 5-Day BOD Test, Membrane Electrode Method[4] |
| 12 | Carbaryl | High-Performance Liquid Chromatographic Method[4] |
| 13 | Carbofuran | High-Performance Liquid Chromatographic Method[4] |
| 14 | Cadmium | 1) Digestion, Inductively Coupled Plasma Method[4]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4] |
| 15 | Chemical Oxygen Demand | 1) Closed Reflux, Colorimetric Method[4]<br>2) Closed Reflux, Tritimetric Method[4] |
| 16 | Chlordane | Liquid-Liquid Extraction, Gas Chromatographic Method[4] |
| 17 | Chromium | 1) Digestion, Inductively Coupled Plasma Method[4]<br>2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method[4] |
| 18 | Color | ADMI Weighted-Ordinate Spectrophotometric Method |

(นางริกาญจน์ ฉัตรสกุลวิไล)
ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ
และทะเบียนห้องปฏิบัติการ

19 Copper...



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| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 19 | Copper | 1) Digestion, Inductively Coupled Plasma Method[4]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4] |
| 20 | Cyanide | Distillation, Colorimetric Method[4] |
| 21 | 2,4´-DDD | Liquid-Liquid Extraction, Gas Chromatographic Method[4] |
| 22 | 4,4´-DDD | Liquid-Liquid Extraction, Gas Chromatographic Method[4] |
| 23 | 2,4´-DDE | Liquid-Liquid Extraction, Gas Chromatographic Method[4] |
| 24 | 4,4´-DDE | Liquid-Liquid Extraction, Gas Chromatographic Method[4] |
| 25 | 2,4´-DDT | Liquid-Liquid Extraction, Gas Chromatographic Method[4] |
| 26 | 4,4´-DDT | Liquid-Liquid Extraction, Gas Chromatographic Method[4] |
| 27 | Dieldrin | Liquid-Liquid Extraction, Gas Chromatographic Method[4] |
| 28 | Endosulfan Sulfate | Liquid-Liquid Extraction, Gas Chromatographic Method[4] |
| 29 | Endosulfan I | Liquid-Liquid Extraction, Gas Chromatographic Method[4] |
| 30 | Endosulfan II | Liquid-Liquid Extraction, Gas Chromatographic Method[4] |
| 31 | Endrin | Liquid-Liquid Extraction, Gas Chromatographic Method[4] |
| 32 | Endrin Aldehyde | Liquid-Liquid Extraction, Gas Chromatographic Method[4] |
| 33 | Formaldehyde | Distillation, Colorimetric Method[3] |
| 34 | Free Chlorine | 1) DPD Ferrous Titrimetric Method[4]<br>2) Iodometric Method[4] |
| 35 | Heptachlor | Liquid-Liquid Extraction, Gas Chromatographic Method[4] |
| 36 | Heptachlor epoxide | Liquid-Liquid Extraction, Gas Chromatographic Method[4] |
| 37 | Hexavalent Chromium | Filtration, Colorimetric Method[4] |
| 38 | 3-Hydroxycarbofuran | High-Performance Liquid Chromatographic Method[4] |
| 39 | Lead | 1) Digestion, Inductively Coupled Plasma Method[4]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4] |
| 40 | Manganese | 1) Digestion, Inductively Coupled Plasma Method[4]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4] |
| 41 | Mercury | 1) Digestion, Cold-Vapor Atomic Absorption Spectrometric Method[4]<br>2) Digestion, Inductively Coupled Plasma/Mass spectrometric Method[4] |
| 42 | Methiocarb | High-Performance Liquid Chromatographic Method[4] |
| 43 | Methoxychlor | Liquid-Liquid Extraction, Gas Chromatographic Method[4] |

(นางริกาญจน์ ฉัตรสกุลวิไล)
ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ
และทะเบียนห้องปฏิบัติการ

44 Methomyl...



| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 44 | Methomyl | High-Performance Liquid Chromatographic Method[4] |
| 45 | Nickel | 1) Digestion, Inductively Coupled Plasma Method[4]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4] |
| 46 | Oil & Grease | 1) Liquid-Liquid, Partition-Gravimetric Method[4]<br>2) Soxhlet Extraction Method[4] |
| 47 | Oxamyl | High-Performance Liquid Chromatographic Method[4] |
| 48 | Propoxur | High-Performance Liquid Chromatographic Method[4] |
| 49 | pH | Electrometric Method[4] |
| 50 | Phenols | 1) Distillation, Chloroform Extraction Method[4]<br>2) Distillation, Direct Photometric Method[4] |
| 51 | Selenium | 1) Digestion, Inductively Coupled Plasma Method[4]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4] |
| 52 | Sulfide | Iodometric Method[4] |
| 53 | Temperature | Laboratory and Field Methods[4] |
| 54 | Total Dissolved Solids | Dried at 180 $^{o}$C[4] |
| 55 | Total Kjeldahl Nitrogen | Semi-Micro Kjeldahl Method[4] |
| 56 | Total Suspended Solids | Dried at 103-105 $^{o}$C[4] |
| 57 | Toxaphene | Liquid-Liquid Extraction, Gas Chromatographic Method[4] |
| 58 | Trivalent Chromium | 1) Digestion, Inductively Coupled Plasma Method; Colorimetric Method; Calculation[4]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method; Colorimetric Method; Calculation[4] |
| 59 | Zinc | 1) Digestion, Inductively Coupled Plasma Method[4]<br>2) Digestion, Inductively Coupled Plasma/Mass Spectrometric Method[4] |

<u>น้ำใต้ดิน จำนวน 126 รายการ</u>

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 1 | Acenaphthene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 2 | Acetone | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |

(นางริกาญจน์ ฉัตรสกุลวิไล)
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และทะเบียนห้องปฏิบัติการ

3 Aldrin...

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 3 | Aldrin | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 4 | Anthracene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 5 | Antimony | 1) Digestion, Inductively Coupled Plasma Method[4]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4] |
| 6 | Arsenic | 1) Digestion, Inductively Coupled Plasma Method[4]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4] |
| 7 | Atrazine | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 8 | Barium | 1) Digestion, Inductively Coupled Plasma Method[4]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4] |
| 9 | Benz(a)anthracene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 10 | Benzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 11 | Benzo(b)fluoranthene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 12 | Benzo(k)fluoranthene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 13 | Benzoic Acid | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 14 | Benzo(a)pyrene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 15 | Benzo[g,h,i]perylene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 16 | Beryllium | 1) Digestion, Inductively Coupled Plasma Method[4]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4] |
| 17 | Bis(2-chloroethyl)ether | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |

18 Bis(2-ethylhexyl)phthalate...

(นางริกาญจน์ ฉัตรสกุลวิไล)
ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ
และเทียบห้องปฏิบัติการ



| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 18 | Bis(2-ethylhexyl)phthalate | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 19 | Bromodichloromethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 20 | Bromoform | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 21 | Butanol | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4]<br>Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 22 | Butyl Benzyl Phthalate | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 23 | Cadmium | 1) Digestion, Inductively Coupled Plasma Method[4]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4] |
| 24 | Carbazole | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 25 | Carbon Disulfide | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 26 | Carbon tetrachloride | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 27 | Chlordane | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 28 | p-Chloroaniline | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 29 | Chlorobenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 30 | Chlorodibromomethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 31 | Chloroform | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 32 | 2-Chlorophenol | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 33 | Chromium | 1) Digestion, Inductively Coupled Plasma Method[4]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4] |

34 Chromium (III)...

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MM-N12

น.9/6

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 34 | Chromium (III) | 1) Digestion, Inductively Coupled Plasma Method; Colorimetric Method; Calculation[4]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method; Colorimetric Method; Calculation[4] |
| 35 | Chromium (VI) | Colorimetric Method[4] |
| 36 | Chrysene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 37 | Cyanide | Distillation, Colorimetric Method[4] |
| 38 | 2,4-D | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 39 | DDD | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 40 | DDE | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 41 | DDT | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 42 | Dibenz(a,h)anthracene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 43 | Di-n-Butyl Phthalate | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 44 | 1,2-Dichlorobenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 45 | 1,3-Dichlorobenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 46 | 1,4-Dichlorobenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 47 | 3,3-Dichlorobenzidine | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 48 | 1,1-Dichloroethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 49 | 1,2-Dichloroethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 50 | 1,1-Dichloroethylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |

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51 cis-1,2-Dichloroethylene...



| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 51 | cis-1,2-Dichloroethylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 52 | trans-1,2-Dichloroethylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 53 | 2,4-Dichlorophenol | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 54 | 1,2-Dichloropropane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 55 | 1,3-Dichloropropane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 56 | 1,3-Dichloropropene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 57 | Dieldrin | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 58 | Diethyl Phthalate | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 59 | 2,4-Dimethylphenol | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 60 | 2,4-Dinitrophenol | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 61 | 2,4-Dinitrotoluene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 62 | 2,6-Dinitrotoluene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 63 | Di-n-Octyl Phthalate | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 64 | Endosulfan | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 65 | Endrin | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 66 | Ethylbenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 67 | Fluoranthene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |

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68 Fluorene...

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 68 | Fluorene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 69 | Heptachlor | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 70 | Heptachlor epoxide | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 71 | Hexachlorobenzene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 72 | Hexachloro-1,3-butadiene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 73 | n-Hexane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 74 | α-HCH | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 75 | β-HCH | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 76 | γ-HCH | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 77 | Hexachlorocyclopentadiene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 78 | Hexachloroethane | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 79 | Indeno(1,2,3-cd)pyrene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 80 | Isophorone | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 81 | Lead | 1) Digestion, Inductively Coupled Plasma Method[4]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4] |
| 82 | Manganese | 1) Digestion, Inductively Coupled Plasma Method[4]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4] |
| 83 | Mercury | 1) Cold Vapor Atomic Absorption Spectrometric Method[4]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4] |

84 Methanol...

(นางริกาญจน์ ฉัตรสกุลวิไล)
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| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 84 | Methanol | 1) Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4]<br>2) Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 85 | Methoxychlor | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 86 | Methyl Bromide | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 87 | Methylene Chloride | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 88 | 2-Methylphenol | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 89 | 2-Methylnapthalene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 90 | Methyl tert-Butyl Ether | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 91 | Naphthalene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 92 | Nickel | 1) Digestion, Inductively Coupled Plasma Method[4]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4] |
| 93 | Nitrobenzene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 94 | N-Nitrosodiphenylamine | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 95 | N-Nitrosodi-n-Propylamine | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 96 | Polychlorinated Biphenyls<br>- PCB 1016<br>- PCB 1221<br>- PCB 1232<br>- PCB 1242<br>- PCB 1248<br>- PCB 1254<br>- PCB 1260 | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |

97 Pentachlorophenol...

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| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 114 | 1,1,2-Trichloroethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 115 | Trichloroethylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 116 | 2,4,5-Trichlorophenol | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 117 | 2,4,6-Trichlorophenol | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 118 | 1,3,5-Trimethylbenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 119 | Vanadium | 1) Digestion, Inductively Coupled Plasma Method[4]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4] |
| 120 | Vinyl Acetate | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 121 | Vinyl Chloride | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 122 | m-Xylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 123 | o-Xylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 124 | p-Xylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 125 | Xylene (Total) | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 126 | Zinc | 1) Digestion, Inductively Coupled Plasma Method[4]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4] |

<u>อากาศเสีย (ปล่องระบาย) จำนวน 16 รายการ</u>

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 1 | Antimony | Isokinetic, Digestion, Inductively Coupled Plasma Method[5] |
| 2 | Arsenic | Isokinetic, Digestion, Inductively Coupled Plasma Method[5] |

3 Carbon Monoxide...

(นางริกาญจน์ ฉัตรสกุลวิไล)
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| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 97 | Pentachlorophenol | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 98 | pH | Electrometric Method[4] |
| 99 | Phenanthrene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 100 | Phenol | 1) Distillation, Direct Photometric Method[4]<br>2) Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 101 | Pyrene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 102 | Selenium | 1) Digestion, Inductively Coupled Plasma Method[4]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4] |
| 103 | Silver | 1) Digestion, Inductively Coupled Plasma Method[4]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[4] |
| 104 | Styrene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 105 | 1,1,2,2-Tetrachloroethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 106 | Tetrachloroethylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 107 | Toluene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 108 | Toxaphene | Liquid-Liquid Extraction, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 109 | TPH ($C_5$-$C_8$) | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[13,24] |
| 110 | TPH ($C_{>8}$-$C_{16}$) | Solvent Extraction, Gas Chromatographic Method[9,21] |
| 111 | TPH ($C_{>16}$-$C_{35}$) | Solvent Extraction, Gas Chromatographic Method[9,21] |
| 112 | 1,2,4-Trichlorobenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |
| 113 | 1,1,1-Trichloroethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[4] |

114 1,1,2-Trichloroethane...

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**สิ่งปฏิกูลหรือวัสดุที่ไม่ใช้แล้ว จำนวน 35 รายการ**

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 1 | Aldrin | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method[1,9,25]<br>2) Soxhlet Extraction, Gas Chromatographic Method [10,22]<br>3) Automated Soxhlet Extraction, Gas Chromatographic Method [22,31] |
| 2 | Antimony | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method[1,6,15]<br>2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method[1,6,16]<br>3) Digestion, Inductively Coupled Plasma Method[7,15]<br>4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |
| 3 | Arsenic | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method[1,6,15]<br>2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method[1,6,16]<br>3) Digestion, Inductively Coupled Plasma Method[7,15]<br>4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |
| 4 | Barium | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method[1,6,15]<br>2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method[1,6,16]<br>3) Digestion, Inductively Coupled Plasma Method[7,15]<br>4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |
| 5 | Beryllium | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method[1,6,15]<br>2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method[1,6,16]<br>3) Digestion, Inductively Coupled Plasma Method[7,15]<br>4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |

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6 Cadmium...



| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 3 | Carbon Monoxide | 1) Sampling Bag Non-Dispersive Infrared Method[5]<br>2) Non-Dispersive Infrared Method[5]<br>3) Instrumental Analyzer Method[5] |
| 4 | Chlorine | 1) Absorption Sampling, Ion Chromatographic Method[5]<br>2) Isokinetic Sampling, Ion Chromatographic Method [5] |
| 5 | Copper | Isokinetic, Digestion, Inductively Coupled Plasma Method[5] |
| 6 | Dioxins | Isokinetic Sampling, Analysis by ISO/IEC 17025 Accredited Laboratory or Analysis by Department of Industrial Works Registered Laboratory (Dioxins/Furans Analysis Approved)[5] |
| 7 | Hydrogen Chloride | 1) Absorption Sampling, Ion Chromatographic Method[5]<br>2) Isokinetic Sampling, Ion Chromatographic Method[5] |
| 8 | Hydrogen Sulfide | Absorption Sampling, Iodometric Method[5] |
| 9 | Lead | Isokinetic, Digestion, Inductively Coupled Plasma Method[5] |
| 10 | Mercury | 1) Isokinetic Sampling, Digestion, Cold-Vapor Atomic Absorption Spectrometric Method[5]<br>2) Isokinetic, Digestion, Inductively Coupled Plasma Method[5] |
| 11 | Opacity | Ringelmann's Method[2] |
| 12 | Oxides of Nitrogen | 1) Absorption Sampling, Phenoldisulfonic Acid Method[5]<br>2) Chemiluminescence Method[5]<br>3) Instrumental Analyzer Method[5] |
| 13 | Sulfur Dioxide | 1) Absorption Sampling, Barium-Thorin Titrimetric Method[5]<br>2) UV Fluorescence Method[5]<br>3) Instrumental Analyzer Method[5] |
| 14 | Sulfuric Acid | Isokinetic Sampling, Barium-Thorin Titrimetric Method[5] |
| 15 | Total Suspended Particulate | Isokinetic Sampling, Gravimetric Method[5] |
| 16 | Xylene | Adsorption Sampling, Gas Chromatographic Method[5] |

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สิ่งปฏิกูล...

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 6 | Cadmium | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method[1,6,15]<br>2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method[1,6,16]<br>3) Digestion, Inductively Coupled Plasma Method[7,15]<br>4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |
| 7 | Chlordane | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method[1,19,25]<br>2) Soxhlet Extraction, Gas Chromatographic Method [10,22]<br>3) Automated Soxhlet Extraction, Gas Chromatographic Method [22,31] |
| 8 | Chromium | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method[1,6,15]<br>2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method[1,6,16]<br>3) Digestion, Inductively Coupled Plasma Method[7,15]<br>4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |
| 9 | Chromium (III) | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method; Waste Extraction, Colorimetric Method; Calculation Method[1,6,15,17]<br>2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method; Waste Extraction, Colorimetric Method; Calculation Method[1,6,16,17]<br>3) Digestion, Inductively Coupled Plasma Method; Alkaline Digestion, Colorimetric Method; Calculation Method[7,8,15,17]<br>4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method; Alkaline Digestion, Colorimetric Method; Calculation Method[7,8, 16,17] |
| 10 | Chromium (VI) | 1) Waste Extraction, Colorimetric Method[1,6,17]<br>2) Alkaline Digestion, Colorimetric Method[8,17] |

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11 Cobalt...



| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 11 | Cobalt | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method[1,6,15]<br>2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method[1,6,16]<br>3) Digestion, Inductively Coupled Plasma Method[7,15]<br>4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |
| 12 | Copper | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method[1,6,15]<br>2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method[1,6,16]<br>3) Digestion, Inductively Coupled Plasma Method[7,15]<br>4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |
| 13 | 2,4-D | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method[1,9,25]<br>2) Soxhlet Extraction, Gas Chromatographic Method[10,22]<br>3) Automated Soxhlet Extraction, Gas Chromatographic Method [22,31] |
| 14 | DDD | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method[1,9,25]<br>2) Soxhlet Extraction, Gas Chromatographic Method[10,22]<br>3) Automated Soxhlet Extraction, Gas Chromatographic Method [22,31] |
| 15 | DDE | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method[1,9,25]<br>2) Soxhlet Extraction, Gas Chromatographic Method[10,22]<br>3) Automated Soxhlet Extraction, Gas Chromatographic Method [22,31] |
| 16 | DDT | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method[1,9,25] |

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2) Soxhlet...

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| | | 2) Soxhlet Extraction, Gas Chromatographic Method[10,22]<br>3) Automated Soxhlet Extraction, Gas Chromatographic Method [22,31] |
| 17 | Dieldrin | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method[1,9,25]<br>2) Soxhlet Extraction, Gas Chromatographic Method[10,22]<br>3) Automated Soxhlet Extraction, Gas Chromatographic Method [22,31] |
| 18 | Endrin | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method[1,9,25]<br>2) Soxhlet Extraction, Gas Chromatographic Method[10,22]<br>3) Automated Soxhlet Extraction, Gas Chromatographic Method [22,31] |
| 19 | Heptachlor | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method[1,9,25]<br>2) Soxhlet Extraction, Gas Chromatographic Method[10,22]<br>3) Automated Soxhlet Extraction, Gas Chromatographic Method [22,31] |
| 20 | Lead | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method[1,6,15]<br>2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method[1,6,16]<br>3) Digestion, Inductively Coupled Plasma Method[7,15]<br>4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |
| 21 | Lindane | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method[1,9,25]<br>2) Soxhlet Extraction, Gas Chromatographic Method [10,22]<br>3) Automated Soxhlet Extraction, Gas Chromatographic Method [22,31] |
| 22 | Mercury | 1) Waste Extraction, Digestion, Cold-Vapor Atomic Absorption Spectrometric Method[1,6,18] |

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2) Waste Extraction...



| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| | | 2) Waste Extraction, Thermal Decomposition Amalgamation and Atomic Absorption Spectrometric Method[1,6,19]<br>3) Waste Extraction, Digestion, Cold-Vapor Atomic Fluorescence Spectrometric Method[1,6,20]<br>4) Digestion, Cold-Vapor Atomic Absorption Spectrometric Method[18]<br>5) Thermal Decomposition Amalgamation and Atomic Absorption Spectrometric Method[19]<br>6) Digestion, Cold-Vapor Atomic Fluorescence Spectrometric Method[20] |
| 23 | Methoxychlor | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method[1,9,25]<br>2) Soxhlet Extraction, Gas Chromatographic Method [10,22]<br>3) Automated Soxhlet Extraction, Gas Chromatographic Method [22,31] |
| 24 | Mirex | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method[1,9,25]<br>2) Soxhlet Extraction, Gas Chromatographic Method [10,22]<br>3) Automated Soxhlet Extraction, Gas Chromatographic Method [22,31] |
| 25 | Molybdenum | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method[1,6,15]<br>2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method[1,6,16]<br>3) Digestion, Inductively Coupled Plasma Method[7,15]<br>4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |
| 26 | Nickel | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method[1,6,15]<br>2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method[1,6,16]<br>3) Digestion, Inductively Coupled Plasma Method[7,15]<br>4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |

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27 Polychlorinated...

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 28 | Pentachlorophenol | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method[1,9,25]<br>2) Soxhlet Extraction, Gas Chromatographic Method [10,22]<br>3) Automated Soxhlet Extraction, Gas Chromatographic Method [22,31] |
| 29 | pH | Electrometric Method[29,30] |
| 30 | Selenium | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method[1,6,15]<br>2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method[1,6,16]<br>3) Digestion, Inductively Coupled Plasma Method[7,15]<br>4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |
| 31 | Silver | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method[1,6,15]<br>2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method[1,6,16] |
| 32 | Thallium | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method[1,6,15]<br>2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method[1,6,16]<br>3) Digestion, Inductively Coupled Plasma Method[7,15]<br>4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |
| 33 | Toxaphene | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic/Mass Spectrometric Method[1,9,25]<br>2) Soxhlet Extraction, Gas Chromatographic Method [10,22]<br>3) Automated Soxhlet Extraction, Gas Chromatographic Method [22,31] |
| 34 | Vanadium | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method[1,6,15]<br>2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method[1,6,16]<br>3) Digestion, Inductively Coupled Plasma Method[7,15] |

4) Digestion...

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| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 27 | Polychlorinated biphenyls (PCBs)<br>- Aroclor 1016<br>- Aroclor 1221<br>- Aroclor 1232<br>- Aroclor 1242<br>- Aroclor 1248<br>- Aroclor 1254<br>- Aroclor 1260<br>- 2-Chlorobiphenyl<br>- 2,3-Dichlorobiphenyl<br>- 2,2',5-Trichlorobiphenyl<br>- 2,4',5-Trichlorobiphenyl<br>- 2,2',3,5'-Tetrachlorobiphenyl<br>- 2,2',5,5'-Tetrachlorobiphenyl<br>- 2,3',4,4'-Tetrachlorobiphenyl<br>- 2,2',3,4,5'-Pentachlorobiphenyl<br>- 2,2',4,5,5'-Pentachlorobiphenyl<br>- 2,3,3',4',6-Pentachlorobiphenyl<br>- 2,2',3,4,4',5'-Hexachlorobiphenyl<br>- 2,2',3,4,5,5'-Hexachlorobiphenyl<br>- 2,2',3,5,5',6-Hexachlorobiphenyl<br>- 2,2',4,4',5,5'-Hexachlorobiphenyl<br>- 2,2',3,3',4,4',5-Heptachlorobiphenyl<br>- 2,2',3,4,4',5,5'-Heptachlorobiphenyl<br>- 2,2',3,4,4',5',6-Heptachlorobiphenyl<br>- 2,2',3,4',5,5',6-Heptachlorobiphenyl<br>- 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl | 1) Waste Extraction, Separatory Funnel Liquid-Liquid Extraction, Gas Chromatographic Method[1,9,23]<br>2) Soxhlet Extraction, Gas Chromatographic Method[10,23]<br>3) Automated Soxhlet Extraction, Gas Chromatographic Method [22,31] |

28 Pentachlorophenol...

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| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 9 | Benz(a)anthracene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 10 | Benzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 11 | Benzo(b)fluoranthene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 12 | Benzo(k)fluoranthene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 13 | Benzoic acid | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 14 | Benzo(a)pyrene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 15 | Benzo(g,h,i)perylene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 16 | Beryllium | 1) Digestion, Inductively Coupled Plasma Method[7,15]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |
| 17 | Bis(2-chloroethyl)ether | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 18 | Bis(2-ethylhexyl)phthalate | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 19 | Bromodichloromethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 20 | Bromoform | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 21 | Butanol | Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method[12,24] |
| 22 | Butyl Benzyl Phthalate | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 23 | Cadmium | 1) Digestion, Inductively Coupled Plasma Method[7,15]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |
| 24 | Carbazole | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 25 | Carbon Disulfide | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |

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26 Carbon tetrachloride...



| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| | | 4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |
| 35 | Zinc | 1) Waste Extraction, Digestion, Inductively Coupled Plasma Method[1,6,15]<br>2) Waste Extraction, Digestion, Inductively Coupled Plasma/Mass Spectrometric Method[1,6,16]<br>3) Digestion, Inductively Coupled Plasma Method[7,15]<br>4) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |

<u>ดิน จำนวน 125 รายการ</u>

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 1 | Acenaphthene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 2 | Acetone | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 3 | Aldrin | 1) Soxhlet Extraction, Gas Chromatographic Method[10,22]<br>2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 4 | Anthracene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 5 | Antimony | 1) Digestion, Inductively Coupled Plasma Method[7,15]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |
| 6 | Arsenic | 1) Digestion, Inductively Coupled Plasma Method[7,15]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |
| 7 | Atrazine | 1) Soxhlet Extraction, Gas Chromatographic Method[10,22]<br>2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 8 | Barium | 1) Digestion, Inductively Coupled Plasma Method[7,15]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |

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9 Benz(a)anthracene...

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 26 | Carbon tetrachloride | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 27 | Chlordane | 1) Soxhlet Extraction, Gas Chromatographic Method[10,22]<br>2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 28 | p-Chloroaniline | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 29 | Chlorobenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 30 | Chlorodibromomethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 31 | Chloroform | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 32 | 2-Chlorophenol | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 33 | Chromium | 1) Digestion, Inductively Coupled Plasma Method[7,15]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |
| 34 | Chromium (III) | 1) Digestion, Inductively Coupled Plasma Method; Alkaline Digestion, Colorimetric Method; Calculation Method[7,8,15,17]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method; Alkaline Digestion, Colorimetric Method; Calculation Method[7,8,16,17] |
| 35 | Chromium (VI) | Alkaline Digestion, Colorimetric Method[8,17] |
| 36 | Chrysene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 37 | Cyanide | Extraction, Distillation, Colorimetric Method[26,27,28] |
| 38 | 2,4-D | 1) Soxhlet Extraction, Gas Chromatographic Method[10,22]<br>2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 39 | DDD | 1) Soxhlet Extraction, Gas Chromatographic Method[10,22]<br>2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |

40 DDE...

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| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 40 | DDE | 1) Soxhlet Extraction, Gas Chromatographic Method[10,22]<br>2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 41 | DDT | 1) Soxhlet Extraction, Gas Chromatographic Method[10,22]<br>2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 42 | Dibenz(a,h)anthracene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 43 | Di-n-Butyl Phthalate | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 44 | 1,2-Dichlorobenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 45 | 1,3-Dichlorobenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 46 | 1,4-Dichlorobenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 47 | 3,3-Dichlorobenzidine | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 48 | 1,1-Dichloroethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 49 | 1,2-Dichloroethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 50 | 1,1-Dichloroethylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 51 | cis-1,2-Dichloroethylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 52 | trans-1,2-Dichloroethylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 53 | 2,4-Dichlorophenol | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 54 | 1,2-Dichloropropane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 55 | 1,3-Dichloropropane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 56 | 1,3-Dichloropropene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |

57 Dieldrin...

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| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 57 | Dieldrin | 1) Soxhlet Extraction, Gas Chromatographic Method[10,22]<br>2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 58 | Diethyl Phthalate | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 59 | 2,4-Dimethylphenol | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 60 | 2,4-Dinitrophenol | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 61 | 2,4-Dinitrotoluene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 62 | 2,6-Dinitrotoluene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 63 | Di-n-Octyl Phthalate | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 64 | Endosulfan | 1) Soxhlet Extraction, Gas Chromatographic Method[10,22]<br>2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 65 | Endrin | 1) Soxhlet Extraction, Gas Chromatographic Method[10,22]<br>2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 66 | Ethylbenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 67 | Fluoranthene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 68 | Fluorene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 69 | Heptachlor | 1) Soxhlet Extraction, Gas Chromatographic Method[10,22]<br>2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 70 | Heptachlor Epoxide | 1) Soxhlet Extraction, Gas Chromatographic Method[10,22]<br>2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |

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71 Hexachlorobenzene...



| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 71 | Hexachlorobenzene | 1) Soxhlet Extraction, Gas Chromatographic Method[10,22]<br>2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 72 | Hexachloro-1,3-butadiene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 73 | n-Hexane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 74 | α-HCH | 1) Soxhlet Extraction, Gas Chromatographic Method[10,22]<br>2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 75 | β-HCH | 1) Soxhlet Extraction, Gas Chromatographic Method[10,22]<br>2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 76 | γ-HCH | 1) Soxhlet Extraction, Gas Chromatographic Method[10,22]<br>2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 77 | Hexachlorocyclopentadiene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 78 | Hexachloroethane | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 79 | Indeno(1,2,3-cd)pyrene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 80 | Isophorone | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 81 | Lead | 1) Digestion, Inductively Coupled Plasma Method[7,15]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |
| 82 | Manganese | 1) Digestion, Inductively Coupled Plasma Method[7,15]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |
| 83 | Mercury | 1) Digestion, Cold-Vapor Atomic Absorption Spectrometric Method[18] |

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2) Thermal...

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| | | 2) Thermal Decomposition, Amalgamation, and Atomic Absorption Spectrophotometry[19]<br>3) Digestion, Cold-Vapor Atomic Fluorescence Spectrometric Method[20] |
| 84 | Methanol | Equilibrium Headspace, Gas Chromatographic/ Mass Spectrometric Method[12,24] |
| 85 | Methoxychlor | 1) Soxhlet Extraction, Gas Chromatographic Method[10,22]<br>2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 86 | Methyl Bromide | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 87 | Methylene Chloride | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 88 | 2-methylphenol | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 89 | 2-Methylnaphthalene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 90 | Methyl tert-Butyl Ether | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 91 | Naphthalene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 92 | Nickel | 1) Digestion, Inductively Coupled Plasma Method[7,15]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |
| 93 | Nitrobenzene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 94 | N-Nitrosodiphenylamine | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 95 | N-Nitrosodi-n-propylamine | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 96 | Polychlorinated biphenyls (PCBs)<br>- Aroclor 1016<br>- Aroclor 1221<br>- Aroclor 1232 | 1) Soxhlet Extraction, Gas Chromatographic Method [10,23]<br>2) Automated Soxhlet Extraction, Gas Chromatographic Method [23,32] |

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- Aroclor 1242...



| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| | - Aroclor 1242<br>- Aroclor 1248<br>- Aroclor 1254<br>- Aroclor 1260<br>- 2-Chlorobiphenyl<br>- 2,2',3,5'-Tetrachlorobiphenyl<br>- 2,2',5,5'-Tetrachlorobiphenyl<br>- 2,3',4,4'-Tetrachlorobiphenyl<br>- 2,2',3,4,5'-Pentachlorobiphenyl<br>- 2,2',4,5,5'-Pentachlorobiphenyl<br>- 2,3,3',4',6-Pentachlorobiphenyl<br>- 2,2',3,4,4',5'-Hexachlorobiphenyl<br>- 2,2',3,4,5,5'-Hexachlorobiphenyl<br>- 2,2',3,5,5',6-Hexachlorobiphenyl<br>- 2,2',4,4',5,5'-Hexachlorobiphenyl<br>- 2,2',3,3',4,4',5-Heptachlorobiphenyl<br>- 2,2',3,4,4',5,5'-Heptachlorobiphenyl<br>- 2,2',3,4,4',5',6-Heptachlorobiphenyl<br>- 2,2',3,4',5,5',6-Heptachlorobiphenyl<br>- 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl | |
| 97 | Pentachlorophenol | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 98 | Phenanthrene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 99 | Phenol | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 100 | Pyrene | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |

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และทะเบียนห้องปฏิบัติการ

101 Selenium...

| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 101 | Selenium | 1) Digestion, Inductively Coupled Plasma Method[7,15]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |
| 102 | Silver | 1) Digestion, Inductively Coupled Plasma Method[7,15]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |
| 103 | Styrene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 104 | 1,1,2,2-Tetrachloroethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 105 | Tetrachloroethylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 106 | Toluene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 107 | Toxaphene | 1) Soxhlet Extraction, Gas Chromatographic Method[10,22]<br>2) Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 108 | TPH ($C_5$–$C_8$) | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 109 | TPH ($C_{>8}$– $C_{16}$) | 1) Solvent Extraction, Gas Chromatographic Method[11,21]<br>2) Automated Soxhlet Extraction, Gas Chromatographic Method[21,31] |
| 110 | TPH ($C_{>16}$ – $C_{35}$) | 1) Solvent Extraction, Gas Chromatographic Method[11,21]<br>2) Automated Soxhlet Extraction, Gas Chromatographic Method[21,31] |
| 111 | 1,2,4-Trichlorobenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 112 | 1,1,1-Trichloroethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 113 | 1,1,2-Trichloroethane | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 114 | Trichloroethylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 115 | 2,4,5-Trichlorophenol | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |

(นางริกาญจน์ ฉัตรสกุลวิไล)
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116 2,4,6-Trichlorophenol...



| ลำดับที่ | สารมลพิษ | วิธีวิเคราะห์ |
|---|---|---|
| 116 | 2,4,6-Trichlorophenol | Automated Soxhlet Extraction, Gas Chromatographic/ Mass Spectrometric Method[25,31] |
| 117 | 1,3,5-Trimethylbenzene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 118 | Vanadium | 1) Digestion, Inductively Coupled Plasma Method[7,15]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |
| 119 | Vinyl Acetate | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 120 | Vinyl Chloride | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 121 | m-Xylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 122 | o-Xylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 123 | p-Xylene | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 124 | Xylene (Total) | Purge and Trap, Gas Chromatographic/ Mass Spectrometric Method[14,24] |
| 125 | Zinc | 1) Digestion, Inductively Coupled Plasma Method[7,15]<br>2) Digestion, Inductively Coupled Plasma/ Mass Spectrometric Method[7,16] |

<u>เอกสารอ้างอิง</u>


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2. กระทรวงอุตสาหกรรม. ประกาศกระทรวงอุตสาหกรรม, พ.ศ. 2549. เรื่อง กำหนดค่าปริมาณเขม่าควันที่เจือปนในอากาศที่ระบายออกจากปล่องของหม้อน้ำโรงสีข้าวที่ใช้แกลบเป็นเชื้อเพลิง. **ราชกิจจานุเบกษา.** 4 ธันวาคม 2549. เล่มที่ 123 ตอนพิเศษ 125ง.

3. สมาคมวิศวกรรมสิ่งแวดล้อมแห่งประเทศไทย. **คู่มือวิเคราะห์น้ำเสีย.** พิมพ์ครั้งที่ 4. กรุงเทพฯ: เรือนแก้วการพิมพ์, 2547.

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(นางริกาญจน์ ฉัตรสกุลวิไล)
ผู้อำนวยการกลุ่มมาตรฐานวิธีการวิเคราะห์ทดสอบมลพิษ

7. United States...

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(นางริกาญจน์ ฉัตรสกุลวิไล)
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และทะเบียนห้องปฏิบัติการ





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และทะเบียนห้องปฏิบัติการ

20. United States...

MM-N12

JIRANATEE ASSOCIATES CO. LTD.

Jiranatee Associates Co.,Ltd
63/14 15, 67/35-36
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Bangkok 10600(Thailand)
Tel +66086808812
Mobile: +66863999453
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Web site: www.jiranatee.com

*Accredited calibration laboratory*
*ISO/IEC 17025:2017*
*NSC-TISI-TIS 17025*
*CALIBRATION 0367*

*Air speed measurement laboratory*
*Calibration services department.*

REVIEW BY Pimalom P.
APPROVED BY
NEXT CAL. DATE 17/5/24

| Certificate Number |
|---|
| CL-001-65 |

# CERTIFICATE OF CALIBRATION



**MEASUREMENT ITEM** : Wind Direction Sensor
**MANUFACTURER** : Novalynx
**MODEL/TYPE** : Sensor: WS-02F
Data logger: 110-WS-25DL-D
**SERIAL NUMBER** : Sensor: WSD-011
Data logger: A5908
**ID NUMBER** : BKK_FS1213
**CONDITION AS-RECEIVED** : New item
**CUSTOMER** : ALS laboratory group (Thailand) co., ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

**RECEIVED DATE** : 09 Nov 2022
**MEASUREMENT DATE** : 17 Nov 2022
**ISSUE DATE** : 23 Nov 2022

**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 |

**PLACE OF CALIBRATION** : Eiffel-type wind tunnel of Jiranatee Associates Co., Ltd.

**CALIBRATION CONDITION**

| | | |
|---|---|---|
| : Wind tunnel cross-section area[1] | 900 | $cm^2$ |
| Win direction frontal area[2] | 129 | $cm^2$ |
| Diameter of mounting pipe[3] | - | mm |
| Blockage ratio of test object[4] | 0.143 | [-] |

**Preconditioning** : 24 hours at ambient conditions.
**Measurement Condition** : The average values during measurement are (24.0)°C, (49.7) %RH and (1009.5) hPa.

***Calibration procedure:***
*The wind direction sensor was calibrated against Standard Rotary Encoder model: AX4009TS-DM04-P3-S-U0 in an close test section of Eiffel type wind tunnel with 900 $cm^2$ cross test section area. The WI-CL-008 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 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 NIMT (National Metrology Institute of Thailand) via Certificate number: DA 0043-22*

***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'*

**TABULATION OF RESULTS:**
The table on next page give the measured values.

Calibrated by:
[✓] Mr. Sorawit Thachalad
[ ] Miss Jittraporn Lertsomphol

JIRANATE ASSOCIATES CO., LTD.

Approved signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

**Remark:**
[1] Nozzle cross-section area of the wind tunnel
[2] Projected cross-section area of the tested object include mounting pipe
[3] Diameter of mounting pipe
[4] Ratio [2] to [1]

THIS CERTIFICATE OF CALIBRATION MAY NOT BE REPRODUCED EXCEPT IN FULL UNLESS PERMISSION FOR REPRODUCTION HAS BEEN OBTAINED IN WRITING FROM THE LABORATORY



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right partner.

**รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ**

| Sample Name | Parameter | Equipment Name | ID No. | Calibrated Date | Next Cal | Freq. Calibrate (Months) |
|---|---|---|---|---|---|---|
| Ambient | Wind Speed / Wind Direction | Wind Speed / Wind Direct | BKK_FS1213 | 17-Nov-22 | 17-May-24 | 18 |
| Ambient | Particulate Matter (PM-10) | High Volume | BKK_FS1060 | - | - | On site Calibration |
| Ambient | Particulate Matter (PM-10) | High Volume | BKK_FS0388 | - | - | On site Calibration |
| Ambient | Particulate Matter (PM-10) | High Volume | BKK_FS0379 | - | - | On site Calibration |
| Ambient | Particulate Matter (PM-10) | High Volume | BKK_FS0378 | - | - | On site Calibration |
| Ambient | Particulate Matter (PM-10) | High Volume | BKK_FS0387 | - | - | On site Calibration |
| Ambient | Particulate Matter (PM-10) | High Volume | BKK_FS1063 | - | - | On site Calibration |
| Ambient | Particulate Matter (PM-10) | High Volume | BKK_FS0386 | - | - | On site Calibration |
| Ambient | Particulate Matter (PM-10) | High Volume | BKK_FS0382 | - | - | On site Calibration |
| Ambient | Particulate Matter (PM-10) | High Volume | BKK_FS0384 | - | - | On site Calibration |
| Ambient | Particulate Matter (PM-10) | Digital Balance | BKK_EN0004 | 8-Feb-23 | 8-Feb-24 | 12 |
| Ambient | Total Suspended Particulate | High Volume | BKK_FS0368 | - | - | On site Calibration |
| Ambient | Total Suspended Particulate | High Volume | BKK_FS0373 | - | - | On site Calibration |
| Ambient | Total Suspended Particulate | High Volume | BKK_FS0360 | - | - | On site Calibration |
| Ambient | Total Suspended Particulate | High Volume | BKK_FS1058 | - | - | On site Calibration |
| Ambient | Total Suspended Particulate | High Volume | BKK_FS0369 | - | - | On site Calibration |
| Ambient | Total Suspended Particulate | High Volume | BKK_FS0372 | - | - | On site Calibration |
| Ambient | Total Suspended Particulate | High Volume | BKK_FS1056 | - | - | On site Calibration |
| Ambient | Total Suspended Particulate | High Volume | BKK_FS0362 | - | - | On site Calibration |
| Ambient | Total Suspended Particulate | High Volume | BKK_FS1059 | - | - | On site Calibration |
| Ambient | Total Suspended Particulate | Digital Balance | BKK_EN0004 | 8-Feb-23 | 8-Feb-24 | 12 |

14/9/20

MM-N12

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*Accredited calibration laboratory*
*ISO/IEC 17025:2017*
*NSC-TISI-TIS 17025*
*CALIBRATION 0367*

*Air speed measurement laboratory*
*Calibration services department.*

| Certificate Number |
|---|
| CL-001-65 |

# CERTIFICATE OF CALIBRATION



**MEASUREMENT ITEM** : Cup anemometer
**MANUFACTURER** : Novalynx
**MODEL/TYPE** : Sensor: WS-02F
Data logger: 110-WS-25DL-D
**SERIAL NUMBER** : Sensor: WSD-011
Data logger: A5908
**ID NUMBER** : BKK_FS1213
**CONDITION AS-RECEIVED** : New item
**CUSTOMER** : ALS laboratory group (Thailand) co., ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

**RECEIVED DATE** : 09 Nov 2022
**MEASUREMENT DATE** : 17 Nov 2022
**ISSUE DATE** : 23 Nov 2022

**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 |

**PLACE OF CALIBRATION** : Eiffel-type wind tunnel of Jiranatee Associates Co., Ltd.

**CALIBRATION CONDITIONS**

| | | |
|---|---|---|
| : Wind tunnel cross-section area[1] | 900 | $cm^2$ |
| Win direction frontal area[2] | 100 | $cm^2$ |
| Diameter of mounting pipe[3] | - | mm |
| Blockage ratio of test object[4] | 0.111 | [-] |

**Preconditioning** : 24 hours at ambient conditions.
**Measurement Condition** : The average values during measurement are (23.8) °C, (49.5) %RH and (1012.2) hPa.

