# ภาคผนวก ฒ

ใบรับรองการสอบเทียบเครื่องมือ

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## รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

| Sample Name | Parameter | Equipment Name | ID No. | Calibrated Date | Next Cal | Freq. Calibrate (Months) |
|---|---|---|---|---|---|---|
| Ambient | Total Suspended Particulate | High Volume | BKK_FS0372 | - | - | On site Calibration |
| Ambient | Total Suspended Particulate | High Volume | RYG_FS0664 | - | - | On site Calibration |
| Ambient | Total Suspended Particulate | High Volume | RYG_FS0173 | - | - | On site Calibration |
| Ambient | Total Suspended Particulate | High Volume | RYG_FS0396 | - | - | On site Calibration |
| Ambient | Total Suspended Particulate | High Volume | RYG_FS0179 | - | - | On site Calibration |
| Ambient | Total Suspended Particulate | Digital Balance | RYG_EN0001 | 1-Mar-23 | 1-Mar-24 | 12 |
| Ambient | Particulate Matter (PM-10) | High Volume | BKK_FS0389 | - | - | On site Calibration |
| Ambient | Particulate Matter (PM-10) | High Volume | RYG_FS0666 | - | - | On site Calibration |
| Ambient | Particulate Matter (PM-10) | High Volume | RYG_FS0189 | - | - | On site Calibration |
| Ambient | Particulate Matter (PM-10) | High Volume | RYG_FS0191 | - | - | On site Calibration |
| Ambient | Particulate Matter (PM-10) | High Volume | RYG_FS0668 | - | - | On site Calibration |
| Ambient | Particulate Matter (PM-10) | Digital Balance | RYG_EN0001 | 1-Mar-23 | 1-Mar-24 | 12 |
| Ambient | Nitrogen Dioxide | $NO_2$ Analyzer | BKK_FS1090 | 1-Jul-23 | 1-Jan-24 | 6 |
| Ambient | Nitrogen Dioxide | $NO_2$ Analyzer | BKK_FS0776 | 1-Jul-23 | 1-Jan-24 | 6 |
| Ambient | Nitrogen Dioxide | $NO_2$ Analyzer | BKK_FS1092 | 1-Jul-23 | 1-Jan-24 | 6 |
| Ambient | Nitrogen Dioxide | $NO_2$ Analyzer | RYG_FS0255 | 1-Jul-23 | 1-Jan-24 | 6 |
| Ambient | Nitrogen Dioxide | $NO_2$ Analyzer | BKK_FS0789 | 1-Jul-23 | 1-Jan-24 | 6 |
| Ambient | Sulfur Dioxide | $SO_2$ Analyzer | BKK_FS1089 | 2-Jul-23 | 2-Jan-24 | 6 |
| Ambient | Sulfur Dioxide | $SO_2$ Analyzer | BKK_FS0775 | 2-Jul-23 | 2-Jan-24 | 6 |
| Ambient | Sulfur Dioxide | $SO_2$ Analyzer | BKK_FS0788 | 2-Jul-23 | 2-Jan-24 | 6 |
| Ambient | Sulfur Dioxide | $SO_2$ Analyzer | RYG_FS0254 | 2-Jul-23 | 2-Jan-24 | 6 |
| Ambient | Sulfur Dioxide | $SO_2$ Analyzer | BKK_FS1091 | 2-Jul-23 | 2-Jan-24 | 6 |
| Ambient | Ozone | Ozone Analyzer | BKK_FS1073 | 1-Jul-23 | 1-Jan-24 | 6 |
| Ambient | Ozone | Ozone Analyzer | BKK_FS1074 | 1-Jul-23 | 1-Jan-24 | 6 |
| Ambient | Ozone | Ozone Analyzer | BKK_FS0732 | 1-Jul-23 | 1-Jan-24 | 6 |
| Ambient | Ozone | Ozone Analyzer | 635RSBRR | 5-Apr-23 | 5-Apr-24 | 12 |
| Ambient | Ozone | Ozone Analyzer | BKK_FS0761 | 1-Jul-23 | 1-Jan-24 | 6 |
| Ambient | Wind Speed / Wind Direction | Wind Speed / Wind Direction | RYG_FS0649 | 20-Jun-23 | 20-Dec-24 | 18 |
| Noise | Leq 24 hrs | Sound Calibrator | RYG_FS0496 | 17-Jan-23 | 17-Jan-24 | 12 |