***Calibration procedure:***
*The cup anemometer was calibrated against Standard air velocity transducer model: 8455-12 and pitot tube with precision differential pressure meter model: DPM2500 in an close test-section of Eiffel type wind tunnel with 900 $cm^2$ cross test section area. The WI CL 007 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 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 NIMT (National Metrology Institute of Thailand) via Certificate number: MW-0052-21 and MW-0066-22*

***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'*

**TABULATION OF RESULTS:**
The table on next page give the measured values.

Calibrated by:
[x] Mr. Sorawit Thachalad
[ ] Miss Jittraporn Lertsomphol

JIRANATE ASSOCIATES CO., LTD.

Approved signatory: .....
Mr. Parinya Booncharoen
Calibration Department Manager

**Remark:**
[1] Nozzle cross-section area of the wind tunnel
[2] Projected cross-section area of the tested object include mounting pipe
[3] Diameter of mounting pipe
[4] Ratio [2] to [1]

THIS CERTIFICATE OF CALIBRATION MAY NOT BE REPRODUCED EXCEPT IN FULL UNLESS PERMISSION FOR REPRODUCTION HAS BEEN OBTAINED IN WRITING FROM THE LABORATORY

| Certificate Number |
|---|
| CL-001-65 |



MEASUREMENT RESULTS [5]

The wind direction sensor was calibrated against standard rotary encoder by comparison method. During calibration, the measurement was carried out at 45° intervals in clockwise and counterclockwise directions after offset adjustment has been made. The flow speed of wind tunnel (usually 5 m/s) is kept constant while the sensor is rotated around its vertical axis. The results of calibration and associated measurement uncertainties are reported in the table below.

| Air speed | $D'_{std}$ | $D'_{uut}$ | Error | U (k=2) |
|---|---|---|---|---|
| m/s | Degree (°) | Degree (°) | Degree (°) | Degree (°) |
| 4.99 | 0.001 | 0 | 0 | 0.58 |
| | 45.001 | 45 | 0 | 0.68 |
| | 90.000 | 89 | -1 | 0.74 |
| | 135.000 | 133 | -2 | 0.74 |
| | 180.000 | 177 | -3 | 0.68 |
| | 225.000 | 223 | -2 | 0.74 |
| | 270.001 | 271 | 1 | 0.68 |
| | 315.001 | 318 | 3 | 0.68 |

**Remark:**
[5] Calibration results only count for the tested circumstances and environmental conditions during which calibration took place
[6] Direction of standard
[7] Direction of Unit Under Calibration

***End of Certificate of Calibration***

JIRANATE ASSOCIATES CO., LTD.

14/9/21

63/14-15,67/35-36, Soi Petchkasem7,7/1, Petchkasem Rd,
Wathapra, Bangkokyai, Bangkok 10600 Thailand.
TTel.: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatec.com

# CERTIFICATE OF CALIBRATION

Certificate No.: CL-156 65
Page 1 of 2

**Equipment Name:** Data Logger with Temperature Sensor
**Manufacturer:** Novalynx
**Model:** 110 WS 25DL D
**Serial No.:** A5908
**ID No.:** BKK_FS1213

**Customer**
**Name:** ALS laboratory group (Thailand) Co.,Ltd.
**Address:** 104 Phatthanakan 40, Phatthanakan Rd.,Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250Thailand.

**Received date:** 09 Nov 2022
**Calibration date:** 18 Nov2022
**Issue date:** 23 Nov 2022

**Reference Used During Calibration**
1.Standard Temperature Probe Model: STS-100 A500, Serial No.: 667682-09, Due date: 23 Mar 2023
2.Digital Temperature Indicator Model: DTI-1000-A MK II, Serial No.: 671407-00591 Due date: 22 July 2023

**Calibration Condition**
Temperature: (23±3)° C
Relative Humidity: (55±15)%

**Calibration Procedure**
The temperature calibration was done by In-House calibration method as WI-CL-001 according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale use was based on ITS-90.

**Traceability**
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TT-0034-22, Certificate number: FR-0092-22

**Calibrated by**
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

JIRANATE ASSOCIATES CO., LTD.

Approved Signatory: .....
Mr. Parinya Booncharoen
Calibration Department Manager

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| Certificate Number |
|---|
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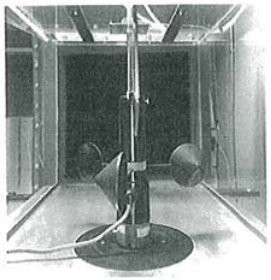
**MEASUREMENT RESULTS** [5]

The cup anemometer, Unit Under Calibration (UUC) was exercise at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 300 mm respectively away from wind tunnel nozzle, UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

| $V_{std}$ [6] (m/s) | Temp. wind tunnel (°C) | Temp. room (°C) | $V_{UUC}$ [7] (m/s) | Error (m/s) | U (k=2) (m/s) |
|---|---|---|---|---|---|
| 0.975 | 24.02 | 23.75 | 0.8 | -0.2 | 0.16 |
| 2.073 | 23.54 | 23.75 | 1.8 | -0.3 | 0.16 |
| 3.068 | 24.02 | 23.75 | 2.8 | -0.2 | 0.21 |
| 4.180 | 23.84 | 23.75 | 3.8 | -0.3 | 0.20 |
| 5.01 | 23.92 | 23.75 | 4.8 | -0.2 | 0.17 |
| 6.00 | 23.96 | 23.75 | 5.8 | -0.2 | 0.18 |
| 7.07 | 23.84 | 23.75 | 6.9 | -0.2 | 0.19 |
| 8.20 | 23.86 | 23.75 | 7.9 | -0.3 | 0.19 |
| 9.11 | 23.80 | 23.75 | 8.9 | -0.2 | 0.22 |
| 10.10 | 23.92 | 23.75 | 9.8 | -0.3 | 0.21 |
| 11.16 | 23.82 | 23.75 | 10.9 | -0.2 | 0.20 |
| 12.14 | 23.96 | 23.75 | 11.9 | -0.3 | 0.21 |
| 13.20 | 23.90 | 23.75 | 12.9 | -0.3 | 0.21 |
| 14.27 | 23.94 | 23.75 | 14.0 | -0.3 | 0.25 |
| 15.19 | 23.90 | 23.75 | 14.9 | -0.2 | 0.22 |
| 16.32 | 23.90 | 23.75 | 16.1 | -0.3 | 0.26 |

**Remark:**
[5] Calibration results only count for the tested circumstances and environmental conditions during which calibration took place
[6] Velocity of standard
[7] Velocity of Unit Under Calibration

**PHOTO OF CALIBRATION SET-UP**



Calibration set-up of the cup anemometer calibration in the wind tunnel of Jiranatee Associates Co., Ltd. The cup anemometer shown may differ from the calibrated one. Remark: The proportion of the set- up is not true to scale due to imaging geometry.

***End of Certificate of Calibration***

JIRANATE ASSOCIATES CO., LTD.

63/14-15,67/35-36, Soi Petchkasem7,7/1, Petchkasem Rd,
Wathapra, Bangkokyai,Bangkok 10600 Thailand.
Tel.: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatee.com

# CERTIFICATE OF CALIBRATION

Calibration No. : RH-01112022
Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger
Manufacturer : Novalynx
Model/Type : 110-WS-25DL-D
Serial Number : A5908
ID No. : BKK_FS1213
Customer : ALS laboratory group (Thailand) Co., Ltd.
: 104 Phalthanakan 40, Phalthanakan Rd., Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

Environmental Condition:
The measurement was carried out in an ambient temperature of (25±3)°C, and relative humidity of (50±15)%.

Measurement Method:
Unit Under Calibration (UUC) was calibrated by comparison method with standard thermo hygrometer in the humidity generator chamber to determine the errors.

Traceability:
This instrument was calibrated using standard equipment whose accuracy is traceability through National Institute of Standards and Technology to the international system of units (SI) via MCS Calibration, Inc. Certificate number: 20314-101. Due date: Mar 14, 2023.

Measurement Date : Nov 18, 2022
Issued Date : Nov 23, 2022

Measurement Results:
This equipment was connected with Indoor air quality probe and Displayed (UR) on display. Model: HMP60, Serial number: U3641221
Calibration was performed in the range of 20%RH to 80%RH
The results of calibration are reported in table below.

| Determined (%RH) | Standard (Reading) (%RH) | UUC (Reading) (%RH) | Error (%RH) | Uncertainty ±(%RH) |
|---|---|---|---|---|
| 20 | 19.93 | 17.6 | -2.3 | 0.61 |
| 50 | 50.45 | 47.7 | -2.8 | 0.57 |
| 80 | 80.30 | 77.6 | -2.7 | 0.55 |

Performed by
☑ Mr. Sorawit Thachatad
☐ Miss Jittraporn Lertsomphot

JIRANATE ASSOCIATES CO., LTD.

Approved Signatory: .....
Mr. Parinya Booncharoen.
Calibration Department Manager

THIS CALIBRATION REPORT MAY NOT BE REPRODUCEDUCED EXCEPT IN FULL UNLESS PERMISSION FOR REPRODUCTION HAS BEEN OBTAINED IN WRITING FROM THE LABORATORY.

63/14-15,67/35-36, Soi Petchkasem7,7/1, Petchkasem Rd,
Wathapra, Bangkokyai, Bangkok 10600 Thailand.
Tel.: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatee.com



Result of Calibration:- ☑ Without Adjustment ☐ With Adjustment
Calibration Range: 20-40 °C

Function:
This equipment was connected with temperature sensor Model: HMP60 S/N: U3641221.

Dimension : Diameter 12 mm. Length 80 mm.

| Immersion Depth (mm) | Standard Reading (°C) | UUC Reading (°C) | Error (°C) | Uncertainty (°C) |
|---|---|---|---|---|
| 60 | 20.00 | 19.9 | 0.1 | 0.30 |
| 60 | 24.96 | 24.8 | 0.2 | 0.30 |
| 60 | 30.00 | 29.8 | 0.2 | 0.30 |
| 60 | 35.00 | 34.6 | 0.4 | 0.30 |
| 60 | 40.00 | 39.5 | 0.5 | 0.30 |

UUC*: Unit Under Calibration
The reported expanded uncertainty is based on standard uncertainty multiplied by a coverage factor k=2 providing a level of confidence of approximately 95%

✲ End of Certificate ✲

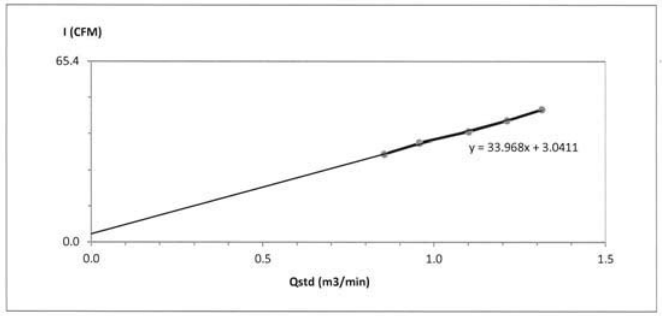
JIRANATE ASSOCIATES CO., LTD.

MM-N12

## High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Akara Resources Public Co.,Ltd. | **Barometric Pressure (mm Hg) :** | 755 |
| **Calibrate Location :** | Ban Nong Ra Man | **Temperature ( °C) :** | 30 |
| **Calibrate Date :** | 21-Feb-23 | **High Volume ID :** | BKK_FS0388 |
| **CalibrationSheet No.:** | **C-210223-BKK_FS0388** | **High Volume Model :** | TE-5009X |
| **Calibrator ID:** | BKK_FS0624 | **High Volume S/N :** | 5328 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 1.64942 |
| **Calibrator S/N :** | 2584 | **Calibrator Intercept :** | -0.02902 |

| Test No. | Delta $H_2O$ (inch) | $Q_{std}$ ($m^3$/min) | I : Chart (CFM) | Linear Regression |
|---|---|---|---|---|
| 1 | 1.9 | 0.8551 | 32 | Slope : 33.9680 |
| 2 | 2.4 | 0.9574 | 36 | Intercept : 3.0411 |
| 3 | 3.2 | 1.1010 | 40 | Correlation Coefficient : 0.9983 |
| 4 | 3.9 | 1.2125 | 44 | |
| 5 | 4.6 | 1.3143 | 48 | |




Calibrated by _____ ( Mr.Teeravut Sukdee ) Field Scientist(1)

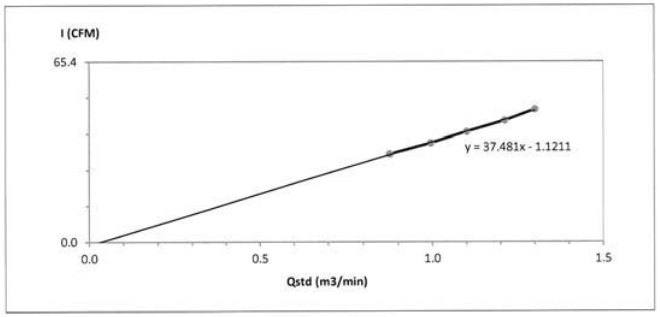
Approved by : _____ (Mr. Noppong Juntarupan) Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-074 REVISION NO.: - ISSUE DATE: 14/03/16

## High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Akara Resources Public Co.,Ltd. | **Barometric Pressure (mm Hg) :** | 755 |
| **Calibrate Location :** | Ban Dong Long | **Temperature ( °C) :** | 30 |
| **Calibrate Date :** | 21-Feb-23 | **High Volume ID :** | BKK_FS1060 |
| **CalibrationSheet No.:** | **C-210223-BKK_FS1060** | **High Volume Model :** | TE-5009X |
| **Calibrator ID:** | BKK_FS0624 | **High Volume S/N :** | 5503 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 1.64942 |
| **Calibrator S/N :** | 2584 | **Calibrator Intercept :** | -0.02902 |

| Test No. | Delta $H_2O$ (inch) | $Q_{std}$ ($m^3$/min) | I : Chart (CFM) | Linear Regression |
|---|---|---|---|---|
| 1 | 2.0 | 0.8765 | 32 | Slope : 37.4812 |
| 2 | 2.6 | 0.9953 | 36 | Intercept : -1.1211 |
| 3 | 3.2 | 1.1010 | 40 | Correlation Coefficient : 0.9988 |
| 4 | 3.9 | 1.2125 | 44 | |
| 5 | 4.5 | 1.3003 | 48 | |




Calibrated by _____ ( Mr.Teeravut Sukdee ) Field Scientist(1)

Approved by : _____ (Mr. Noppong Juntarupan) Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-074 REVISION NO.: - ISSUE DATE: 14/03/16

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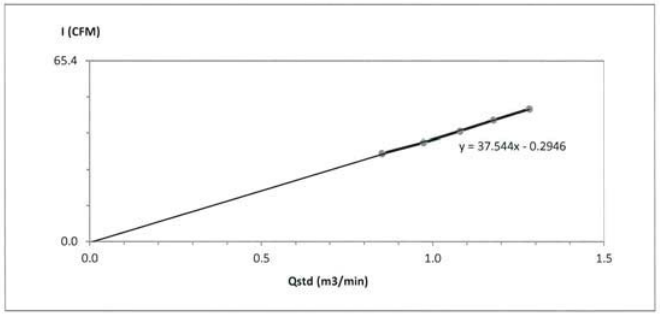
MM-N12

## High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Akara Resources Public Co.,Ltd. | **Barometric Pressure (mm Hg) :** | 755 |
| **Calibrate Location :** | Ban Khao Mor | **Temperature ( °C) :** | 32 |
| **Calibrate Date :** | 21-Feb-23 | **High Volume ID :** | BKK_FS0378 |
| **CalibrationSheet No.:** | **C-210223-BKK_FS0378** | **High Volume Model :** | TE-5009X |
| **Calibrator ID:** | BKK_FS0624 | **High Volume S/N :** | 4155 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 1.64942 |
| **Calibrator S/N :** | 2584 | **Calibrator Intercept :** | -0.02902 |

| Test No. | Delta $H_2O$ (inch) | $Q_{std}$ ($m^3$/min) | I : Chart (CFM) | Linear Regression |
|---|---|---|---|---|
| 1 | 1.9 | 0.8523 | 32 | Slope : 37.5441 |
| 2 | 2.5 | 0.9734 | 36 | Intercept : -0.2946 |
| 3 | 3.1 | 1.0807 | 40 | Correlation Coefficient : 0.9992 |
| 4 | 3.7 | 1.1779 | 44 | |
| 5 | 4.4 | 1.2819 | 48 | |




Calibrated by _____ ( Mr.Teeravut Sukdee ) Field Scientist(1)

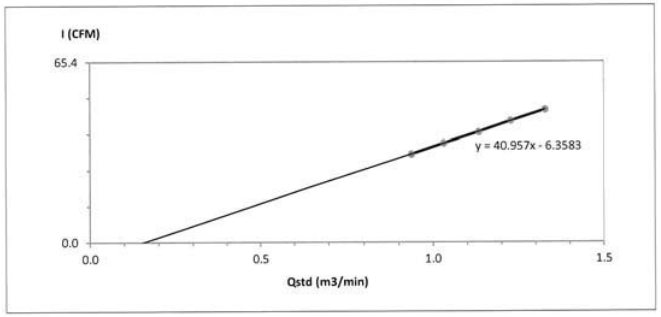
Approved by : _____ (Mr. Noppong Juntarupan) Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-074 REVISION NO.: - ISSUE DATE: 14/03/16

## High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Akara Resources Public Co.,Ltd. | **Barometric Pressure (mm Hg) :** | 755 |
| **Calibrate Location :** | Ban Nong Sang | **Temperature ( °C) :** | 30 |
| **Calibrate Date :** | 21-Feb-23 | **High Volume ID :** | BKK_FS0379 |
| **CalibrationSheet No.:** | **C-210223-BKK_FS0379** | **High Volume Model :** | TE-5009X |
| **Calibrator ID:** | BKK_FS0624 | **High Volume S/N :** | 4158 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 1.64942 |
| **Calibrator S/N :** | 2584 | **Calibrator Intercept :** | -0.02902 |

| Test No. | Delta $H_2O$ (inch) | $Q_{std}$ ($m^3$/min) | I : Chart (CFM) | Linear Regression |
|---|---|---|---|---|
| 1 | 2.3 | 0.9379 | 32 | Slope : 40.9570 |
| 2 | 2.8 | 1.0318 | 36 | Intercept : -6.3583 |
| 3 | 3.4 | 1.1340 | 40 | Correlation Coefficient : 0.9999 |
| 4 | 4.0 | 1.2276 | 44 | |
| 5 | 4.7 | 1.3282 | 48 | |




Calibrated by _____ ( Mr.Teeravut Sukdee ) Field Scientist(1)

Approved by : _____ (Mr. Noppong Juntarupan) Enviro Field Coordinator Scientist (3)

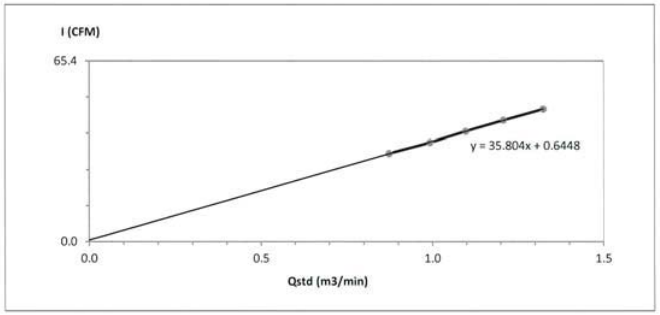
FORM NO.: F 06-074 REVISION NO.: - ISSUE DATE: 14/03/16

MM-N12

## High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Akara Resources Public Co.,Ltd. | **Barometric Pressure (mm Hg) :** | 755 |
| **Calibrate Location :** | Ban Tung Thong | **Temperature ( °C) :** | 32 |
| **Calibrate Date :** | 21-Feb-23 | **High Volume ID :** | BKK_FS1063 |
| **CalibrationSheet No.:** | **C-210223-BKK_FS1063** | **High Volume Model :** | TE-5009X |
| **Calibrator ID:** | BKK_FS0624 | **High Volume S/N :** | 5685 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 1.64942 |
| **Calibrator S/N :** | 2584 | **Calibrator Intercept :** | -0.02902 |

| Test No. | Delta $H_2O$ (inch) | $Q_{std}$ ($m^3$/min) | I : Chart (CFM) | Linear Regression | |
|---|---|---|---|---|---|
| 1 | 2.0 | 0.8737 | 32 | Slope : | 35.8043 |
| 2 | 2.6 | 0.9921 | 36 | Intercept : | 0.6448 |
| 3 | 3.2 | 1.0975 | 40 | Correlation Coefficient : | 0.9999 |
| 4 | 3.9 | 1.2086 | 44 | | |
| 5 | 4.7 | 1.3239 | 48 | | |




Calibrated by _____ ( Mr.Teeravut Sukdee ) Field Scientist(1)

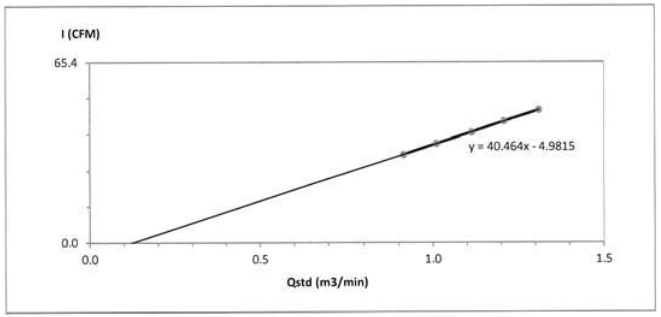
Approved by : _____ (Mr. Noppong Juntarupan) Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-074 REVISION NO.: - ISSUE DATE: 14/03/16

## High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Akara Resources Public Co.,Ltd. | **Barometric Pressure (mm Hg) :** | 755 |
| **Calibrate Location :** | Ban Khao Kham | **Temperature ( °C) :** | 32 |
| **Calibrate Date :** | 21-Feb-23 | **High Volume ID :** | BKK_FS0387 |
| **CalibrationSheet No.:** | **C-210223-BKK_FS0387** | **High Volume Model :** | G1051 |
| **Calibrator ID:** | BKK_FS0624 | **High Volume S/N :** | 1626 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 1.64942 |
| **Calibrator S/N :** | 2584 | **Calibrator Intercept :** | -0.02902 |

| Test No. | Delta $H_2O$ (inch) | $Q_{std}$ ($m^3$/min) | I : Chart (CFM) | Linear Regression | |
|---|---|---|---|---|---|
| 1 | 2.2 | 0.9150 | 32 | Slope : | 40.4644 |
| 2 | 2.7 | 1.0105 | 36 | Intercept : | -4.9815 |
| 3 | 3.3 | 1.1141 | 40 | Correlation Coefficient : | 0.9999 |
| 4 | 3.9 | 1.2086 | 44 | | |
| 5 | 4.6 | 1.3101 | 48 | | |




Calibrated by _____ ( Mr.Teeravut Sukdee ) Field Scientist(1)

Approved by : _____ (Mr. Noppong Juntarupan) Enviro Field Coordinator Scientist (3)

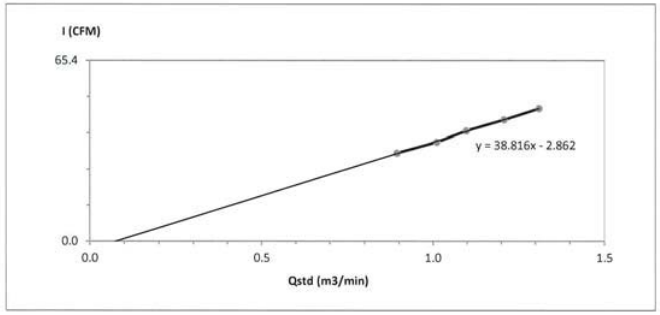
FORM NO.: F 06-074 REVISION NO.: - ISSUE DATE: 14/03/16

MM-N12

## High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Akara Resources Public Co.,Ltd. | **Barometric Pressure (mm Hg) :** | 755 |
| **Calibrate Location :** | Ban Klong Sai Yang Rong | **Temperature ( °C) :** | 32 |
| **Calibrate Date :** | 21-Feb-23 | **High Volume ID :** | BKK_FS0382 |
| **CalibrationSheet No.:** | **C-210223-BKK_FS0382** | **High Volume Model :** | TE-5009X |
| **Calibrator ID:** | BKK_FS0624 | **High Volume S/N :** | 4786 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 1.64942 |
| **Calibrator S/N :** | 2584 | **Calibrator Intercept :** | -0.02902 |

| Test No. | Delta $H_2O$ (inch) | $Q_{std}$ ($m^3$/min) | I : Chart (CFM) | Linear Regression |
|---|---|---|---|---|
| 1 | 2.1 | 0.8946 | 32 | Slope : 38.8156 |
| 2 | 2.7 | 1.0105 | 36 | Intercept : -2.8620 |
| 3 | 3.2 | 1.0975 | 40 | Correlation Coefficient : 0.9993 |
| 4 | 3.9 | 1.2086 | 44 | |
| 5 | 4.6 | 1.3101 | 48 | |




Calibrated by _____ ( Mr.Teeravut Sukdee ) Field Scientist(1)

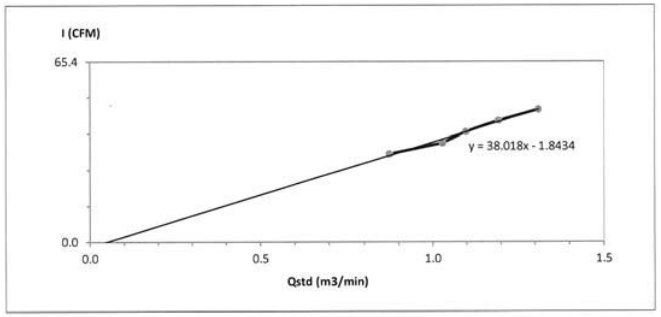
Approved by : _____ (Mr. Noppong Juntarupan) Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-074 REVISION NO.: - ISSUE DATE: 14/03/16

## High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Akara Resources Public Co.,Ltd. | **Barometric Pressure (mm Hg) :** | 755 |
| **Calibrate Location :** | Ban Mai Klong Ta Lud | **Temperature ( °C) :** | 32 |
| **Calibrate Date :** | 21-Feb-23 | **High Volume ID :** | BKK_FS0386 |
| **CalibrationSheet No.:** | **C-210223-BKK_FS0386** | **High Volume Model :** | TE-5009X |
| **Calibrator ID:** | BKK_FS0624 | **High Volume S/N :** | 4790 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 1.64942 |
| **Calibrator S/N :** | 2584 | **Calibrator Intercept :** | -0.02902 |

| Test No. | Delta $H_2O$ (inch) | $Q_{std}$ ($m^3$/min) | I : Chart (CFM) | Linear Regression |
|---|---|---|---|---|
| 1 | 2.0 | 0.8737 | 32 | Slope : 38.0176 |
| 2 | 2.8 | 1.0285 | 36 | Intercept : -1.8434 |
| 3 | 3.2 | 1.0975 | 40 | Correlation Coefficient : 0.9931 |
| 4 | 3.8 | 1.1934 | 44 | |
| 5 | 4.6 | 1.3101 | 48 | |




Calibrated by _____ ( Mr.Teeravut Sukdee ) Field Scientist(1)

Approved by : _____ (Mr. Noppong Juntarupan) Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-074 REVISION NO.: - ISSUE DATE: 14/03/16

MM-N12

**Sartorius (Thailand) Co., Ltd.**
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8361-6 , e-mail: service.thailand@sartorius.com

NSC-TISI-TIS 17025
CALIBRATION 0426

SARTORIUS

# Certificate of Calibration

REVIEW BY Sirilak P.
APPROVED BY KL AL
NEXT CAL. DATE 8/2/24

| | | | |
|---|---|---|---|
| Model Number : | XP105DU | Certificate No. : | 23BCI0071 |
| Description : | Semi-micro Balance | Issued Date : | Monday, February 13, 2023 |
| Serial Number : | 1123091884 | Reference No. : | 203245 |
| ID No. | BKK_EN0004 | | |
| Manufacturer : | Mettler Toledo | Page No. : | 1 0f 3 |

Customer Name : ALS Laboratory Group (Thailand)Co., Ltd.
104 Phatthanakan 40,Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250.

Calibrated Place : Balance Room.

Calibrated By : Mr. Chonchai Inthana
Calibration Date : Wednesday, February 08, 2023

Calibration Procedure No. : This calibration was conducted by Using in-house calibration procedure number (WI-003) Based on UKAS LAB 14 : 2019

*Metrological data :*
Capacity : 31/120 g Readability : 0.0001 g

*Ambients Conditions:*
Temperature : 21.0 °C ± 3.0 °C
Humidity : 65.0 % RH ± 5.0 % RH
Pressure – ± –

*Reasons for calibration*
☐ New Installation ☐ Service / Repaired ☑ Re-calibration/ Maintenance

*Equipment Condition:* ☑ Good Operate ☐ Fair

## Measurement Method UKAS Publication Ref :Lab 14

The measurement uncertainty stated is the expended 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). The calibration certificate documents the traceability to National Standards, which realise the unit of measurement according to the International Standard System of Units (SI). Report of Tolerance came form list of Sartorius Metrological Specifications.

## Traceability:

| Model Number | Description | Traceability | Cetificate No. | Due Date |
|---|---|---|---|---|
| YCS011-522-00 | Sartorius weight set 1mg - 1kg E2 s/n 37929119 | SPC-RT | C02212565 | 14-Sep-2023 |
| MHB-382SD | Humidity/Barometer/Temp Lutron MHB-382SD | DKSH | C19220444 | 5-Sep-2023 |

This certificate relate and apply this equipment only.
This certificate may not be reproduced other than in full except with the prior written approval of the Verification Operation Division Sartorius (Thailand) Co., Ltd.

Mr.Chonchai Inthana(Technical Manager)

STAMP SARTORIUS (THAILAND) CO., LTD. SARTORIUS ISO/IEC 17025:2017

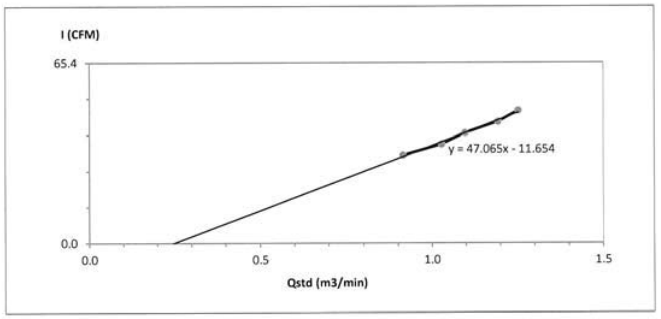
SOP FM 33 03 Feburary 2022

ALS

## High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Akara Resources Public Co.,Ltd. | **Barometric Pressure (mm Hg) :** | 755 |
| **Calibrate Location :** | Ban Long Du | **Temperature ( °C) :** | 32 |
| **Calibrate Date :** | 21-Feb-23 | **High Volume ID :** | BKK_FS0384 |
| **CalibrationSheet No.:** | C-210223-BKK_FS0384 | **High Volume Model :** | TE-5009X |
| **Calibrator ID:** | BKK_FS0624 | **High Volume S/N :** | 4788 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 1.64942 |
| **Calibrator S/N :** | 2584 | **Calibrator Intercept :** | -0.02902 |

| Test No. | Delta $H_2O$ (inch) | $Q_{std}$ ($m^3$/min) | I : Chart (CFM) | Linear Regression | |
|---|---|---|---|---|---|
| 1 | 2.2 | 0.9150 | 32 | Slope : | 47.0655 |
| 2 | 2.8 | 1.0285 | 36 | Intercept : | -11.6537 |
| 3 | 3.2 | 1.0975 | 40 | Correlation Coefficient : | 0.9949 |
| 4 | 3.8 | 1.1934 | 44 | | |
| 5 | 4.2 | 1.2531 | 48 | | |




Calibrated by
( Mr.Teeravut Sukdee )
Field Scientist(1)

Approved by :
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-074 REVISION NO.: - ISSUE DATE: 14/03/16

MM-N12

**Sartorius (Thailand) Co., Ltd.**
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8361-6 Fax: +66 2643-8367,

SARTORIUS

# Certificate of Calibration

Model Number : XS105DU
Description : Semi-micro Balance
Serial Number : 1123091884
ID No. BKK_EN0004
Manufacturer : Mettler Toledo

Certificate No. : 23BCI0071
Issued Date : Monday, February 13, 2023
Reference No. : 203245

Page No. : 3 of 3

## Calibration Results : Without Adjustment

### Repeatability

*The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.*

Nominal Value : (Low Load) 2 g
Tolerance N/A g

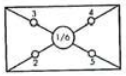
Nominal Value : (High Load) 100 g
Tolerance N/A g

| |
|---|
| 100.0000 |
| 100.0000 |
| 100.0000 |
| 100.0000 |
| 100.0000 |
| 100.0000 |
| 100.0000 |
| 99.9999 |
| 100.0000 |
| 100.0000 |
| ***Standard Deviation*** 0.00003 |

### Eccentricity (Off-center loading error)

*The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/3 or 1/4 of maximim capacity, placed in the middle of the weighing pan and between each of four additional measurement points ( positions defined according to OIML R76).*

Nominal value : g
Tolerance N/A g




| | Difference |
|---|---|
| 1 | – |
| 2 | – |
| 3 | – |
| 4 | – |
| 5 | – |
| 6 | – |

### Linearity

*The linearity, also called linearity error. Describes the deviation of the characteristic curve of a weighing instrument from the linear slope.*

Tolerance N/A g

| Nominal Value (g) | Conventional Mass Value (g) | Displayed Value (g) | Deviation (g) | Uncertainty (g) |
|---|---|---|---|---|
| 50 | 50.0000 | 50.0000 | 0.0000 | 0.00012 |
| 55 | 55.0000 | 55.0000 | 0.0000 | 0.00015 |
| 60 | 60.0000 | 60.0000 | 0.0000 | 0.00015 |
| 65 | 65.0001 | 65.0001 | 0.0000 | 0.00015 |
| 70 | 70.0000 | 70.0000 | 0.0000 | 0.00015 |
| 80 | 80.0000 | 80.0000 | 0.0000 | 0.00017 |
| 90 | 90.0001 | 90.0001 | 0.0000 | 0.00018 |
| 100 | 100.0000 | 100.0000 | 0.0000 | 0.00018 |
| 110 | 110.0000 | 110.0000 | 0.0000 | 0.00026 |
| 120 | 120.0000 | 120.0000 | 0.0000 | 0.00026 |

End of Report.



**Sartorius (Thailand) Co., Ltd.**
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8361-6 Fax: +66 2643-8367,

SARTORIUS

# Certificate of Calibration

Model Number : XP105DU
Description : Semi-micro Balance
Serial Number : 1123091884
ID No. BKK_EN0004
Manufacturer : Mettler Toledo

Certificate No. : 23BCI0071
Issued Date : Monday, February 13, 2023
Reference No. : 203245

Page No. : 2 of 3

## Calibration Results : Without Adjustment

### Repeatability

*The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.*

Nominal Value : (Low Load) 2 g
Tolerance N/A g

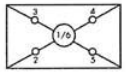
Nominal Value : (High Load) 20 g
Tolerance N/A g

| | |
|---|---|
| 2.00002 | 20.00002 |
| 2.00001 | 20.00001 |
| 2.00002 | 20.00001 |
| 2.00002 | 20.00001 |
| 2.00002 | 20.00000 |
| 2.00002 | 20.00000 |
| 2.00002 | 20.00001 |
| 2.00002 | 20.00000 |
| 2.00001 | 20.00000 |
| 2.00001 | 20.00001 |
| ***Standard Deviation*** 0.000005 | 0.000007 |

### Eccentricity (Off-center loading error)

*The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/3 or 1/4 of maximim capacity, placed in the middle of the weighing pan and between each of four additional measurement points ( positions defined according to OIML R76).*

Nominal value : 20 g
Tolerance N/A g




| | Difference |
|---|---|
| 1 | – |
| 2 | -0.00002 |
| 3 | -0.00004 |
| 4 | 0.00002 |
| 5 | 0.00003 |
| 6 | – |

### Linearity

*The linearity, also called linearity error. Describes the deviation of the characteristic curve of a weighing instrument from the linear slope.*

Tolerance N/A g

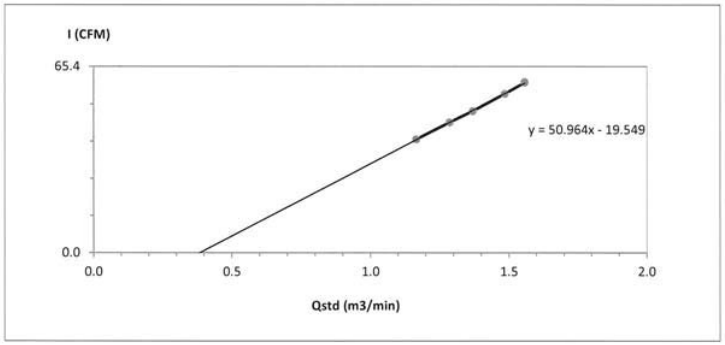
| Nominal Value (g) | Conventional Mass Value (g) | Displayed Value (g) | Deviation (g) | Uncertainty (g) |
|---|---|---|---|---|
| 0.1 | 0.10000 | 0.10000 | 0.00000 | 0.000022 |
| 0.5 | 0.50001 | 0.50000 | -0.00001 | 0.000023 |
| 1 | 1.00000 | 1.00000 | 0.00000 | 0.000024 |
| 2 | 2.00002 | 2.00001 | -0.00001 | 0.000026 |
| 5 | 5.00002 | 5.00002 | 0.00000 | 0.000030 |
| 10 | 10.00002 | 10.00002 | 0.00000 | 0.000035 |
| 15 | 15.00004 | 15.00004 | 0.00000 | 0.000053 |
| 20 | 20.00000 | 20.00000 | 0.00000 | 0.000053 |
| 25 | 25.00002 | 25.00002 | 0.00000 | 0.000089 |
| 30 | 30.00002 | 30.00004 | 0.00002 | 0.000089 |

MM-N12

## High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Akara Resources Public Co.,Ltd. | **Barometric Pressure (mm Hg) :** | 755 |
| **Calibrate Location :** | Ban Nong Ra Man | **Temperature ( °C) :** | 30 |
| **Calibrate Date :** | 21-Feb-23 | **High Volume ID :** | BKK_FS0373 |
| **CalibrationSheet No.:** | **C-210223-BKK_FS0373** | **High Volume Model :** | G1051 |
| **Calibrator ID:** | BKK_FS0624 | **High Volume S/N :** | 1330 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 1.64942 |
| **Calibrator S/N :** | 2584 | **Calibrator Intercept :** | -0.02902 |

| Test No. | Delta $H_2O$ (inch) | $Q_{std}$ ($m^3$/min) | I : Chart (CFM) | Linear Regression |
|---|---|---|---|---|
| 1 | 3.6 | 1.1660 | 40 | Slope : 50.9641 |
| 2 | 4.4 | 1.2861 | 46 | Intercept : -19.5493 |
| 3 | 5.0 | 1.3690 | 50 | Correlation Coefficient : 0.9998 |
| 4 | 5.9 | 1.4846 | 56 | |
| 5 | 6.5 | 1.5569 | 60 | |




Calibrated by _____ ( Mr.Teeravut Sukdee )
Field Scientist(1)

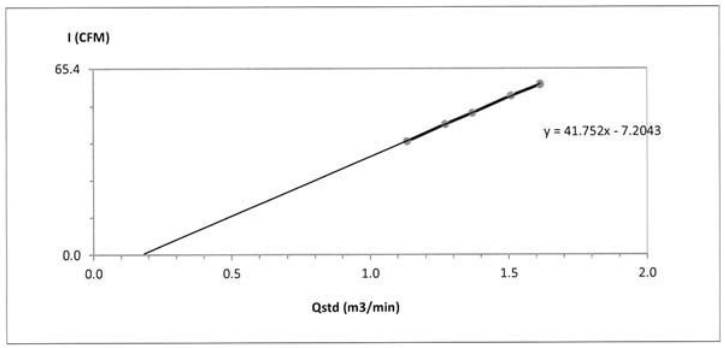
Approved by : _____ (Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-073 REVISION NO.: - ISSUE DATE: 14/03/16

## High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Akara Resources Public Co.,Ltd. | **Barometric Pressure (mm Hg) :** | 755 |
| **Calibrate Location :** | Ban Dong Long | **Temperature ( °C) :** | 30 |
| **Calibrate Date :** | 21-Feb-23 | **High Volume ID :** | BKK_FS0368 |
| **CalibrationSheet No.:** | **C-210223-BKK_FS0368** | **High Volume Model :** | TE-5009X |
| **Calibrator ID:** | BKK_FS0624 | **High Volume S/N :** | 4165 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 1.64942 |
| **Calibrator S/N :** | 2584 | **Calibrator Intercept :** | -0.02902 |

| Test No. | Delta $H_2O$ (inch) | $Q_{std}$ ($m^3$/min) | I : Chart (CFM) | Linear Regression |
|---|---|---|---|---|
| 1 | 3.4 | 1.1340 | 40 | Slope : 41.7523 |
| 2 | 4.3 | 1.2717 | 46 | Intercept : -7.2043 |
| 3 | 5.0 | 1.3690 | 50 | Correlation Coefficient : 0.9998 |
| 4 | 6.1 | 1.5091 | 56 | |
| 5 | 7.0 | 1.6145 | 60 | |




Calibrated by _____ ( Mr.Teeravut Sukdee )
Field Scientist(1)

Approved by : _____ (Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

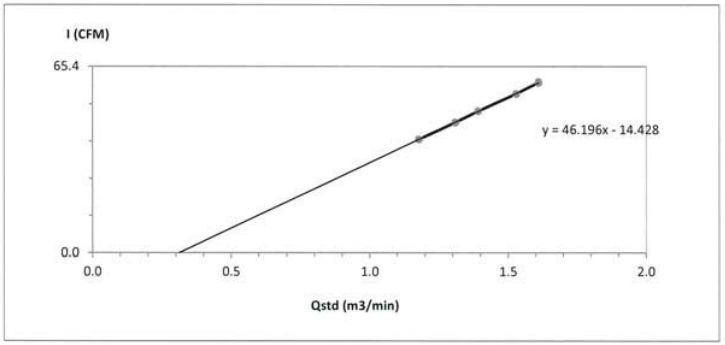
FORM NO.: F 06-073 REVISION NO.: - ISSUE DATE: 14/03/16

MM-N12

## High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Akara Resources Public Co.,Ltd. | **Barometric Pressure (mm Hg) :** | 755 |
| **Calibrate Location :** | Ban Khao Mor | **Temperature ( °C) :** | 32 |
| **Calibrate Date :** | 21-Feb-23 | **High Volume ID :** | BKK_FS1058 |
| **CalibrationSheet No.:** | **C-210223-BKK_FS1058** | **High Volume Model :** | TE-5009X |
| **Calibrator ID:** | BKK_FS0624 | **High Volume S/N :** | 5689 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 1.64942 |
| **Calibrator S/N :** | 2584 | **Calibrator Intercept :** | -0.02902 |

| Test No. | Delta $H_2O$ (inch) | $Q_{std}$ ($m^3$/min) | I : Chart (CFM) | Linear Regression | |
|---|---|---|---|---|---|
| 1 | 3.7 | 1.1779 | 40 | Slope : | 46.1960 |
| 2 | 4.6 | 1.3101 | 46 | Intercept : | -14.4282 |
| 3 | 5.2 | 1.3911 | 50 | Correlation Coefficient : | 0.9999 |
| 4 | 6.3 | 1.5282 | 56 | | |
| 5 | 7.0 | 1.6093 | 60 | | |




Calibrated by _____ ( Mr.Teeravut Sukdee )
Field Scientist(1)

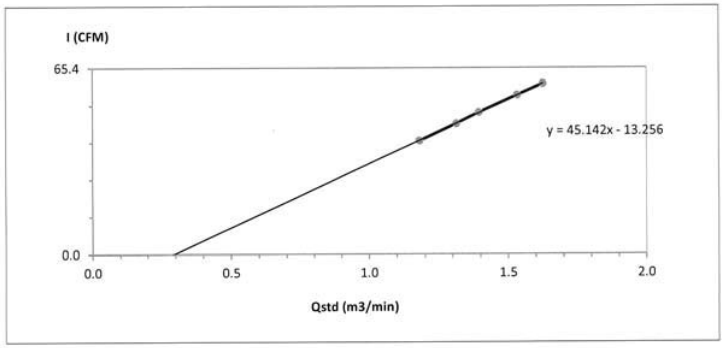
Approved by : _____ (Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-073 REVISION NO.: - ISSUE DATE: 14/03/16

## High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Akara Resources Public Co.,Ltd. | **Barometric Pressure (mm Hg) :** | 755 |
| **Calibrate Location :** | Ban Nong Sang | **Temperature ( °C) :** | 30 |
| **Calibrate Date :** | 21-Feb-23 | **High Volume ID :** | BKK_FS0360 |
| **CalibrationSheet No.:** | **C-210223-BKK_FS0360** | **High Volume Model :** | G1051 |
| **Calibrator ID:** | BKK_FS0624 | **High Volume S/N :** | 1331 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 1.64942 |
| **Calibrator S/N :** | 2584 | **Calibrator Intercept :** | -0.02902 |

| Test No. | Delta $H_2O$ (inch) | $Q_{std}$ ($m^3$/min) | I : Chart (CFM) | Linear Regression | |
|---|---|---|---|---|---|
| 1 | 3.7 | 1.1817 | 40 | Slope : | 45.1424 |
| 2 | 4.6 | 1.3143 | 46 | Intercept : | -13.2559 |
| 3 | 5.2 | 1.3956 | 50 | Correlation Coefficient : | 0.9998 |
| 4 | 6.3 | 1.5332 | 56 | | |
| 5 | 7.1 | 1.6258 | 60 | | |




Calibrated by _____ ( Mr.Teeravut Sukdee )
Field Scientist(1)

Approved by : _____ (Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

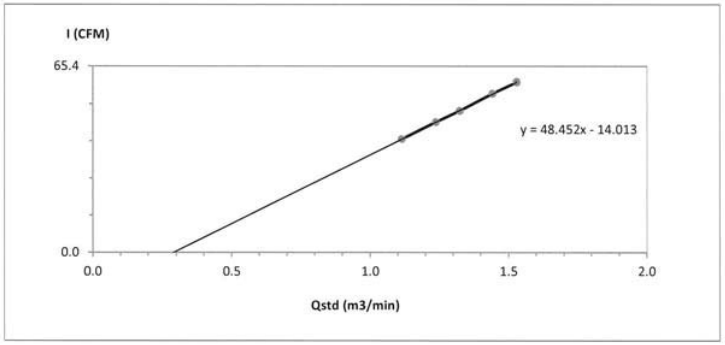
FORM NO.: F 06-073 REVISION NO.: - ISSUE DATE: 14/03/16

MM-N12

## High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Akara Resources Public Co.,Ltd. | **Barometric Pressure (mm Hg) :** | 755 |
| **Calibrate Location :** | Ban Tung Thong | **Temperature ( °C) :** | 32 |
| **Calibrate Date :** | 21-Feb-23 | **High Volume ID :** | BKK_FS0372 |
| **CalibrationSheet No.:** | **C-210223-BKK_FS0372** | **High Volume Model :** | TE-5009X |
| **Calibrator ID:** | BKK_FS0624 | **High Volume S/N :** | 5332 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 1.64942 |
| **Calibrator S/N :** | 2584 | **Calibrator Intercept :** | -0.02902 |

| Test No. | Delta $H_2O$ (inch) | $Q_{std}$ ($m^3$/min) | I : Chart (CFM) | Linear Regression |
|---|---|---|---|---|
| 1 | 3.3 | 1.1141 | 40 | Slope : 48.4517 |
| 2 | 4.1 | 1.2385 | 46 | Intercept : -14.0132 |
| 3 | 4.7 | 1.3239 | 50 | Correlation Coefficient : 0.9999 |
| 4 | 5.6 | 1.4425 | 56 | |
| 5 | 6.3 | 1.5282 | 60 | |




Calibrated by _____
( Mr.Teeravut Sukdee )
Field Scientist(1)

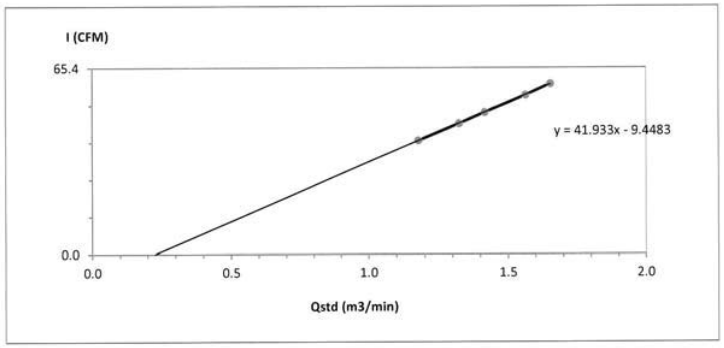
Approved by : _____
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-073 REVISION NO.: - ISSUE DATE: 14/03/16

## High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Akara Resources Public Co.,Ltd. | **Barometric Pressure (mm Hg) :** | 755 |
| **Calibrate Location :** | Ban Khao Kham | **Temperature ( °C) :** | 32 |
| **Calibrate Date :** | 3-Nov-22 | **High Volume ID :** | BKK_FS0369 |
| **CalibrationSheet No.:** | **C-031122-BKK_FS0369** | **High Volume Model :** | TE-5009X |
| **Calibrator ID:** | BKK_FS0624 | **High Volume S/N :** | 4166 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 1.64942 |
| **Calibrator S/N :** | 2584 | **Calibrator Intercept :** | -0.02902 |

| Test No. | Delta $H_2O$ (inch) | $Q_{std}$ ($m^3$/min) | I : Chart (CFM) | Linear Regression |
|---|---|---|---|---|
| 1 | 3.7 | 1.1779 | 40 | Slope : 41.9327 |
| 2 | 4.7 | 1.3239 | 46 | Intercept : -9.4483 |
| 3 | 5.4 | 1.4170 | 50 | Correlation Coefficient : 0.9999 |
| 4 | 6.6 | 1.5635 | 56 | |
| 5 | 7.4 | 1.6538 | 60 | |




Calibrated by _____
( Mr.Teeravut Sukdee )
Field Scientist(1)

Approved by : _____
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

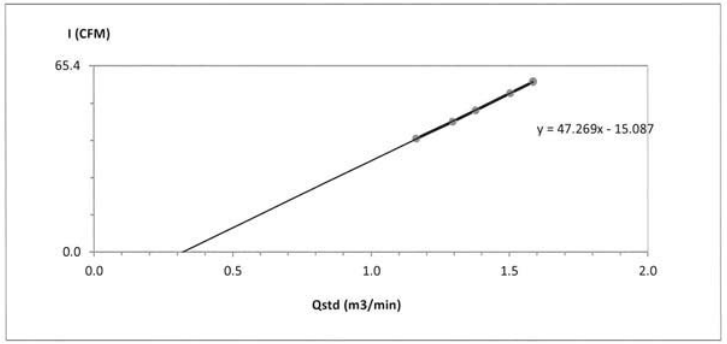
FORM NO.: F 06-073 REVISION NO.: - ISSUE DATE: 14/03/16

MM-N12

## High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Akara Resources Public Co.,Ltd. | **Barometric Pressure (mm Hg) :** | 755 |
| **Calibrate Location :** | Ban Klong Sai Yang Rong | **Temperature ( °C) :** | 32 |
| **Calibrate Date :** | 21-Feb-23 | **High Volume ID :** | BKK_FS0362 |
| **CalibrationSheet No.:** | **C-210223-BKK_FS0362** | **High Volume Model :** | G1051 |
| **Calibrator ID:** | BKK_FS0624 | **High Volume S/N :** | 1452 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 1.64942 |
| **Calibrator S/N :** | 2584 | **Calibrator Intercept :** | -0.02902 |

| Test No. | Delta $H_2O$ (inch) | $Q_{std}$ ($m^3$/min) | I : Chart (CFM) | Linear Regression | |
|---|---|---|---|---|---|
| 1 | 3.6 | 1.1623 | 40 | Slope : | 47.2689 |
| 2 | 4.5 | 1.2961 | 46 | Intercept : | -15.0874 |
| 3 | 5.1 | 1.3779 | 50 | Correlation Coefficient : | 0.9999 |
| 4 | 6.1 | 1.5042 | 56 | | |
| 5 | 6.8 | 1.5866 | 60 | | |




Calibrated by _____
( Mr.Teeravut Sukdee )
Field Scientist(1)

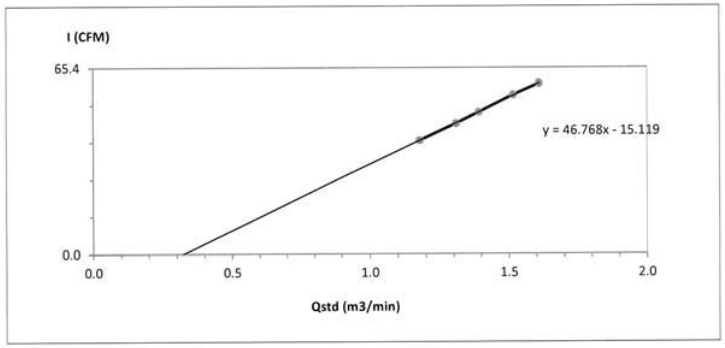
Approved by : _____
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-073 REVISION NO.: - ISSUE DATE: 14/03/16

## High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Akara Resources Public Co.,Ltd. | **Barometric Pressure (mm Hg) :** | 755 |
| **Calibrate Location :** | Ban Mai Klong Ta Lud | **Temperature ( °C) :** | 32 |
| **Calibrate Date :** | 21-Feb-23 | **High Volume ID :** | BKK_FS1056 |
| **CalibrationSheet No.:** | **C-210223-BKK_FS1056** | **High Volume Model :** | TE-5009X |
| **Calibrator ID:** | BKK_FS0624 | **High Volume S/N :** | 5499 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 1.64942 |
| **Calibrator S/N :** | 2584 | **Calibrator Intercept :** | -0.02902 |

| Test No. | Delta $H_2O$ (inch) | $Q_{std}$ ($m^3$/min) | I : Chart (CFM) | Linear Regression | |
|---|---|---|---|---|---|
| 1 | 3.7 | 1.1779 | 40 | Slope : | 46.7681 |
| 2 | 4.6 | 1.3101 | 46 | Intercept : | -15.1193 |
| 3 | 5.2 | 1.3911 | 50 | Correlation Coefficient : | 0.9998 |
| 4 | 6.2 | 1.5163 | 56 | | |
| 5 | 7.0 | 1.6093 | 60 | | |




Calibrated by _____
( Mr.Teeravut Sukdee )
Field Scientist(1)

Approved by : _____
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-073 REVISION NO.: - ISSUE DATE: 14/03/16

MM-N12

right solutions.
right partner.

รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

| Sample Name | Parameter | Equipment Name | ID No. | Calibrated Date | Next Cal | Freq. Calibrate (Months) |
|---|---|---|---|---|---|---|
| Noise | Leq 24 hrs | Sound Calibrator | BKK_FS0632 | 17-Jan-23 | 17-Jan-24 | 12 |
| Noise | Leq 24 hrs | Sound Level Meter | BKK_FS0103 | 13-Dec-22 | 13-Dec-23 | 12 |
| Noise | Leq 24 hrs | Sound Level Meter | BKK_FS0104 | 13-Dec-22 | 13-Dec-23 | 12 |
| Noise | Leq 24 hrs | Sound Level Meter | BKK_FS0108 | 19-Jan-23 | 19-Jan-24 | 12 |
| Noise | Leq 24 hrs | Sound Level Meter | BKK_FS0110 | 3-Jan-23 | 3-Jan-24 | 12 |
| Noise | Leq 24 hrs | Sound Level Meter | BKK_FS0115 | 3-Jan-23 | 3-Jan-24 | 12 |
| Noise | Leq 24 hrs | Sound Level Meter | BKK_FS0116 | 3-Jan-23 | 3-Jan-24 | 12 |
| Noise | Leq 24 hrs | Sound Level Meter | BKK_FS0117 | 3-Jan-23 | 3-Jan-24 | 12 |
| Noise | Leq 24 hrs | Sound Level Meter | BKK_FS0877 | 25-Oct-22 | 25-Oct-23 | 12 |
| Noise | Leq 24 hrs | Sound Level Meter | BKK_FS0922 | 19-Jan-23 | 19-Jan-24 | 12 |

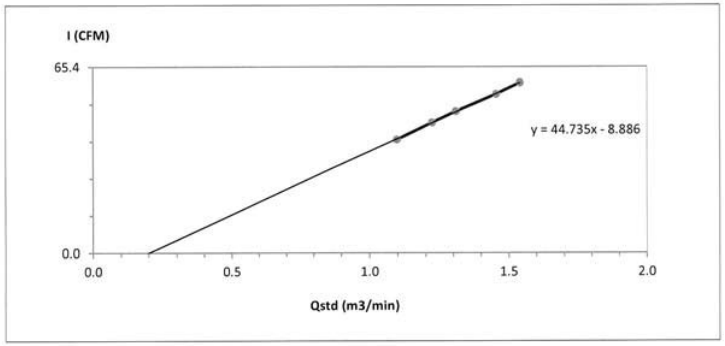




## High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Akara Resources Public Co.,Ltd. | **Barometric Pressure (mm Hg) :** | 755 |
| **Calibrate Location :** | Ban Long Du | **Temperature ( °C) :** | 32 |
| **Calibrate Date :** | 21-Feb-23 | **High Volume ID :** | BKK_FS1059 |
| **CalibrationSheet No.:** | C-210223-BKK_FS1059 | **High Volume Model :** | TE-5009X |
| **Calibrator ID:** | BKK_FS0624 | **High Volume S/N :** | 5693 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 1.64942 |
| **Calibrator S/N :** | 2584 | **Calibrator Intercept :** | -0.02902 |

| Test No. | Delta $H_2O$ (inch) | $Q_{std}$ ($m^3$/min) | I : Chart (CFM) | Linear Regression |
|---|---|---|---|---|
| 1 | 3.2 | 1.0975 | 40 | Slope : 44.7353 |
| 2 | 4.0 | 1.2236 | 46 | Intercept : -8.8860 |
| 3 | 4.6 | 1.3101 | 50 | Correlation Coefficient : 0.9996 |
| 4 | 5.7 | 1.4550 | 56 | |
| 5 | 6.4 | 1.5401 | 60 | |




Calibrated by _____
( Mr.Teeravut Sukdee )
Field Scientist(1)

Approved by : _____
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-073 REVISION NO.: - ISSUE DATE: 14/03/16

SITHIPORN associates

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACC23006
Job No. : VC66AC0024
Pages : 2 of 3

**Calibration Procedure :** CP-AC-03

**Calibration Method :**

This equipment was calibrated by based on IEC-60942-2003 Standard.

The sound pressure level, frequency and total distortion of the sound calibrator was measured using the reference microphone.

**Condition of this result of calibration :**

1. Reference Standard Instruments :

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|---|---|---|---|---|
| Waveform Generator | 33511B | MY52302742 | EF-0008-22 | 04-Feb-23 |
| Digital Multimeter | 33461A | MY53220104 | EEL.BP. 04/0265 | 09-Feb-23 |
| Digital Multimeter | 33461A | MY53220076 | EEL.BP. 03/0265 | 09-Feb-23 |
| Digital Multimeter | 33461A | MY60024273 | EEL.BP. 05/0265 | 09-Feb-23 |
| Programmable Attenuator | MAT-1070 | 62100114 | EF-0009-22 | 07-Feb-23 |
| Condenser Microphone | 4180 | 2977900 | AA-1013-22 | 24-Feb-23 |
| Measuring Amplifier | NA-42KAI | 34560495 | AA-3005-22 | 22-Feb-23 |
| Audio Analyzer | AVR-3360A | V744B6069 | EF-0010-22 | 07-Feb-23 |

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 National Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).



T. Petch.



SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

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NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : ACC23006
Pages : 1 of 3

# Calibration Certificate

**Equipment :** SOUND CALIBRATOR
**Manufacturer :** RION
**Model :** NC-74
**Serial No.:** 34178119
**ID No.:** BKK_FS0632

**Condition As Found :** GOOD

**Customer :** ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

**Location :** -
**Ambient Temperature :** ( 23.0 ± 3 ) °C
**Pressure :** ( 101.3 ± 3 ) kPa
**Relative Humidity :** ( 50.0 ± 20 ) %

REVIEW BY Nwakorn P
APPROVED BY
NEXT CAL. DATE 17/1/24

**Received Date :** 06 JANUARY 2023
**Calibration Date :** 17 JANUARY 2023
**Date of Issue :** 19 JANUARY 2023

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :** T. Petch.
( Thanakul Petchurai )

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MM-N12

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# CALIBRATION LABORATORY

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NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : ACL22288
Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER
**Manufacturer :** RION
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24
**Serial No.:** 00858513 / 158763 / 58765
**ID No.:** BKK_FS0103

**Condition As Found :** GOOD

**Customer :** ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

**Location :** -
**Ambient Temperature :** ( 23.0 ± 3 ) °C
**Pressure :** ( 101.3 ± 3 ) kPa
**Relative Humidity :** ( 50.0 ± 20 ) %

REVIEW BY Nanakorn P.
APPROVED BY
NEXT CAL. DATE 13/12/23

**Received Date :** 30 NOVEMBER 2022
**Calibration Date :** 13-16 DECEMBER 2022
**Date of Issue :** 19 DECEMBER 2022

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :** T. Petch.
( Thanakul Petchurai )

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





Cert. No. : ACC23006
Job No. : VC66AC0024
Pages : 3 of 3

**Result of calibration :**

**1. Sound pressure level**

| Specified sound pressure level (dB) | Measured value (dB) | Deviated value (dB) | Uncertainty (dB) | Tolerance limit (dB) |
|---|---|---|---|---|
| 94 | 93.93 | -0.07 | 0.14 | 0.40 |

**2. Frequency**

| Specified Frequency (Hz) | Measured value (Hz) | Deviated value ( % ) | Uncertainty ( % ) | Tolerance limit ( % ) |
|---|---|---|---|---|
| 1000 | 1001.0 | 0.1 | 0.1 | 1.0 |

**3. Total distortion**

| Measured value ( % ) | Uncertainty ( % ) | Tolerance limit ( % ) |
|---|---|---|
| 1.71 | 0.10 | 3.0 |

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation,providing a lavel of confidence of approximately 95 %

**End of Calibration Certificate**



T. Petch.

**Summary of Measurement Result :**

| Parameter | Pass | Fail | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|---|---|---|---|---|
| 1. Absolute sensitivity | ✓ | - | 0.2 | N/A |
| 2. Self-generated noise | ✓ | - | 0.2 | N/A |
| 3. Acoustical signal tests of frequency weightings | | | | |
| 125 Hz | ✓ | - | 0.3 | 0.6 |
| 1000 Hz | ✓ | - | 0.3 | 0.6 |
| 8000 Hz | ✓ | - | 0.3 | 0.7 |
| 4. Electrical signal tests of frequency weightings | | | | |
| For 10 Hz to 4 kHz | ✓ | - | 0.3 | 0.6 |
| For > 4 kHz to 10 kHz | ✓ | - | 0.3 | 0.7 |
| For > 10 kHz to 20 kHz | - | - | - | 1.0 |
| 5. Frequency and time weightings at 1 kHz | ✓ | - | 0.2 | 0.2 |
| 6. Long - term stability | ✓ | - | 0.1 | 0.1 |
| 7. Level linearity on the reference level range | ✓ | - | 0.2 | 0.3 |
| 8. Level linearity including the level range control | ✓ | - | 0.2 | 0.3 |
| 9. Tone burst response | ✓ | - | 0.2 | 0.3 |
| 10. Peak C sound level | ✓ | - | 0.2 | 0.35 |
| 11. Overload indication | ✓ | - | 0.2 | 0.25 |
| 12. High level stability | ✓ | - | 0.1 | 0.1 |



T. Petch.



**Calibration Procedure :** CP-AC-01

**Calibration Method :**

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.
For tests results of each items were made by observation of each Instruments display and also with SLM's display.

**Condition of this result of calibration :**

1. Reference Standard Instruments :

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|---|---|---|---|---|
| Waveform Generator | 33210A | MY48017076 | EF-0007-22 | 04-Feb-23 |
| Waveform Generator | 33511B | MY52302742 | EF-0008-22 | 04-Feb-23 |
| Digital Multimeter | 33461A | MY53220104 | EEL.BP. 04/0265 | 09-Feb-23 |
| Digital Multimeter | 33461A | MY53220076 | EEL.BP. 03/0265 | 09-Feb-23 |
| Digital Multimeter | 34461A | MY60024273 | EEL.BP. 05/0265 | 09-Feb-23 |
| Programmable Attenuator | MAT-1070 | 62100114 | EF-0009-22 | 07-Feb-23 |
| Condenser Microphone | 4180 | 2977900 | AA-1013-22 | 24-Feb-23 |
| Measuring Amplifier | NA-42KAI | 34560495 | AA-3005-22 | 22-Feb-23 |

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 National Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).



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**4. Electrical signal tests of frequency weightings**

Weighting network response with relative to 1 kHz.

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|---|---|---|---|---|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 63 | -0.1 | -0.1 | -0.1 | ±2.0 |
| 125 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 250 | 0.0 | 0.0 | -0.1 | ±1.5 |
| 500 | 0.0 | 0.0 | -0.1 | ±1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 2000 | 0.0 | 0.0 | 0.0 | ±2.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±3.0 |
| 8000 | 0.0 | 0.1 | 0.1 | ±5.0 |

**5. Frequency and time weightings at 1 kHz**

5.1 Frequency weightings at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|
| A - weight | 94.0 | 0.0 | - |
| C - weight | 94.0 | 0.0 | ± 0.2 |
| Flat | 94.0 | 0.0 | ± 0.2 |

5.2 Time weighting at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|
| Fast | 94.0 | 0.0 | - |
| Slow | 94.0 | 0.0 | ± 0.1 |
| Leq | 94.0 | 0.0 | ± 0.1 |

**6. Long - term stability**

| Frequency Weighting | SLM Display at initial (dB) | SLM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|---|
| A - weight | 94.0 | 94.0 | 0.0 | ± 0.3 |



T. Petch.



**Result of calibration :**

**1. Absolute sensitivity**

| Reference Acoustic Signal (dB) | Measured Value (dB) | Deviation (dB) | Acceptance Limit (dB) |
|---|---|---|---|
| 93.9 (93.95) | 93.9 | 0.0 | ±0.3 |

**2. Self-generated noise**

2.1 Normal test

| Measured Value (dB) |
|---|
| 14.8 |

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

| Frequency Weighting | Measured value (dB) |
|---|---|
| A - weight | 11.6 |
| C - weight | 18.1 |
| Flat | 23.5 |

**3. Acoustical signal tests of frequency weightings**

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

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|---|---|---|---|---|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 125 | 0.7 | 0.7 | 0.8 | ± 1.5 |
| 1000 | 0.1 | 0.1 | 0.1 | ± 1.0 |
| 8000 | -2.3 | -2.2 | -2.2 | ±5.0 |



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**8. Level linearity including the level range control**

| Range | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| Auto | 94.0 | 94.0 | 0.0 | ±1.1 |

**9. Tone burst response**

| Time Weighting | Tone burst duration, Tb ( ms ) | Cycle | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|---|---|
| Fast | 0.25 | 1 | 108.0 | 107.9 | -0.1 | 1.5 ; -5.0 |
| | 2 | 8 | 117.0 | 117.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 134.0 | 134.0 | 0.0 | ±1.0 |
| Slow | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.5 ; -5.0 |
| | 200 | 800 | 127.6 | 127.6 | 0.0 | ±1.0 |
| SEL | 0.25 | 1 | 99.0 | 98.9 | -0.1 | 1.5 ; -5.0 |
| | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 128.0 | 128.0 | 0.0 | ±1.0 |

**10. Peak C sound level**

| Number of cycle in test signal | Anticipated Value ( dB ) | Measured Value, Lcpeak ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| One | 136.4 | 135.8 | -0.6 | ±3.0 |

| Number of cycle in test signal | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| Positive half cycle | 135.4 | 135.1 | -0.3 | ±2.0 |
| Negative half cycle | 135.4 | 135.1 | -0.3 | ±2.0 |



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**7. Level linearity on the reference level range**

| Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|
| 137.0 | 137.0 | 0.0 | ± 1.1 |
| 136.0 | 136.0 | 0.0 | ± 1.1 |
| 135.0 | 135.0 | 0.0 | ± 1.1 |
| 134.0 | 134.0 | 0.0 | ± 1.1 |
| 133.0 | 133.0 | 0.0 | ± 1.1 |
| 132.0 | 132.0 | 0.0 | ± 1.1 |
| 131.0 | 131.0 | 0.0 | ± 1.1 |
| 129.0 | 129.0 | 0.0 | ± 1.1 |
| 124.0 | 124.0 | 0.0 | ± 1.1 |
| 119.0 | 119.0 | 0.0 | ± 1.1 |
| 114.0 | 114.0 | 0.0 | ± 1.1 |
| 109.0 | 109.0 | 0.0 | ± 1.1 |
| 104.0 | 104.0 | 0.0 | ± 1.1 |
| 99.0 | 99.0 | 0.0 | ± 1.1 |
| 94.0 | 94.0 | 0.0 | ± 1.1 |
| 89.0 | 89.0 | 0.0 | ± 1.1 |
| 84.0 | 84.0 | 0.0 | ± 1.1 |
| 79.0 | 79.0 | 0.0 | ± 1.1 |
| 74.0 | 74.1 | 0.1 | ± 1.1 |
| 69.0 | 69.0 | 0.0 | ± 1.1 |
| 64.0 | 64.0 | 0.0 | ± 1.1 |
| 59.0 | 59.0 | 0.0 | ± 1.1 |
| 54.0 | 54.0 | 0.0 | ± 1.1 |
| 49.0 | 49.0 | 0.0 | ± 1.1 |
| 44.0 | 44.0 | 0.0 | ± 1.1 |
| 39.0 | 39.0 | 0.0 | ± 1.1 |
| 34.0 | 34.0 | 0.0 | ± 1.1 |
| 30.0 | 30.0 | 0.0 | ± 1.1 |
| 29.0 | 29.0 | 0.0 | ± 1.1 |
| 28.0 | 28.0 | 0.0 | ± 1.1 |
| 27.0 | 26.9 | -0.1 | ± 1.1 |
| 26.0 | 25.9 | -0.1 | ± 1.1 |
| 25.0 | 24.9 | -0.1 | ± 1.1 |



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NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : ACL22289
Pages : 1 of 8

# Calibration Certificate

**Equipment :** SOUND LEVEL METER
**Manufacturer :** RION
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24
**Serial No.:** 00858514 / 158764 / 58766
**ID No.:** BKK_FS0104

**Condition As Found :** GOOD

**Customer :** ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

**Location :** -
**Ambient Temperature :** ( 23.0 ± 3 ) °C
**Pressure :** ( 101.3 ± 3 ) kPa
**Relative Humidity :** ( 50.0 ± 20 ) %

REVIEW BY Nattakorn P.
APPROVED BY
NEXT CAL. DATE 13/12/23

**Received Date :** 30 NOVEMBER 2022
**Calibration Date :** 13-16 DECEMBER 2022
**Date of Issue :** 19 DECEMBER 2022

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :** T. Petch.
( Thanakul Petchurai )

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





**11. Overload indication**

| Measured value ( dB ) | | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|
| Positive one-half cycle | Negative one-half cycle | | |
| 89.5 | 89.5 | 0.0 | ±1.5 |

**12. High level stability**

| Frequency Weighting | SLM Display at initial ( dB ) | SLM Display at final ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| A - weight | 137.0 | 137.0 | 0.0 | ±0.3 |

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation,providing a lavel of confidence of approximately 95 %

**End of Calibration Certificate**



T. Petch

**Summary of Measurement Result :**

| Parameter | Pass | Fail | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|---|---|---|---|---|
| 1. Absolute sensitivity | ✓ | - | 0.2 | N/A |
| 2. Self-generated noise | ✓ | - | 0.2 | N/A |
| 3. Acoustical signal tests of frequency weightings | | | | |
| 125 Hz | ✓ | - | 0.3 | 0.6 |
| 1000 Hz | ✓ | - | 0.3 | 0.6 |
| 8000 Hz | ✓ | - | 0.3 | 0.7 |
| 4. Electrical signal tests of frequency weightings | | | | |
| For 10 Hz to 4 kHz | ✓ | - | 0.3 | 0.6 |
| For > 4 kHz to 10 kHz | ✓ | - | 0.3 | 0.7 |
| For > 10 kHz to 20 kHz | - | - | - | 1.0 |
| 5. Frequency and time weightings at 1 kHz | ✓ | - | 0.2 | 0.2 |
| 6. Long - term stability | ✓ | - | 0.1 | 0.1 |
| 7. Level linearity on the reference level range | ✓ | - | 0.2 | 0.3 |
| 8. Level linearity including the level range control | ✓ | - | 0.2 | 0.3 |
| 9. Tone burst response | ✓ | - | 0.2 | 0.3 |
| 10. Peak C sound level | ✓ | - | 0.2 | 0.35 |
| 11. Overload indication | ✓ | - | 0.2 | 0.25 |
| 12. High level stability | ✓ | - | 0.1 | 0.1 |





**Calibration Procedure :** CP-AC-01

**Calibration Method :**

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).

The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

For tests results of each items were made by observation of each Instruments display and also with SLM's display.

**Condition of this result of calibration :**

1. Reference Standard Instruments :

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|---|---|---|---|---|
| Waveform Generator | 33210A | MY48017076 | EF-0007-22 | 04-Feb-23 |
| Waveform Generator | 33511B | MY52302742 | EF-0008-22 | 04-Feb-23 |
| Digital Multimeter | 33461A | MY53220104 | EEL.BP. 04/0265 | 09-Feb-23 |
| Digital Multimeter | 33461A | MY53220076 | EEL.BP. 03/0265 | 09-Feb-23 |
| Digital Multimeter | 34461A | MY60024273 | EEL.BP. 05/0265 | 09-Feb-23 |
| Programmable Attenuator | MAT-1070 | 62100114 | EF-0009-22 | 07-Feb-23 |
| Condenser Microphone | 4180 | 2977900 | AA-1013-22 | 24-Feb-23 |
| Measuring Amplifier | NA-42KAI | 34560495 | AA-3005-22 | 22-Feb-23 |

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 National Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).

**4. Electrical signal tests of frequency weightings**

Weighting network response with relative to 1 kHz.

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|---|---|---|---|---|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 63 | -0.1 | -0.1 | -0.1 | ±2.0 |
| 125 | -0.1 | 0.0 | 0.0 | ±1.5 |
| 250 | 0.0 | -0.1 | -0.1 | ±1.5 |
| 500 | 0.0 | 0.0 | -0.1 | ±1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 2000 | 0.0 | 0.0 | 0.0 | ±2.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±3.0 |
| 8000 | 0.0 | 0.0 | 0.0 | ±5.0 |

**5. Frequency and time weightings at 1 kHz**

5.1 Frequency weightings at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|
| A - weight | 94.0 | 0.0 | - |
| C - weight | 94.0 | 0.0 | ± 0.2 |
| Flat | 94.0 | 0.0 | ± 0.2 |

5.2 Time weighting at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|
| Fast | 94.0 | 0.0 | - |
| Slow | 94.0 | 0.0 | ± 0.1 |
| Leq | 94.0 | 0.0 | ± 0.1 |

**6. Long - term stability**

| Frequency Weighting | SLM Display at initial (dB) | SLM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|---|
| A - weight | 94.0 | 94.0 | 0.0 | ± 0.3 |



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Continuation of Calibration Certificate



**Result of calibration :**

**1. Absolute sensitivity**

| Reference Acoustic Signal (dB) | Measured Value (dB) | Deviation (dB) | Acceptance Limit (dB) |
|---|---|---|---|
| 93.9 (93.95) | 93.9 | 0.0 | ±0.3 |

**2. Self-generated noise**

2.1 Normal test

| Measured Value (dB) |
|---|
| 13.8 |

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

| Frequency Weighting | Measured value (dB) |
|---|---|
| A - weight | 9.9 |
| C - weight | 16.4 |
| Flat | 22.4 |

**3. Acoustical signal tests of frequency weightings**

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

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|---|---|---|---|---|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 125 | 0.7 | 0.7 | 0.7 | ± 1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ± 1.0 |
| 8000 | -3.2 | -3.3 | -3.2 | ±5.0 |



T. Petch.

**8. Level linearity including the level range control**

| Range | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| Auto | 94.0 | 94.0 | 0.0 | ±1.1 |

**9. Tone burst response**

| Time Weighting | Tone burst duration, Tb ( ms ) | Cycle | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|---|---|
| Fast | 0.25 | 1 | 108.0 | 107.9 | -0.1 | 1.5 ; -5.0 |
| | 2 | 8 | 117.0 | 117.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 134.0 | 134.0 | 0.0 | ±1.0 |
| Slow | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.5 ; -5.0 |
| | 200 | 800 | 127.6 | 127.6 | 0.0 | ±1.0 |
| SEL | 0.25 | 1 | 99.0 | 98.9 | -0.1 | 1.5 ; -5.0 |
| | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 128.0 | 128.0 | 0.0 | ±1.0 |

**10. Peak C sound level**

| Number of cycle in test signal | Anticipated Value ( dB ) | Measured Value, Lcpeak ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| One | 136.4 | 135.4 | -1.0 | ±3.0 |

| Number of cycle in test signal | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| Positive half cycle | 135.4 | 135.1 | -0.3 | ±2.0 |
| Negative half cycle | 135.4 | 135.1 | -0.3 | ±2.0 |





**7. Level linearity on the reference level range**

| Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|
| 137.0 | 137.0 | 0.0 | ± 1.1 |
| 136.0 | 136.0 | 0.0 | ± 1.1 |
| 135.0 | 135.0 | 0.0 | ± 1.1 |
| 134.0 | 134.0 | 0.0 | ± 1.1 |
| 133.0 | 132.9 | -0.1 | ± 1.1 |
| 132.0 | 131.9 | -0.1 | ± 1.1 |
| 131.0 | 130.9 | -0.1 | ± 1.1 |
| 129.0 | 128.9 | -0.1 | ± 1.1 |
| 124.0 | 123.9 | -0.1 | ± 1.1 |
| 119.0 | 119.0 | 0.0 | ± 1.1 |
| 114.0 | 114.0 | 0.0 | ± 1.1 |
| 109.0 | 109.0 | 0.0 | ± 1.1 |
| 104.0 | 104.0 | 0.0 | ± 1.1 |
| 99.0 | 99.0 | 0.0 | ± 1.1 |
| 94.0 | 94.0 | 0.0 | ± 1.1 |
| 89.0 | 89.0 | 0.0 | ± 1.1 |
| 84.0 | 84.0 | 0.0 | ± 1.1 |
| 79.0 | 79.0 | 0.0 | ± 1.1 |
| 74.0 | 74.0 | 0.0 | ± 1.1 |
| 69.0 | 69.0 | 0.0 | ± 1.1 |
| 64.0 | 64.0 | 0.0 | ± 1.1 |
| 59.0 | 59.0 | 0.0 | ± 1.1 |
| 54.0 | 54.0 | 0.0 | ± 1.1 |
| 49.0 | 49.0 | 0.0 | ± 1.1 |
| 44.0 | 44.0 | 0.0 | ± 1.1 |
| 39.0 | 39.0 | 0.0 | ± 1.1 |
| 34.0 | 34.0 | 0.0 | ± 1.1 |
| 30.0 | 29.9 | -0.1 | ± 1.1 |
| 29.0 | 28.9 | -0.1 | ± 1.1 |
| 28.0 | 28.0 | 0.0 | ± 1.1 |
| 27.0 | 26.9 | -0.1 | ± 1.1 |
| 26.0 | 25.9 | -0.1 | ± 1.1 |
| 25.0 | 24.9 | -0.1 | ± 1.1 |

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NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : ACL23056
Pages : 1 of 8

# Calibration Certificate

**Equipment :** SOUND LEVEL METER
**Manufacturer :** RION
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24
**Serial No.:** 00858518 / 158769 / 58770
**ID No.:** BKK_FS0108

**Condition As Found :** GOOD

**Customer :** ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

**Location :** -
**Ambient Temperature :** ( 23.0 ± 3 ) °C
**Pressure :** ( 101.3 ± 3 ) kPa
**Relative Humidity :** ( 50.0 ± 20 ) %

REVIEW BY Nanlomi P.
APPROVED BY
NEXT CAL. DATE 19/1/24

**Received Date :** 17 JANUARY 2023
**Calibration Date :** 19-20 JANUARY 2023
**Date of Issue :** 23 JANUARY 2023

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :** T. Petch.
( Thanakul Petchurai )

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



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CALIBRATION LABORATORY
Continuation of Calibration Certificate

Cert. No. : ACL22289
Job No. : VC66AC0015
Pages : 8 of 8

**11. Overload indication**

| Measured value ( dB ) | | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|
| Positive one-half cycle | Negative one-half cycle | | |
| 89.6 | 89.5 | -0.1 | ±1.5 |

**12. High level stability**

| Frequency Weighting | SLM Display at initial ( dB ) | SLM Display at final ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| A - weight | 137.0 | 137.0 | 0.0 | ±0.3 |

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation,providing a lavel of confidence of approximately 95 %

**End of Calibration Certificate**



T. Petch.

**Summary of Measurement Result :**

| Parameter | Pass | Fail | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|---|---|---|---|---|
| 1. Absolute sensitivity | ✓ | - | 0.2 | N/A |
| 2. Self-generated noise | ✓ | - | 0.2 | N/A |
| 3. Acoustical signal tests of frequency weightings | | | | |
| 125 Hz | ✓ | - | 0.3 | 0.6 |
| 1000 Hz | ✓ | - | 0.3 | 0.6 |
| 8000 Hz | ✓ | - | 0.3 | 0.7 |
| 4. Electrical signal tests of frequency weightings | | | | |
| For 10 Hz to 4 kHz | ✓ | - | 0.3 | 0.6 |
| For > 4 kHz to 10 kHz | ✓ | - | 0.3 | 0.7 |
| For > 10 kHz to 20 kHz | - | - | - | 1.0 |
| 5. Frequency and time weightings at 1 kHz | ✓ | - | 0.2 | 0.2 |
| 6. Long - term stability | ✓ | - | 0.1 | 0.1 |
| 7. Level linearity on the reference level range | ✓ | - | 0.2 | 0.3 |
| 8. Level linearity including the level range control | ✓ | - | 0.2 | 0.3 |
| 9. Tone burst response | ✓ | - | 0.2 | 0.3 |
| 10. Peak C sound level | ✓ | - | 0.2 | 0.35 |
| 11. Overload indication | ✓ | - | 0.2 | 0.25 |
| 12. High level stability | ✓ | - | 0.1 | 0.1 |



T. Petch.



**Calibration Procedure :** CP-AC-01

**Calibration Method :**

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).

The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

For tests results of each items were made by observation of each Instruments display and also with SLM's display.

**Condition of this result of calibration :**

1. Reference Standard Instruments :

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|---|---|---|---|---|
| Waveform Generator | 33210A | MY48017076 | EF-0007-22 | 04-Feb-23 |
| Waveform Generator | 33511B | MY52302742 | EF-0008-22 | 04-Feb-23 |
| Digital Multimeter | 33461A | MY53220104 | EEL.BP. 04/0265 | 09-Feb-23 |
| Digital Multimeter | 33461A | MY53220076 | EEL.BP. 03/0265 | 09-Feb-23 |
| Digital Multimeter | 34461A | MY60024273 | EEL.BP. 05/0265 | 09-Feb-23 |
| Programmable Attenuator | MAT-1070 | 62100114 | EF-0009-22 | 07-Feb-23 |
| Condenser Microphone | 4180 | 2977900 | AA-1013-22 | 24-Feb-23 |
| Measuring Amplifier | NA-42KAI | 34560495 | AA-3005-22 | 22-Feb-23 |

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 National Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).



T. Petch.

**4. Electrical signal tests of frequency weightings**

Weighting network response with relative to 1 kHz.