| Noise | Leq 24 hrs | Sound Level Meter | RYG_FS0624 | 23-Jan-23 | 23-Jan-24 | 12 |
| Noise | Leq 24 hrs | Sound Level Meter | RYG_FS0627 | 26-Jan-23 | 26-Jan-24 | 12 |
| Noise | Leq 24 hrs | Sound Level Meter | RYG_FS0432 | 25-Jan-23 | 25-Jan-24 | 12 |
| Noise | Leq 24 hrs | Sound Level Meter | RYG_FS0437 | 19-Oct-23 | 19-Oct-24 | 12 |
| Noise | Leq 24 hrs | Sound Level Meter | RYG_FS0628 | 26-Jan-23 | 26-Jan-24 | 12 |
| Noise | Leq 5 min | Sound Calibrator | RYG_FS0496 | 17-Jan-23 | 17-Jan-24 | 12 |
| Noise | Leq 5 min | Sound Level Meter | RYG_FS0624 | 23-Jan-23 | 23-Jan-24 | 12 |
| Noise | Leq 5 min | Sound Level Meter | RYG_FS0627 | 26-Jan-23 | 26-Jan-24 | 12 |
| Noise | Leq 5 min | Sound Level Meter | RYG_FS0432 | 25-Jan-23 | 25-Jan-24 | 12 |
| Noise | Leq 5 min | Sound Level Meter | RYG_FS0437 | 19-Oct-23 | 19-Oct-24 | 12 |
| Noise | Leq 5 min | Sound Level Meter | RYG_FS0628 | 26-Jan-23 | 26-Jan-24 | 12 |
| Noise | Noise Annoyance | Sound Calibrator | RYG_FS0496 | 17-Jan-23 | 17-Jan-24 | 12 |
| Noise | Noise Annoyance | Sound Level Meter | RYG_FS0624 | 23-Jan-23 | 23-Jan-24 | 12 |
| Noise | Noise Annoyance | Sound Level Meter | RYG_FS0627 | 26-Jan-23 | 26-Jan-24 | 12 |
| Noise | Noise Annoyance | Sound Level Meter | RYG_FS0432 | 25-Jan-23 | 25-Jan-24 | 12 |
| Noise | Noise Annoyance | Sound Level Meter | RYG_FS0437 | 19-Oct-23 | 19-Oct-24 | 12 |
| Noise | Noise Annoyance | Sound Level Meter | RYG_FS0628 | 26-Jan-23 | 26-Jan-24 | 12 |
| Noise | Noise Annoyance | Sound Calibrator | RYG_FS0496 | 17-Jan-23 | 17-Jan-24 | 12 |
| Noise | Noise Annoyance | Sound Level Meter | RYG_FS0495 | 13-Jan-23 | 13-Jan-24 | 12 |
| Noise | Noise Annoyance | Sound Level Meter | RYG_FS0625 | 23-Jan-23 | 23-Jan-24 | 12 |
| Noise | Noise Annoyance | Sound Level Meter | RYG_FS0433 | 25-Jan-23 | 25-Jan-24 | 12 |
| Noise | Noise Annoyance | Sound Level Meter | RYG_FS0623 | 23-Jan-23 | 23-Jan-24 | 12 |
| Noise | Noise Annoyance | Sound Level Meter | RYG_FS0629 | 26-Jan-23 | 26-Jan-24 | 12 |

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| Sample Name | Parameter | Equipment Name | ID No. | Calibrated Date | Next Cal | Freq. Calibrate (Months) |
|---|---|---|---|---|---|---|
| Rayong Lab | Cyanide | SPECTROPHOTOMETER | RYG_EN0037 | 27-Sep-22 | 27-Mar-24 | 18 |
| Rayong Lab | Formaldehyde | SPECTROPHOTOMETER | RYG_EN0037 | 27-Sep-22 | 27-Mar-24 | 18 |
| Rayong Lab | Phenol | SPECTROPHOTOMETER | RYG_EN0037 | 27-Sep-22 | 27-Mar-24 | 18 |
| Rayong Lab | pH at 25 °C | pH Meter | RYG_EN0152 | 22-Dec-22 | 22-Dec-23 | 12 |
| Rayong Lab | Non-Carbonate Hardness | Chamber (Cold Room) | RYG_EN0184 | 25-Jan-23 | 25-Jul-24 | 18 |
| Rayong Lab | Nitrate | SPECTROPHOTOMETER | RYG_EN0037 | 27-Sep-22 | 27-Mar-24 | 18 |
| Rayong Lab | Ammonia Nitrogen | SPECTROPHOTOMETER | RYG_EN0037 | 27-Sep-22 | 27-Mar-24 | 18 |
| Rayong Lab | Color | Chamber (Cold Room) | RYG_EN0184 | 25-Jan-23 | 25-Jul-24 | 18 |