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|---|---|---|---|---|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 63 | 0.0 | 0.0 | 0.0 | ±2.0 |
| 125 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 250 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 500 | 0.0 | 0.1 | 0.0 | ±1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 2000 | 0.0 | 0.1 | 0.0 | ±2.0 |
| 4000 | 0.0 | 0.1 | 0.0 | ±3.0 |
| 8000 | 0.0 | 0.1 | 0.1 | ±5.0 |

**5. Frequency and time weightings at 1 kHz**

5.1 Frequency weightings at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|
| A - weight | 94.0 | 0.0 | - |
| C - weight | 94.0 | 0.0 | ± 0.2 |
| Flat | 94.0 | 0.0 | ± 0.2 |

5.2 Time weighting at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|
| Fast | 94.0 | 0.0 | - |
| Slow | 94.0 | 0.0 | ± 0.1 |
| Leq | 94.0 | 0.0 | ± 0.1 |

**6. Long - term stability**

| Frequency Weighting | SLM Display at initial (dB) | SLM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|---|
| A - weight | 94.0 | 94.1 | 0.1 | ± 0.3 |



T. Petch.



**Result of calibration :**

**1. Absolute sensitivity**

| Reference Acoustic Signal (dB) | Measured Value (dB) | Deviation (dB) | Acceptance Limit (dB) |
|---|---|---|---|
| 93.9 (93.95) | 93.9 | 0.0 | ±0.3 |

**2. Self-generated noise**

2.1 Normal test

| Measured Value (dB) |
|---|
| 17.2 |

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

| Frequency Weighting | Measured value (dB) |
|---|---|
| A - weight | 14.8 |
| C - weight | 20.8 |
| Flat | 26.6 |

**3. Acoustical signal tests of frequency weightings**

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

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|---|---|---|---|---|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 125 | 0.2 | 0.3 | 0.3 | ± 1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ± 1.0 |
| 8000 | -0.8 | -0.7 | -0.7 | ±5.0 |



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**8. Level linearity including the level range control**

| Range | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| Auto | 94.0 | 94.0 | 0.0 | ±1.1 |

**9. Tone burst response**

| Time Weighting | Tone burst duration, Tb ( ms ) | Cycle | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|---|---|
| Fast | 0.25 | 1 | 108.0 | 108.0 | 0.0 | 1.5 ; -5.0 |
| | 2 | 8 | 117.0 | 117.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 134.0 | 134.1 | 0.1 | ±1.0 |
| Slow | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.5 ; -5.0 |
| | 200 | 800 | 127.6 | 127.6 | 0.0 | ±1.0 |
| SEL | 0.25 | 1 | 99.0 | 98.9 | -0.1 | 1.5 ; -5.0 |
| | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 128.0 | 128.1 | 0.1 | ±1.0 |

**10. Peak C sound level**

| Number of cycle in test signal | Anticipated Value ( dB ) | Measured Value, Lcpeak ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| One | 136.4 | 136.2 | -0.2 | ±3.0 |

| Number of cycle in test signal | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| Continuous | 133.0 | 132.9 | -0.1 | - |
| Positive half cycle | 135.4 | 135.1 | -0.3 | ±2.0 |
| Negative half cycle | 135.4 | 135.1 | -0.3 | ±2.0 |



T. Petch.



**7. Level linearity on the reference level range**

| Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|
| 137.0 | 137.0 | 0.0 | ± 1.1 |
| 136.0 | 136.0 | 0.0 | ± 1.1 |
| 135.0 | 135.0 | 0.0 | ± 1.1 |
| 134.0 | 134.0 | 0.0 | ± 1.1 |
| 133.0 | 133.0 | 0.0 | ± 1.1 |
| 132.0 | 132.0 | 0.0 | ± 1.1 |
| 131.0 | 131.0 | 0.0 | ± 1.1 |
| 129.0 | 129.0 | 0.0 | ± 1.1 |
| 124.0 | 124.0 | 0.0 | ± 1.1 |
| 119.0 | 119.1 | 0.1 | ± 1.1 |
| 114.0 | 114.0 | 0.0 | ± 1.1 |
| 109.0 | 109.0 | 0.0 | ± 1.1 |
| 104.0 | 104.0 | 0.0 | ± 1.1 |
| 99.0 | 99.0 | 0.0 | ± 1.1 |
| 94.0 | 94.0 | 0.0 | ± 1.1 |
| 89.0 | 89.0 | 0.0 | ± 1.1 |
| 84.0 | 84.0 | 0.0 | ± 1.1 |
| 79.0 | 79.0 | 0.0 | ± 1.1 |
| 74.0 | 74.0 | 0.0 | ± 1.1 |
| 69.0 | 69.0 | 0.0 | ± 1.1 |
| 64.0 | 64.0 | 0.0 | ± 1.1 |
| 59.0 | 59.0 | 0.0 | ± 1.1 |
| 54.0 | 54.0 | 0.0 | ± 1.1 |
| 49.0 | 49.0 | 0.0 | ± 1.1 |
| 44.0 | 44.0 | 0.0 | ± 1.1 |
| 39.0 | 38.9 | -0.1 | ± 1.1 |
| 34.0 | 33.9 | -0.1 | ± 1.1 |
| 30.0 | 29.9 | -0.1 | ± 1.1 |
| 29.0 | 29.0 | 0.0 | ± 1.1 |
| 28.0 | 27.9 | -0.1 | ± 1.1 |
| 27.0 | 26.9 | -0.1 | ± 1.1 |
| 26.0 | 25.9 | -0.1 | ± 1.1 |
| 25.0 | 24.8 | -0.2 | ± 1.1 |



T. Petch.

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NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : ACL23004
Pages : 1 of 8

# Calibration Certificate

**Equipment :** SOUND LEVEL METER
**Manufacturer :** RION
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24
**Serial No.:** 00858520 / 158771 / 58772
**ID No.:** BKK_FS0110

**Condition As Found :** GOOD

**Customer :** ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

**Location :** -
**Ambient Temperature :** ( 23.0 ± 3 ) °C
**Pressure :** ( 101.3 ± 3 ) kPa
**Relative Humidity :** ( 50.0 ± 20 ) %

REVIEW BY Nathakorn P.
APPROVED BY
NEXT CAL DATE 3/1/24

**Received Date :** 14 DECEMBER 2022
**Calibration Date :** 03-05 JANUARY 2023
**Date of Issue :** 06 JANUARY 2023

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :** T. Petch.
( Thanakul Petchurai )

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





**11. Overload indication**

| Measured value ( dB ) | | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|
| Positive one-half cycle | Negative one-half cycle | | |
| 89.7 | 89.5 | -0.2 | ±1.5 |

**12. High level stability**

| Frequency Weighting | SLM Display at initial ( dB ) | SLM Display at final ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| A - weight | 137.0 | 137.0 | 0.0 | ±0.3 |

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation,providing a lavel of confidence of approximately 95 %

**End of Calibration Certificate**



T. Petch.

**Summary of Measurement Result :**

| Parameter | Pass | Fail | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|---|---|---|---|---|
| 1. Absolute sensitivity | ✓ | - | 0.2 | N/A |
| 2. Self-generated noise | ✓ | - | 0.2 | N/A |
| 3. Acoustical signal tests of frequency weightings | | | | |
| 125 Hz | ✓ | - | 0.3 | 0.6 |
| 1000 Hz | ✓ | - | 0.3 | 0.6 |
| 8000 Hz | ✓ | - | 0.3 | 0.7 |
| 4. Electrical signal tests of frequency weightings | | | | |
| For 10 Hz to 4 kHz | ✓ | - | 0.3 | 0.6 |
| For > 4 kHz to 10 kHz | ✓ | - | 0.3 | 0.7 |
| For > 10 kHz to 20 kHz | - | - | - | 1.0 |
| 5. Frequency and time weightings at 1 kHz | ✓ | - | 0.2 | 0.2 |
| 6. Long - term stability | ✓ | - | 0.1 | 0.1 |
| 7. Level linearity on the reference level range | ✓ | - | 0.2 | 0.3 |
| 8. Level linearity including the level range control | ✓ | - | 0.2 | 0.3 |
| 9. Tone burst response | ✓ | - | 0.2 | 0.3 |
| 10. Peak C sound level | ✓ | - | 0.2 | 0.35 |
| 11. Overload indication | ✓ | - | 0.2 | 0.25 |
| 12. High level stability | ✓ | - | 0.1 | 0.1 |





**Calibration Procedure :** CP-AC-01

**Calibration Method :**

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.
For tests results of each items were made by observation of each Instruments display and also with SLM's display.

**Condition of this result of calibration :**

1. Reference Standard Instruments :

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|---|---|---|---|---|
| Waveform Generator | 33210A | MY48017076 | EF-0007-22 | 04-Feb-23 |
| Waveform Generator | 33511B | MY52302742 | EF-0008-22 | 04-Feb-23 |
| Digital Multimeter | 33461A | MY53220104 | EEL.BP. 04/0265 | 09-Feb-23 |
| Digital Multimeter | 33461A | MY53220076 | EEL.BP. 03/0265 | 09-Feb-23 |
| Digital Multimeter | 34461A | MY60024273 | EEL.BP. 05/0265 | 09-Feb-23 |
| Programmable Attenuator | MAT-1070 | 62100114 | EF-0009-22 | 07-Feb-23 |
| Condenser Microphone | 4180 | 2977900 | AA-1013-22 | 24-Feb-23 |
| Measuring Amplifier | NA-42KAI | 34560495 | AA-3005-22 | 22-Feb-23 |

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 National Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).

**Result of calibration :**

**1. Absolute sensitivity**

| Reference Acoustic Signal ( dB ) | Measured Value ( dB ) | Deviation ( dB ) | Acceptance Limit ( dB ) |
|---|---|---|---|
| 93.9 (93.95) | 93.9 | 0.0 | ±0.3 |

**2. Self-generated noise**

2.1 Normal test

| Measured Value ( dB ) |
|---|
| 16.1 |

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

| Frequency Weighting | Measured value ( dB ) |
|---|---|
| A - weight | 12.5 |
| C - weight | 18.8 |
| Flat | 24.4 |

**3. Acoustical signal tests of frequency weightings**

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

| Frequency ( Hz ) | Deviation from various frequency weighting response curve (dB) | | | |
|---|---|---|---|---|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 125 | 0.3 | 0.3 | 0.4 | ± 1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ± 1.0 |
| 8000 | -1.4 | -1.4 | -1.4 | ±5.0 |



T. Ketch.



**4. Electrical signal tests of frequency weightings**

Weighting network response with relative to 1 kHz.

| Frequency ( Hz ) | Deviation from various frequency weighting response curve (dB) | | | |
|---|---|---|---|---|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 63 | 0.0 | -0.1 | -0.1 | ±2.0 |
| 125 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 250 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 500 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 2000 | 0.0 | 0.1 | 0.0 | ±2.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±3.0 |
| 8000 | 0.0 | 0.1 | 0.1 | ±5.0 |

**5. Frequency and time weightings at 1 kHz**

5.1 Frequency weightings at 1 kHz

| Frequency Weighting | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|
| A - weight | 94.0 | 0.0 | - |
| C - weight | 94.0 | 0.0 | ± 0.2 |
| Flat | 94.0 | 0.0 | ± 0.2 |

5.2 Time weighting at 1 kHz

| Frequency Weighting | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|
| Fast | 94.0 | 0.0 | - |
| Slow | 94.0 | 0.0 | ± 0.1 |
| Leq | 94.0 | 0.0 | ± 0.1 |

**6. Long - term stability**

| Frequency Weighting | SLM Display at initial ( dB ) | SLM Display at final ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| A - weight | 94.0 | 94.0 | 0.0 | ± 0.3 |



T. Ketch.

**8. Level linearity including the level range control**

| Range | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| Auto | 94.0 | 94.0 | 0.0 | ±1.1 |

**9. Tone burst response**

| Time Weighting | Tone burst duration, Tb ( ms ) | Cycle | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|---|---|
| Fast | 0.25 | 1 | 108.0 | 107.9 | -0.1 | 1.5 ; -5.0 |
| | 2 | 8 | 117.0 | 117.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 134.0 | 134.1 | 0.1 | ±1.0 |
| Slow | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.5 ; -5.0 |
| | 200 | 800 | 127.6 | 127.6 | 0.0 | ±1.0 |
| SEL | 0.25 | 1 | 99.0 | 98.9 | -0.1 | 1.5 ; -5.0 |
| | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 128.0 | 128.1 | 0.1 | ±1.0 |

**10. Peak C sound level**

| Number of cycle in test signal | Anticipated Value ( dB ) | Measured Value, Lcpeak ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| One | 136.4 | 135.3 | -1.1 | ±3.0 |

| Number of cycle in test signal | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| Positive half cycle | 135.4 | 135.2 | -0.2 | ±2.0 |
| Negative half cycle | 135.4 | 135.2 | -0.2 | ±2.0 |



T. Petch



**7. Level linearity on the reference level range**

| Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|
| 137.0 | 137.0 | 0.0 | ± 1.1 |
| 136.0 | 136.0 | 0.0 | ± 1.1 |
| 135.0 | 135.0 | 0.0 | ± 1.1 |
| 134.0 | 134.0 | 0.0 | ± 1.1 |
| 133.0 | 133.0 | 0.0 | ± 1.1 |
| 132.0 | 132.0 | 0.0 | ± 1.1 |
| 131.0 | 131.0 | 0.0 | ± 1.1 |
| 129.0 | 129.0 | 0.0 | ± 1.1 |
| 124.0 | 124.0 | 0.0 | ± 1.1 |
| 119.0 | 119.0 | 0.0 | ± 1.1 |
| 114.0 | 114.0 | 0.0 | ± 1.1 |
| 109.0 | 109.0 | 0.0 | ± 1.1 |
| 104.0 | 104.0 | 0.0 | ± 1.1 |
| 99.0 | 99.0 | 0.0 | ± 1.1 |
| 94.0 | 94.0 | 0.0 | ± 1.1 |
| 89.0 | 89.0 | 0.0 | ± 1.1 |
| 84.0 | 84.0 | 0.0 | ± 1.1 |
| 79.0 | 79.0 | 0.0 | ± 1.1 |
| 74.0 | 74.0 | 0.0 | ± 1.1 |
| 69.0 | 69.0 | 0.0 | ± 1.1 |
| 64.0 | 64.0 | 0.0 | ± 1.1 |
| 59.0 | 59.0 | 0.0 | ± 1.1 |
| 54.0 | 54.0 | 0.0 | ± 1.1 |
| 49.0 | 49.0 | 0.0 | ± 1.1 |
| 44.0 | 44.0 | 0.0 | ± 1.1 |
| 39.0 | 39.0 | 0.0 | ± 1.1 |
| 34.0 | 33.9 | -0.1 | ± 1.1 |
| 30.0 | 29.9 | -0.1 | ± 1.1 |
| 29.0 | 28.9 | -0.1 | ± 1.1 |
| 28.0 | 27.9 | -0.1 | ± 1.1 |
| 27.0 | 26.9 | -0.1 | ± 1.1 |
| 26.0 | 25.9 | -0.1 | ± 1.1 |
| 25.0 | 24.8 | -0.2 | ± 1.1 |



T. Petch

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

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NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : ACL23005
Pages : 1 of 8

# Calibration Certificate

| | |
|---|---|
| **Equipment :** | SOUND LEVEL METER |
| **Manufacturer :** | RION |
| **Model :** | NL-42/ Microphone UC-52 / Preamplifier NH-24 |
| **Serial No.:** | 00858525 / 170383 / 72889 |
| **ID No.:** | BKK_FS0115 |
| **Condition As Found :** | GOOD |
| **Customer :** | ALS LABORATORY GROUP (THAILAND) CO., LTD.<br>104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,<br>KHWAENG PHATTHANAKAN, KHET SUAN LUANG,<br>BANGKOK, 10250 THAILAND. |
| **Location :** | - |
| **Ambient Temperature :** | ( 23.0 ± 3 ) °C |
| **Pressure :** | ( 101.3 ± 3 ) kPa |
| **Relative Humidity :** | ( 50.0 ± 20 ) % |
| **Received Date :** | 14 DECEMBER 2022 |
| **Calibration Date :** | 03-05 JANUARY 2023 |
| **Date of Issue :** | 06 JANUARY 2023 |

REVIEW BY Nnalorn P.
APPROVED BY
NEXT CAL DATE 3/1/24

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

( Thanakul Petchurai )

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





**11. Overload indication**

| Measured value ( dB ) | | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|
| Positive one-half cycle | Negative one-half cycle | | |
| 89.6 | 89.7 | 0.1 | ±1.5 |

**12. High level stability**

| Frequency Weighting | SLM Display at initial ( dB ) | SLM Display at final ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| A - weight | 137.0 | 137.0 | 0.0 | ±0.3 |

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation,providing a lavel of confidence of approximately 95 %

**End of Calibration Certificate**

**Summary of Measurement Result :**

| Parameter | Pass | Fail | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|---|---|---|---|---|
| 1. Absolute sensitivity | ✓ | - | 0.2 | N/A |
| 2. Self-generated noise | ✓ | - | 0.2 | N/A |
| 3. Acoustical signal tests of frequency weightings | | | | |
| 125 Hz | ✓ | - | 0.3 | 0.6 |
| 1000 Hz | ✓ | - | 0.3 | 0.6 |
| 8000 Hz | ✓ | - | 0.3 | 0.7 |
| 4. Electrical signal tests of frequency weightings | | | | |
| For 10 Hz to 4 kHz | ✓ | - | 0.3 | 0.6 |
| For > 4 kHz to 10 kHz | ✓ | - | 0.3 | 0.7 |
| For > 10 kHz to 20 kHz | - | - | - | 1.0 |
| 5. Frequency and time weightings at 1 kHz | ✓ | - | 0.2 | 0.2 |
| 6. Long - term stability | ✓ | - | 0.1 | 0.1 |
| 7. Level linearity on the reference level range | ✓ | - | 0.2 | 0.3 |
| 8. Level linearity including the level range control | ✓ | - | 0.2 | 0.3 |
| 9. Tone burst response | ✓ | - | 0.2 | 0.3 |
| 10. Peak C sound level | ✓ | - | 0.2 | 0.35 |
| 11. Overload indication | ✓ | - | 0.2 | 0.25 |
| 12. High level stability | ✓ | - | 0.1 | 0.1 |





**Calibration Procedure :** CP-AC-01

**Calibration Method :**

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.
For tests results of each items were made by observation of each Instruments display and also with SLM's display.

**Condition of this result of calibration :**

1. Reference Standard Instruments :

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|---|---|---|---|---|
| Waveform Generator | 33210A | MY48017076 | EF-0007-22 | 04-Feb-23 |
| Waveform Generator | 33511B | MY52302742 | EF-0008-22 | 04-Feb-23 |
| Digital Multimeter | 33461A | MY53220104 | EEL.BP. 04/0265 | 09-Feb-23 |
| Digital Multimeter | 33461A | MY53220076 | EEL.BP. 03/0265 | 09-Feb-23 |
| Digital Multimeter | 34461A | MY60024273 | EEL.BP. 05/0265 | 09-Feb-23 |
| Programmable Attenuator | MAT-1070 | 62100114 | EF-0009-22 | 07-Feb-23 |
| Condenser Microphone | 4180 | 2977900 | AA-1013-22 | 24-Feb-23 |
| Measuring Amplifier | NA-42KAI | 34560495 | AA-3005-22 | 22-Feb-23 |

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 National Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).

**4. Electrical signal tests of frequency weightings**

Weighting network response with relative to 1 kHz.

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|---|---|---|---|---|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 63 | 0.0 | -0.1 | 0.0 | ±2.0 |
| 125 | -0.1 | 0.0 | 0.0 | ±1.5 |
| 250 | 0.0 | 0.0 | -0.1 | ±1.5 |
| 500 | 0.0 | 0.0 | -0.1 | ±1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 2000 | 0.0 | 0.0 | 0.0 | ±2.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±3.0 |
| 8000 | 0.0 | 0.1 | 0.1 | ±5.0 |

**5. Frequency and time weightings at 1 kHz**

5.1 Frequency weightings at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|
| A - weight | 94.0 | 0.0 | - |
| C - weight | 94.0 | 0.0 | ± 0.2 |
| Flat | 94.0 | 0.0 | ± 0.2 |

5.2 Time weighting at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|
| Fast | 94.0 | 0.0 | - |
| Slow | 94.0 | 0.0 | ± 0.1 |
| Leq | 94.0 | 0.0 | ± 0.1 |

**6. Long - term stability**

| Frequency Weighting | SLM Display at initial (dB) | SLM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|---|
| A - weight | 94.0 | 94.0 | 0.0 | ± 0.3 |



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**Result of calibration :**

**1. Absolute sensitivity**

| Reference Acoustic Signal (dB) | Measured Value (dB) | Deviation (dB) | Acceptance Limit (dB) |
|---|---|---|---|
| 93.9 (93.95) | 93.9 | 0.0 | ±0.3 |

**2. Self-generated noise**

2.1 Normal test

| Measured Value (dB) |
|---|
| 15.5 |

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

| Frequency Weighting | Measured value (dB) |
|---|---|
| A - weight | 14.2 |
| C - weight | 20.4 |
| Flat | 25.9 |

**3. Acoustical signal tests of frequency weightings**

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

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|---|---|---|---|---|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 125 | 0.2 | 0.3 | 0.3 | ± 1.5 |
| 1000 | -0.1 | -0.1 | -0.1 | ± 1.0 |
| 8000 | -1.7 | -1.6 | -1.6 | ±5.0 |



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**8. Level linearity including the level range control**

| Range | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| Auto | 94.0 | 94.0 | 0.0 | ±1.1 |

**9. Tone burst response**

| Time Weighting | Tone burst duration, Tb ( ms ) | Cycle | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|---|---|
| Fast | 0.25 | 1 | 108.0 | 107.9 | -0.1 | 1.5 ; -5.0 |
| | 2 | 8 | 117.0 | 117.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 134.0 | 134.0 | 0.0 | ±1.0 |
| Slow | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.5 ; -5.0 |
| | 200 | 800 | 127.6 | 127.6 | 0.0 | ±1.0 |
| SEL | 0.25 | 1 | 99.0 | 98.9 | -0.1 | 1.5 ; -5.0 |
| | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 128.0 | 128.0 | 0.0 | ±1.0 |

**10. Peak C sound level**

| Number of cycle in test signal | Anticipated Value ( dB ) | Measured Value, Lcpeak ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| One | 136.4 | 136.4 | 0.0 | ±3.0 |

| Number of cycle in test signal | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| Positive half cycle | 135.4 | 135.1 | -0.3 | ±2.0 |
| Negative half cycle | 135.4 | 135.1 | -0.3 | ±2.0 |



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**7. Level linearity on the reference level range**

| Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|
| 137.0 | 137.0 | 0.0 | ± 1.1 |
| 136.0 | 136.0 | 0.0 | ± 1.1 |
| 135.0 | 135.0 | 0.0 | ± 1.1 |
| 134.0 | 134.0 | 0.0 | ± 1.1 |
| 133.0 | 133.0 | 0.0 | ± 1.1 |
| 132.0 | 132.0 | 0.0 | ± 1.1 |
| 131.0 | 131.0 | 0.0 | ± 1.1 |
| 129.0 | 129.0 | 0.0 | ± 1.1 |
| 124.0 | 124.0 | 0.0 | ± 1.1 |
| 119.0 | 119.0 | 0.0 | ± 1.1 |
| 114.0 | 114.0 | 0.0 | ± 1.1 |
| 109.0 | 109.0 | 0.0 | ± 1.1 |
| 104.0 | 104.0 | 0.0 | ± 1.1 |
| 99.0 | 99.0 | 0.0 | ± 1.1 |
| 94.0 | 94.0 | 0.0 | ± 1.1 |
| 89.0 | 89.0 | 0.0 | ± 1.1 |
| 84.0 | 84.1 | 0.1 | ± 1.1 |
| 79.0 | 79.0 | 0.0 | ± 1.1 |
| 74.0 | 74.1 | 0.1 | ± 1.1 |
| 69.0 | 69.0 | 0.0 | ± 1.1 |
| 64.0 | 64.0 | 0.0 | ± 1.1 |
| 59.0 | 59.0 | 0.0 | ± 1.1 |
| 54.0 | 54.0 | 0.0 | ± 1.1 |
| 49.0 | 49.0 | 0.0 | ± 1.1 |
| 44.0 | 44.0 | 0.0 | ± 1.1 |
| 39.0 | 39.0 | 0.0 | ± 1.1 |
| 34.0 | 34.0 | 0.0 | ± 1.1 |
| 30.0 | 30.0 | 0.0 | ± 1.1 |
| 29.0 | 29.0 | 0.0 | ± 1.1 |
| 28.0 | 28.0 | 0.0 | ± 1.1 |
| 27.0 | 27.0 | 0.0 | ± 1.1 |
| 26.0 | 26.0 | 0.0 | ± 1.1 |
| 25.0 | 25.0 | 0.0 | ± 1.1 |



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MM-N12


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NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : ACL23006
Pages : 1 of 8

# Calibration Certificate

**Equipment :** SOUND LEVEL METER
**Manufacturer :** RION
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24
**Serial No.:** 00858526 / 175176 / 85721
**ID No.:** BKK_FS0116

**Condition As Found :** GOOD

**Customer :** ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

**Location :** -
**Ambient Temperature :** ( 23.0 ± 3 ) °C
**Pressure :** ( 101.3 ± 3 ) kPa
**Relative Humidity :** ( 50.0 ± 20 ) %

REVIEW BY Nopadorn P.
APPROVED BY
NEXT CAL. DATE 3/1/24

**Received Date :** 14 DECEMBER 2022
**Calibration Date :** 03-05 JANUARY 2023
**Date of Issue :** 06 JANUARY 2023

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :** T. Petch
( Thanakul Petchurai )


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






**11. Overload indication**

| Measured value ( dB ) | | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|
| Positive one-half cycle | Negative one-half cycle | | |
| 89.5 | 89.5 | 0.0 | ±1.5 |

**12. High level stability**

| Frequency Weighting | SLM Display at initial ( dB ) | SLM Display at final ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| A - weight | 137.0 | 137.0 | 0.0 | ±0.3 |

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation,providing a lavel of confidence of approximately 95 %

**End of Calibration Certificate**



T. Petch

14/9/56

## Continuation of Calibration Certificate

Cert. No. : ACL23006
Job No. : VC66AC0021
Pages : 3 of 8

**Summary of Measurement Result :**

| Parameter | Pass | Fail | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|---|---|---|---|---|
| 1. Absolute sensitivity | ✓ | - | 0.2 | N/A |
| 2. Self-generated noise | ✓ | - | 0.2 | N/A |
| 3. Acoustical signal tests of frequency weightings | | | | |
| 125 Hz | ✓ | - | 0.3 | 0.6 |
| 1000 Hz | ✓ | - | 0.3 | 0.6 |
| 8000 Hz | ✓ | - | 0.3 | 0.7 |
| 4. Electrical signal tests of frequency weightings | | | | |
| For 10 Hz to 4 kHz | ✓ | - | 0.3 | 0.6 |
| For > 4 kHz to 10 kHz | ✓ | - | 0.3 | 0.7 |
| For > 10 kHz to 20 kHz | - | - | - | 1.0 |
| 5. Frequency and time weightings at 1 kHz | ✓ | - | 0.2 | 0.2 |
| 6. Long - term stability | ✓ | - | 0.1 | 0.1 |
| 7. Level linearity on the reference level range | ✓ | - | 0.2 | 0.3 |
| 8. Level linearity including the level range control | ✓ | - | 0.2 | 0.3 |
| 9. Tone burst response | ✓ | - | 0.2 | 0.3 |
| 10. Peak C sound level | ✓ | - | 0.2 | 0.35 |
| 11. Overload indication | ✓ | - | 0.2 | 0.25 |
| 12. High level stability | ✓ | - | 0.1 | 0.1 |





## Continuation of Calibration Certificate

Cert. No. : ACL23006
Job No. : VC66AC0021
Pages : 2 of 8

**Calibration Procedure :** CP-AC-01

**Calibration Method :**

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.
For tests results of each items were made by observation of each Instruments display and also with SLM's display.

**Condition of this result of calibration :**

1. Reference Standard Instruments :

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|---|---|---|---|---|
| Waveform Generator | 33210A | MY48017076 | EF-0007-22 | 04-Feb-23 |
| Waveform Generator | 33511B | MY52302742 | EF-0008-22 | 04-Feb-23 |
| Digital Multimeter | 33461A | MY53220104 | EEL.BP. 04/0265 | 09-Feb-23 |
| Digital Multimeter | 33461A | MY53220076 | EEL.BP. 03/0265 | 09-Feb-23 |
| Digital Multimeter | 34461A | MY60024273 | EEL.BP. 05/0265 | 09-Feb-23 |
| Programmable Attenuator | MAT-1070 | 62100114 | EF-0009-22 | 07-Feb-23 |
| Condenser Microphone | 4180 | 2977900 | AA-1013-22 | 24-Feb-23 |
| Measuring Amplifier | NA-42KAI | 34560495 | AA-3005-22 | 22-Feb-23 |

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 National Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).

**4. Electrical signal tests of frequency weightings**

Weighting network response with relative to 1 kHz.

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|---|---|---|---|---|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 63 | 0.0 | -0.1 | -0.1 | ±2.0 |
| 125 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 250 | 0.0 | 0.0 | -0.1 | ±1.5 |
| 500 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 2000 | 0.0 | 0.0 | 0.0 | ±2.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±3.0 |
| 8000 | 0.0 | 0.1 | 0.1 | ±5.0 |

**5. Frequency and time weightings at 1 kHz**

5.1 Frequency weightings at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|
| A - weight | 94.0 | 0.0 | - |
| C - weight | 94.0 | 0.0 | ± 0.2 |
| Flat | 94.0 | 0.0 | ± 0.2 |

5.2 Time weighting at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|
| Fast | 94.0 | 0.0 | - |
| Slow | 94.0 | 0.0 | ± 0.1 |
| Leq | 94.0 | 0.0 | ± 0.1 |

**6. Long - term stability**

| Frequency Weighting | SLM Display at initial (dB) | SLM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|---|
| A - weight | 94.0 | 94.0 | 0.0 | ± 0.3 |



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**Result of calibration :**

**1. Absolute sensitivity**

| Reference Acoustic Signal (dB) | Measured Value (dB) | Deviation (dB) | Acceptance Limit (dB) |
|---|---|---|---|
| 93.9 (93.95) | 93.9 | 0.0 | ±0.3 |

**2. Self-generated noise**

2.1 Normal test

| Measured Value (dB) |
|---|
| 15.4 |

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

| Frequency Weighting | Measured value (dB) |
|---|---|
| A - weight | 13.4 |
| C - weight | 19.9 |
| Flat | 25.5 |

**3. Acoustical signal tests of frequency weightings**

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

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|---|---|---|---|---|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 125 | 0.0 | 0.1 | 0.1 | ± 1.5 |
| 1000 | 0.1 | 0.1 | 0.1 | ± 1.0 |
| 8000 | 1.3 | 1.4 | 1.3 | ±5.0 |



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**8. Level linearity including the level range control**

| Range | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|---|
| Auto | 94.0 | 94.0 | 0.0 | ±1.1 |

**9. Tone burst response**

| Time Weighting | Tone burst duration, Tb (ms) | Cycle | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|---|---|---|
| Fast | 0.25 | 1 | 108.0 | 107.9 | -0.1 | 1.5 ; -5.0 |
| | 2 | 8 | 117.0 | 117.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 134.0 | 134.0 | 0.0 | ±1.0 |
| Slow | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.5 ; -5.0 |
| | 200 | 800 | 127.6 | 127.6 | 0.0 | ±1.0 |
| SEL | 0.25 | 1 | 99.0 | 98.9 | -0.1 | 1.5 ; -5.0 |
| | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 128.0 | 128.0 | 0.0 | ±1.0 |

**10. Peak C sound level**

| Number of cycle in test signal | Anticipated Value (dB) | Measured Value, Lcpeak (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|---|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| One | 136.4 | 136.0 | -0.4 | ±3.0 |

| Number of cycle in test signal | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|---|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| Positive half cycle | 135.4 | 135.2 | -0.2 | ±2.0 |
| Negative half cycle | 135.4 | 135.2 | -0.2 | ±2.0 |





**7. Level linearity on the reference level range**

| Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|
| 137.0 | 137.0 | 0.0 | ± 1.1 |
| 136.0 | 136.0 | 0.0 | ± 1.1 |
| 135.0 | 135.0 | 0.0 | ± 1.1 |
| 134.0 | 134.0 | 0.0 | ± 1.1 |
| 133.0 | 133.0 | 0.0 | ± 1.1 |
| 132.0 | 132.0 | 0.0 | ± 1.1 |
| 131.0 | 131.0 | 0.0 | ± 1.1 |
| 129.0 | 129.0 | 0.0 | ± 1.1 |
| 124.0 | 124.0 | 0.0 | ± 1.1 |
| 119.0 | 119.0 | 0.0 | ± 1.1 |
| 114.0 | 114.0 | 0.0 | ± 1.1 |
| 109.0 | 109.0 | 0.0 | ± 1.1 |
| 104.0 | 104.0 | 0.0 | ± 1.1 |
| 99.0 | 99.0 | 0.0 | ± 1.1 |
| 94.0 | 94.0 | 0.0 | ± 1.1 |
| 89.0 | 89.1 | 0.1 | ± 1.1 |
| 84.0 | 84.1 | 0.1 | ± 1.1 |
| 79.0 | 79.1 | 0.1 | ± 1.1 |
| 74.0 | 74.1 | 0.1 | ± 1.1 |
| 69.0 | 69.1 | 0.1 | ± 1.1 |
| 64.0 | 64.0 | 0.0 | ± 1.1 |
| 59.0 | 59.1 | 0.1 | ± 1.1 |
| 54.0 | 54.0 | 0.0 | ± 1.1 |
| 49.0 | 49.0 | 0.0 | ± 1.1 |
| 44.0 | 44.0 | 0.0 | ± 1.1 |
| 39.0 | 39.0 | 0.0 | ± 1.1 |
| 34.0 | 34.0 | 0.0 | ± 1.1 |
| 30.0 | 30.0 | 0.0 | ± 1.1 |
| 29.0 | 29.0 | 0.0 | ± 1.1 |
| 28.0 | 28.0 | 0.0 | ± 1.1 |
| 27.0 | 27.0 | 0.0 | ± 1.1 |
| 26.0 | 25.9 | -0.1 | ± 1.1 |
| 25.0 | 24.9 | -0.1 | ± 1.1 |



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CALIBRATION LABORATORY

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NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : ACL23007
Pages : 1 of 8

# Calibration Certificate

**Equipment :** SOUND LEVEL METER
**Manufacturer :** RION
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24
**Serial No.:** 00858527 / 158778 / 58779
**ID No.:** BKK_FS0117

**Condition As Found :** GOOD

**Customer :** ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

**Location :** -
**Ambient Temperature :** ( 23.0 ± 3 ) °C
**Pressure :** ( 101.3 ± 3 ) kPa
**Relative Humidity :** ( 50.0 ± 20 ) %

REVIEW BY Narakorn P.
APPROVED BY
NEXT CAL. DATE 3/1/24

**Received Date :** 14 DECEMBER 2022
**Calibration Date :** 03-05 JANUARY 2023
**Date of Issue :** 06 JANUARY 2023

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :** T. Petch.
( Thanakul Petchurai )

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## Continuation of Calibration Certificate

Cert. No. : ACL23006
Job No. : VC66AC0021
Pages : 8 of 8

**11. Overload indication**

| Measured value ( dB ) | | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|
| Positive one-half cycle | Negative one-half cycle | | |
| 89.6 | 89.6 | 0.0 | ±1.5 |

**12. High level stability**

| Frequency Weighting | SLM Display at initial ( dB ) | SLM Display at final ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| A - weight | 137.0 | 137.0 | 0.0 | ±0.3 |

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation,providing a lavel of confidence of approximately 95 %

**End of Calibration Certificate**

## Continuation of Calibration Certificate

Cert. No. : ACL23007
Job No. : VC66AC0021
Pages : 3 of 8

**Summary of Measurement Result :**

| Parameter | Pass | Fail | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|---|---|---|---|---|
| 1. Absolute sensitivity | ✓ | - | 0.2 | N/A |
| 2. Self-generated noise | ✓ | - | 0.2 | N/A |
| 3. Acoustical signal tests of frequency weightings | | | | |
| 125 Hz | ✓ | - | 0.3 | 0.6 |
| 1000 Hz | ✓ | - | 0.3 | 0.6 |
| 8000 Hz | ✓ | - | 0.3 | 0.7 |
| 4. Electrical signal tests of frequency weightings | | | | |
| For 10 Hz to 4 kHz | ✓ | - | 0.3 | 0.6 |
| For > 4 kHz to 10 kHz | ✓ | - | 0.3 | 0.7 |
| For > 10 kHz to 20 kHz | - | - | - | 1.0 |
| 5. Frequency and time weightings at 1 kHz | ✓ | - | 0.2 | 0.2 |
| 6. Long - term stability | ✓ | - | 0.1 | 0.1 |
| 7. Level linearity on the reference level range | ✓ | - | 0.2 | 0.3 |
| 8. Level linearity including the level range control | ✓ | - | 0.2 | 0.3 |
| 9. Tone burst response | ✓ | - | 0.2 | 0.3 |
| 10. Peak C sound level | ✓ | - | 0.2 | 0.35 |
| 11. Overload indication | ✓ | - | 0.2 | 0.25 |
| 12. High level stability | ✓ | - | 0.1 | 0.1 |



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Continuation of Calibration Certificate

Cert. No. : ACL23007
Job No. : VC66AC0021
Pages : 2 of 8

**Calibration Procedure :** CP-AC-01

**Calibration Method :**

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.
For tests results of each items were made by observation of each Instruments display and also with SLM's display.

**Condition of this result of calibration :**

1. Reference Standard Instruments :

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|---|---|---|---|---|
| Waveform Generator | 33210A | MY48017076 | EF-0007-22 | 04-Feb-23 |
| Waveform Generator | 33511B | MY52302742 | EF-0008-22 | 04-Feb-23 |
| Digital Multimeter | 33461A | MY53220104 | EEL.BP. 04/0265 | 09-Feb-23 |
| Digital Multimeter | 33461A | MY53220076 | EEL.BP. 03/0265 | 09-Feb-23 |
| Digital Multimeter | 34461A | MY60024273 | EEL.BP. 05/0265 | 09-Feb-23 |
| Programmable Attenuator | MAT-1070 | 62100114 | EF-0009-22 | 07-Feb-23 |
| Condenser Microphone | 4180 | 2977900 | AA-1013-22 | 24-Feb-23 |
| Measuring Amplifier | NA-42KAI | 34560495 | AA-3005-22 | 22-Feb-23 |

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 National Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).

QF-TS12-04-04-020664

**4. Electrical signal tests of frequency weightings**

Weighting network response with relative to 1 kHz.

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|---|---|---|---|---|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 63 | 0.0 | 0.0 | 0.0 | ±2.0 |
| 125 | 0.0 | 0.1 | 0.0 | ±1.5 |
| 250 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 500 | 0.0 | 0.1 | 0.0 | ±1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 2000 | 0.0 | 0.1 | 0.1 | ±2.0 |
| 4000 | 0.0 | 0.1 | 0.0 | ±3.0 |
| 8000 | 0.1 | 0.1 | 0.1 | ±5.0 |

**5. Frequency and time weightings at 1 kHz**

5.1 Frequency weightings at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|
| A - weight | 94.0 | 0.0 | - |
| C - weight | 94.0 | 0.0 | ± 0.2 |
| Flat | 94.0 | 0.0 | ± 0.2 |

5.2 Time weighting at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|
| Fast | 94.0 | 0.0 | - |
| Slow | 94.0 | 0.0 | ± 0.1 |
| Leq | 94.0 | 0.0 | ± 0.1 |

**6. Long - term stability**

| Frequency Weighting | SLM Display at initial (dB) | SLM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|---|
| A - weight | 94.0 | 94.1 | 0.1 | ± 0.3 |





**Result of calibration :**

**1. Absolute sensitivity**

| Reference Acoustic Signal (dB) | Measured Value (dB) | Deviation (dB) | Acceptance Limit (dB) |
|---|---|---|---|
| 93.9 (93.95) | 93.9 | 0.0 | ±0.3 |

**2. Self-generated noise**

2.1 Normal test

| Measured Value (dB) |
|---|
| 17.1 |

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

| Frequency Weighting | Measured value (dB) |
|---|---|
| A - weight | 15.8 |
| C - weight | 22.0 |
| Flat | 27.6 |

**3. Acoustical signal tests of frequency weightings**

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

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|---|---|---|---|---|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 125 | 1.1 | 1.1 | 1.1 | ± 1.5 |
| 1000 | 0.2 | 0.2 | 0.2 | ± 1.0 |
| 8000 | -1.6 | -1.5 | -1.5 | ±5.0 |



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**8. Level linearity including the level range control**

| Range | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| Auto | 94.0 | 94.0 | 0.0 | ±1.1 |

**9. Tone burst response**

| Time Weighting | Tone burst duration, Tb ( ms ) | Cycle | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|---|---|
| Fast | 0.25 | 1 | 108.0 | 108.0 | 0.0 | 1.5 ; -5.0 |
| | 2 | 8 | 117.0 | 117.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 134.0 | 134.1 | 0.1 | ±1.0 |
| Slow | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.5 ; -5.0 |
| | 200 | 800 | 127.6 | 127.6 | 0.0 | ±1.0 |
| SEL | 0.25 | 1 | 99.0 | 98.9 | -0.1 | 1.5 ; -5.0 |
| | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 128.0 | 128.1 | 0.1 | ±1.0 |

**10. Peak C sound level**

| Number of cycle in test signal | Anticipated Value ( dB ) | Measured Value, Lcpeak ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| One | 136.4 | 135.6 | -0.8 | ±3.0 |

| Number of cycle in test signal | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| Positive half cycle | 135.4 | 135.1 | -0.3 | ±2.0 |
| Negative half cycle | 135.4 | 135.1 | -0.3 | ±2.0 |





**7. Level linearity on the reference level range**

| Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|
| 137.0 | 137.0 | 0.0 | ± 1.1 |
| 136.0 | 136.0 | 0.0 | ± 1.1 |
| 135.0 | 135.0 | 0.0 | ± 1.1 |
| 134.0 | 134.0 | 0.0 | ± 1.1 |
| 133.0 | 133.0 | 0.0 | ± 1.1 |
| 132.0 | 132.0 | 0.0 | ± 1.1 |
| 131.0 | 131.0 | 0.0 | ± 1.1 |
| 129.0 | 129.0 | 0.0 | ± 1.1 |
| 124.0 | 124.0 | 0.0 | ± 1.1 |
| 119.0 | 119.1 | 0.1 | ± 1.1 |
| 114.0 | 114.0 | 0.0 | ± 1.1 |
| 109.0 | 109.0 | 0.0 | ± 1.1 |
| 104.0 | 104.1 | 0.1 | ± 1.1 |
| 99.0 | 99.0 | 0.0 | ± 1.1 |
| 94.0 | 94.0 | 0.0 | ± 1.1 |
| 89.0 | 89.0 | 0.0 | ± 1.1 |
| 84.0 | 84.0 | 0.0 | ± 1.1 |
| 79.0 | 79.0 | 0.0 | ± 1.1 |
| 74.0 | 74.0 | 0.0 | ± 1.1 |
| 69.0 | 69.0 | 0.0 | ± 1.1 |
| 64.0 | 64.0 | 0.0 | ± 1.1 |
| 59.0 | 59.0 | 0.0 | ± 1.1 |
| 54.0 | 54.0 | 0.0 | ± 1.1 |
| 49.0 | 49.0 | 0.0 | ± 1.1 |
| 44.0 | 44.0 | 0.0 | ± 1.1 |
| 39.0 | 39.0 | 0.0 | ± 1.1 |
| 34.0 | 34.0 | 0.0 | ± 1.1 |
| 30.0 | 29.9 | -0.1 | ± 1.1 |
| 29.0 | 28.9 | -0.1 | ± 1.1 |
| 28.0 | 27.9 | -0.1 | ± 1.1 |
| 27.0 | 26.9 | -0.1 | ± 1.1 |
| 26.0 | 25.9 | -0.1 | ± 1.1 |
| 25.0 | 25.0 | 0.0 | ± 1.1 |



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NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : ACL22244
Pages : 1 of 8

# Calibration Certificate

**Equipment :** SOUND LEVEL METER
**Manufacturer :** RION
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24
**Serial No.:** 00572552 / 170384 / 72890
**ID No.:** BKK_FS0877

**Condition As Found :** GOOD

**Customer :** ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

**Location :** -
**Ambient Temperature :** ( 23.0 ± 3 ) °C
**Pressure :** ( 101.3 ± 3 ) kPa
**Relative Humidity :** ( 50.0 ± 20 ) %

N. VIEW BY Nanakorn P.
APPROVED BY
NEXT CAL. DATE 25/10/23

**Received Date :** 11 OCTOBER 2022
**Calibration Date :** 25-26 OCTOBER 2022
**Date of Issue :** 27 OCTOBER 2022

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :** T. Petch.
( Thanakul Petchurai )


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**11. Overload indication**

| Measured value ( dB ) | | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|
| Positive one-half cycle | Negative one-half cycle | | |
| 89.6 | 89.5 | -0.1 | ±1.5 |

**12. High level stability**

| Frequency Weighting | SLM Display at initial ( dB ) | SLM Display at final ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| A - weight | 137.0 | 137.0 | 0.0 | ±0.3 |

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation,providing a lavel of confidence of approximately 95 %

**End of Calibration Certificate**



T. Petch.

**Summary of Measurement Result :**

| Parameter | Pass | Fail | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|---|---|---|---|---|
| 1. Absolute sensitivity | ✓ | - | 0.2 | N/A |
| 2. Self-generated noise | ✓ | - | 0.2 | N/A |
| 3. Acoustical signal tests of frequency weightings | | | | |
| 125 Hz | ✓ | - | 0.3 | 0.6 |
| 1000 Hz | ✓ | - | 0.3 | 0.6 |
| 8000 Hz | ✓ | - | 0.3 | 0.7 |
| 4. Electrical signal tests of frequency weightings | | | | |
| For 10 Hz to 4 kHz | ✓ | - | 0.3 | 0.6 |
| For > 4 kHz to 10 kHz | ✓ | - | 0.3 | 0.7 |
| For > 10 kHz to 20 kHz | - | - | - | 1.0 |
| 5. Frequency and time weightings at 1 kHz | ✓ | - | 0.2 | 0.2 |
| 6. Long - term stability | ✓ | - | 0.1 | 0.1 |
| 7. Level linearity on the reference level range | ✓ | - | 0.2 | 0.3 |
| 8. Level linearity including the level range control | ✓ | - | 0.2 | 0.3 |
| 9. Tone burst response | ✓ | - | 0.2 | 0.3 |
| 10. Peak C sound level | ✓ | - | 0.2 | 0.35 |
| 11. Overload indication | ✓ | - | 0.2 | 0.25 |
| 12. High level stability | ✓ | - | 0.1 | 0.1 |





**Calibration Procedure :** CP-AC-01

**Calibration Method :**

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).

The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

For tests results of each items were made by observation of each Instruments display and also with SLM's display.

**Condition of this result of calibration :**

1. Reference Standard Instruments :

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|---|---|---|---|---|
| Waveform Generator | 33210A | MY48017076 | EF-0007-22 | 04-Feb-23 |
| Waveform Generator | 33511B | MY52302742 | EF-0008-22 | 04-Feb-23 |
| Digital Multimeter | 33461A | MY53220104 | EEL.BP. 04/0265 | 09-Feb-23 |
| Digital Multimeter | 33461A | MY53220076 | EEL.BP. 03/0265 | 09-Feb-23 |
| Digital Multimeter | 34461A | MY60024273 | EEL.BP. 05/0265 | 09-Feb-23 |
| Programmable Attenuator | MAT-1070 | 62100114 | EF-0009-22 | 07-Feb-23 |
| Condenser Microphone | 4180 | 2977900 | AA-1013-22 | 24-Feb-23 |
| Measuring Amplifier | NA-42KAI | 34560495 | AA-3005-22 | 22-Feb-23 |

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 National Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).



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**4. Electrical signal tests of frequency weightings**

Weighting network response with relative to 1 kHz.

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|---|---|---|---|---|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 63 | 0.0 | 0.0 | 0.0 | ±2.0 |
| 125 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 250 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 500 | 0.0 | 0.0 | -0.1 | ±1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 2000 | 0.0 | 0.0 | 0.0 | ±2.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±3.0 |
| 8000 | 0.0 | 0.1 | 0.1 | ±5.0 |

**5. Frequency and time weightings at 1 kHz**

5.1 Frequency weightings at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|
| A - weight | 94.0 | 0.0 | - |
| C - weight | 94.0 | 0.0 | ± 0.2 |
| Flat | 94.0 | 0.0 | ± 0.2 |

5.2 Time weighting at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|
| Fast | 94.0 | 0.0 | - |
| Slow | 94.0 | 0.0 | ± 0.1 |
| Leq | 94.0 | 0.0 | ± 0.1 |

**6. Long - term stability**

| Frequency Weighting | SLM Display at initial (dB) | SLM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|---|
| A - weight | 94.0 | 94.0 | 0.0 | ± 0.3 |



T. Petch.



**Result of calibration :**

**1. Absolute sensitivity**

| Reference Acoustic Signal (dB) | Measured Value (dB) | Deviation (dB) | Acceptance Limit (dB) |
|---|---|---|---|
| 93.9 (93.95) | 93.9 | 0.0 | ±0.3 |

**2. Self-generated noise**

2.1 Normal test

| Measured Value (dB) |
|---|
| 14.8 |

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

| Frequency Weighting | Measured value (dB) |
|---|---|
| A - weight | 11.6 |
| C - weight | 17.5 |
| Flat | 23.3 |

**3. Acoustical signal tests of frequency weightings**

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

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|---|---|---|---|---|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 125 | 0.3 | 0.4 | 0.4 | ± 1.5 |
| 1000 | -0.1 | -0.1 | -0.1 | ± 1.0 |
| 8000 | -1.7 | -1.6 | -1.6 | ±5.0 |



T. Petch.

**8. Level linearity including the level range control**

| Range | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| Auto | 94.0 | 94.0 | 0.0 | ±1.1 |

**9. Tone burst response**

| Time Weighting | Tone burst duration, Tb ( ms ) | Cycle | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|---|---|
| Fast | 0.25 | 1 | 108.0 | 107.9 | -0.1 | 1.5 ; -5.0 |
| | 2 | 8 | 117.0 | 117.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 134.0 | 134.0 | 0.0 | ±1.0 |
| Slow | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.5 ; -5.0 |
| | 200 | 800 | 127.6 | 127.6 | 0.0 | ±1.0 |
| SEL | 0.25 | 1 | 99.0 | 98.9 | -0.1 | 1.5 ; -5.0 |
| | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 128.0 | 128.0 | 0.0 | ±1.0 |

**10. Peak C sound level**

| Number of cycle in test signal | Anticipated Value ( dB ) | Measured Value, Lcpeak ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| One | 136.4 | 135.7 | -0.7 | ±3.0 |

| Number of cycle in test signal | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| Positive half cycle | 135.4 | 135.2 | -0.2 | ±2.0 |
| Negative half cycle | 135.4 | 135.2 | -0.2 | ±2.0 |



T. Petch.



**7. Level linearity on the reference level range**

| Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|
| 137.0 | 137.0 | 0.0 | ± 1.1 |
| 136.0 | 136.0 | 0.0 | ± 1.1 |
| 135.0 | 135.0 | 0.0 | ± 1.1 |
| 134.0 | 134.0 | 0.0 | ± 1.1 |
| 133.0 | 133.0 | 0.0 | ± 1.1 |
| 132.0 | 132.0 | 0.0 | ± 1.1 |
| 131.0 | 131.0 | 0.0 | ± 1.1 |
| 129.0 | 129.0 | 0.0 | ± 1.1 |
| 124.0 | 124.0 | 0.0 | ± 1.1 |
| 119.0 | 119.0 | 0.0 | ± 1.1 |
| 114.0 | 114.0 | 0.0 | ± 1.1 |
| 109.0 | 109.0 | 0.0 | ± 1.1 |
| 104.0 | 104.0 | 0.0 | ± 1.1 |
| 99.0 | 99.0 | 0.0 | ± 1.1 |
| 94.0 | 94.0 | 0.0 | ± 1.1 |
| 89.0 | 89.0 | 0.0 | ± 1.1 |
| 84.0 | 84.0 | 0.0 | ± 1.1 |
| 79.0 | 79.0 | 0.0 | ± 1.1 |
| 74.0 | 74.0 | 0.0 | ± 1.1 |
| 69.0 | 69.0 | 0.0 | ± 1.1 |
| 64.0 | 64.0 | 0.0 | ± 1.1 |
| 59.0 | 59.0 | 0.0 | ± 1.1 |
| 54.0 | 54.0 | 0.0 | ± 1.1 |
| 49.0 | 49.0 | 0.0 | ± 1.1 |
| 44.0 | 44.0 | 0.0 | ± 1.1 |
| 39.0 | 39.0 | 0.0 | ± 1.1 |
| 34.0 | 34.0 | 0.0 | ± 1.1 |
| 30.0 | 30.0 | 0.0 | ± 1.1 |
| 29.0 | 29.0 | 0.0 | ± 1.1 |
| 28.0 | 28.1 | 0.1 | ± 1.1 |
| 27.0 | 27.1 | 0.1 | ± 1.1 |
| 26.0 | 26.1 | 0.1 | ± 1.1 |
| 25.0 | 25.1 | 0.1 | ± 1.1 |



T. Petch.

MM-N12


# SITHIPORN ASSOCIATES CO.,LTD.
## CALIBRATION LABORATORY

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NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : ACL23053
Pages : 1 of 8

# Calibration Certificate

**Equipment :** SOUND LEVEL METER
**Manufacturer :** RION
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24
**Serial No.:** 00572452 / 171618 / 72790
**ID No.:** BKK_FS0922

**Condition As Found :** GOOD

**Customer :** ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

**Location :** -
**Ambient Temperature :** ( 23.0 ± 3 ) °C
**Pressure :** ( 101.3 ± 3 ) kPa
**Relative Humidity :** ( 50.0 ± 20 ) %

REVIEW BY Monalom P.
APPROVED BY
NEXT CAL. DATE 19/1/24

**Received Date :** 17 JANUARY 2023
**Calibration Date :** 19-20 JANUARY 2023
**Date of Issue :** 23 JANUARY 2023

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :** T. Petch.
( Thanakul Petchurai )


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






**11. Overload indication**

| Measured value ( dB ) | | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|
| Positive one-half cycle | Negative one-half cycle | | |
| 89.6 | 89.7 | 0.1 | ±1.5 |

**12. High level stability**

| Frequency Weighting | SLM Display at initial ( dB ) | SLM Display at final ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| A - weight | 137.0 | 137.0 | 0.0 | ±0.3 |

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation,providing a lavel of confidence of approximately 95 %

**End of Calibration Certificate**



T. Petch.

**Summary of Measurement Result :**

| Parameter | Pass | Fail | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|---|---|---|---|---|
| 1. Absolute sensitivity | ✓ | - | 0.2 | N/A |
| 2. Self-generated noise | ✓ | - | 0.2 | N/A |
| 3. Acoustical signal tests of frequency weightings | | | | |
| 125 Hz | ✓ | - | 0.3 | 0.6 |
| 1000 Hz | ✓ | - | 0.3 | 0.6 |
| 8000 Hz | ✓ | - | 0.3 | 0.7 |
| 4. Electrical signal tests of frequency weightings | | | | |
| For 10 Hz to 4 kHz | ✓ | - | 0.3 | 0.6 |
| For > 4 kHz to 10 kHz | ✓ | - | 0.3 | 0.7 |
| For > 10 kHz to 20 kHz | - | - | - | 1.0 |
| 5. Frequency and time weightings at 1 kHz | ✓ | - | 0.2 | 0.2 |
| 6. Long - term stability | ✓ | - | 0.1 | 0.1 |
| 7. Level linearity on the reference level range | ✓ | - | 0.2 | 0.3 |
| 8. Level linearity including the level range control | ✓ | - | 0.2 | 0.3 |
| 9. Tone burst response | ✓ | - | 0.2 | 0.3 |
| 10. Peak C sound level | ✓ | - | 0.2 | 0.35 |
| 11. Overload indication | ✓ | - | 0.2 | 0.25 |
| 12. High level stability | ✓ | - | 0.1 | 0.1 |



T. Petch-



**Calibration Procedure :** CP-AC-01

**Calibration Method :**

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.
For tests results of each items were made by observation of each Instruments display and also with SLM's display.

**Condition of this result of calibration :**

1. Reference Standard Instruments :

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|---|---|---|---|---|
| Waveform Generator | 33210A | MY48017076 | EF-0007-22 | 04-Feb-23 |
| Waveform Generator | 33511B | MY52302742 | EF-0008-22 | 04-Feb-23 |
| Digital Multimeter | 33461A | MY53220104 | EEL.BP. 04/0265 | 09-Feb-23 |
| Digital Multimeter | 33461A | MY53220076 | EEL.BP. 03/0265 | 09-Feb-23 |
| Digital Multimeter | 34461A | MY60024273 | EEL.BP. 05/0265 | 09-Feb-23 |
| Programmable Attenuator | MAT-1070 | 62100114 | EF-0009-22 | 07-Feb-23 |
| Condenser Microphone | 4180 | 2977900 | AA-1013-22 | 24-Feb-23 |
| Measuring Amplifier | NA-42KAI | 34560495 | AA-3005-22 | 22-Feb-23 |

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 National Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).



T. Petch-

**4. Electrical signal tests of frequency weightings**

Weighting network response with relative to 1 kHz.

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|---|---|---|---|---|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 63 | 0.0 | 0.0 | 0.0 | ±2.0 |
| 125 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 250 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 500 | 0.0 | 0.0 | 0.0 | ±1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 2000 | 0.0 | 0.0 | 0.0 | ±2.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±3.0 |
| 8000 | 0.0 | 0.1 | 0.1 | ±5.0 |

**5. Frequency and time weightings at 1 kHz**

5.1 Frequency weightings at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|
| A - weight | 94.0 | 0.0 | - |
| C - weight | 94.0 | 0.0 | ± 0.2 |
| Flat | 94.0 | 0.0 | ± 0.2 |

5.2 Time weighting at 1 kHz

| Frequency Weighting | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|
| Fast | 94.0 | 0.0 | - |
| Slow | 94.0 | 0.0 | ± 0.1 |
| Leq | 94.0 | 0.0 | ± 0.1 |

**6. Long - term stability**

| Frequency Weighting | SLM Display at initial (dB) | SLM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|---|---|---|---|---|
| A - weight | 94.0 | 94.0 | 0.0 | ± 0.3 |



T. Petch.



**Result of calibration :**

**1. Absolute sensitivity**

| Reference Acoustic Signal (dB) | Measured Value (dB) | Deviation (dB) | Acceptance Limit (dB) |
|---|---|---|---|
| 93.9 (93.95) | 93.9 | 0.0 | ±0.3 |

**2. Self-generated noise**

2.1 Normal test

| Measured Value (dB) |
|---|
| 14.2 |

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

| Frequency Weighting | Measured value (dB) |
|---|---|
| A - weight | 10.8 |
| C - weight | 16.9 |
| Flat | 22.7 |

**3. Acoustical signal tests of frequency weightings**

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

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|---|---|---|---|---|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 125 | 0.2 | 0.2 | 0.2 | ± 1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ± 1.0 |
| 8000 | -0.6 | -0.5 | -0.4 | ±5.0 |



T. Petch.

Cert. No. : ACL23053
Job No. : VC66AC0026
Pages : 7 of 8

**8. Level linearity including the level range control**

| Range | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| Auto | 94.0 | 94.0 | 0.0 | ±1.1 |

**9. Tone burst response**

| Time Weighting | Tone burst duration, Tb ( ms ) | Cycle | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|---|---|
| Fast | 0.25 | 1 | 108.0 | 107.9 | -0.1 | 1.5 ; -5.0 |
| | 2 | 8 | 117.0 | 117.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 134.0 | 134.1 | 0.1 | ±1.0 |
| Slow | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.5 ; -5.0 |
| | 200 | 800 | 127.6 | 127.6 | 0.0 | ±1.0 |
| SEL | 0.25 | 1 | 99.0 | 98.9 | -0.1 | 1.5 ; -5.0 |
| | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 128.0 | 128.1 | 0.1 | ±1.0 |

**10. Peak C sound level**

| Number of cycle in test signal | Anticipated Value ( dB ) | Measured Value, Lcpeak ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| One | 136.4 | 136.3 | -0.1 | ±3.0 |

| Number of cycle in test signal | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| Continuous | 133.0 | 133.0 | 0.0 | - |
| Positive half cycle | 135.4 | 135.2 | -0.2 | ±2.0 |
| Negative half cycle | 135.4 | 135.2 | -0.2 | ±2.0 |







**7. Level linearity on the reference level range**

| Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|
| 137.0 | 137.0 | 0.0 | ± 1.1 |
| 136.0 | 136.0 | 0.0 | ± 1.1 |
| 135.0 | 135.0 | 0.0 | ± 1.1 |
| 134.0 | 134.0 | 0.0 | ± 1.1 |
| 133.0 | 133.0 | 0.0 | ± 1.1 |
| 132.0 | 132.0 | 0.0 | ± 1.1 |
| 131.0 | 131.0 | 0.0 | ± 1.1 |
| 129.0 | 129.0 | 0.0 | ± 1.1 |
| 124.0 | 124.0 | 0.0 | ± 1.1 |
| 119.0 | 119.0 | 0.0 | ± 1.1 |
| 114.0 | 114.0 | 0.0 | ± 1.1 |
| 109.0 | 109.0 | 0.0 | ± 1.1 |
| 104.0 | 104.0 | 0.0 | ± 1.1 |
| 99.0 | 99.0 | 0.0 | ± 1.1 |
| 94.0 | 94.0 | 0.0 | ± 1.1 |
| 89.0 | 89.0 | 0.0 | ± 1.1 |
| 84.0 | 84.0 | 0.0 | ± 1.1 |
| 79.0 | 79.0 | 0.0 | ± 1.1 |
| 74.0 | 74.0 | 0.0 | ± 1.1 |
| 69.0 | 69.0 | 0.0 | ± 1.1 |
| 64.0 | 64.0 | 0.0 | ± 1.1 |
| 59.0 | 59.0 | 0.0 | ± 1.1 |
| 54.0 | 54.0 | 0.0 | ± 1.1 |
| 49.0 | 49.0 | 0.0 | ± 1.1 |
| 44.0 | 44.0 | 0.0 | ± 1.1 |
| 39.0 | 39.0 | 0.0 | ± 1.1 |
| 34.0 | 33.9 | -0.1 | ± 1.1 |
| 30.0 | 29.9 | -0.1 | ± 1.1 |
| 29.0 | 28.9 | -0.1 | ± 1.1 |
| 28.0 | 27.9 | -0.1 | ± 1.1 |
| 27.0 | 26.9 | -0.1 | ± 1.1 |
| 26.0 | 25.9 | -0.1 | ± 1.1 |
| 25.0 | 24.9 | -0.1 | ± 1.1 |

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right partner.

รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

| Sample Name | Parameter | Equipment Name | ID No. | Calibrated Date | Next Cal | Freq. Calibrate (Months) |
|---|---|---|---|---|---|---|
| Water Lab | Total Alkalinity | Burette | BKK_EN0171 | 30-Aug-22 | 1-Mar-24 | 18 |
| Water Lab | Bicarbonate Alkalinity | Burette | BKK_EN0171 | 30-Aug-22 | 1-Mar-24 | 18 |
| Water Lab | Carbonate Alkalinity | Burette | BKK_EN0171 | 30-Aug-22 | 1-Mar-24 | 18 |
| Water Lab | Hydroxide Alkalinity | Burette | BKK_EN0171 | 30-Aug-22 | 1-Mar-24 | 18 |
| Water Lab | Phenolphthalein Alkalinity | Burette | BKK_EN0171 | 30-Aug-22 | 1-Mar-24 | 18 |
| Water Lab | Total Hardness | Burette | BKK_EN0171 | 30-Aug-22 | 1-Mar-24 | 18 |
| Water Lab | Total Suspended Solids | Electronic Top-Loading Balance | BKK_EN0002 | 25-Feb-22 | 25-Feb-23 | 12 |
| Water Lab | Total Suspended Solids | Oven | BKK_EN0009 | 2-Sep-21 | 3-Mar-23 | 18 |
| Water Lab | Total Dissolved Solids 180°C | Electronic Top-Loading Balance | BKK_EN0002 | 25-Feb-22 | 25-Feb-23 | 12 |
| Water Lab | Total Dissolved Solids 180°C | Oven | BKK_EN0007 | 1-Dec-21 | 1-Jun-23 | 18 |
| Water Lab | Calcium | ICP-OES | BKK_EL0037 | 13-Sep-21 | 12-Mar-23 | 18 |
| Water Lab | Calcium | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Water Lab | Calcium | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Magnesium | ICP-OES | BKK_EL0037 | 13-Sep-21 | 12-Mar-23 | 18 |
| Water Lab | Magnesium | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Water Lab | Magnesium | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Potassium | ICP-OES | BKK_EL0037 | 13-Sep-21 | 12-Mar-23 | 18 |
| Water Lab | Potassium | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Water Lab | Potassium | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Sodium | ICP-OES | BKK_EL0037 | 13-Sep-21 | 12-Mar-23 | 18 |
| Water Lab | Sodium | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Water Lab | Sodium | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Arsenic | ICP-MS | BKK_EL0043 | 30-Sep-21 | 29-Mar-23 | 18 |
| Water Lab | Arsenic | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Water Lab | Arsenic | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Cobalt | ICP-MS | BKK_EL0043 | 30-Sep-21 | 29-Mar-23 | 18 |
| Water Lab | Cobalt | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Water Lab | Cobalt | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Copper | ICP-MS | BKK_EL0043 | 30-Sep-21 | 29-Mar-23 | 18 |
| Water Lab | Copper | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Water Lab | Copper | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Iron | ICP-MS | BKK_EL0043 | 30-Sep-21 | 29-Mar-23 | 18 |
| Water Lab | Iron | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Water Lab | Iron | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Lead | ICP-MS | BKK_EL0043 | 30-Sep-21 | 29-Mar-23 | 18 |
| Water Lab | Lead | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Water Lab | Lead | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Manganese | ICP-MS | BKK_EL0043 | 30-Sep-21 | 29-Mar-23 | 18 |
| Water Lab | Manganese | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Water Lab | Manganese | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Mercury | CVAFS | BKK_EL0011 | 7-Jun-22 | 6-Jun-23 | 12 |
| Water Lab | Weak Acid Dissociable Cyanide | Discrete analyzer | BKK_EN0037 | 30-Jun-22 | 30-Jun-23 | 12 |
| Water Lab | Weak Acid Dissociable Cyanide | Chamber (Cold Room) | BKK_EN0168 | 1-Jul-22 | 1-Jan-24 | 18 |
| Water Lab | Chloride | Discrete analyzer | BKK_EN0037 | 30-Jun-22 | 30-Jun-23 | 12 |
| Water Lab | Chloride | Chamber (Cold Room) | BKK_EN0168 | 1-Jul-22 | 1-Jan-24 | 18 |
| Water Lab | Sulfate | Discrete analyzer | BKK_EN0037 | 30-Jun-22 | 30-Jun-23 | 12 |
| Water Lab | Sulfate | Chamber (Cold Room) | BKK_EN0168 | 1-Jul-22 | 1-Jan-24 | 18 |
| Water Lab | Cyanide | Discrete analyzer | BKK_EN0037 | 30-Jun-22 | 30-Jun-23 | 12 |
| Water Lab | Cyanide | Chamber (Cold Room) | BKK_EN0168 | 1-Jul-22 | 1-Jan-24 | 18 |
| Water Lab | Total Organic carbon | TOC Analyzer | BKK_EN0066 | 3-Oct-22 | 3-Oct-23 | 12 |
| Water Lab | Aluminium | ICP-MS | BKK_EL0043 | 30-Sep-21 | 29-Mar-23 | 18 |
| Water Lab | Aluminium | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Water Lab | Aluminium | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Antimony | ICP-MS | BKK_EL0043 | 30-Sep-21 | 29-Mar-23 | 18 |
| Water Lab | Antimony | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Water Lab | Antimony | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Barium | ICP-MS | BKK_EL0043 | 30-Sep-21 | 29-Mar-23 | 18 |
| Water Lab | Barium | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Water Lab | Barium | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |







**11. Overload indication**

| Measured value ( dB ) | | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|
| Positive one-half cycle | Negative one-half cycle | | |
| 89.5 | 89.5 | 0.0 | ±1.5 |

**12. High level stability**

| Frequency Weighting | SLM Display at initial ( dB ) | SLM Display at final ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| A - weight | 137.0 | 137.0 | 0.0 | ±0.3 |

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation,providing a lavel of confidence of approximately 95 %

**End of Calibration Certificate**

MM-N12

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

ilac-MRA

NSC-TISI-TIS17025 CALIBRATION 0008

Cert.No.: 22CG3154
Page.: 1 of 2

# Certificate of Calibration

| | |
|---|---|
| **Equipment :** | Burette |
| **Capacity :** | 50 mL |
| **Serial No. :** | - |
| **ID. No. :** | BKK_EN0171 |
| **Manufacturer :** | Witeg |
| **Made in :** | Germany |
| **Submitted by :** | ALS Laboratory Group (Thailand) Co.,Ltd.<br>104 Phatthanakan 40, Phatthanakan Rd.<br>Khwaeng Phatthanakan, Khet Suan Luang<br>Bangkok 10250 Thailand |
| **Ambient Temperature :** | (20 ± 2.5) °C |
| **Relative Humidity :** | (50 ± 10) % |
| **Barometric Pressure :** | 759 mmHg |
| **Calibration Procedure :** | ASTM E 542 - 01 |
| **Calibrated by :** | Panward Pramklam |
| **Approved by :** | Approved Signatory |
| **Issue Date :** | 31 August 2022 |

REVIEW BY Siriluk P.
APPROVED BY
NEXT CAL. DATE 29/03/2024

( ) Pornthippa Tameyakul
( ) Malee Butkruea
(✓) Ponpan Paipim
( ) Srisuda Khamtha

**The Uncertainties are for a confidence probability of approximately 95%**

This certificate may not be reproduced other than in full, except with the prior written
Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

A 0044607

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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

| Sample Name | Parameter | Equipment Name | ID No. | Calibrated Date | Next Cal | Freq. Calibrate (Months) |
|---|---|---|---|---|---|---|
| Water Lab | Boron | ICP-MS | BKK_EL0043 | 30-Sep-21 | 29-Mar-23 | 18 |
| Water Lab | Boron | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Water Lab | Boron | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Cadmium | ICP-MS | BKK_EL0043 | 30-Sep-21 | 29-Mar-23 | 18 |
| Water Lab | Cadmium | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Water Lab | Cadmium | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Chromium | ICP-MS | BKK_EL0043 | 30-Sep-21 | 29-Mar-23 | 18 |
| Water Lab | Chromium | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Water Lab | Chromium | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Molybdenum | ICP-MS | BKK_EL0043 | 30-Sep-21 | 29-Mar-23 | 18 |
| Water Lab | Molybdenum | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Water Lab | Molybdenum | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Nickel | ICP-MS | BKK_EL0043 | 30-Sep-21 | 29-Mar-23 | 18 |
| Water Lab | Nickel | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Water Lab | Nickel | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Selenium | ICP-MS | BKK_EL0043 | 30-Sep-21 | 29-Mar-23 | 18 |
| Water Lab | Selenium | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Water Lab | Selenium | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Silver | ICP-MS | BKK_EL0043 | 30-Sep-21 | 29-Mar-23 | 18 |
| Water Lab | Silver | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Water Lab | Silver | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Zinc | ICP-MS | BKK_EL0043 | 30-Sep-21 | 29-Mar-23 | 18 |
| Water Lab | Zinc | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Water Lab | Zinc | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Ammonia Nitrogen | Discrete analyzer | BKK_EN0037 | 30-Jun-22 | 30-Jun-23 | 12 |
| Water Lab | Nitrate | Discrete analyzer | BKK_EN0037 | 30-Jun-22 | 30-Jun-23 | 12 |
| Water Lab | Reactive Phosphorus | Discrete analyzer | BKK_EN0037 | 30-Jun-22 | 30-Jun-23 | 12 |
| Water Lab | Reactive Phosphorus | Chamber (Cold Room) | BKK_EN0168 | 1-Jul-22 | 1-Jan-24 | 18 |
| Water Lab | Turbidity | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |

MM-N12

**PENTA CALIBRATION**

**PENTA CALIBRATION CO., LTD.**
66/124 The Connect 33 Village Kanchanaphisek Road
Dokmai Prawet Bangkok 10250
Tel: +66 (0) 2069-9773
www.pentacal.com

# Certificate of Calibration

NSC-TISI-TIS17025 CALIBRATION 0324

Represent to Certificate of Calibration ,PTC/07/22071

| | | | |
|---|---|---|---|
| Certificate No.: | PTC/07/22071 | Page: | 1 of 2 |
| Equipment: | Digital Balance | Condition: | Normal |
| Manufacturer: | Sartorius | Serial No: | 26207042 |
| Model: | MSE224-100-DU | ID No: | BKK_EN0002 |
| Type of Balance: | Single interval | | |

Customer: ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakarn 40 Phatthanakarn Rd.,
khwaeng Phatthanakarn, Khet Suan Luang, Bangkok 10250.

| Environment Condition: | | | | |
|---|---|---|---|---|
| | Temperature | 21.5 °C | ± | 0.7 °C |
| | Humidity | 61.8 %RH | ± | 4.7 %RH |
| | Air density | 1.19 | | kg/m$^3$ |

REVIEW BY Sarasat M.
APPROVED BY
NEXT CAL. DATE 25/02/23

Calibration Place: ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakarn 40 Phatthanakarn Rd.,
khwaeng Phatthanakarn, Khet Suan Luang, Bangkok 10250.

The Method used: In house method, PTC-WI-07, base on Euramet cg. 18

Traceability: This certificate is traceable to the SI Units through Thai Calibration Service Co.,ltd. , NSC-ONSC Accreditation No.: Calibration 0189

Date Received: February 25, 2022

Calibration Date: February 25, 2022

Issued Date: March 01, 2022

Calibration By: Mr. Rungroje Metakul

PENTA CALIBRATION CO.,LTD

( Mr.Kriangsak Kalasri )
Reviewed by

Approved By :
( Mr. Keattisak Kerdto )
Laboratory Manager

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 recognised 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). The effect that the results relate only to the items calibrated.

This calibration certificate shall not be reproduced except in full only, without written approval from penta calibration co ., ltd





**Equipment :** Burette
**Received Date :** 26 August 2022
**Condition As-Received :** Used Item
**Calibration Date :** 30 August 2022
**Reference :** 2208-0918DSC-2

**Condition of this result of calibration**

1. Reference Standard Instruments :

| Instruments | Model | Serial No. | ID. No. | Certificate No. | Traceability | Due date |
|---|---|---|---|---|---|---|
| 1) Balance | AE200S | N03679 | 140RC001 | 21MM429 | NIMT | 22 Sep 2022 |
| 2) Thermo-Hygrograph | THDX-CE | 00016540 | 140EC001 | 22H1243 | NIST,NIMT | 09 June 2023 |
| 3) Thermometer | - | 1594592 | 140EC010 | 22I181 | NIMT | 10 Feb 2023 |

This certification is traceable to SI Unit
2. The certificate is valid only to the item calibrated on date and place of calibration.
3. True value is converted to true volume at the standard temperature of 20 °C

**Calibration result :**

| Nominal capacity ( mL ) | Reading ( mL ) | Uncertainty ( ± mL ) | *k* Factor |
|---|---|---|---|
| 50 | 49.9959 | 0.010 | 2.00 |

**Remark** mL = cm$^3$

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-

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MM-N12

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

ilac-MRA

NSC-TISI-TIS17025 CALIBRATION 0008

**Cert. No.:** 21TM1629
**Page.:** 1 of 3

# Certificate of Calibration

| | |
|---|---|
| **Equipment :** | Hot Air Oven |
| **Manufacturer :** | Memmert |
| **Model :** | UFE 500 |
| **Serial No. :** | G511.0314 |
| **ID No. :** | BKK_EN0009 |
| **Submitted by :** | ALS Laboratory Group (Thailand) Co.,Ltd.<br>104 Phatthanakan 40, Phatthanakan Rd.,<br>Kwaeng Suan Luang, Khet Suan Luang,<br>Bangkok 10250 |
| **Location :** | Oven Room |
| **Received Order :** | 2 September 2021 |
| **Calibration Date :** | 2 September 2021 |
| **Ambient Temperature :** | ( 26 ± 10 ) °C |
| **Relative Humidity :** | ( 50 ± 30 ) % |
| **Calibrated by :** | Man Pattanapongpaiboon |
| **Approved by :** | Approved Signatory |

REVIEW BY Sirilk P.
APPROVED BY
NEXT CAL. DATE 3/3/23

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

**Issue Date :** 14 September 2021

**The Uncertainties are for a confidence probability of approximately 95%**

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A 0031775



PENTA CALIBRATION

**PENTA CALIBRATION CO., LTD.**
66/124 The Connect 33 Village Kanchanaphisek Road
Dokmai Prawet Bangkok 10250
Tel: +66 (0) 2069-9773
www.pentacal.com

Represent to Certificate of Calibration ,PTC/07/22071

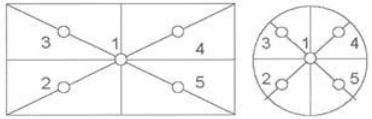
Certificate No.: PTC/07/22071 Page: 2 of 2

## Measurement Results:

Without Adjustment :

Function Calibration: Non Adjustment

Eccentric Error: Weight to be 1/3 ,1/2 or of Maximum capacity




Eccentricity test 100 (g)

| Position (g) | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| 0.0000 | -0.0002 | -0.0001 | 0.0001 | -0.0001 |
| Maximum deviation: | | | 0.0002 | |

Repeatability Test : Weight to be 1/2 $\leq L_1 \leq$ Maximum capacity

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

| Nominal test value (g) | Standard Deviation |
|---|---|
| 200 | 0.00005 |

Error of indication : from nominal value., Readability 0.0001 (g)

| Nominal Value (g) | Conventional Mass (g) | Indication (g) | Correction of Balance (g) | Uncertainty (g) | *k* |
|---|---|---|---|---|---|
| 0 | 0.00000 | 0.0000 | 0.0000 | 0.00016 | 2.52 |
| 0.1 | 0.10000 | 0.1000 | 0.0000 | 0.00017 | 2.20 |
| 0.5 | 0.50000 | 0.5000 | 0.0000 | 0.00016 | 2.28 |
| 1 | 1.00001 | 1.0000 | 0.0000 | 0.00016 | 2.28 |
| 2 | 2.00001 | 2.0000 | 0.0000 | 0.00016 | 2.28 |
| 5 | 5.00001 | 5.0000 | 0.0000 | 0.00016 | 2.28 |
| 10 | 10.00002 | 10.0000 | 0.0000 | 0.00016 | 2.28 |
| 20 | 20.00002 | 20.0000 | 0.0000 | 0.00016 | 2.23 |
| 50 | 50.00001 | 50.0000 | 0.0000 | 0.00017 | 2.15 |
| 100 | 100.00002 | 99.9999 | 0.0001 | 0.00020 | 2.06 |
| 120 | 120.00004 | 120.0000 | 0.0000 | 0.00023 | 2.03 |
| 150 | 150.00003 | 150.0000 | 0.0000 | 0.00026 | 2.00 |
| 200 | 200.00003 | 199.9999 | 0.0001 | 0.00030 | 2.00 |

Note: Weight of adjust - (g)

The End of Certificate

**Equipment :** Hot Air Oven
**Condition As-Received :** Used Item
**Reference :** 2109-0004OC-1
**Result of Calibration :-** ( * ) Without Adjustment
**Function of UUC* :** Temperature Source
**Fresh air setting :** Close

**Cert. No.:** 21TM1629


| Calibration Point ( °C ) | UUC* Setting ( °C ) | UUC* Reading ( °C ) | Temperature stability ( ± °C ) | Temperature uniformity ( °C ) | Overall Variation ( °C ) | Uncertainty ( ±°C ) | Coverage Factor *k* |
|---|---|---|---|---|---|---|---|
| 60.0 | 60.0 | 60.0 | 0.047 | 0.32 | 0.52 | 0.42 | 2 |
| 95.0 | 95.0 | 95.0 | 0.034 | 0.51 | 0.83 | 0.42 | 2 |
| 103.0 | 103.0 | 103.0 | 0.053 | 0.57 | 1.0 | 0.42 | 2 |
| 104.0 | 104.0 | 104.0 | 0.095 | 0.62 | 1.1 | 0.43 | 2 |

| Calibration Point ( °C ) | Measured Temperature ( °C ) Position | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 (ref.) |
| 60.0 | 59.912 | 59.968 | 59.859 | 59.772 | 60.200 | 60.076 | 60.203 | 60.120 | 60.067 |
| 95.0 | 94.767 | 94.809 | 94.720 | 94.582 | 95.347 | 95.025 | 95.098 | 95.016 | 94.879 |
| 103.0 | 102.814 | 102.866 | 102.712 | 102.555 | 103.482 | 103.204 | 103.288 | 103.190 | 102.976 |
| 104.0 | 103.742 | 103.794 | 103.643 | 103.484 | 104.486 | 104.180 | 104.265 | 104.154 | 103.924 |

**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-

Malu .





**Equipment :** Hot Air Oven
**Condition As-Received :** Used Item
**Reference :** 2109-0004OC-1

**Cert. No.:** 21TM1629


**Procedure Used :-**

Calibration were conducted using calibration procedure CP-OT02 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**

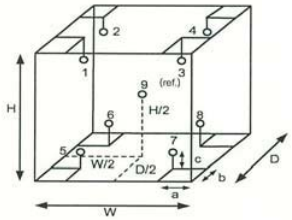
1. Reference standard instrument:-

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|---|---|---|---|---|
| 1 ) Data Acquisition | 34972A | MY57013711 | 21LM7 | 16 Jun 2022 |

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

**Result of Calibration :-** ( * ) Without Adjustment
**Function of UUC* :** Temperature Source
**Fresh air setting :** Close

| Environment during calibration | Beginning | Finished |
|---|---|---|
| Temp. ( °C ) | 25 | 25 |
| REL.Humid. ( % ) | 56 | 58 |
| AC Supply ( Volt ) | 221 | 222 |




| Position : | Ref. Std. ID No.: |
|---|---|
| 1 | 18-18RTD-01 |
| 2 | 18-18RTD-02 |
| 3 | 18-18RTD-03 |
| 4 | 18-18RTD-04 |
| 5 | 18-18RTD-05 |
| 6 | 18-18RTD-06 |
| 7 | 18-18RTD-07 |
| 8 | 18-18RTD-08 |
| 9 (ref.) | 18-18RTD-09 |

**Probe Installation Details :**

a = 5.0 cm
b = 5.0 cm
c = 5.0 cm

**Dimension of Chamber :**

D = 0.40 m
W = 0.56 m
H = 0.48 m
Capacity = 0.11 $m^3$

Malu .

**Equipment :** Hot Air Oven
**Condition As-Received :** Used Item
**Reference :** 2112-0002OC-1

**Cert. No.:** 21TM2189
**Page.:** 2 of 3

**Procedure Used :-**

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector ( RTD ) and Thermocouple Type T.

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

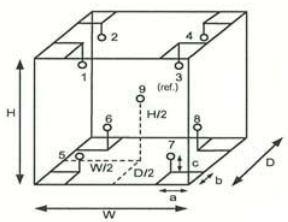
| Instrument | Model | Serial No. | Cert. No. | Due Date |
|---|---|---|---|---|
| 1 ) Data Acquisition | 34970A | MY44060450 | 21LM4/1 | 06 Mar 2022 |

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

**Result of Calibration :-** ( * ) Without Adjustment

**Function of UUC* :** Temperature Source

**Fresh air setting :** Close




| Environment during calibration | | |
|---|---|---|
| | Beginning | Finished |
| Temp. ( °C ) | 25 | 25 |
| REL.Humid. ( % ) | 51 | 53 |
| AC Supply ( Volt ) | 221 | 222 |

| Position : | Ref. Std. ID No.: @ Calibration Point ( 104 ) °C | ( 121,175,180 ) °C |
|---|---|---|
| 1 | 19-14RTD-01 | 19-14TC-01 |
| 2 | 19-14RTD-02 | 19-14TC-02 |
| 3 | 19-14RTD-03 | 19-14TC-03 |
| 4 | 19-14RTD-04 | 19-14TC-04 |
| 5 | 19-14RTD-05 | 19-14TC-05 |
| 6 | 19-14RTD-06 | 19-14TC-06 |
| 7 | 21-14RTD-07 | 19-14TC-07 |
| 8 | 19-14RTD-08 | 19-14TC-08 |
| 9 (ref.) | 19-14RTD-09 | 19-14TC-09 |

**Probe Installation Details :**

| | | |
|---|---|---|
| a = | 5.0 | cm |
| b = | 5.0 | cm |
| c = | 5.0 | cm |

**Dimension of Chamber :**

| | | |
|---|---|---|
| D = | 0.40 | m |
| W = | 0.56 | m |
| H = | 0.48 | m |
| Capacity = | 0.11 | m³ |

Malu

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

NSC-TISI-TIS17025 CALIBRATION 0008

**Cert. No.:** 21TM2189
**Page.:** 1 of 3

# Certificate of Calibration

REVIEW BY Siriluk P
APPROVED BY KL AL
NEXT CAL. DATE 01/06/23

**Equipment :** Hot Air Oven
**Manufacturer :** Memmert
**Model :** UFE 500
**Serial No. :** G511.1574
**ID No. :** BKK_EN0007
**Submitted by :** ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Phatthanakan, Khet Suan Luang,
Bangkok 10250 Thailand
**Location :** Oven Room

**Received Order :** 1 December 2021
**Calibration Date :** 1 December 2021
**Ambient Temperature :** ( 26 ± 10 ) °C
**Relative Humidity :** ( 50 ± 30 ) %

**Calibrated by :** Khit Ruttanaprapachai

**Approved by :** Malu
Approved Signatory

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

**Issue Date :** 7 December 2021

**The Uncertainties are for a confidence probability of approximately 95%**

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Agilent CrossLab Compliance Services

# Certificate of System Qualification

ES-OQ

| | |
|---|---|
| System ID: | MY16010005 |
| Organization Name: | ALS Laboratory Group (Thailand) Co., Ltd. |
| Organization Location: | 104 Phatthanakan 40 Phatthanakan Rd., Bangkok 10250 |
| Date: | September 13, 2021 5:49:11 PM |
| EQP Name: | AgilentRecommended |
| EQP Revision: | ES.02.50 |
| Overall Qualification Status: | Pass |

**Preparation**

Pass

**Instrument Tests**

Pass

**Autosampler Operation**

Pass

REVIEW BY Thiting B.