| Rayong Lab | Dissolved Oxygen | Chamber (Cold Room) | RYG_EN0184 | 25-Jan-23 | 25-Jul-24 | 18 |
| Rayong Lab | BOD | DO meter with Sensor | RYG_EN0032 | 24-Jul-23 | 24-Jan-25 | 18 |
| Rayong Lab | BOD | Incubator | RYG_EN0154 | 29-May-23 | 29-Nov-24 | 18 |
| Rayong Lab | COD | Spectrophotometer | RYG_EN0037 | 27-Sep-22 | 27-Mar-24 | 18 |
| Rayong Lab | Oil & Grease | Electronic Balance | RYG_EN0002 | 1-Mar-23 | 1-Mar-24 | 12 |
| Rayong Lab | Oil & Grease | Hot Air Oven | RYG_EN0006 | 20-Oct-22 | 20-Apr-24 | 18 |
| Rayong Lab | Oil & Grease | Water Bath | RYG_EN0061 | 20-Oct-22 | 20-Apr-24 | 18 |
| Rayong Lab | Total Hardness | Chamber (Cold Room) | RYG_EN0184 | 25-Jan-23 | 25-Jul-24 | 18 |
| Rayong Lab | Sulfide | Chamber (Cold Room) | RYG_EN0184 | 25-Jan-23 | 25-Jul-24 | 18 |
| Rayong Lab | Total Suspended Solids | Electronic Balance | RYG_EN0002 | 1-Mar-23 | 1-Mar-24 | 12 |
| Rayong Lab | Total Suspended Solids | Hot Air Oven | RYG_EN0010 | 20-Oct-22 | 20-Apr-24 | 18 |
| Rayong Lab | Total Dissolved Solids 180°C | Electronic Balance | RYG_EN0002 | 1-Mar-23 | 1-Mar-24 | 12 |
| Rayong Lab | Total Dissolved Solids 180°C | Hot Air Oven | RYG_EN0010 | 20-Oct-22 | 20-Apr-24 | 18 |
| Rayong Lab | Temperature | Digital Thermometer With Sensor | RYG_FS0541 | 10-Oct-23 | 10-Oct-24 | 12 |
| Rayong Lab | Total Kjeldahl Nitrogen | Block Digestion Unit | RYG_EN0188 | 15-Mar-23 | 15-Mar-24 | 12 |
| Rayong Lab | Total Kjeldahl Nitrogen | pH Meter | RYG_EN0152 | 22-Dec-22 | 22-Dec-23 | 12 |
| Rayong Lab | Sulfate | Spectrophotometer | RYG_EN0037 | 27-Sep-22 | 27-Mar-24 | 18 |
| Rayong Lab | Turbidity | Chamber (Cold Room) | RYG_EN0184 | 25-Jan-23 | 25-Jul-24 | 18 |
| Rayong Lab | Chloride | Burette | RYG_EN0216 | 25-Sep-23 | 25-Sep-24 | 12 |
| Rayong Lab | Fluoride | pH Meter | RYG_EN0152 | 22-Dec-22 | 22-Dec-23 | 12 |
| Water Lab | Hexavalent Chromium | Spectrophotometer | BKK_EN0018 | 15-Sep-23 | 15-Sep-24 | 12 |
| Water Lab | Silver | ICP-MS | BKK_EL0026 | 12-Jun-23 | 11-Jun-24 | 12 |
| Water Lab | Silver | Hot Block | BKK_EL0054 | 22-Sep-23 | 22-Mar-25 | 18 |
| Water Lab | Silver | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Aluminium | ICP-MS | BKK_EL0026 | 12-Jun-23 | 11-Jun-24 | 12 |
| Water Lab | Aluminium | Hot Block | BKK_EL0054 | 22-Sep-23 | 22-Mar-25 | 18 |
| Water Lab | Aluminium | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Barium | ICP-MS | BKK_EL0026 | 12-Jun-23 | 11-Jun-24 | 12 |
| Water Lab | Barium | Hot Block | BKK_EL0054 | 22-Sep-23 | 22-Mar-25 | 18 |
| Water Lab | Barium | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Lead | ICP-MS | BKK_EL0026 | 12-Jun-23 | 11-Jun-24 | 12 |
| Water Lab | Lead | Hot Block | BKK_EL0054 | 22-Sep-23 | 22-Mar-25 | 18 |
| Water Lab | Lead | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Iron | ICP-MS | BKK_EL0026 | 12-Jun-23 | 11-Jun-24 | 12 |
| Water Lab | Iron | Hot Block | BKK_EL0054 | 22-Sep-23 | 22-Mar-25 | 18 |