APPROVED BY Sawitan N.

NEXT CAL. DATE 12 Mar 23



**Equipment :** Hot Air Oven
**Condition As-Received :** Used Item
**Reference :** 2112-0002OC-1
**Result of Calibration :-** ( * ) Without Adjustment
**Function of UUC* :** Temperature Source
**Fresh air setting :** Close

**Cert. No.:** 21TM2189
**Page.:** 3 of 3

| Calibration Point ( °C ) | UUC* Setting ( °C ) | UUC* Reading ( °C ) | Temperature stability ( ± °C ) | Temperature uniformity ( °C ) | Overall Variation ( °C ) | Uncertainty ( ±°C ) | Coverage Factor *k* |
|---|---|---|---|---|---|---|---|
| 104.0 | 104.0 | 104.0 | 0.059 | 0.52 | 0.59 | 0.45 | 2 |
| 121.0 | 121.0 | 121.0 | 0.11 | 0.75 | 1.2 | 1.1 | 2 |
| 175.0 | 175.0 | 175.0 | 0.13 | 0.90 | 1.6 | 1.1 | 2 |
| 180.0 | 180.0 | 180.0 | 0.13 | 0.93 | 1.6 | 1.1 | 2 |

| Calibration Point ( °C ) | Measured Temperature ( °C ) Position 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 (ref.) |
|---|---|---|---|---|---|---|---|---|---|
| 104.0 | 104.265 | 104.229 | 104.080 | 103.922 | 104.390 | 104.304 | 104.284 | 103.994 | 103.909 |
| 121.0 | 120.838 | 120.519 | 120.661 | 120.524 | 121.162 | 120.855 | 120.703 | 120.126 | 120.726 |
| 175.0 | 175.021 | 174.603 | 174.848 | 174.652 | 175.830 | 175.321 | 175.411 | 174.440 | 175.222 |
| 180.0 | 179.792 | 179.374 | 179.575 | 179.376 | 180.643 | 180.081 | 180.174 | 179.217 | 180.014 |

**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 %.

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**Details**

| | |
|---|---|
| Full Name of Signer: | Kanyakorn Sukpathrajarern |
| Logged On User Name: | phimprapha.jeeraphong@agilent.com |
| Signature Creation Date: | September 13, 2021 |
| Reason for Signature: | Executed protocol and published this original version of document |

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# Instrument Details

**Purpose**

This section describes the as found system configuration.

**Details**

| | |
|---|---|
| Spectrometer 1 | |
| Manufacturer | Agilent Technologies |
| Name | 5100 SVDV |
| Model Number | G8010A |
| Sample Introduction | Double pass glass cyclonic spraychamber and seaspray nebulizer |
| Serial Number | MY16010005 |
| Firmware Revision | 5395 |
| Chiller 1 | |
| Manufacturer | Agilent Technologies |
| Name | Other Unspecified |
| Other Unspecified Name | Chiller |
| Model Number | Other Unspecified |
| Other Unspecified Model Number | G3292-80201 |
| Serial Number | 2008-00159 |
| Autosampler 1 | |
| Manufacturer | Agilent Technologies |
| Name | SPS4 |
| Model Number | G8410A |
| Serial Number | AU15440764 |
| Switching Valve Accessory 1 | |
| Manufacturer | Agilent Technologies |
| Name | SVS 2+ |
| Model Number | G8485A |
| Serial Number | AU16040115 |

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User Name: phimprapha.jeeraphong
Hostname: ASBKKWX328

System Id: MY16010005
Print Date: September 13, 2021 5:49:12 PM

OQHW 5100 ICPOES ALS 08Sep21 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|---|---|---|---|---|
| September 8, 2021 9:51:30 AM | Start | Execution | Autosampler Operation : Autosampler 1 - SPS4: Qualitative Test - No setpoints associated | None |
| September 8, 2021 9:51:36 AM | End | Execution | Autosampler Operation : Autosampler 1 - SPS4: Qualitative Test - No setpoints associated | Run Count : 1 |
| September 8, 2021 9:51:38 AM | End | Qualification | Session | OQ |
| September 8, 2021 9:51:38 AM | Start | Reporting | Session | None |
| September 8, 2021 10:55:40 AM | Audit | AceClosed | Session | None |
| September 13, 2021 5:01:26 PM | Audit | AceRestarted | Session | None |
| September 13, 2021 5:01:26 PM | Audit | SessionReloaded | Session | None |
| September 13, 2021 5:01:28 PM | Start | Qualification | Session | OQ |
| September 13, 2021 5:47:55 PM | Audit | Reporting | Session | Report Generated : Certificate |

Page 2 / 2



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User Name: phimprapha.jeeraphong
Hostname: ASBKKWX328

System Id: MY16010005
Print Date: September 13, 2021 5:49:12 PM

OQHW 5100 ICPOES ALS 08Sep21 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|---|---|---|---|---|
| September 8, 2021 8:49:59 AM | Audit | SessionCreated | Session | None |
| September 8, 2021 8:49:59 AM | Start | Configuration | Session | None |
| September 8, 2021 8:49:59 AM | Audit | Entitlement | Licensing | User is FieldEngineer and does not require an unlock code |
| September 8, 2021 9:07:06 AM | Audit | EqpLoaded | Session | EQP details for primary technique [Es] - File path: [ProtocolPacks/Es/Configurations/02.50/Es.02.50.eqp], EQP File Name: [Es.02.50.eqp], EQP Name: [AgilentRecommended] |
| September 8, 2021 9:07:11 AM | End | Configuration | Session | None |
| September 8, 2021 9:07:15 AM | Start | Qualification | Session | OQ |
| September 8, 2021 9:07:15 AM | Start | Execution | Preparation : 5100 SVDV: Qualitative Test - No setpoints associated | None |
| September 8, 2021 9:34:35 AM | End | Execution | Preparation : 5100 SVDV: Qualitative Test - No setpoints associated | Run Count : 1 |
| September 8, 2021 9:34:39 AM | Start | Execution | Instrument Tests : 5100 SVDV: Qualitative Test - No setpoints associated | None |
| September 8, 2021 9:51:27 AM | End | Execution | Instrument Tests : 5100 SVDV: Qualitative Test - No setpoints associated | Run Count : 1 |

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Agilent CrossLab Compliance Services

Agilent CrossLab
From Insight to Outcome

# EQUIPMENT QUALIFICATION REPORT (EQR)

## Agilent CrossLab Compliance

| | |
|---|---|
| Qualification Type: | ES-OQ |
| System ID: | MY16010005 |
| EQP Name: | AgilentRecommended |
| EQP Details: | Agilent Technologies System |
| EQP Revision: | ES.02.50 |
| EQP Release Date: | March 2020 |
| Date: | September 13, 2021 5:50:41 PM |
| Report Type: | Report |
| Org. Name: | ALS Laboratory Group (Thailand) Co., Ltd. |
| Org. Location: | 104 Phatthanakan 40 Phatthanakan Rd., Bangkok 10250 |

# Service Details

**Purpose**

This section includes local contact and delivery details for this service.

**General Details**

| | |
|---|---|
| Service Order No./Request: | 6004823273 |
| EQP Name: | AgilentRecommended |
| EQP Revision: | ES.02.50 |
| Report Type: | Report |

**Organization Details**

| | |
|---|---|
| Name: | ALS Laboratory Group (Thailand) Co., Ltd. |
| Location: | 104 Phatthanakan 40 Phatthanakan Rd., Bangkok 10250 |

**Local Contact Details**

| | |
|---|---|
| Name: | Khun Thitima Boonpeng |
| Job Title: | Scientist 2, Life Sciences |
| Qualification Location: | ICP Room |

**Operator Details**

| | |
|---|---|
| Name: | Kanyakorn sukpathrajarern |
| Job Title: | Field Service Engineer |

**Data Acquisition Details**

| | |
|---|---|
| Acquisition Software Name: | ICP Expert |
| Acquisition Software Revision: | 7.5.3.11953 |
| Customer Data System (CDS): | Es: ICP Expert |





# Test Summary

**Purpose**

This section includes a status for each scheduled test and the overall qualification. For each test that is run, (1) the status is automatically determined based on pre-defined limits, and (2) the total number of times the test was run is displayed. For detailed results and specifications for a test, refer to the test results in this EQR.

**Details**

| Test | Status | Runs |
|---|---|---|
| Preparation : 5100 SVDV | Pass | 1 |
| Instrument Tests : 5100 SVDV | Pass | 1 |
| Autosampler Operation : Autosampler 1 - SPS4 | Pass | 1 |

**Overall Qualification Status**

Pass



MM-N12
819/82

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# Protocol Details

**Purpose**

This section lists the revisions for all test units used in this report. For complete test-specific and high-level change details, refer to the Revision History document.

| Test Revision | Test |
|---|---|
| ES.02.50 | Autosampler Operation |
| ES.02.50 | Instrument Tests |
| ES.02.50 | Preparation |



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# Instrument Details

**Purpose**

This section describes the as found system configuration.

**Details**

Spectrometer 1

| | |
|---|---|
| Manufacturer | Agilent Technologies |
| Name | 5100 SVDV |
| Model Number | G8010A |
| Sample Introduction | Double pass glass cyclonic spraychamber and seaspray nebulizer |
| Serial Number | MY16010005 |
| Firmware Revision | 5395 |

Chiller 1

| | |
|---|---|
| Manufacturer | Agilent Technologies |
| Name | Other Unspecified |
| Other Unspecified Name | Chiller |
| Model Number | Other Unspecified |
| Other Unspecified Model Number | G3292-80201 |
| Serial Number | 2008-00159 |

Autosampler 1

| | |
|---|---|
| Manufacturer | Agilent Technologies |
| Name | SPS4 |
| Model Number | G8410A |
| Serial Number | AU15440764 |

Switching Valve Accessory 1

| | |
|---|---|
| Manufacturer | Agilent Technologies |
| Name | SVS 2+ |
| Model Number | G8485A |
| Serial Number | AU16040115 |

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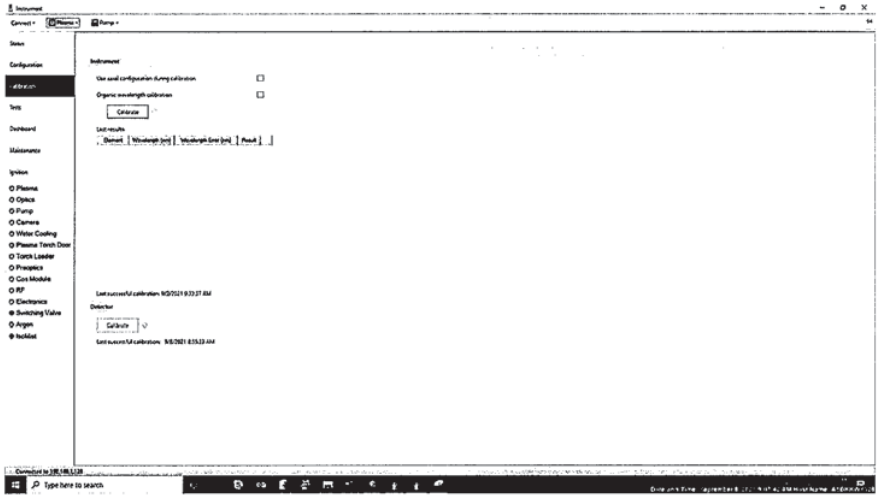
**Test Evidence**

| | |
|---|---|
| Image Details: | Was the detector calibration performed and completed successfully? |
| Date and Time: | September 8, 2021 9:07:42 AM |
| Host Name: | ASBKKWX328 |





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# Preparation

**Purpose**

This test records a status for each preparation task for the Agilent ICP-OES.

**Configuration Details**

| | | |
|---|---|---|
| Model/Serial No.: | G8010A | MY16010005 |

**Results**

| Criteria | Observed Result | Expected Result | Status |
|---|---|---|---|
| Does the plasma ignite successfully in the first three attempts? | Yes | Yes | Pass |
| Was the detector calibration performed and completed successfully? | Yes | Yes | Pass |
| Was the instrument calibration performed and completed successfully? | Yes | Yes | Pass |

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# Instrument Tests

**Purpose**

This test records a status for each of the automated tests within the Agilent ICP-OES CDS. For detailed test criteria, refer to the attached report.

**Configuration Details**

| | | |
|---|---|---|
| Model/Serial No.: | G8010A | MY16010005 |

| **Results** | Observed Result | Expected Result | Status |
|---|---|---|---|
| Are the Functional Tests results within acceptance criteria? | | | |
| Subsystem Communications | Yes | Yes | Pass |
| Air Flow | Yes | Yes | Pass |
| Water Flow | Yes | Yes | Pass |
| Gas Flows | Yes | Yes | Pass |
| RF Generator | Yes | Yes | Pass |
| Camera | Yes | Yes | Pass |
| Optics | Yes | Yes | Pass |
| Are the Instrument Performance Tests results within acceptance criteria? | | | |
| Resolution | Yes | Yes | Pass |
| Sensitivity | Yes | Yes | Pass |
| Precision | Yes | Yes | Pass |

**Overall Test Status**

| | |
|---|---|
| Pass | Runs: 1 |



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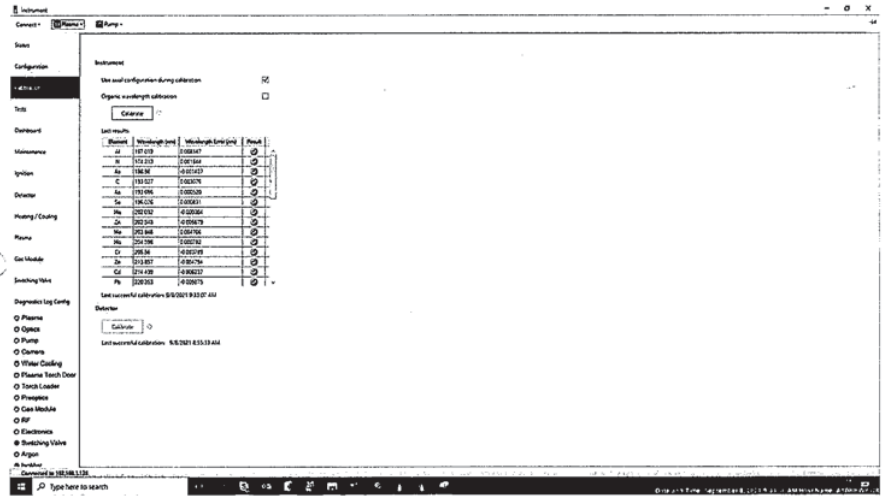
| | |
|---|---|
| Image Details: | Was the instrument calibration performed and completed successfully? |
| Date and Time: | September 8, 2021 9:33:30 AM |
| Host Name: | ASBKKWX328 |



**Overall Test Status**

| | |
|---|---|
| Pass | Runs: 1 |

## Declaration of Change Control

This document is under change control. Revision history is maintained and printed on each document. Access to the master documents is limited to process owners. Documents receive periodic review and cannot be assigned an evergreen status. The qualification performed according to this document refers only to the hardware/software configuration in place at the time of the qualification. Agilent Technologies recommends that instrument configuration change management procedures be in place in order to maintain the validation process. Any changes to the analytical or computer hardware or software must be clearly specified. A change management system provides a means for determining the degree of requalification required according to the extent of the changes made. All details of the changes must be thoroughly recorded and documented, together with details of completed tests and their results. Note: Hardware/software configuration management is the customer's responsibility.





## Autosampler Operation

**Purpose**

This test verifies that the autosampler operates properly.

**Configuration Details**

| | | |
|---|---|---|
| Model/Serial No.: | G8410A | AU15440764 |

**Results**

| Criteria | Observed Result | Expected Result | Status |
|---|---|---|---|
| Does the autosampler successfully move to the specified location(s)? | Yes | Yes | Pass |

**Overall Test Status**

Pass

Runs: 1



MM-N12
419/86

General

**Document Name:** Certificate of Qualification for ACE

Agilent Technologies

## Agilent Compliance Engine Self Qualification

**Date:** September 8, 2021 10:10:10 AM

**Drive Serial #:** EAF04572 **Platform Revision:** A.03.01

Individual self-qualification reports for each specific technique installed are also available upon request. They provide additional details on the general report from the concise summary and are structured by the actual algorithms challenged during the process. There is not a one-to-one relationship between algorithms and OQ program tests because some algorithms are used by several tests and across multiple similar hardware components of the qualified systems.

| Technique Type | Tests Completed | Result |
|---|---|---|
| UV-Vis Spectrophotometer | 13 | Conforms |
| Atomic Absorption | 7 | Conforms |
| Capillary Electrophoresis | 10 | Conforms |
| Software | 6 | Conforms |
| Emission Spectroscopy | 3 | Conforms |
| Infrared Spectroscopy | 7 | Conforms |

**Overall Qualification Status**

Conforms





## Attachments

| Location | Category | Document Name | Page |
|---|---|---|---|
| EQR | General | Certificate of Qualification for ACE | 1 |
| EQR | General | Certificate of Qualification for ACE | 1 |
| EQR | General | Operator's training certificate and qualifications | 1 |
| EQR | Material | Certificate of Analysis Wavelength calibration solution | 4 |
| EQR | Comments | General | 1 |
| EQR | General | Instrument's Test Report | 5 |
| EQR | General | Instrument's Test Report | 4 |



MM-N12
9.9/87

**Document Name:** Operator's training certificate and qualifications

Agilent Technologies

## Certificate of Completion

| | |
|---|---|
| Learner Name: | Kanyakorn Sukpathrajarern |
| Title Of Course: | ANV-CE-ICPOES-2-008-A: Agilent 5100 ICP-OES Support Neophyte Training |
| Completion Date: | November 2, 2017 |
| Certified By Company: | Learning at Agilent |

**All Service and Support training certificates have the following specific limitations.**

A certificate for Service and Support training is only valid while employed by Agilent Technologies or while working as an Agilent-authorized service provider, through which the service employee has ongoing access to Agilent's: Safety Alerts, Service Notes, internal technical updates, update training, current documentation, technical support, current parts, and parts updates. Completion of training alone, without being employed by Agilent Technologies, does not qualify an individual to safely install, service or maintain Agilent products.





**Document Name:** Certificate of Qualification for ACE

Agilent Technologies

## Certificate of Completion

| | |
|---|---|
| Learner Name: | Kanyakorn Sukpathrajarern |
| Title Of Course: | AN-CE-SS-II-030-A: ACE 3.X User Update Training |
| Completion Date: | June 25, 2020 |
| Certified By Company: | Learning at Agilent |

**All Service and Support training certificates have the following specific limitations.**

A certificate for Service and Support training is only valid while employed by Agilent Technologies or while working as an Agilent-authorized service provider, through which the service employee has ongoing access to Agilent's: Safety Alerts, Service Notes, internal technical updates, update training, current documentation, technical support, current parts, and parts updates. Completion of training alone, without being employed by Agilent Technologies, does not qualify an individual to safely install, service or maintain Agilent products.



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88/619

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**Document Name:** Certificate of Analysis Wavelength calibration solution

Agilent

**Period of Validity:** Agilent ensures the accuracy of this solution until the expiration date shown below, provided the instructions for use are followed. During the period of validity, the purchaser will be notified if this product is recalled due to any significant changes in the stability of the solution.

**Sample lot approver:**

**Date of release:** 6 April 2020
**Date of expiration:** 6 October 2021

Chuck Goudreau, Certifying Officer



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**Materials**

**Document Name:** Certificate of Analysis Wavelength calibration solution

Agilent

# CERTIFICATE OF ANALYSIS

**Agilent Product Name:** Wavelength Calibration Solution for ICP-OES & MP-AES, 5 mg/L, 500mL
**Agilent Part No:** 8510030100
**Lot No:** 0010578941

## Product Specifications

| Analyte | Starting Material | CAS # | Certified Conc. | Analyte | Starting Material | CAS # | Certified Conc. |
|---|---|---|---|---|---|---|---|
| Al | $Al(NO_3)_3$ | 7784-27-2 | 5.000 ± 0.025 mg/L | Mn | Mn | 7439-96-5 | 5.001 ± 0.025 mg/L |
| As | As | 7440-38-2 | 5.001 ± 0.025 mg/L | Mo | $(NH_4)_6Mo_7O_{24}$ | 13106-76-8 | 5.007 ± 0.025 mg/L |
| Ba | $Ba(NO_3)_2$ | 10022-31-8 | 5.000 ± 0.025 mg/L | Ni | Ni | 7440-02-0 | 5.004 ± 0.025 mg/L |
| Cd | Cd | 7440-43-9 | 5.002 ± 0.025 mg/L | Pb | Pb | 7439-92-1 | 4.999 ± 0.025 mg/L |
| Co | Co | 7440-48-4 | 4.996 ± 0.025 mg/L | Se | Se | 7782-49-2 | 5.004 ± 0.025 mg/L |
| Cr | $Cr(NO_3)_3$ | 13548-38-4 | 5.002 ± 0.025 mg/L | Sr | $Sr(NO_3)_2$ | 10042-76-9 | 5.000 ± 0.025 mg/L |
| Cu | Cu | 7440-50-8 | 5.007 ± 0.025 mg/L | Zn | Zn | 7440-66-6 | 5.002 ± 0.025 mg/L |
| K | $KNO_3$ | 7757-79-1 | 50.00 ± 0.25 mg/L | | | | |

**Matrix:** 5% $HNO_3$

**Intended Use:** This solution is intended for use as a certified reference material or calibration standard for inductively coupled plasma optical emission spectroscopy (ICP-OES), inductively coupled plasma mass spectrometry (ICP-MS), atomic absorption spectroscopy (flame AAS or GFAAS), microwave plasma atomic emission spectroscopy (MP-AES), x-ray fluorescence spectroscopy (XRF), and other techniques for elemental analysis.

**Certification & Traceability:** This CRM was manufactured under a quality management system that is registered to **ISO 9001, ISO 17034** and **ISO/IEC 17025**. This CRM was prepared to the certified concentrations shown above by gravimetric methods using single-element concentrates that were certified using the "High Performance ICP-OES" protocol developed by NIST and are directly traceable to the NIST SRMs listed below. This solution was stabilized using high purity nitric acid ($HNO_3$) and diluted with filtered (0.22µm), 18 M-ohm deionized water. The balances used in the preparation of this CRM are calibrated regularly with traceability to NIST. All volumetric dilutions are performed in Class A calibrated glassware. The certified concentrations were determined based upon gravimetric procedures. Secondary verification of the certified concentrations was performed using ICP-OES that was calibrated and/or referenced against NIST SRMs: 3101a, 3103a, 3104a, 3108, 3113, 3112a, 3114, 3141a, 3132, 3134, 3135, 3128, 3149, 3153a, and 3168a. The uncertainty associated with each certified concentration represents the expanded uncertainty at the 95% confidence level using a coverage factor of k=2.

**Instructions for Use:** Agilent recommends that the solution be thoroughly mixed by repeated shaking or swirling of the bottle immediately prior to use. To achieve the highest accuracy the analyst should: (1) use only pre-cleaned containers and transferware, (2) avoid pipetting directly from the CRM's original container, (3) use a minimum sub-sample size of 500µL, (4) make dilutions using calibrated balances or certified volumetric class A flasks and pipettes, (5) dilute to volume using the same matrix as the original CRM, and (6) never pour used product back into the original container. The solution should be kept tightly capped and stored under normal laboratory conditions. Do not freeze, heat, or expose to direct sunlight. Minimize exposure to moisture or high humidity.

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**Document Name:** Certificate of Analysis Wavelength calibration solution

**Date:** September 13, 2021 5:50:41 PM
**System ID:** MY16010005

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**Document Name:** Certificate of Analysis Wavelength calibration solution

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**Hazard Information:** Refer to the Safety Data Sheet (SDS), which can be obtained at www.agilent.com/chem/sds.

**Homogeneity:** This solution was determined to be homogeneous by procedures consistent with the requirements of ISO 17034 and ISO Guide 35. Replicate samples of the finished solution were analyzed to confirm its homogeneity, in accordance with GSP 8-13 Assessment of Homogeneity and Stability. To ensure homogeneity, users should not take a smaller sub-sample than specified in the Instructions for Use, as doing so will invalidate the certified values and uncertainties.

**Further Information:** Please contact Agilent for further information about this CRM.

**Quality Certifications:** This CRM was prepared under a quality management system that is:

- Registered to ISO 9001 – Quality Management Systems – Requirements (TUV NORD Cert. Reg. No. 44 100 16580231)
- Accredited to ISO 17034– General Requirements for the Competence of Reference Material Producers (A2LA Cert. No. 2848.02)
  - ISO 17034 references additional requirements specified in ISO Guide 31 and ISO Guide 35.
- Accredited to ISO/IEC 17025 – General Requirements for the Competence of Testing and Calibration Laboratories (A2LA Cert. No. 2848.01)

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## General

**Document Name:** Instrument's Test Report

**Report Summary**

| | |
|---|---|
| Instrument Model | Agilent 5100/5110 SVDV ICP-OES |
| Instrument ID | G8010A/G8014A |
| Instrument Serial Number | MY16010005 |
| Software Version | 7.5.3.11953 |
| Firmware Version | 5395 |
| Tested By | Kanyakorn S. |
| Test started on | 9/8/2021 9:51:21 AM |
| Test Completed On | 9/8/2021 9:56:35 AM |

**Result Summary**

| | |
|---|---|
| Subsystem Communications Test | Pass |
| Air Flow Test | Skipped |
| Water Flow Test | Skipped |
| Gas Flows Test | Skipped |
| RF Generator Test | Skipped |
| Camera Test | Skipped |
| Optics Test | Pass |
| Advanced Valve System Test | Skipped |
| Resolution Test | Pass |
| Sensitivity Test | Pass |
| Precision Test | Pass |

**Subsystem Communications Test** **Pass**

**Optics Test** **Pass**

| | Radial | Axial | SVDV |
|---|---|---|---|
| Intensity | 3082176 | 3162050 | 3419288 |
| Wavelength | 737.212 | 737.212 | 737.212 |

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## Comments

| | |
|---|---|
| Date/Time: | September 13, 2021 5:27:56 PM |
| Test: | General |
| Comment: | Start OQ on 08 Sep 21 and found water flow fail, So repair job complete for 13 Sep 21 and OQ continue to complete. |

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**Document Name:** Instrument's Test Report

**Sensitivity Test** **Pass**

Radial

| Element Wavelength | Specification | Method | Ratio | Standard | Blank |
|---|---|---|---|---|---|
| As (188.980 nm) | ≥ 46.0 | SRBR | 88.8 | 960.1 | 94.9 |
| Se (196.026 nm) | ≥ 41.0 | SRBR | 55.8 | 709.4 | 113.8 |
| Zn (213.857 nm) | ≥ 1421.0 | SRBR | 2095.3 | 29674.4 | 197.9 |
| Pb (220.353 nm) | ≥ 46.0 | SRBR | 100.6 | 1392.6 | 152.2 |
| Mn (257.610 nm) | ≥ 3518.0 | SRBR | 6641.7 | 127413.8 | 365.9 |
| Al (396.152 nm) | ≥ 3.4 | SBR | 6.9 | 24237.9 | 3081.8 |
| Ba (493.408 nm) | ≥ 34.0 | SBR | 95.1 | 1015416.2 | 10563.7 |
| K (766.491 nm) | ≥ 1.8 | SBR | 4.4 | 82043.9 | 15321.8 |

Axial

| Element Wavelength | Specification | Method | Ratio | Standard | Blank |
|---|---|---|---|---|---|
| As (188.980 nm) | ≥ 208.0 | SRBR | 292.4 | 5108.5 | 273.5 |
| Se (196.026 nm) | ≥ 159.0 | SRBR | 199.9 | 3903.2 | 321.0 |
| Zn (206.200 nm) | ≥ 243.0 | SRBR | 793.6 | 12455.9 | 237.0 |
| Zn (213.857 nm) | ≥ 1743.0 | SRBR | 4924.5 | 130652.8 | 696.4 |
| Cd (214.439 nm) | ≥ 4227.0 | SRBR | 4508.6 | 87692.4 | 375.1 |
| Pb (220.353 nm) | ≥ 320.0 | SRBR | 327.3 | 7653.1 | 480.3 |
| Mn (257.610 nm) | ≥ 10625.0 | SRBR | 19008.6 | 632891.9 | 1104.7 |
| Cr (267.716 nm) | ≥ 1048.0 | SRBR | 4115.3 | 173999.6 | 1751.9 |
| Cu (324.754 nm) | ≥ 19.0 | SBR | 46.6 | 188303.3 | 3960.0 |
| Al (396.152 nm) | ≥ 6.0 | SBR | 16.7 | 156852.5 | 8877.5 |
| Ba (493.408 nm) | ≥ 60.0 | SBR | 168.0 | 5374075.7 | 31797.5 |
| K (766.491 nm) | ≥ 24.0 | SBR | 64.8 | 2536127.0 | 38564.9 |

**Precision Test** **Pass**

Radial

| Element Wavelength | Specification | Measured Value % RSD |
|---|---|---|
| As (188.980 nm) | ≤ 2.60 | 1.08 |
| Se (196.026 nm) | ≤ 2.60 | 1.38 |
| Zn (213.857 nm) | ≤ 1.50 | 0.62 |
| Pb (220.353 nm) | ≤ 2.60 | 0.72 |
| Mn (257.610 nm) | ≤ 1.50 | 0.44 |





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**Document Name:** Instrument's Test Report

**Resolution Test** **Pass**

| Element Wavelength | Specification | Width |
|---|---|---|
| N (174.213 nm) | ≤ 9.40 | 7.54 |
| As (188.980 nm) | ≤ 8.20 | 6.43 |
| C (193.027 nm) | ≤ 11.50 | 8.89 |
| Mo (202.032 nm) | ≤ 8.20 | 6.50 |
| Cr (206.158 nm) | ≤ 13.40 | 11.05 |
| Zn (213.857 nm) | ≤ 8.70 | 7.27 |
| Pb (220.353 nm) | ≤ 9.50 | 7.52 |
| Co (228.615 nm) | ≤ 17.20 | 12.66 |
| Ba (230.424 nm) | ≤ 9.40 | 7.80 |
| Mn (257.610 nm) | ≤ 13.30 | 9.99 |
| Mn (260.568 nm) | ≤ 20.30 | 16.83 |
| Cr (267.716 nm) | ≤ 11.00 | 8.53 |
| Cu (324.754 nm) | ≤ 25.00 | 19.14 |
| Cu (327.395 nm) | ≤ 14.20 | 11.75 |
| Sr (338.071 nm) | ≤ 33.50 | 26.94 |
| Ba (455.403 nm) | ≤ 44.00 | 33.57 |
| Sr (460.733 nm) | ≤ 36.00 | 22.38 |
| Ba (493.408 nm) | ≤ 36.00 | 25.86 |
| Ba (614.171 nm) | ≤ 42.00 | 28.49 |
| Ar (675.283 nm) | ≤ 74.00 | 60.58 |
| K (766.491 nm) | ≤ 80.00 | 66.42 |

| | | |
|---|---|---|
| Al (396.152 nm) | ≤ 1.50 | 0.45 |
| Ba (493.408 nm) | ≤ 1.50 | 0.48 |
| K (766.491 nm) | ≤ 1.50 | 0.34 |

Axial

| Element Wavelength | Specification | Measured Value % RSD |
|---|---|---|
| As (188.980 nm) | ≤ 1.50 | 0.64 |
| Se (196.026 nm) | ≤ 1.50 | 0.58 |
| Zn (206.200 nm) | ≤ 1.50 | 0.29 |
| Zn (213.857 nm) | ≤ 1.50 | 0.38 |
| Cd (214.439 nm) | ≤ 1.50 | 0.30 |
| Pb (220.353 nm) | ≤ 1.50 | 0.47 |
| Mn (257.610 nm) | ≤ 1.50 | 0.78 |
| Cr (267.716 nm) | ≤ 1.50 | 0.30 |
| Cu (324.754 nm) | ≤ 1.50 | 0.45 |
| Al (396.152 nm) | ≤ 1.50 | 0.35 |
| Ba (493.408 nm) | ≤ 1.50 | 0.50 |
| K (766.491 nm) | ≤ 1.50 | 0.46 |

**Report Detail**

Tests Run - Operator: Kanyakorn S.

Subsystem Communications Test- Started

SubSystem Status

Mains Power Module - Passed
Gas Control Module - Passed
RF Generator - Passed
pre-optics Module - Passed
Optics/Camera Control Module - Passed
Peristaltic Pump - Passed
Subsystem Communications Test Completed - Passed

Optics Test- Started

Test View Mode Intensities Status

LED Off - Passed
Shutter opened - Passed
Peak Intensity Radial mode 3082176.14 - Passed
Shutter closed - Passed
Peak Intensity(closed shutter) Radial mode 55.00 - Passed
Shutter opened - Passed
Optical Argon Ratio: Calculated Value = 2.56, Factory Value = 2.60
Peak Intensity Axial mode 3162050.49 - Passed





Radial-Axial Intensity Ratio:(Range 0-100) - 1.03 - Passed
Peak Intensity Simultaneous mode 3419287.63 - Passed
Shutter closed - Passed
Optics Test Completed - Passed

Instrument Performance- Started

Instrument Performance Completed - Passed



MM-N12
9.9/93

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**Document Name:** Instrument's Test Report

**Gas Flows Test** — Pass

| Nebulizer Target Flow | Actual Flow | Back Pressure | Auxiliary Target Flow | Actual Flow | Back Pressure |
|---|---|---|---|---|---|
| 0.70 | 0.71 | 276.73 | 2.00 | 2.00 | 106.21 |

| Makeup Target Flow | Actual Flow | Back Pressure | Plasma Target Flow | Actual Flow | Back Pressure |
|---|---|---|---|---|---|
| 2.00 | 2.00 | 106.63 | 18.00 | 17.96 | 19.78 |

**RF Generator Test** — Pass

| | |
|---|---|
| RF Power Supply Test | Passed |
| RF Power Supply (V) | 130.332 |
| RF Oscillator Test | Passed |
| RF Oscillator Frequency (MHz) | 25.917 |
| Work Coil Current (A) | 44.873 |
| RF Power Supply Current (A) | 1.996 |

**Camera Test** — Pass

| Black Level Test | Noise Test | Photo Response Test |
|---|---|---|
| Passed | Passed | Passed |

**Optics Test** — Pass

| | Radial | Axial | SVDV |
|---|---|---|---|
| Intensity | 2965633 | 3009947 | 3265038 |
| Wavelength | 737.212 | 737.212 | 737.212 |

**Report Detail**

Tests Run - Operator: Kanyakorn S.

Subsystem Communications Test- Started

SubSystem Status

Mains Power Module - Passed
Gas Control Module - Passed
RF Generator - Passed
pre-optics Module - Passed
Optics/Camera Control Module - Passed

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General

**Document Name:** Instrument's Test Report

**Report Summary**

| | |
|---|---|
| Instrument Model | Agilent 5100/5110 SVDV ICP-OES |
| Instrument ID | G8010A/G8014A |
| Instrument Serial Number | MY16010005 |
| Software Version | 7.5.3.11953 |
| Firmware Version | 5395 |
| Tested By | Kanyakorn S. |
| Test started on | 9/13/2021 5:33:48 PM |
| Test Completed On | 9/13/2021 5:46:50 PM |

**Result Summary**

| | |
|---|---|
| Subsystem Communications Test | Pass |
| Air Flow Test | Pass |
| Water Flow Test | Pass |
| Gas Flows Test | Pass |
| RF Generator Test | Pass |
| Camera Test | Pass |
| Optics Test | Pass |
| Advanced Valve System Test | Skipped |
| Resolution Test | Skipped |
| Sensitivity Test | Skipped |
| Precision Test | Skipped |

**Subsystem Communications Test** — Pass

**Air Flow Test** — Pass

| 30% Air Flow (relative speed) | 60% Air Flow (relative speed) |
|---|---|
| 11.00 | 16.00 |

**Water Flow Test** — Pass

| RF Water Flow(L/min) | Camera Water Flow (L/min) | Water Inlet Temperature (°C) |
|---|---|---|
| 1.21 | 1.14 | 23.01 |

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Plasma ignite Started
Plasma ignite - Passed
Waiting 5 min for plasma warm up
Shutter opened - Passed
Peak Intensity Radial mode 2965632.60 - Passed
Shutter closed - Passed
Peak Intensity(closed shutter) Radial mode 55.46 - Passed
Shutter opened - Passed
Optical Argon Ratio: Calculated Value = 2.53, Factory Value = 2.60
Peak Intensity Axial mode 3009947.39 - Passed
Radial-Axial Intensity Ratio:(Range 0-100) - 1.01 - Passed
Peak Intensity Simultaneous mode 3265038.45 - Passed
Shutter closed - Passed
Optics Test Completed - Passed



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Peristaltic Pump - Passed
Subsystem Communications Test Completed - Passed

Air Flow- Started

Fan Speed(%) Air Flow(relative speed) Status

30% 11 - Passed
60% 16 - Passed
Air Flow Completed - Passed

Water Flow- Started

RF Water Flow(L/min) = 1.21
Camera Water Flow (L/min) = 1.14
Water Inlet Temperature = 23.01
RF Water Flow(L/min) (off) = 0.00
Water Flow Completed - Passed

Gas Flows- Started

Channel Target Actual Pressure Failure Status

Auxiliary Gas 0.00 0.06 N/A N/A - Passed
Auxiliary Gas 2.00 2.00 N/A N/A - Passed
Nebulizer Gas 0.00 0.07 0.00 N/A - Passed
Nebulizer Gas 0.70 0.71 276.73 N/A - Passed
Plasma Gas 0.00 1.18 N/A N/A - Passed
Plasma Gas 18.00 17.96 N/A N/A - Passed
Makeup Gas 0.00 0.06 N/A N/A - Passed
Makeup Gas 2.00 2.00 N/A N/A - Passed
Purge Gas 0.70 0.70 N/A N/A - Passed
Purge Gas 3.70 3.70 N/A N/A - Passed
All Channel flows ON : - Passed
All Channel flows OFF : - Passed
Gas Flows Completed - Passed

RF Generator- Started

RF generator turned off - Passed
RF generator turned on - Passed
Bias Control = 0 V - Passed
RF Power Supply - Set Value = 150V, Actual Value = 130.33V - Passed
RF Oscillator Started - Passed
RF Oscillator Frequency(MHz) = 25.92 , Workcoil Current(Amps) = 44.87, RF Power Supply Current(Amps) = 2.00 - Passed
RF Oscillator stopped - Passed
RF generator turned off - Passed
RF Generator Completed - Passed

Camera Test- Started

Black level test - PASSED
Noise test - PASSED
Photo response test - PASSED
Camera Test Completed - Passed

Optics Test- Started

Test View Mode Intensities Status

LED Off - Passed

User Name: phimprapha.jeeraphong
Hostname: ASBKKWX328

System Id: MY16010005
Print Date: September 13, 2021 5:50:44 PM

OQHW 5100 ICPOES ALS 08Sep21 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|---|---|---|---|---|
| September 8, 2021 8:49:59 AM | Audit | SessionCreated | Session | None |
| September 8, 2021 8:49:59 AM | Start | Configuration | Session | None |
| September 8, 2021 8:49:59 AM | Audit | Entitlement | Licensing | User is FieldEngineer and does not require an unlock code |
| September 8, 2021 9:07:06 AM | Audit | EqpLoaded | Session | EQP details for primary technique [Es] - File path: [ProtocolPacks/Es/Configurations/02.50/Es.02.50.eqp], EQP File Name: [Es.02.50.eqp], EQP Name: [AgilentRecommended] |
| September 8, 2021 9:07:11 AM | End | Configuration | Session | None |
| September 8, 2021 9:07:15 AM | Start | Qualification | Session | OQ |
| September 8, 2021 9:07:15 AM | Start | Execution | Preparation : 5100 SVDV: Qualitative Test - No setpoints associated | None |
| September 8, 2021 9:34:35 AM | End | Execution | Preparation : 5100 SVDV: Qualitative Test - No setpoints associated | Run Count : 1 |
| September 8, 2021 9:34:39 AM | Start | Execution | Instrument Tests : 5100 SVDV: Qualitative Test - No setpoints associated | None |
| September 8, 2021 9:51:27 AM | End | Execution | Instrument Tests : 5100 SVDV: Qualitative Test - No setpoints associated | Run Count : 1 |

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# Electronic Signature

## Purpose

This signature page was created and published because the ACE sign-off action was executed, which is valid for the entire document, including attachments. The ACE sign-off is an electronic signature that requires two distinct identification components: unique username and personal password. The Agilent representative who has delivered this service understands the meaning and legal status of an electronic signature. As a trained official operator, the Agilent representative has a unique password and logon to access ACE and electronically sign this document. (Other e-signatures can be applied to this document using a Document Content Management or other suitable method defined in your data access and control procedures.)

## Details

| | |
|---|---|
| Full Name of Signer: | Kanyakorn Sukpathrajarern |
| Logged On User Name: | phimprapha.jeeraphong@agilent.com |
| Signature Creation Date: | September 13, 2021 |
| Reason for Signature: | Executed protocol and published this original version of document |

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MM-N12
9/9/96

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User Name: phimprapha.jeeraphong
Hostname: ASBKKWX328

System Id: MY16010005
Print Date: September 13, 2021 5:50:44 PM

OQHW 5100 ICPOES ALS 08Sep21 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|---|---|---|---|---|
| September 13, 2021 5:49:13 PM | Audit | Reporting | Session | Report Signed : Certificate PDF Name: OQHW 5100 ICPOES ALS 08Sep21_20210913_Certificate_1.pdf User Name: phimprapha.jeeraphong@agilent.com Full Name of Signer: Kanyakorn Sukpathrajarern Reason for signature: Executed protocol and published this original version of document |
| September 13, 2021 5:49:25 PM | Audit | Reporting | Session | Report Generated : Report |

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User Name: phimprapha.jeeraphong
Hostname: ASBKKWX328

System Id: MY16010005
Print Date: September 13, 2021 5:50:44 PM

OQHW 5100 ICPOES ALS 08Sep21 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|---|---|---|---|---|
| September 8, 2021 9:51:30 AM | Start | Execution | Autosampler Operation : Autosampler 1 - SPS4: Qualitative Test - No setpoints associated | None |
| September 8, 2021 9:51:36 AM | End | Execution | Autosampler Operation : Autosampler 1 - SPS4: Qualitative Test - No setpoints associated | Run Count : 1 |
| September 8, 2021 9:51:38 AM | End | Qualification | Session | OQ |
| September 8, 2021 9:51:38 AM | Start | Reporting | Session | None |
| September 8, 2021 10:55:40 AM | Audit | AceClosed | Session | None |
| September 13, 2021 5:01:26 PM | Audit | AceRestarted | Session | None |
| September 13, 2021 5:01:26 PM | Audit | SessionReloaded | Session | None |
| September 13, 2021 5:01:28 PM | Start | Qualification | Session | OQ |
| September 13, 2021 5:47:55 PM | Audit | Reporting | Session | Report Generated : Certificate |

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MM-N12


# Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110

Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

Website : www.scieco.co.th E-Mail : calibrate@scg.co.th




## Calibration Report

**Equipment** : **HEATING BLOCK**
**Date of Calibration** : **7 April 2022**
**Environment** : **Temperature : 21.8-23.1 °C**
**Line Voltage : 221.6-226.3 V**
**Relative Humidity : 55 - 65 %RH**

**Condition of this results of calibration :**

1. This equipment was calibrated by insert nine standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20.
   All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .
2. Reference Standard Instrument :

| Instrument | Model | Instrument No. | Certificate No. | Due Date |
|---|---|---|---|---|
| TC | TYPE T | TN221-TN230 | T210008 | 08 June 2022 |
| TC | TYPE T | TN231-TN240 | T210008 | 08 June 2022 |
| DATA LOGGER | 34970A | T149 | T210008 | 08 June 2022 |

3. This certificate is traceable to :
   National Institute of Metrology ( Thailand ) through Metrological Center ( NSC-TISI-TIS 17025 CALIBRATION 0244.)
4. Condition of calibrated item : good
   Equipment Description :
   Time Constant 2 Hour 25 Minute At 95 °C
   Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
   ☐ Close
   ☒ Not Available
5. Adjustment :
   ( ) without adjustment ( X ) after adjustment

Approved By.




# Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110

Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

Website : www.scieco.co.th E-Mail : calibrate@scg.co.th




## Certificate of Calibration

**Equipment** : **HEATING BLOCK**

**Manufacturer** : **Environmental Express**

**Model** : **SC 196**

**Serial No.** : **6974CECW3285**

**Customer Code** : **BKK_EL0054**

**ID No.** : **T5306A3**

**Customer** : **ALS Laboratory Group (Thailand) Co.,Ltd.**
**104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250**

**Customer Location** : **Acid Digestion Lab**

**Date of Receipt** : **30 March 2022**

**Calibrated By** : **Watcharapon Sangtong (Technician )**

**Approved By** : _____ / **Sujjar Naknakred ( Site Calibration Manager )**

**Date of Issue** : 12 APR 2022

REVIEW BY Tattaporn C.
APPROVED BY Sanitun
NEXT CAL. DATE 7/10/23

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 standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.




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Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

Website : www.scieco.co.th E-Mail : calibrate@scg.co.th




## Calibration Report

Measurement Results

| Calibration Point | | Average Standard Reading at each position (°C) | | | | | |
|---|---|---|---|---|---|---|---|
| R1 Hole1-Hole6 | | TN221 | TN222 | TN223 | TN224 | TN225 | TN226 |
| CAL POINT | Max | 93.60 | 93.82 | 94.05 | 94.20 | 94.36 | 94.26 |
| 95 | Min | 93.07 | 93.26 | 93.51 | 93.66 | 93.82 | 93.71 |
| | Average | 93.33 | 93.54 | 93.78 | 93.93 | 94.09 | 93.98 |
| R2 Hole7-Hole12 | | TN227 | TN228 | TN229 | TN230 | TN231 | TN232 |
| | Max | 94.59 | 94.79 | 94.63 | 94.55 | 94.82 | 95.00 |
| | Min | 94.05 | 94.25 | 94.08 | 93.97 | 94.26 | 94.44 |
| | Average | 94.32 | 94.52 | 94.36 | 94.26 | 94.54 | 94.72 |
| R3 Hole13-Hole18 | | TN233 | TN234 | TN235 | TN236 | TN237 | TN238 |
| | Max | 95.03 | 94.54 | 94.78 | 94.84 | 95.06 | 94.73 |
| | Min | 94.46 | 93.98 | 94.20 | 94.28 | 94.49 | 94.18 |
| | Average | 94.74 | 94.26 | 94.49 | 94.56 | 94.78 | 94.45 |
| R4 Hole19-Hole24 | | TN239 | TN240 | TN221 | TN222 | TN223 | TN224 |
| | Max | 94.89 | 94.82 | 95.73 | 95.85 | 95.73 | 96.10 |
| | Min | 94.33 | 94.26 | 95.51 | 95.62 | 95.51 | 95.85 |
| | Average | 94.61 | 94.54 | 95.62 | 95.73 | 95.62 | 95.97 |
| R5 Hole25-Hole30 | | TN225 | TN226 | TN227 | TN228 | TN229 | TN230 |
| | Max | 96.28 | 96.39 | 96.37 | 96.54 | 96.19 | 96.04 |
| | Min | 96.01 | 96.10 | 96.02 | 96.20 | 95.89 | 95.71 |
| | Average | 96.15 | 96.24 | 96.20 | 96.37 | 96.04 | 95.88 |
| R6 Hole31-Hole36 | | TN231 | TN232 | TN233 | TN234 | TN235 | TN236 |
| | Max | 96.84 | 96.97 | 97.03 | 96.48 | 96.33 | 95.76 |
| | Min | 96.53 | 96.65 | 96.71 | 96.08 | 95.98 | 95.43 |
| | Average | 96.68 | 96.81 | 96.87 | 96.28 | 96.16 | 95.60 |
| R7 Hole37-Hole42 | | TN237 | TN238 | TN239 | TN240 | TN221 | TN222 |
| | Max | 96.46 | 96.15 | 96.19 | 96.06 | 96.95 | 97.09 |
| | Min | 96.13 | 95.84 | 95.85 | 95.72 | 96.64 | 96.78 |
| | Average | 96.30 | 95.99 | 96.02 | 95.89 | 96.80 | 96.93 |
| R8 Hole43-Hole48 | | TN223 | TN224 | TN225 | TN226 | TN227 | TN228 |
| | Max | 96.91 | 96.58 | 96.13 | 96.19 | 96.34 | 96.19 |
| | Min | 96.55 | 96.21 | 95.80 | 95.87 | 96.03 | 95.88 |
| | Average | 96.73 | 96.40 | 95.96 | 96.03 | 96.18 | 96.03 |

Approved By. _____




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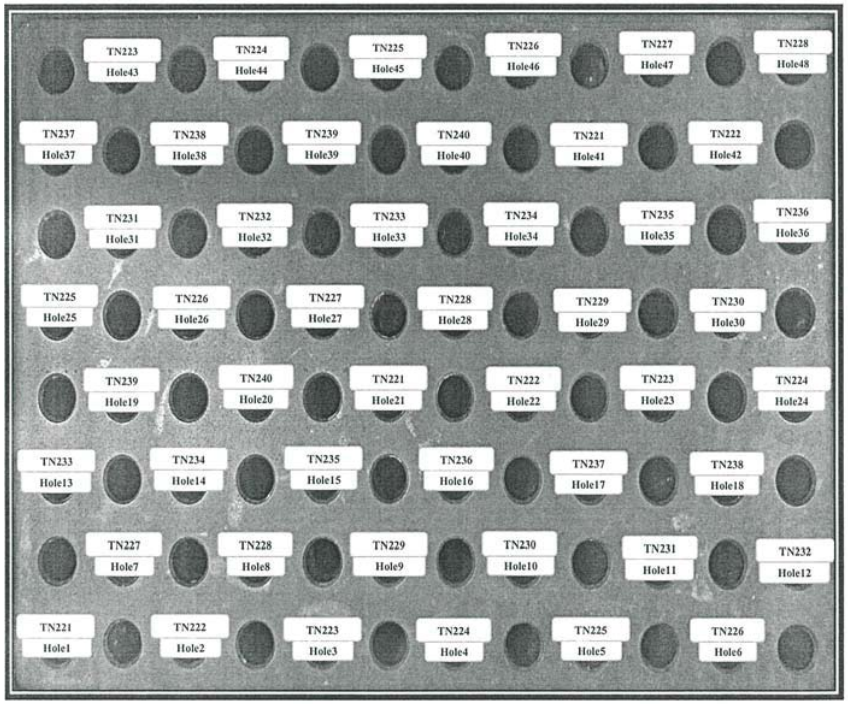
Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

Website : www.scieco.co.th E-Mail : calibrate@scg.co.th




## Calibration Report




FRONT CONTROL

Approved By. _____



MM-N12

4.9/99

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Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

Website : www.scieco.co.th E-Mail : calibrate@scg.co.th




## Calibration Report

**Measurement Results:**

| HEATING BLOCK | | | Temperature Distribution | |
|---|---|---|---|---|
| Setting (°C) | Reading (°C) | | Stability (±°C) | Uncertainty (±°C) |
| | Min , Max | Average | | |
| 100.0 | 100.0 , 100.4 | 100.1 | 0.29 | 0.83 |
| 105.0 | 105.0 , 105.4 | 105.1 | 0.20 | 0.79 |

* The quoted uncertainty exclude " uniformity "

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k$ which for a t-distribution, providing a level of confidence of approximately 95 % .

Approved By. _____




# Metrological Center

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Website : www.scieco.co.th E-Mail : calibrate@scg.co.th




## Calibration Report

**Measurement Results**

| Calibration Point | | Average Standard Reading at each position (°C) | | | | | |
|---|---|---|---|---|---|---|---|
| R1 Hole1-Hole6 | | TN221 | TN222 | TN223 | TN224 | TN225 | TN226 |
| CAL POINT | Max | 104.47 | 104.65 | 104.79 | 105.31 | 105.47 | 105.46 |
| 105 | Min | 104.15 | 104.27 | 104.45 | 104.98 | 105.14 | 105.20 |
| | Average | 104.31 | 104.46 | 104.62 | 105.15 | 105.31 | 105.33 |
| R2 Hole7-Hole12 | | TN227 | TN228 | TN229 | TN230 | TN231 | TN232 |
| | Max | 105.55 | 105.73 | 105.65 | 105.84 | 105.97 | 106.07 |
| | Min | 105.28 | 105.43 | 105.35 | 105.52 | 105.68 | 105.83 |
| | Average | 105.42 | 105.58 | 105.50 | 105.68 | 105.82 | 105.95 |
| R3 Hole13-Hole18 | | TN233 | TN234 | TN235 | TN236 | TN237 | TN238 |
| | Max | 106.14 | 106.06 | 105.81 | 106.05 | 105.81 | 105.87 |
| | Min | 105.85 | 105.81 | 105.55 | 105.80 | 105.53 | 105.64 |
| | Average | 106.00 | 105.94 | 105.68 | 105.92 | 105.67 | 105.75 |
| R4 Hole19-Hole24 | | TN239 | TN240 | TN221 | TN222 | TN223 | TN224 |
| | Max | 105.86 | 105.60 | 104.44 | 104.51 | 104.28 | 104.78 |
| | Min | 105.61 | 105.37 | 104.27 | 104.35 | 104.12 | 104.61 |
| | Average | 105.74 | 105.48 | 104.35 | 104.43 | 104.20 | 104.69 |
| R5 Hole25-Hole30 | | TN225 | TN226 | TN227 | TN228 | TN229 | TN230 |
| | Max | 104.94 | 104.93 | 104.97 | 105.08 | 104.68 | 104.69 |
| | Min | 104.77 | 104.75 | 104.76 | 104.90 | 104.51 | 104.49 |
| | Average | 104.85 | 104.84 | 104.86 | 104.99 | 104.60 | 104.59 |
| R6 Hole31-Hole36 | | TN231 | TN232 | TN233 | TN234 | TN235 | TN236 |
| | Max | 105.44 | 105.45 | 105.61 | 104.95 | 104.84 | 104.42 |
| | Min | 105.27 | 105.27 | 105.44 | 104.76 | 104.66 | 104.25 |
| | Average | 105.36 | 105.36 | 105.53 | 104.86 | 104.75 | 104.33 |
| R7 Hole37-Hole42 | | TN237 | TN238 | TN239 | TN240 | TN221 | TN222 |
| | Max | 105.17 | 104.70 | 104.59 | 104.51 | 105.22 | 105.53 |
| | Min | 105.00 | 104.53 | 104.41 | 104.35 | 105.04 | 105.37 |
| | Average | 105.08 | 104.62 | 104.50 | 104.43 | 105.13 | 105.45 |
| R8 Hole43-Hole48 | | TN223 | TN224 | TN225 | TN226 | TN227 | TN228 |
| | Max | 105.61 | 105.45 | 105.10 | 104.77 | 104.87 | 105.02 |
| | Min | 105.44 | 105.28 | 104.92 | 104.60 | 104.70 | 104.85 |
| | Average | 105.53 | 105.37 | 105.01 | 104.69 | 104.79 | 104.93 |

Approved By. _____

SCG

Metrological Center
SCI ECO Services Company Limited
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.

NSC-TISI-TIS 17025
CALIBRATION 0244

Certificate No. T221644



# Calibration Report

**Equipment** : **Chamber ( Cold Room )**
**Date of Calibration** : **30 June - 1 July 2022**
**Environment** : **Temperature : 18.9-23.7 °C**
**Line Voltage : 222.9-226.5 V**
**Relative Humidity : 55 - 65 %RH**

**Condition of this results of calibration :**

1. This equipment was calibrated by insert nine standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20 ( based on ASTM E145-94 ( Reapproved 2001) and AS2853-1986 ).
   All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .
2. Reference Standard Instrument :

| Instrument | Model | Instrument No. | Certificate No. | Due Date |
|---|---|---|---|---|
| TC | TYPE T | TN161-TN170 | T210009 | 30 July 2022 |
| TC | TYPE T | TN171-TN180 | T210009 | 30 July 2022 |
| DATA LOGGER | 34970A | T149 | T210009 | 30 July 2022 |

3. This certificate is traceable to :
   National Institute of Metrology ( Thailand ) through Metrological Center ( NSC-TISI-TIS 17025 CALIBRATION 0244.)
4. Condition of calibrated item : good
   Equipment Description :
   Time Constant 3 Hour - Minute At 3 °C
   Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
   ☐ Close
   ☒ Not Available
5. Adjustment :
   ( ) without adjustment ( X ) after adjustment

Approved By.





SCG

Metrological Center
SCI ECO Services Company Limited
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.
Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100
Bangkok Tel : +668 9205 6851 , +669 8247 2360
Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

NSC-TISI-TIS 17025
CALIBRATION 0244

Certificate No. T221644



# Certificate of Calibration

**Equipment** : **Chamber ( Cold Room )**
**Manufacturer** : **KOLDTECH**
**Model** : **KM 320**
**Serial No.** : **TBN-1012061/05**
**Customer Code** : **BKK_EN0167**
**ID No.** : **T2463A3**
**Customer** : **ALS Laboratory Group (Thailand) Co.,Ltd.**
**104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,**
**Khet Suan Luang, Bangkok 10250**
**Customer Location** : **Environmental Laboratory**
**Date of Receipt** : **27 June 2022**
**Calibrated By** : **Sujjar Naknakred ( Site Calibration Manager )**
**Approved By** : / **Boonchai Suriyawong (Site Calibration Manager)**
**Date of Issue** : 04 JUL 2022

REVIEW BY Sirilak P.
APPROVED BY
NEXT CAL. DATE 30/12/23

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 standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

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NSC-TISI-TIS 17025
CALIBRATION 0244

Certificate No. T221644



# Calibration Report

**Measurement Results:**

| Calibration Point | Average Standard Reading at each position (°C) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | TN161 | TN162 | TN163 | TN164 | TN165 | TN166 | TN167 | TN168 | TN169 | TN170 |
| 3 | 2.71 | 2.82 | 2.75 | 2.89 | 2.95 | 3.68 | 3.02 | 2.96 | 3.03 | 2.85 |
| | TN171 | TN172 | TN173 | TN174 | TN175 | TN176 | | | | |
| | 2.97 | 3.02 | 2.89 | 3.04 | 2.97 | 3.33 | | | | |

| Chamber ( Cold Room ) | | | Temperature Distribution | | | | |
|---|---|---|---|---|---|---|---|
| Setting (°C) | Reading (°C) | | Average (°C) | Stability (±°C) | Uniformity (°C) | Uncertainty (±°C) | Coverage Factor *k* |
| | Min , Max | Average | | | | | |
| 3.0 | 2.9 , 4.0 | 3.2 | 2.99 | 1.05 | 1.30 | 1.66 | 2.00 |

* The quoted uncertainty exclude " uniformity "
The calibration result apply only the above calibrated item.
The result of test was found accurate as shown on date and place of test only.
The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor *k* which for a t-distribution, providing a level of confidence of approximately 95 % .

Approved By.

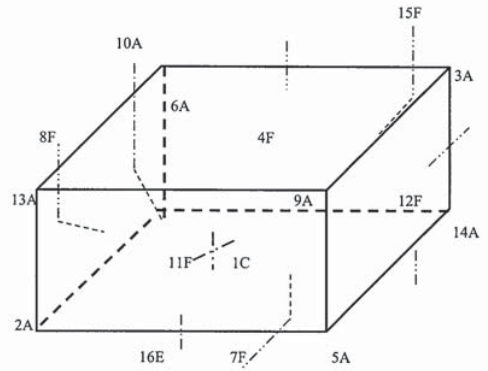


SCG
Metrological Center
SCI ECO Services Company Limited
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.
NSC-TISI-TIS 17025
CALIBRATION 0244

Certificate No. T221644



# Calibration Report




C = Centre , F = Centre of Face , A = Corner , E = Centre of Edge

| | | |
|---|---|---|
| 1C | = | TN161 |
| 2A | = | TN162 |
| 3A | = | TN163 |
| 4F | = | TN164 |
| 5A | = | TN165 |
| 6A | = | TN166 |
| 7F | = | TN167 |
| 8F | = | TN168 |
| 9A | = | TN169 |
| 10A | = | TN170 |

| | | |
|---|---|---|
| 11F | = | TN171 |
| 12F | = | TN172 |
| 13A | = | TN173 |
| 14A | = | TN174 |
| 15F | = | TN175 |
| 16E | = | TN176 |

Approved By.

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Agilent CrossLab Compliance Services

Agilent CrossLab
From Insight to Outcome

# EQUIPMENT QUALIFICATION REPORT (EQR)

## Agilent CrossLab Compliance

| | |
|---|---|
| Qualification Type: | ICPMS-OQ |
| System ID: | JP15471169 |
| EQP Name: | AgilentRecommended |
| EQP Revision: | ICPMS.02.50 |
| EQP Publish Date: | March 2020 |
| Date: | September 30, 2021 4:07:18 PM |
| Report Type: | Report |
| Org. Name: | ALS Laboratory Group ( Thailand) Co.,Ltd. |
| Org. Location: | 104 Phattanakarn 40, Suan Luang, Bangkok 10250. |

REVIEW BY Supaporn M.
APPROVED BY Saowtru N.
NEXT CAL. DATE 29 March 2023

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## Service Details

**Purpose**

This section includes local contact and delivery details for this service.

**General Details**

| | |
|---|---|
| Service Order No./Request: | 6004837154 |
| EQP Name: | AgilentRecommended |
| EQP Revision: | ICPMS.02.50 |
| Report Type: | Report |

**Organization Details**

| | |
|---|---|
| Name: | ALS Laboratory Group ( Thailand) Co.,Ltd. |
| Location: | 104 Phattanakarn 40, Suan Luang, Bangkok 10250. |

**Local Contact Details**

| | |
|---|---|
| Name: | Chatchanai Komarakul. |
| Job Title: | Manager |
| Qualification Location: | Laboratory |

**Operator Details**

| | |
|---|---|
| Name: | Panthep Kurasathain |
| Job Title: | Field Service Emgineer. |

**Data Acquisition Details**

| | |
|---|---|
| Acquisition Software Name: | MassHunter |
| Acquisition Software Revision: | C.01.04 |
| Customer Data System (CDS): | IcpMs: MassHunter |



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## Test Summary

**Purpose**

This section includes a status for each scheduled test and the overall qualification. For each test that is run, (1) the status is automatically determined based on pre-defined limits, and (2) the total number of times the test was run is displayed. For detailed results and specifications for a test, refer to the test results in this EQR.

**Details**

| Test | Status | Runs |
|---|---|---|
| Autosampler Check : SPS4 | Pass | 1 |
| Integrated Sample Introduction System (ISIS) Check : ISIS3 | Pass | 1 |
| Autotune : G8403A | Pass | 1 |
| Background (No Gas Mode) : G8403A | Pass | 1 |
| Background (Gas Modes) : G8403A | Pass | 1 |
| 20-Minute Stability (No Gas Mode) : G8403A | Pass | 1 |

**Overall Qualification Status**

Pass

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Chiller 1

| | |
|---|---|
| Manufacturer | Agilent Technologies |
| Name | Chiller |
| Model Number | G3292A |
| Serial Number | 3U1610713 |



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# Instrument Details

**Purpose**

This section describes the as found system configuration.

**Details**

ICP-MS 1

| | |
|---|---|
| Manufacturer | Agilent Technologies |
| Name | 7900 |
| Model Number | G8403A |
| Installed Options | #100H: Standard Package with Hydrogen option |
| Detector Type | SQ |
| Nebulizer | Mira Mist (G3161) |
| Spray Chamber | Quartz |
| Torch | Quartz |
| Sampling Cone | Ni |
| Skimmer Cone | Ni |
| Serial Number | JP15471169 |
| Firmware Revision | C.01.04 |

ISIS 1

| | |
|---|---|
| Manufacturer | Agilent Technologies |
| Name | ISIS3 |
| Model Number | G8411A |
| Type | Peristaltic pump system |
| Serial Number | JP15510227 |

Autosampler 1

| | |
|---|---|
| Manufacturer | Agilent Technologies |
| Name | SPS4 |
| Model Number | G8410A |
| Serial Number | AU15430722 |

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## Protocol Details

**Purpose**

This section lists the revisions for all test units used in this report. For complete test-specific and high-level change details, refer to the Revision History document.

| Test Revision | Test |
|---|---|
| ICPMS.02.50 | 20-Minute Stability (No Gas Mode) |
| ICPMS.02.50 | Autosampler Check |
| ICPMS.02.50 | Autotune |
| ICPMS.02.50 | Background (Gas Modes) |
| ICPMS.02.50 | Background (No Gas Mode) |
| ICPMS.02.50 | Integrated Sample Introduction System (ISIS) Check |



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## Calculation Formulas

**Purpose**

This section includes calculation formulas for all available tests. Depending upon which tests are scheduled, all or some apply to your qualification.

For a description of calculations for ICP-MS tests performed by the MassHunter software, refer to the MassHunter application and documentation.

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# Integrated Sample Introduction System (ISIS) Check

**Purpose**

This test demonstrates that the ISIS module is correctly installed and connected. It does not test module performance.

**Setpoint**

**Results**

| Criteria | Observed Result | Expected Result | Status |
|---|---|---|---|
| As commanded, does the pump rotate? | Yes | Yes | Pass |
| As commanded, do the valves load and inject? | Yes | Yes | Pass |

**Setpoint Status:** **Pass** Runs: 1

**Overall Integrated Sample Introduction System (ISIS) Check Test Status**

Pass



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# Autosampler Check

**Purpose**

This test demonstrates that the autosampler module is correctly installed and connected. It does not test module performance.

**Setpoint**

**Results**

| Criteria | Observed Result | Expected Result | Status |
|---|---|---|---|
| After the self test, is probe in the home position? | Yes | Yes | Pass |
| As commanded, is the probe positioned at vial 2? | Yes | Yes | Pass |

**Setpoint Status:** **Pass** Runs: 1

**Overall Autosampler Check Test Status**

Pass

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| | | | |
|---|---|---|---|
| Mass 7 Sensitivity No Gas | | 94.28 | Mcps/ppm |
| Agilent Recommended: | >= | 25.5 | |
| Status: | Pass | | |
| Mass 89 Sensitivity No Gas | | 307.15 | Mcps/ppm |
| Agilent Recommended: | >= | 127.5 | |
| Status: | Pass | | |
| Mass 205 Sensitivity No Gas | | 203.77 | Mcps/ppm |
| Agilent Recommended: | >= | 76.5 | |
| Status: | Pass | | |
| Mass 59 Sensitivity He | | 28.38 | Mcps/ppm |
| Agilent Recommended: | >= | 23.8 | |
| Status: | Pass | | |
| Mass 89 Sensitivity H2 | | 129.27 | Mcps/ppm |
| Agilent Recommended: | >= | 68 | |
| Status: | Pass | | |
| Oxide Ratio 156/140 | | 1.047 | % |
| Agilent Recommended: | <= | 1.38 | |
| Status: | Pass | | |
| Doubly Charged Species Ratio 70/140 | | 1.482 | % |
| Agilent Recommended: | <= | 2.3 | |
| Status: | Pass | | |

**Setpoint Status:** Pass Runs: 1

**Overall Autotune Test Status**

Pass



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# Autotune

**Purpose**

This test uses traceable checkout standards to run a software-executed autotune in all modes. The tune report provides values for peak width, mass axis, sensitivity, oxide species, and doubly-charged species tests.

**Setpoint**

**Results**

| | | | |
|---|---|---|---|
| Peakwidth Mass 7 | | 0.719 | AMU |
| Agilent Recommended: | >= | 0.65 | |
| | <= | 0.80 | |
| Status: | Pass | | |
| Peakwidth Mass 89 | | 0.750 | AMU |
| Agilent Recommended: | >= | 0.65 | |
| | <= | 0.80 | |
| Status: | Pass | | |
| Peakwidth Mass 205 | | 0.713 | AMU |
| Agilent Recommended: | >= | 0.65 | |
| | <= | 0.80 | |
| Status: | Pass | | |
| Mass Axis 7 | | 7.05 | AMU |
| Agilent Recommended: | >= | 6.9 | |
| | <= | 7.1 | |
| Status: | Pass | | |
| Mass Axis 89 | | 88.95 | AMU |
| Agilent Recommended: | >= | 88.9 | |
| | <= | 89.1 | |
| Status: | Pass | | |
| Mass Axis 205 | | 205.00 | AMU |
| Agilent Recommended: | >= | 204.9 | |
| | <= | 205.1 | |
| Status: | Pass | | |

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## Background (Gas Mode)

**Purpose**

This test examines the background of the ICP-MS in the various gas modes by monitoring ions during a blank run.

**Setpoint** Gas Mode: Helium

**Conditions**

| | | |
|---|---|---|
| Mass: | 78 | AMU |
| Integration Time: | 1.0 | sec |
| Cycles: | 20 | |

**Measurements and Results**

| | | | |
|---|---|---|---|
| Mass (AMU): | | 78 | |
| Measured Value: | | 42.8500 | cps |
| Agilent Recommended: | <= | 115 | |
| Status: | | Pass | |

**Setpoint Status:** Pass Runs: 1

**Setpoint** Gas Mode: Hydrogen

**Conditions**

| | | |
|---|---|---|
| Mass: | 78 | AMU |
| Integration Time: | 1.0 | sec |
| Cycles: | 20 | |

**Measurements and Results**

| | | | |
|---|---|---|---|
| Mass (AMU): | | 78 | |
| Measured Value: | | 2.1500 | cps |
| Agilent Recommended: | <= | 4.6 | |
| Status: | | Pass | |

**Setpoint Status:** Pass Runs: 1

**Overall Background (Gas Mode) Test Status**

Pass



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## Background (No Gas Mode)

**Purpose**

This test examines the background of the ICP-MS in no gas mode by monitoring ions during a blank run.

**Setpoint**

**Conditions**

| | | |
|---|---|---|
| Masses: | 7 | AMU |
| | 89 | AMU |
| | 205 | AMU |

**Measurements and Results**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Masses (AMU): | | 7 | | 89 | | 205 | | |
| Measured Value: | | 3.200 | | 3.300 | | 9.900 | cps | |
| Agilent Recommended: | <= | 6.9 | <= | 4.6 | <= | 11.5 | | |
| Status: | | Pass | | Pass | | Pass | | |

**Setpoint Status:** Pass Runs: 1

**Overall Background (No Gas Mode) Test Status**

Pass

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## Declaration of Change Control

This document is under change control. Revision history is maintained and printed on each document. Access to the master documents is limited to process owners. Documents receive periodic review and cannot be assigned an evergreen status. The qualification performed according to this document refers only to the hardware/software configuration in place at the time of the qualification. Agilent Technologies recommends that instrument configuration change management procedures be in place in order to maintain the validation process. Any changes to the analytical or computer hardware or software must be clearly specified. A change management system provides a means for determining the degree of requalification required according to the extent of the changes made. All details of the changes must be thoroughly recorded and documented, together with details of completed tests and their results. Note: Hardware/software configuration management is the customer's responsibility.



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## 20-Minute Stability (No Gas Mode)

**Purpose**

This test monitors the abundance of ions present in the checkout standard over a 20-minute period to verify that the signal is stable. The %RSD of the abundance of given ions is calculated internally by the software and compared to the limit.

**Setpoint**

**Conditions**

| | | |
|---|---|---|
| Mode: | Spectrum | |
| Masses: | 7, 9, 59, 89, 140, 205 | |
| Integration Time: | 9.99 | sec |
| Peak Pattern: | 3 | points/peak |
| Repetitions: | 20 | |
| Sweeps/Replicates: | 100 | |

**Measurements and Results**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Masses (AMU): | | 7 | | 89 | | 205 | |
| Stability RSD: | | 0.96400 | | 0.51495 | | 0.73011 | % |
| Agilent Recommended: | <= | 2.3 | <= | 2.3 | <= | 2.3 | |
| Status: | Pass | | Pass | | Pass | | |

**Setpoint Status:** Pass Runs: 1

**Overall 20-Minute Stability (No Gas Mode) Test Status**

Pass

General

**Document Name:** Certificate of System Qualification

Agilent Technologies

## Agilent Compliance Engine Self Qualification

**Date:** September 14, 2021 4:59:15 PM

**Drive Serial #:** ACA025C9 **Platform Revision:** ACE 3.11

Individual self-qualification reports for each specific technique installed are also available upon request. They provide additional details on the general report from the concise summary and are structured by the actual algorithms challenged during the process. There is not a one-to-one relationship between algorithms and OQ program tests because some algorithms are used by several tests and across multiple similar hardware components of the qualified systems.

| Technique Type | Tests Completed | Result |
|---|---|---|
| Atomic Absorption | 7 | Conforms |
| Capillary Electrophoresis | 10 | Conforms |
| Dissolution | 6 | Conforms |
| Emission Spectroscopy | 3 | Conforms |
| Gas Chromatography - GCMS | 17 | Conforms |
| Gas Chromatography | 29 | Conforms |
| Gel Permeation Chromatography | 9 | Conforms |
| ICP-MS | 6 | Conforms |
| Infrared Spectroscopy | 7 | Conforms |
| Liquid Chromatography | 17 | Conforms |
| Liquid Chromatography - LCMS | 8 | Conforms |
| Microfluidics | 18 | Conforms |
| Sample Preparation - Gas Chromatography | 9 | Conforms |
| Sample Preparation - Liquid Chromatography | 8 | Conforms |
| Supercritical Fluid Chromatography | 15 | Conforms |
| Software | 6 | Conforms |
| UV-Vis Spectrophotometer | 13 | Conforms |

Overall Qualification Status

Conforms





## Attachments

Training requirements note: The delivery engineer attaches an ACE technique-specific training certificate to the Equipment Qualification Report (EQR). Obtaining ACE technique-specific certification includes pre-requisite trainings for Data Integrity, General Compliance topics (GMP, GLP, ALCOA, etc.), instrument hardware and software components, and the ACE technique itself. The one certificate encompasses all pre-requisite trainings as documented in the Agilent Learning Management System called Success Factors.


| Location | Category | Document Name | Page |
|---|---|---|---|
| EQR | General | Certificate of System Qualification | 18 |
| EQR | General | Operator's training certificate and qualifications | 19 |
| EQR | General | Certificate of Qualification for ACE | 20 |
| EQR | General | Certificate of Qualification for ACE | 21 |
| EQR | General | Tune reports | 22 |
| EQR | General | Test Report | 25 |
| EQR | General | Test Report | 27 |
| EQR | General | Test Report | 29 |




MM-N12
9.9/111

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General

**Document Name:** Certificate of Qualification for ACE

Agilent Technologies

## Certificate of Completion

| | |
|---|---|
| Learner Name: | Panthep Kurasathain |
| Title Of Course: | AN-CE-SS-II-030-A: ACE 3.X User Update Training |
| Completion Date: | July 7, 2020 |
| Certified By Company: | Learning at Agilent |

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General

**Document Name:** Operator's training certificate and qualifications

Agilent Technologies

## Certificate of Completion

| | |
|---|---|
| Learner Name: | Panthep Kurasathain |
| Title Of Course: | AN-CE-ICPMS-2-038-A:Agilent 7900 ICPMS FSE update training |
| Completion Date: | June 7, 2014 |
| Certified By Company: | Learning at Agilent |

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General

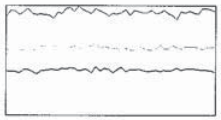
**Document Name:** Tune reports

# Tune Report

| | |
|---|---|
| **Operator Name** | Supakwan Mak |
| **Acq/Data Batch** | C:\Agilent\ICPMH11\UserTune_7900.b |
| **Acq. Date-Time** | 2021-09-30 14:44:08 |
| **Report Comment** | OQ 30 Sep 2021 |
| **Instrument Name** | G8403A JP15471169 |

[No Gas]

**Sensitivity**



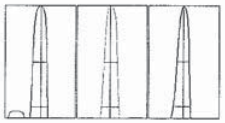
| Mass | Range | Count | RSD% | Background |
|---|---|---|---|---|
| 7 | 10000 | 9428 | 2.630 | 3.200 |
| 89 | 50000 | 30715 | 2.825 | 3.300 |
| 205 | 50000 | 20377 | 3.319 | 9.900 |

Sampling Period [sec] 0.311
Integration Time [sec] 0.1

**Oxide/Doubly Charged Ratio**

Oxide 156 / 140 1.047 %
Doubly Charged 70 / 140 1.482 %

**Resolution/Axis**



| Mass | Peak Height | Axis | W-50% | W-10% |
|---|---|---|---|---|
| 7 | 9474.89 | 7.05 | 0.62 | 0.719 |
| 89 | 38716.43 | 88.95 | 0.59 | 0.750 |
| 205 | 20596.12 | 205.00 | 0.52 | 0.713 |

Integration Time [sec] 0.1
Acquisition Time [sec] 22.74
Y Axis Linear

**Tune Parameters**

**Plasma Parameters**

| | | | | | |
|---|---|---|---|---|---|
| Plasma Mode | --- | Nebulizer Gas | 1.00 L/min | Makeup Gas | 0.10 L/min |
| RF Power | 1550 W | Option Gas | --- | Auxiliary Gas | 0.90 L/min |
| RF Matching | 1.10 V | Nebulizer Pump | 0.10 rps | Plasma Gas | 15.0 L/min |
| Sample Depth | 9.0 mm | S/C Temp | 2 °C | | |

**Lens Parameters**

| | | | | | |
|---|---|---|---|---|---|
| Extract 1 | 0.0 V | Omega Lens | 9.1 V | Deflect | 13.6 V |
| Extract 2 | -205.0 V | Cell Entrance | -30 V | Plate Bias | -35 V |
| Omega Bias | -90 V | Cell Exit | -50 V | | |

**Cell Parameters**

| | | | | |
|---|---|---|---|---|
| Use Gas | No | 3rd Gas Flow | --- | Energy Discrimination 5.0 V |
| He Flow | 0.0 mL/min | OctP Bias | -8.0 V | |

1 of 3 2021-09-30 2:44 PM



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General

**Document Name:** Certificate of Qualification for ACE

Agilent Technologies

# Certificate of Completion

| | |
|---|---|
| Learner Name: | Panthep Kurasathain |
| Title Of Course: | AN-CE-ICPMS-2-035-B: CrossLab Compliance Hardware Specific Delivery for Agilent ICP-MS Systems |
| Completion Date: | October 31, 2020 |
| Certified By Company: | Learning at Agilent |

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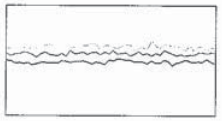
# Tune Report

**EM**

| | | | | | |
|---|---|---|---|---|---|
| Discriminator | 4.0 mV | Analog HV | 2247 V | Pulse HV | 1318 V |

**[He]**

**Sensitivity**



| Mass | Range | Count | RSD% | Background |
|---|---|---|---|---|
| 59 | 5000 | 2838 | 2.592 | 6.000 |
| 89 | 5000 | 3149 | 3.359 | 5.200 |
| 205 | 20000 | 9837 | 2.895 | 4.201 |

Sampling Period [sec] 0.31
Integration Time [sec] 0.1

**Oxide/Doubly Charged Ratio**

| | |
|---|---|
| Oxide | 156 / 140 0.498 % |
| Doubly Charged | 70 / 140 0.788 % |

**Tune Parameters**

**Plasma Parameters**

| | | | | | |
|---|---|---|---|---|---|
| Plasma Mode | --- | Nebulizer Gas | 1.00 L/min | Makeup Gas | 0.10 L/min |
| RF Power | 1550 W | Option Gas | --- | Auxiliary Gas | 0.90 L/min |
| RF Matching | 1.10 V | Nebulizer Pump | 0.10 rps | Plasma Gas | 15.0 L/min |
| Sample Depth | 9.0 mm | S/C Temp | 2 °C | | |

**Lens Parameters**

| | | | | | |
|---|---|---|---|---|---|
| Extract 1 | 0.0 V | Omega Lens | 9.2 V | Deflect | 12.4 V |
| Extract 2 | -225.0 V | Cell Entrance | -30 V | Plate Bias | -100 V |
| Omega Bias | -105 V | Cell Exit | -50 V | | |

**Cell Parameters**

| | | | | | |
|---|---|---|---|---|---|
| Use Gas | Yes | 3rd Gas Flow | --- | Energy Discrimination | 3.5 V |
| He Flow | 3.8 mL/min | OctP Bias | -8.0 V | | |
| H2 Flow | 0.0 mL/min | OctP RF | 200 V | | |

**QP Parameters**

| | | | | | |
|---|---|---|---|---|---|
| Mass Gain | 124 | Axis Gain | 0.9990 | QP Bias | -4.5 V |
| Mass Offset | 125 | Axis Offset | 0.01 | | |

**Hardware Settings**

**Torch**

| | | | |
|---|---|---|---|
| Torch H | -0.3 mm | Torch V | 0.1 mm |

**EM**

| | | | | | |
|---|---|---|---|---|---|
| Discriminator | 4.0 mV | Analog HV | 2247 V | Pulse HV | 1318 V |



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# Tune Report

| | | | | | |
|---|---|---|---|---|---|
| H2 Flow | 0.0 mL/min | OctP RF | 190 V | | |

**QP Parameters**

| | | | | | |
|---|---|---|---|---|---|
| Mass Gain | 124 | Axis Gain | 0.9990 | QP Bias | -3.0 V |
| Mass Offset | 125 | Axis Offset | 0.01 | | |

**Hardware Settings**

**Torch**

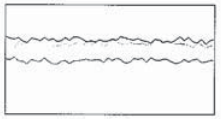
| | | | |
|---|---|---|---|
| Torch H | -0.3 mm | Torch V | 0.1 mm |

**EM**

| | | | | | |
|---|---|---|---|---|---|
| Discriminator | 4.0 mV | Analog HV | 2247 V | Pulse HV | 1318 V |

**[H2]**

**Sensitivity**



| Mass | Range | Count | RSD% | Background |
|---|---|---|---|---|
| 59 | 5000 | 2453 | 3.423 | 0.400 |
| 89 | 20000 | 12927 | 2.822 | 0.200 |
| 205 | 20000 | 13635 | 2.445 | 8.701 |

Sampling Period [sec] 0.31
Integration Time [sec] 0.1

**Oxide/Doubly Charged Ratio**

| | |
|---|---|
| Oxide | 156 / 140 0.804 % |
| Doubly Charged | 70 / 140 1.020 % |

**Tune Parameters**

**Plasma Parameters**

| | | | | | |
|---|---|---|---|---|---|
| Plasma Mode | --- | Nebulizer Gas | 1.00 L/min | Makeup Gas | 0.10 L/min |
| RF Power | 1550 W | Option Gas | --- | Auxiliary Gas | 0.90 L/min |
| RF Matching | 1.10 V | Nebulizer Pump | 0.10 rps | Plasma Gas | 15.0 L/min |
| Sample Depth | 9.0 mm | S/C Temp | 2 °C | | |

**Lens Parameters**

| | | | | | |
|---|---|---|---|---|---|
| Extract 1 | 0.0 V | Omega Lens | 9.0 V | Deflect | 6.0 V |
| Extract 2 | -210.0 V | Cell Entrance | -30 V | Plate Bias | -100 V |
| Omega Bias | -105 V | Cell Exit | -90 V | | |

**Cell Parameters**

| | | | | | |
|---|---|---|---|---|---|
| Use Gas | Yes | 3rd Gas Flow | --- | Energy Discrimination | 3.5 V |
| He Flow | 0.0 mL/min | OctP Bias | -22.0 V | | |
| H2 Flow | 5.0 mL/min | OctP RF | 200 V | | |

**QP Parameters**

| | | | | | |
|---|---|---|---|---|---|
| Mass Gain | 124 | Axis Gain | 0.9990 | QP Bias | -18.5 V |
| Mass Offset | 125 | Axis Offset | 0.01 | | |

**Hardware Settings**

**Torch**

| | | | |
|---|---|---|---|
| Torch H | -0.3 mm | Torch V | 0.1 mm |

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**Document Name:** Test Report

## Batch Summary Report

Analyte Table

| | | 78 [He] |
|---|---|---|
| | Sample Name | CPS |
| 1 | BG He | 42.8500 |





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General

**Document Name:** Test Report

## Batch Summary Report

Batch Folder: C:\Batch2021\BG He.b\
Analysis File: BG He.batch.bin
Tune Step: #1 He

| | Rjct | Acq. Date-Time | Data File | Sample Name | Type | Level | Dilution |
|---|---|---|---|---|---|---|---|
| 1 | | 2021-09-30 14:21:47 | BG He.d | BG He | Sample | | 1.0000 |