| Water Lab | Iron | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Manganese | ICP-MS | BKK_EL0026 | 12-Jun-23 | 11-Jun-24 | 12 |
| Water Lab | Manganese | Hot Block | BKK_EL0054 | 22-Sep-23 | 22-Mar-25 | 18 |
| Water Lab | Manganese | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Copper | ICP-MS | BKK_EL0026 | 12-Jun-23 | 11-Jun-24 | 12 |
| Water Lab | Copper | Hot Block | BKK_EL0054 | 22-Sep-23 | 22-Mar-25 | 18 |
| Water Lab | Copper | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Nickel | ICP-MS | BKK_EL0026 | 12-Jun-23 | 11-Jun-24 | 12 |
| Water Lab | Nickel | Hot Block | BKK_EL0054 | 22-Sep-23 | 22-Mar-25 | 18 |
| Water Lab | Nickel | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Arsenic | ICP-MS | BKK_EL0026 | 12-Jun-23 | 11-Jun-24 | 12 |
| Water Lab | Arsenic | Hot Block | BKK_EL0054 | 22-Sep-23 | 22-Mar-25 | 18 |
| Water Lab | Arsenic | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |

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| Sample Name | Parameter | Equipment Name | ID No. | Calibrated Date | Next Cal | Freq. Calibrate (Months) |
|---|---|---|---|---|---|---|
| Water Lab | Selenium | ICP-MS | BKK_EL0026 | 12-Jun-23 | 11-Jun-24 | 12 |
| Water Lab | Selenium | Hot Block | BKK_EL0054 | 22-Sep-23 | 22-Mar-25 | 18 |
| Water Lab | Selenium | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Cadmium | ICP-MS | BKK_EL0026 | 12-Jun-23 | 11-Jun-24 | 12 |
| Water Lab | Cadmium | Hot Block | BKK_EL0054 | 22-Sep-23 | 22-Mar-25 | 18 |
| Water Lab | Cadmium | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Zinc | ICP-MS | BKK_EL0026 | 12-Jun-23 | 11-Jun-24 | 12 |
| Water Lab | Zinc | Hot Block | BKK_EL0054 | 22-Sep-23 | 22-Mar-25 | 18 |
| Water Lab | Zinc | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Trivalent Chromium | ICP-MS | BKK_EL0026 | 12-Jun-23 | 11-Jun-24 | 12 |
| Water Lab | Trivalent Chromium | Hot Block | BKK_EL0054 | 22-Sep-23 | 22-Mar-25 | 18 |
| Water Lab | Trivalent Chromium | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Water Lab | Mercury | DUO-CVAFS / CVAAS | BKK_EL0023 | 24-May-23 | 24-May-24 | 12 |
| Water Lab | Total Coliform | Autoclave | BKK_ML0037 | 17-Jul-23 | 17-Jan-25 | 18 |
| Water Lab | Total Coliform | Incubator | BKK_ML0010 | 17-Jul-23 | 17-Jan-25 | 18 |
| Water Lab | Total Coliform | Hot Air Oven | BKK_ML0013 | 21-Nov-22 | 21-May-24 | 18 |
| Water Lab | Fecal Coliform | Autoclave | BKK_ML0037 | 17-Jul-23 | 17-Jan-25 | 18 |
| Water Lab | Fecal Coliform | Incubator | BKK_ML0010 | 17-Jul-23 | 17-Jan-25 | 18 |
| Water Lab | Fecal Coliform | Hot Air Oven | BKK_ML0013 | 21-Nov-22 | 21-May-24 | 18 |
| Water Lab | Fecal Coliform | Water Bath | BKK_ML0056 | 20-Apr-23 | 20-Apr-24 | 18 |
| Water Lab | *Escherichia coli* | Autoclave | BKK_ML0037 | 17-Jul-23 | 17-Jan-25 | 18 |
| Water Lab | *Escherichia coli* | Incubator | BKK_ML0010 | 17-Jul-23 | 17-Jan-25 | 18 |
| Water Lab | *Escherichia coli* | Hot Air Oven | BKK_ML0013 | 21-Nov-22 | 21-May-24 | 18 |
| Water Lab | *Escherichia coli* | Water Bath | BKK_ML0056 | 20-Apr-23 | 20-Apr-24 | 18 |
| Water Lab | Organochlorine Pesticide | GC MSMS | BKK_EN0284 | 25-May-23 | 25-Nov-24 | 18 |
| Water Lab | Cresol | Gas Chromatography (MSD) | BKK_EN0049 | 25-Apr-23 | 25-Oct-24 | 18 |
| Water Lab | Phenol & Cresol | Gas Chromatography (MSD) | BKK_EN0049 | 25-Apr-23 | 25-Oct-24 | 18 |
| Water Lab | Standard Plate Count | Autoclave | BKK_ML0037 | 17-Jul-23 | 17-Jan-25 | 18 |
| Water Lab | Standard Plate Count | Incubator | BKK_ML0010 | 17-Jul-23 | 17-Jan-25 | 18 |
| Water Lab | Standard Plate Count | Hot Air Oven | BKK_ML0013 | 21-Nov-22 | 21-May-24 | 18 |
| Sludge | Cyanide | Discrete analyzer | BKK_EN0037 | 12-Jul-23 | 12-Jul-24 | 12 |
| Sludge | Cyanide | Chamber (Cold Room) | BKK_EN0168 | 1-Jul-22 | 1-Jan-24 | 18 |
| Sludge | Aluminium | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Sludge | Aluminium | Hot Block | BKK_EL0054 | 22-Sep-23 | 22-Mar-25 | 18 |
| Sludge | Aluminium | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Sludge | Arsenic | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Sludge | Arsenic | Hot Block | BKK_EL0054 | 22-Sep-23 | 22-Mar-25 | 18 |
| Sludge | Arsenic | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Sludge | Barium | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Sludge | Barium | Hot Block | BKK_EL0054 | 22-Sep-23 | 22-Mar-25 | 18 |
| Sludge | Barium | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Sludge | Cadmium | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Sludge | Cadmium | Hot Block | BKK_EL0054 | 22-Sep-23 | 22-Mar-25 | 18 |
| Sludge | Cadmium | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Sludge | Copper | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Sludge | Copper | Hot Block | BKK_EL0054 | 22-Sep-23 | 22-Mar-25 | 18 |
| Sludge | Copper | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Sludge | Hexavalent Chromium | Spectrophotometer | BKK_EN0018 | 15-Sep-23 | 15-Sep-24 | 12 |
| Sludge | Iron | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Sludge | Iron | Hot Block | BKK_EL0054 | 22-Sep-23 | 22-Mar-25 | 18 |
| Sludge | Iron | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Sludge | Lead | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Sludge | Lead | Hot Block | BKK_EL0054 | 22-Sep-23 | 22-Mar-25 | 18 |
| Sludge | Lead | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Sludge | Manganese | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Sludge | Manganese | Hot Block | BKK_EL0054 | 22-Sep-23 | 22-Mar-25 | 18 |

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| Sample Name | Parameter | Equipment Name | ID No. | Calibrated Date | Next Cal | Freq. Calibrate (Months) |
|---|---|---|---|---|---|---|
| Sludge | Manganese | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Sludge | Mercury | Mercury Analyzer | BKK_EL0128 | 6-Dec-23 | 6-Dec-24 | 12 |