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**Document Name:** Test Report

## Batch Summary Report

Analyte Table

| | | 78 [H2] |
|---|---|---|
| | Sample Name | CPS |
| 1 | BG H2 | 2.1500 |





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General

**Document Name:** Test Report

## Batch Summary Report

Batch Folder: D:\Agilent Service\OQ 30 Sep 2021\BG H2 new.b\
Analysis File: BG H2 new.batch.bin
Tune Step: #1 H2

| | Rct | Acq. Date-Time | Data File | Sample Name | Type | Level | Dilution |
|---|---|---|---|---|---|---|---|
| 1 | | 2021-09-30 15:08:58 | BG H2.d | BG H2 | Sample | | 1.0000 |

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**Document Name:** Test Report

## Batch Summary Report

Analyte Table

| | Sample Name | 7 [ No Gas ] CPS RSD | 9 [ No Gas ] CPS RSD | 59 [ No Gas ] CPS RSD | 89 [ No Gas ] CPS RSD | 140 [ No Gas ] CPS RSD | 205 [ No Gas ] CPS RSD |
|---|---|---|---|---|---|---|---|
| 1 | 20 Min | 0.96400 | 7.02464 | 0.46857 | 0.51495 | 0.61014 | 0.73011 |





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General

**Document Name:** Test Report

## Batch Summary Report

Batch Folder: D:\Agilent Service\OQ 30 Sep 2021\20 Min.b\
Analysis File: 20 Min.batch.bin
Tune Step: #1 No Gas

| | Rjct | Acq. Date-Time | Data File | Sample Name | Type | Level | Dilution |
|---|---|---|---|---|---|---|---|
| 1 | | 2021-09-30 15:17:44 | 20 Min.d | 20 Min | Sample | | 1.0000 |

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User Name: panthep_kurasathain
Hostname: ASBKKWX315

System Id: JP15471169
Print Date: September 30, 2021 4:07:22 PM

**ALS OQHW 7900 30Sep21 Transaction log :**

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|---|---|---|---|---|
| September 30, 2021 3:50:07 PM | Audit | SessionCreated | Session | None |
| September 30, 2021 3:50:07 PM | Start | Configuration | Session | None |
| September 30, 2021 3:50:07 PM | Audit | Entitlement | Licensing | User is FieldEngineer and does not require an unlock code |
| September 30, 2021 3:52:52 PM | Audit | EqpLoaded | Session | EQP details for primary technique [IcpMs] - File path: [ProtocolPacks/IcpMs/Configurations/02.50/IcpMs.02.50.eqp], EQP File Name: [IcpMs.02.50.eqp], EQP Name: [AgilentRecommended] |
| September 30, 2021 3:52:54 PM | End | Configuration | Session | None |
| September 30, 2021 3:52:57 PM | Start | Qualification | Session | OQ |
| September 30, 2021 3:52:57 PM | Start | Execution | Autosampler Check : SPS4: Autosampler Check | None |
| September 30, 2021 3:53:03 PM | End | Execution | Autosampler Check : SPS4: Autosampler Check | Run Count : 1 |
| September 30, 2021 3:53:04 PM | Start | Execution | Integrated Sample Introduction System (ISIS) Check : ISIS3: Integrated Sample Introduction System (ISIS) Check | None |
| September 30, 2021 3:53:08 PM | End | Execution | Integrated Sample Introduction System (ISIS) Check : ISIS3: Integrated Sample Introduction System (ISIS) Check | Run Count : 1 |

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# Electronic Signature

### Purpose

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### Details

| | |
|---|---|
| Full Name of Signer: | Panthep Kurasathain |
| Logged On User Name: | panthep_kurasathain@agilent.com |
| Signature Creation Date: | September 30, 2021 |
| Reason for Signature: | Executed protocol and published this original version of document |

### Regulatory Disclaimer

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User Name: panthep_kurasathain
Hostname: ASBKKWX315

System Id: JP15471169
Print Date: September 30, 2021 4:07:22 PM

ALS OQHW 7900 30Sep21 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|---|---|---|---|---|
| September 30, 2021 4:03:07 PM | Audit | Reporting | Session | Report Generated : Certificate |
| September 30, 2021 4:03:17 PM | Audit | Reporting | Session | Report Generated : Report |
| September 30, 2021 4:03:59 PM | Start | Qualification | Session | OQ |
| September 30, 2021 4:04:08 PM | End | Qualification | Session | OQ |
| September 30, 2021 4:04:08 PM | Start | Reporting | Session | None |
| September 30, 2021 4:04:26 PM | Audit | Reporting | Session | Report Generated : Certificate |
| September 30, 2021 4:04:36 PM | Audit | Reporting | Session | Report Generated : Report |

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User Name: panthep_kurasathain
Hostname: ASBKKWX315

System Id: JP15471169
Print Date: September 30, 2021 4:07:22 PM

ALS OQHW 7900 30Sep21 Transaction log :

| Time | Transaction State | Activity Performed | Type of Transaction | Optional Information |
|---|---|---|---|---|
| September 30, 2021 3:53:10 PM | Start | Execution | Autotune : G8403A: Autotune 1 | None |
| September 30, 2021 3:55:08 PM | End | Execution | Autotune : G8403A: Autotune 1 | Run Count : 1 |
| September 30, 2021 3:55:12 PM | Start | Execution | Background (No Gas Mode) : G8403A: No Gas Mode Background 1 | None |
| September 30, 2021 3:55:40 PM | End | Execution | Background (No Gas Mode) : G8403A: No Gas Mode Background 1 | Run Count : 1 |
| September 30, 2021 3:55:43 PM | Start | Execution | Background (Gas Modes) : G8403A: Gas Mode Background :Helium | None |
| September 30, 2021 3:56:17 PM | End | Execution | Background (Gas Modes) : G8403A: Gas Mode Background :Helium | Run Count : 1 |
| September 30, 2021 3:56:19 PM | Start | Execution | Background (Gas Modes) : G8403A: Gas Mode Background :Hydrogen | None |
| September 30, 2021 3:56:38 PM | End | Execution | Background (Gas Modes) : G8403A: Gas Mode Background :Hydrogen | Run Count : 1 |
| September 30, 2021 3:56:41 PM | Start | Execution | 20-Minute Stability (No Gas Mode) : G8403A: 20-Minute Stability (No Gas Mode) 1 | None |
| September 30, 2021 3:57:22 PM | End | Execution | 20-Minute Stability (No Gas Mode) : G8403A: 20-Minute Stability (No Gas Mode) 1 | Run Count : 1 |
| September 30, 2021 3:57:24 PM | End | Qualification | Session | OQ |
| September 30, 2021 3:57:24 PM | Start | Reporting | Session | None |

Page 2 / 3

analytikjena
An Endress+Hauser Company

Serial-No.: 1700124 Customer-No.: C04-002

Date: 7/06/2022. Carried out by: Mr. Srichai Pak-on.

**Maintenance with following Operational Qualification (OQ)** ☐
(requires a separate OQ protocol)

| | |
|---|---|
| **Company** | บริษัท 101100108 แลบอราทอรี่ กรุ๊ป (ประเทศไทย) จำกัด. |
| **User** | คุณสุวรรณี พนมประสาท. |
| **Department** | Lab |
| **Street** | 104 ซอยโชคชัยการ 40 ถนนพัฒนาการ แขวงสวนหลวง |
| **Zip Code, City** | เขตสวนหลวง กรุงเทพมหานคร 10250 |
| **Country** | ประเทศไทย. |
| **Phone** | |
| **Fax** | |
| **E-mail** | |



analytikjena
An Endress+Hauser Company

REVIEW BY Sudarat N.
APPROVED BY Sudarat N.
NEXT CAL. DATE 06/06/2023

# Maintenance Protocol

## Atomic Fluorescence Spectrometer
## mercur / mercur plus

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An Endress+Hauser Company

| Device parameter | | nominal value | actual value |
|---|---|---|---|
| visual check general tightness inside the Mercur | | o.k.: ☑ | changed: ☐ |
| visual check Goldtraps | | o.k.: ☑ | changed: ☐ |
| visual check spectrometer | | | |
| | cuvette | o.k.: ☑ | changed: ☐ |
| | lens | o.k.: ☑ | changed: ☐ |
| check pump hoses | | o.k.: ☑ | changed: ☐ |
| check hoses and hose connectors | | o.k.: ☑ | changed: ☐ |
| check and clean reactor | | o.k.: ☑ | changed: ☐ |
| check drying hose output Gas-liquid-seperator | | o.k.: ☑ | changed: ☐ |
| check bubble-sensor | | o.k.: ☑ | not o.k.: ☐ |
| **Check gasflow** | | | |
| | Argon pressure valve 4 | 1.2 – 1.5 bar | 1.5 bar |
| | Valve 1 | 10 Nl/h or 0.166 NL/min | 0.167 NL/min |
| | Valve 2 | 50 Nl/h or 0.833 NL/min | 0.83 NL/min |
| | Valve 3 | 5 Nl/h or 0.083 NL/min | 0.083 NL/min |
| | Valve 4 | 10 Nl/h or 0.166 NL/min | 0.166 NL/min. |
| **Check liquid flow** | | | |
| | Acid | 2.5ml/min ± 1 ml | 2.5 ml/min |
| | Red.-agent | 2.5ml/min ± 1 ml | 2.5 ml/min |
| | Sample | 10ml/min ± 2 ml | 10 ml/min. |
| **Adventitious light - values** | **(V)** | **from file** | |
| | 100 | 0 | 0 |
| | 200 | 0 | 0 |
| | 300 | 0 | 0 |
| | 350 | 0 | 0 |
| | 400 | 1 | 1 |
| | 450 | 2 | 2 |
| | 500 | 6 | 6 |
| | 550 | 13 | 14 |
| | 575 | 19 | 20 |
| | 600 | 27 | 28. |



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An Endress+Hauser Company

| Maintenance works basic unit | |
|---|---|
| tightness visual check inside the Mercur | ☑ |
| visual check if gold-traps are broken | ☑ |
| visual check if spectrometer is contaminated | ☑ |
| reactor cleaning | ☑ |
| check pump-hose, if necessary change it | ☑ |
| check drying-hose, output gas-liquid-separator | ☑ |
| test Bubble-Sensor | ☑ |
| check gas flows | ☑ |
| check volume flows, reagents | ☑ |
| recording stray light values | ☑ |
| measurement with 30 ng/l | ☑ |

| Maintenance works Autosampler | Serial No.: 701 239 |
|---|---|
| lubricate the dosing-winding (Teflon-grease-spray) | ☑ |
| clean the dosing cylinder, if necessary exchange it | ☑ |
| lubricate the winding system of the height drive with some drops of oil | ☑ |
| check the toothed belt | ☑ |
| check the position of the mechanical stopper (height: 13mm ) | ☑ |
| check the pump rate of mixing pump (<14s AS52, typ.7s/<20s AS52S, typ.10s) | ☑ |
| check the pump rate of washing cup | ☑ |
| check the electrical hose connections for good contact | ☑ |
| check the connectors of the magnetic valves | ☑ |
| check the dosing hose for buckling, if necessary exchange it | ☑ |

บริษัท ดับเบิ้ล เอส ไดแอคนอสติคส์ จำกัด
DOUBLE S DIAGNOSTICS CO., LTD.
4 ซอยอุดมสุข 14 แขวงบางนา เขตบางนา กรุงเทพฯ 10260 โทรศัพท์: (02) 747-7009 โทรสาร: (02) 747-7008
4 Soi Udomsuk 14, Bangna, Bangkok 10260 Tel. (02) 747-7009 Fax: (02) 747-7008

## Maintenance Plan YEAR : 2022

| เดือน | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| รอบ | | | | | | ph/CK | | | | | | |

### Periodical maintenace check list for Konelab

| | 6M | 12M | Note! |
|---|---|---|---|
| 1.Diluent-wash tubing change | ☐ | ☑ | |
| 2.ISE tubing change | ☒ | ☒ | |
| 3.Syringe check/change | | ☑ | |
| 4.Dispensing check/ change | | ☑ | |
| 5.Waste tubing change when necessary | | ☑ | |
| 6.Lamp check/change | ☐ | ☑ | |
| 7.Mixer paddle/paddle change(not Konelab20) | | ☑ | |
| 8.ISE needles check/change | | ☒ | |
| 9.Pump tubing check/ chance | ☐ | ☑ | |
| 10.Broken/worn out part check /change | | ☑ | |
| 11.Peristaltic pump check /cleaning/ lubrication | ☐ | ☑ | |
| 12.Heating check | | ☑ | |
| 13.Cooling check | | ☑ | |
| 14.Dispenser mechanic check/adjustment | ☐ | ☑ | |
| 15.Cuvette transfer mechanic check/adjustment | ☐ | ☑ | |
| 16.Dispenser movement check/adjustment | ☐ | ☑ | |
| 17.Sample/reagent register check/adjustment | ☐ | ☑ | |
| 18.Dispensing tubing tightness check | ☐ | ☑ | |
| 19.Photometer and optics cleaning/check/adjustment | ☐ | ☑ | |
| 20.Workstation PC cleaning if necessary | ☐ | ☑ | |
| 21.Mechanic cleaning/lubrication | ☐ | ☑ | |
| 22.Instrument cleaning if necessary | ☐ | ☑ | |
| 23.Complete analyzer testing with waterblank/QC or sample | ☐ | ☑ | |
| 24.Test parameters/Adjustment/config. Save to USB key | ☐ | ☑ | |
| 25.UPS Test | ☐ | ☑ | |

Place: ALS LAB Instrument: K20 Aqua Kem 250
Date/Time: 30-6-65 Serial no: 22781
Service done by: Install date:
Signature of customer: [signature] Date/Time: 30/6/22

analytikjena

| Device parameter | | nominal value | actual value |
|---|---|---|---|
| **Analytical parameters** | | | |
| Conditions.: max.conc.: 10µg/L | PMT-voltage: 404 V | | |
| | Blank-solution | | Int 0.0005 |
| | without enrichment / FBR 30 ng/L | Int > 0.0015<br>RSD < 3 % | $Int_1$ 0.0026<br>RSD 1.12 % |
| Conditions.: max.conc.: 1.7µg/L | PMT-voltage: 395 V | | |
| | Blank-solution | | Int 0.0018 |
| | with enrichment / FBR 30 ng/L | Int > 0.008<br>RSD < 3 % | $Int_2$ 0.0104<br>RSD 0.59 % |
| | Fok.- factor ( $Int_2$ / $Int_1$ ) | > 3,5 | 4 |
| **Comments** | | | |

Mr. Srichai Fak-on
Signature Technician

[signature]
Signature Customer

Bangkok., 7/06/2022.
Place, Date (DD/MM/YYYY)

06/06/2022
Place, Date (DD/MM/YYYY)

MM-N12


SCG

Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.

NSC-TISI-TIS 17025 CALIBRATION 0244




# Calibration Report

**Equipment** : **Chamber ( Cold Room )**
**Date of Calibration** : **1 July 2022**
**Environment** : **Temperature : 18.9-23.7 °C**
**Line Voltage : 222.9-226.5 V**
**Relative Humidity : 55 - 65 %RH**

**Condition of this results of calibration :**

1. This equipment was calibrated by insert nine standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20 ( based on ASTM E145-94 ( Reapproved 2001) and AS2853-1986 ).
   All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .
2. Reference Standard Instrument :

| Instrument | Model | Instrument No. | Certificate No. | Due Date |
|---|---|---|---|---|
| TC | TYPE T | TN161-TN170 | T210009 | 30 July 2022 |
| TC | TYPE T | TN171-TN180 | T210009 | 30 July 2022 |
| DATA LOGGER | 34970A | T149 | T210009 | 30 July 2022 |

3. This certificate is traceable to :
   National Institute of Metrology ( Thailand ) through Metrological Center ( NSC-TISI-TIS 17025 CALIBRATION 0244.)
4. Condition of calibrated item : good
   Equipment Description :
   Time Constant 6 Hour 28 Minute At 3 °C
   Fresh Air Damper [ ] Open [ ] Min [ ] Medium [ ] Max
   [ ] Close
   [X] Not Available
5. Adjustment :
   ( ) without adjustment ( X ) after adjustment

**Approved By**




SCG

Metrological Center

SCI ECO Services Company Limited



33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.
Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100
Bangkok Tel : +668 9205 6851 , +669 8247 2360
Website : www.scieco.co.th E-Mail : calibrate@scg.co.th



NSC-TISI-TIS 17025 CALIBRATION 0244




# Certificate of Calibration

**Equipment** : **Chamber ( Cold Room )**
**Manufacturer** : **KOLDTECH**
**Model** : **KM-240**
**Serial No.** : **TBN-1012061/06**
**Customer Code** : **BKK_EN0168**
**ID No.** : **T2462A3**
**Customer** : **ALS Laboratory Group (Thailand) Co.,Ltd.**
**104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250**
**Customer Location** : **Environmental Laboratory**
**Date of Receipt** : **27 June 2022**
**Calibrated By** : **Sujjar Naknakred ( Site Calibration Manager )**
**Approved By** : / **Boonchai Suriyawong (Site Calibration Manager)**
**Date of Issue** : 04 JUL 2022

REVIEW BY Sirilak P.
APPROVED BY
NEXT CAL. DATE 01/07/24

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 standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.




น.9/123

SCG

Metrological Center
SCI ECO Services Company Limited
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.

NSC-TISI-TIS 17025
CALIBRATION 0244

Certificate No. T221645



# Calibration Report

**Measurement Results:**

| Calibration Point | Average Standard Reading at each position (°C) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | TN161 | TN162 | TN163 | TN164 | TN165 | TN166 | TN167 | TN168 | TN169 | TN170 |
| 3 | 2.91 | 2.97 | 2.80 | 3.09 | 3.00 | 2.99 | 3.22 | 2.86 | 3.17 | 3.19 |
| | TN171 | TN172 | TN173 | TN174 | TN175 | TN176 | | | | |
| | 2.95 | 3.41 | 2.71 | 3.30 | 3.04 | 3.01 | | | | |

| Chamber ( Cold Room ) | | | Temperature Distribution | | | | |
|---|---|---|---|---|---|---|---|
| Setting (°C) | Reading (°C) | | Average (°C) | Stability (±°C) | Uniformity (°C) | Uncertainty (±°C) | Coverage Factor *k* |
| | Min , Max | Average | | | | | |
| 3.0 | 2.8 , 4.0 | 3.2 | 3.04 | 1.33 | 0.93 | 1.91 | 2.00 |

* The quoted uncertainty exclude " uniformity "
The calibration result apply only the above calibrated item.
The result of test was found accurate as shown on date and place of test only.
The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor *k* which for a t-distribution, providing a level of confidence of approximately 95 % .

Approved By.



SCG

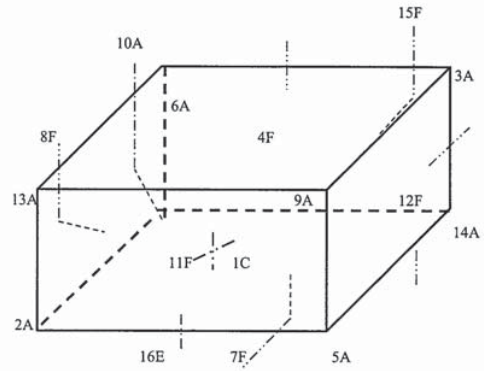
Metrological Center
SCI ECO Services Company Limited
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.

NSC-TISI-TIS 17025
CALIBRATION 0244

Certificate No. T221645



# Calibration Report




C = Centre , F = Centre of Face , A = Corner , E = Centre of Edge

| | | |
|---|---|---|
| 1C | = | TN161 |
| 2A | = | TN162 |
| 3A | = | TN163 |
| 4F | = | TN164 |
| 5A | = | TN165 |
| 6A | = | TN166 |
| 7F | = | TN167 |
| 8F | = | TN168 |
| 9A | = | TN169 |
| 10A | = | TN170 |

| | | |
|---|---|---|
| 11F | = | TN171 |
| 12F | = | TN172 |
| 13A | = | TN173 |
| 14A | = | TN174 |
| 15F | = | TN175 |
| 16E | = | TN176 |

Approved By.

บริษัท ออโตเมชั่น เซอร์วิส จำกัด
Automation Service Co.,Ltd.
929,929/1 ซอยพัฒนาการ 30 ถนนพัฒนาการ แขวงสวนหลวง เขตสวนหลวง กรุงเทพฯ 10250
929,929/1 Soi Pattanakarn 30, Pattanakarn Rd., Suanluang, Suanluang, Bangkok 10250
โทรศัพท์ (Tel.) 0-2319-9994 โทรสาร (FAX) 0-2319-9596 website : www.automation.co.th

MTOC : L-1002/2022

Report No. : ALS-799/02

## Maintenance Sheet

Customer : ALS Laboratory  Date : 03 / 10 / 2022

Model : ASI-L  Serial No. H57415200799

| Item | Carry out maintenance work | Result | Exchange | Comment |
|---|---|---|---|---|
| 1. | Arm Drive section | O.K. | | |
| | Check Arm Drive Belt for wear and tension | O.K. | | |
| | Check grease of Screw Arm Drive | O.K. | | |
| 2. | Rinse pump (only ASI-V 24ml, 40ml) | O.K. | | |
| | Check pump rate(>40mL/min) | O.K. | | |
| | Check pump and tube connection for leakage | O.K. | | |
| | Check if outlet flow is in proper condition | O.K. | | |
| 3. | Check and if necessary exchange consumable, Maintenance parts | O.K. | | See appropriate list of maintenance parts |
| 4. | Check Stirrer [When installed] | O.K. | | |
| 5. | Verify ASI function via mechanical check | O.K. | | |

Inspection by : Peerapong Sangpan
( Mr. Peerapong Sangpan )
Technician

SHIMADZU ANALYZER
2/3



บริษัท ออโตเมชั่น เซอร์วิส จำกัด
Automation Service Co.,Ltd.
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โทรศัพท์ (Tel.) 0-2319-9994 โทรสาร (FAX) 0-2319-9596 website : www.automation.co.th

MTOC : L-1002/2022

Report No. : ALS-799/02

## ASI Maintenance Report

Instrument : Automatic Sample Injector  Measuring : Vial 40 mL
Model : ASI-L  Place of Installation : -
Serial No. : H57415200799  Department : LABOLATORY
Manufacture : Shimadzu

Customer: ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaen Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand

Date of Maintenance : 03 / 10 / 2022

REVIEW BY Vichuta N.
APPROVED BY Sirilak P
NEXT CAL. DATE 3/10/23

Ambient Condition : Temperature 25.4 ± 5 °C
: Humidifier 60 ± 15 %RH

Maintenance By : Peerapong Sangpan
( Mr. Peerapong Sangpan )
Technician

Approved By : N. Phuo
( Mr. Nipon Phungsomsak )
Technician Manager

User Name : Sirilak P
( Ms. Sirilak Puengpang )

SHIMADZU ANALYZER
1/3

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แผนกสินค้าสำนักงาน (Office Automation Division) F. 0-2318-0200 E-mail : marketing-oa@automation.co.th
สาขาระยอง Rayong Branch 1/15 ตำบลห้วยโป่ง อำเภอเมือง ระยอง 21150 1/15 Huaypong, Muang, Rayong 21150 Tel. 038-692-152 Fax. 038-692-345
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โทรศัพท์ (Tel.) 0-2319-9994 โทรสาร (FAX) 0-2319-9596 website : www.automation.co.th

MTOC : L-1001/2022

Report No. : ALS-416/02

# TOC–L Maintenance Report

| | | | |
|---|---|---|---|
| Instrument | : Total Organic Carbon Analyzer | Measuring | : TC 0 ~ 30000 mg/L |
| Model | : TOC-LCSH | Place of Installation | : - |
| Serial No. | : H54425300416 | Department | : LABORATORY |
| Manufacture | : Shimadzu | | |

Customer: ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaen Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand

Date of Maintenance : 03 / 10 / 2022

REVIEW BY Vichuta N.
APPROVED BY Sinlutk P.
NEXT CAL. DATE 3/10/23

Ambient Condition : Temperature 25.4 ± 5 °C

: Humidifier 60 ± 15 %RH

Maintenance By : Peerapong Sangpan
( Mr. Peerapong Sangpan)
Technician

Approved By :
( Mr. Nipon Phungsomsak )
Technician Manager

User Name : Sinlutk P.
( Supervisor )



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122/5 Moo 4, Banklang, Muang, Lamphun 51000
Tel./Fax. 053-581-876

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MTOC : L-1002/2022

Report No. : ALS-799/02

## List of Consumable, Maintenance parts

| Pos. | Part Number | Part Name | Result | Exchange | Recommended Interval |
|---|---|---|---|---|---|
| 1. | 017-27021-01 | Grease Paste, Lubricant 100g | O.K. | | 1 time per year |
| 2. | 032-22661-02 | Belt, 60S2m596, Arm Drive | O.K. | | 1 time per year Depending on condition |
| 3. | 034-03067-02 | Spring, F-642, Arm Drive | O.K. | | Depending on condition |
| 4. | 042-00405-11 | Pump Head, for ASI Rinse Pump (only ASI-V 24mL, 40mL) | O.K. | | After 300 h of operating |
| 5. | 638-41448-01 | Std. Needle Type1 24mL, 40mL* (for tube 2, 1x1, 6),[ Sparge needle] | N/A | | Depending on condition |
| 6. | 638-41448-02 | Std. Needle Type1 125mL* (for tube 2, 1x1, 6) | N/A | | Depending on condition |
| 7. | 631-41660-03 | Flare Pipe 2x1,5x700mm* (for Standard Needle Type1 24mL,40mL, 125mL) | N/A | | Depending on condition (may cut to origin length 600mm) |
| 8. | 638-41450-01 | Needle for Suspended Particles,* 0,8mm (only ASI-V 24mL, 40mL) | N/A | | Depending on condition |
| 9. | 638-41450-01 | Std. Needle Type2 125mL* (for tube 1,4x0,9) | N/A | | Depending on condition |
| 10. | 638-41472-01 | Std. Needle Type2 24mL, 40mL* (for tube 1,4x0,9) | O.K. | | Depending on condition |
| 11. | 631-41660-02 | Flare Pipe 1,4x0,9x600mm* (for Suspended + Needle Type2) | O.K. | | Depending on condition |
| 12. | 638-41449-01 | Double Needle , only 24mL,40mL (simultaneous sparge type)* | N/A | | Depending on condition |
| 13. | 631-41660-01 | Flare Pipe 1,1x0,6x600mm* (for Double Needle 24mL,40mL) | N/A | | Depending on condition |

*Note: needed parts depending on installed needle types!

Inspection by : Peerapong Sangpan
( Mr. Peerapong Sangpan )
Technician



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MTOC : L-1001/2022

Report No. : ALS-416/02

| Item | Carry out maintenance work | Result | Exchange | Comment |
|---|---|---|---|---|
| 8. | Due to instrument condition, clean the instrument inside and outside. | O.K. | | |
| 9. | After checking the system and exchanging of consumable and maintenance parts a new 1-3 point calibration have to be done. | O.K. | | Addition test 1. |
| 10. | After wards the calibration perform check sample measurement. | O.K. | | Addition test 2. |

**Addition test**

| Test no. | Test conditions | Meas. value | Result |
|---|---|---|---|
| 1. | Calibration TC standard solution at 0, 0.1, 0.5, 1, 5 10, 20 injection volume 50 µL No. of measurement 2 times (Max.3) | | Attachment : ALS-416/02 Page 1/4 -2/4 |
| | Criteria : $R^2$ = 0.995 or more | 1.0000 | Pass |
| 2. | Measurement of reagent water and TC standard solution at 5.0 mg/L injection volume 50 µL No. of measurement 2 times ( Max.3 ) and calculate accuracy by Meas. of TC standard – Meas. of Reagent water | | Attachment : ALS-416/02 Page 3/4 – 4/4 |
| | Criteria : Accuracy %Recovery 10% or less | 5.477 – 0.4414 = 5.0356 ppm | Pass |

Inspection by : Peerapong Sangpan

( Mr. Peerapong Sangpan )
Technician



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MTOC : L-1001/2022

Report No. : ALS-416/02

## Maintenance Sheet

Customer : ALS Laboratory  Date : 03 / 10 / 2022

Model : TOC-LCSH  Serial No. H54425300416

| Item | Carry out maintenance work | Result | Exchange | Comment |
|---|---|---|---|---|
| 1. | Check functionality of the device | | | |
| | Check furnace temperature ( Standard cat. 680 °C / for TN cat. 720 °C ) | O.K. | | |
| | Check dehumidifier temperature ( 1 °C ) | O.K. | | |
| | Check the entire flow line related to leakage | O.K. | | |
| | Check baseline status (OK) | O.K. | | |
| | Check carrier gas pressure (200 ±10 kPa) | O.K. | | |
| | Check carrier gas flow rate ( 150 mL/min ) | O.K. | | |
| 2. | Tubes | | | |
| | Check all tubing for contamination, if necessary clean them | O.K. | | |
| | Check all tubing for tight connection | O.K. | | |
| 3. | Container and Drainage | | | |
| | Fill up humidifier with pure water to max. level | O.K. | | |
| | Check filling of dilution water and acid container | O.K. | | |
| | Rinse Drain Pot, after wards refill again with pure water | O.K. | | |
| | Check if outlet flow is in proper conditions | O.K. | | |
| 4. | TC and IC Injection | | | |
| | Clean injector Block | O.K. | | |
| | Check injector Block for wear | O.K. | | |
| | Check injection tube adjustment | O.K. | | |
| | Check injection for leakage | O.K. | | |
| | Check injection for clogging | O.K. | | |
| 5. | IC Measurement ( N-type ) | | | |
| | Check acidification in syringe | | | |
| | Check sparging in syringe | | | |
| 6. | Eye check of 8-Port valve, for sample residues or moist spots that indicate possible leakage | O.K. | | |
| 7. | Check and if necessary exchange consumable, Maintenance parts | O.K. | | See list of consumable, maintenance parts |

Inspection by : Peerapong Sangpan

( Mr. Peerapong Sangpan )
Technician



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# TOC-Control L Report

2022_10_03_001_PM-02.tlx

**Instr.Information**

| | |
|---|---|
| Instrument Options | TOC/ASI/IC Unit/ |
| Catalyst | Regular Sensitivity |

**Cal. Curve**

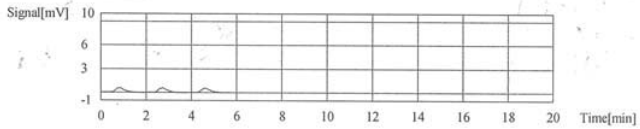
| | |
|---|---|
| Sample Name: | Untitled |
| Sample ID: | Untitled |
| Cal. Curve: | TC 0.1 - 20 ppm.2022_10_03_14_08_24.cal |
| Status | Completed |

| Type | Anal. |
|---|---|
| Standard | TC |

Conc: 0.000mg/L

| No. | Area | Inj. Vol. | Aut. Dil. | Rem. | Ex. | Date / Time |
|---|---|---|---|---|---|---|
| 1 | 1.643 | 50uL | 1.000 | ******* | E | 10/3/2022 2:11:11 PM |
| 2 | 1.368 | 50uL | 1.000 | ******* | | 10/3/2022 2:13:20 PM |
| 3 | 1.381 | 50uL | 1.000 | ******* | | 10/3/2022 2:15:29 PM |

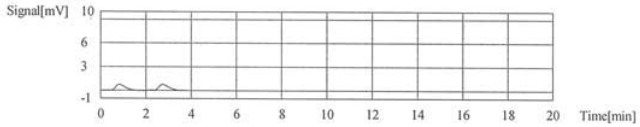
| | |
|---|---|
| Acid Add. | 0.000% |
| Mean Area | 1.375 |
| SD Area | 0.00919 |
| CV Area | 0.67% |




Conc: 0.1000mg/L

| No. | Area | Inj. Vol. | Aut. Dil. | Rem. | Ex. | Date / Time |
|---|---|---|---|---|---|---|
| 1 | 2.165 | 50uL | 10.00 | ******* | | 10/3/2022 2:21:03 PM |
| 2 | 2.153 | 50uL | 10.00 | ******* | | 10/3/2022 2:23:47 PM |

| | |
|---|---|
| Acid Add. | 0.000% |
| Mean Area | 2.159 |
| SD Area | 0.00849 |
| CV Area | 0.39% |




Conc: 0.5000mg/L

| No. | Area | Inj. Vol. | Aut. Dil. | Rem. | Ex. | Date / Time |
|---|---|---|---|---|---|---|
| 1 | 4.159 | 50uL | 2.000 | ******* | E | 10/3/2022 2:29:48 PM |
| 2 | 3.808 | 50uL | 2.000 | ******* | | 10/3/2022 2:31:58 PM |
| 3 | 3.922 | 50uL | 2.000 | ******* | | 10/3/2022 2:34:06 PM |

| | |
|---|---|
| Acid Add. | 0.000% |
| Mean Area | 3.865 |
| SD Area | 0.08061 |
| CV Area | 2.09% |

Conc: 1.000mg/L

| No. | Area | Inj. Vol. | Aut. Dil. | Rem. | Ex. | Date / Time |
|---|---|---|---|---|---|---|
| 1 | 6.174 | 50uL | 1.000 | ******* | | 10/3/2022 2:37:11 PM |
| 2 | 6.210 | 50uL | 1.000 | ******* | | 10/3/2022 2:39:27 PM |



10/3/2022 3:41:23 PM

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MTOC : L-1001/2022

Report No. : ALS-416/02

## List of Consumable, Maintenance parts

| Pos. | Part Number | Part Name | Result | Exchange | Recommended Interval |
|---|---|---|---|---|---|
| 1. | 036-11209-84 | O-ring, 4D P10A ( Viton , for TC,IC Slider) | O.K. | √ | 1 time per year, Depending on condition |
| 2. | 036-11219-84 | O-ring, 4D P20 (for sealing TC-Combustion tube) | O.K. | √ | 1 time per year, Depending on condition |
| 3. | 638-15025 | O-ring, PIFE (for TC,IC-Slider) | O.K. | | 1 time per year, Depending on condition |
| 4. | 630-00105-01 | Platinum net, (2pcs-set) (to support catalyst) | O.K. | | 6 month same time as catalyst exchange |
| 5. | 630-00557 | Silica Wool (to support catalyst) | O.K. | | 6 month same time as catalyst exchange |
| 6. | 630-00992 | Halogen Scrubber | O.K. | √ | 6 month |
| 7. | 630-00996 | High Sensitivity TC Catalyst (When installed) | N/A | | Depending on condition |
| 8. | 638-60116 | Regular Catalyst (33g) (When installed) | O.K. | √ | 6 month |
| 9. | 638-56251-01 | 8-Port valve rotor | O.K. | | 1 time per year |
| 10. | 638-41323 | TC-Combustion Tube | O.K. | | 6 month same time as catalyst exchange |
| 11. | 631-43404-01 | Packing, gasket slider (for TC-Injection tube) | O.K. | | 1 time per year, Depending on condition |
| 12. | 638-59296 | Syringe 5mL | O.K. | | Depending on condition |
| 13. | 638-59296-01 | Plunger Tip (for syringe 5mL) | O.K. | √ | 6 month |
| 14. | 042-00405-11 | IC reagent supply pump head | O.K. | | 1 time per year |
| 15. | 630-00999 | CO2-Absorber (for cell space purge) | O.K. | √ | 1 time per year |
| 16 | 630-00964 | Molecular Sieves 13x | O.K. | | 1 time per year |

Note. Table indicates the guidelines replacement periods when NPOC measurement is performed on sample that are comparatively as clean as tap water ,use standard catalyst and at a rate of about 500 sample per month ( operating five days a week )

Inspector By Peerapong Sangpan

( Mr. Peerapong Sangpan )
Technician

SHIMADZU ANALYZER

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# TOC-Control L Report

2022_10_03_001_PM-02.tlx

**Instr.Information**

| | |
|---|---|
| Instrument Options | TOC/ASI/IC Unit/ |
| Catalyst | Regular Sensitivity |

**Sample**

| | |
|---|---|
| Sample Name: | TC_5 |
| Sample ID: | Untitled |
| Origin: | TC 0.1 - 20 ppm.cal |
| Status | Completed |
| Chk. Result | |

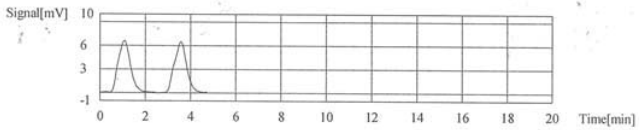
| Type | Anal. | Manual Dilution | Result |
|---|---|---|---|
| Unknown | TC | 1.000 | TC:5.477mg/L |

1. Det

Anal.: TC

| No. | Area | Conc. | Inj. Vol. | Aut. Dil. | Ex. | Cal. Curve | Date / Time |
|---|---|---|---|---|---|---|---|
| 1 | 24.48 | 5.530mg/L | 50uL | 1.000 | | TC 0.1 - 20 ppm.2022_10_03_14_08_24.cal | 10/3/2022 3:23:07 PM |
| 2 | 24.01 | 5.423mg/L | 50uL | 1.000 | | TC 0.1 - 20 ppm.2022_10_03_14_08_24.cal | 10/3/2022 3:25:38 PM |

| | |
|---|---|
| Mean Area | 24.25 |
| Mean Conc. | 5.477mg/L |

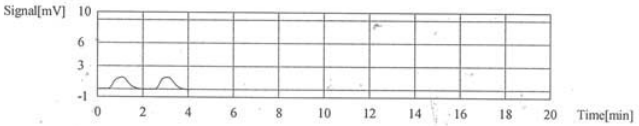





# TOC-Control L Report

2022_10_03_001_PM-02.tlx

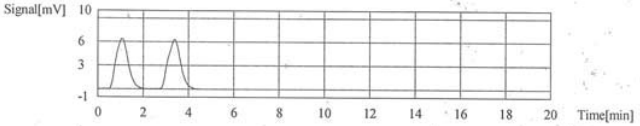
| | |
|---|---|
| Acid Add. | 0.000% |
| Mean Area | 6.192 |
| SD Area | 0.02546 |
| CV Area | 0.41% |




Conc: 5.000mg/L

| No. | Area | Inj. Vol. | Aut. Dil. | Rem. | Ex. | Date / Time |
|---|---|---|---|---|---|---|
| 1 | 23.81 | 50uL | 4.000 | ******* | | 10/3/2022 2:45:27 PM |
| 2 | 23.74 | 50uL | 4.000 | ******* | | 10/3/2022 2:48:07 PM |

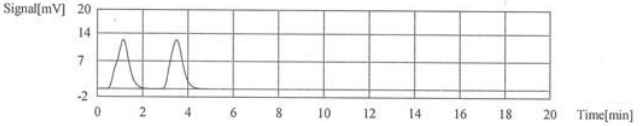
| | |
|---|---|
| Acid Add. | 0.000% |
| Mean Area | 23.78 |
| SD Area | 0.04950 |
| CV Area | 0.21% |




Conc: 10.00mg/L

| No. | Area | Inj. Vol. | Aut. Dil. | Rem. | Ex. | Date / Time |
|---|---|---|---|---|---|---|
| 1 | 46.16 | 50uL | 2.000 | ******* | | 10/3/2022 2:54:27 PM |
| 2 | 46.15 | 50uL | 2.000 | ******* | | 10/3/2022 2:57:11 PM |

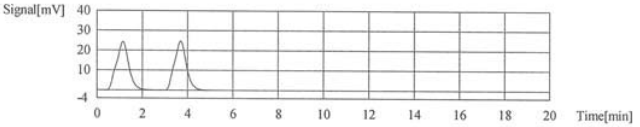
| | |
|---|---|
| Acid Add. | 0.000% |
| Mean Area | 46.16 |
| SD Area | 0.00707 |
| CV Area | 0.02% |



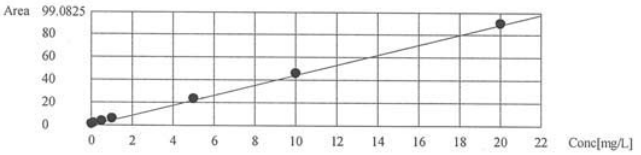

Conc: 20.00mg/L

| No. | Area | Inj. Vol. | Aut. Dil. | Rem. | Ex. | Date / Time |
|---|---|---|---|---|---|---|
| 1 | 90.44 | 50uL | 1.000 | ******* | | 10/3/2022 3:00:47 PM |
| 2 | 89.71 | 50uL | 1.000 | ******* | | 10/3/2022 3:03:32 PM |

| | |
|---|---|
| Acid Add. | 0.000% |
| Mean Area | 90.08 |
| SD Area | 0.5162 |
| CV Area | 0.57% |




| | |
|---|---|
| Slope: | 4.427 |
| Intercept | 0.000 |
| r^2 | 1.0000 |
| r | 1.0000 |
| RSE(%) | N/A |
| Zero Shift | Yes |



# TOC-Control L Report

2022_10_03_001_PM-02.tlx

**Instr.Information**

| | |
|---|---|
| Instrument Options | TOC/ASI/IC Unit/ |
| Catalyst | Regular Sensitivity |

**Sample**

| | |
|---|---|
| Sample Name: | Water |
| Sample ID: | Untitled |
| Origin: | TC 0.1 - 20 ppm.cal |
| Status | Completed |
| Chk. Result | |

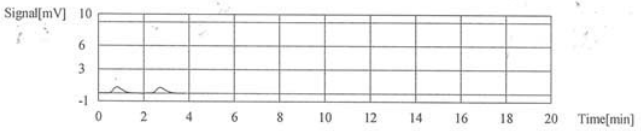
| Type | Anal. | Manual Dilution | Result |
|---|---|---|---|
| Unknown | TC | 1.000 | TC:0.4414mg/L |

1. Det

Anal.: TC

| No. | Area | Conc. | Inj. Vol. | Aut. Dil. | Ex. | Cal. Curve | Date / Time |
|---|---|---|---|---|---|---|---|
| 1 | 2.000 | 0.4518mg/L | 50uL | 1.000 | | TC 0.1 - 20 ppm.2022_10_03_14_08_24.cal | 10/3/2022 3:28:37 PM |
| 2 | 1.908 | 0.4310mg/L | 50uL | 1.000 | | TC 0.1 - 20 ppm.2022_10_03_14_08_24.cal | 10/3/2022 3:30:46 PM |

| | |
|---|---|
| Mean Area | 1.954 |
| Mean Conc. | 0.4414mg/L |






10/3/2022 3:43:13 PM