| Sludge | Nickel | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Sludge | Nickel | Hot Block | BKK_EL0054 | 22-Sep-23 | 22-Mar-25 | 18 |
| Sludge | Nickel | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Sludge | Selenium | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Sludge | Selenium | Hot Block | BKK_EL0054 | 22-Sep-23 | 22-Mar-25 | 18 |
| Sludge | Selenium | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Sludge | Silver | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Sludge | Silver | Hot Block | BKK_EL0054 | 22-Sep-23 | 22-Mar-25 | 18 |
| Sludge | Silver | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Sludge | Trivalent Chromium | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Sludge | Trivalent Chromium | Hot Block | BKK_EL0054 | 22-Sep-23 | 22-Mar-25 | 18 |
| Sludge | Trivalent Chromium | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Sludge | Zinc | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Sludge | Zinc | Hot Block | BKK_EL0054 | 22-Sep-23 | 22-Mar-25 | 18 |
| Sludge | Zinc | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Soil | Aluminium | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Soil | Aluminium | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Soil | Aluminium | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Soil | Arsenic | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Soil | Arsenic | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Soil | Arsenic | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Soil | Barium | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Soil | Barium | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Soil | Barium | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Soil | Cadmium | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Soil | Cadmium | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Soil | Cadmium | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Soil | Cation Exchange Capacity | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Soil | Copper | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Soil | Copper | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Soil | Copper | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Soil | Cyanide | Discrete analyzer | BKK_EN0037 | 12-Jul-23 | 12-Jul-24 | 12 |
| Soil | Cyanide | Chamber (Cold Room) | BKK_EN0168 | 1-Jul-22 | 1-Jan-24 | 18 |
| Soil | Hexavalent Chromium | Spectrophotometer | BKK_EN0018 | 16-Sep-22 | 16-Sep-23 | 12 |
| Soil | Iron | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Soil | Iron | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Soil | Iron | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Soil | Lead | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Soil | Lead | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Soil | Lead | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Soil | Manganese | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Soil | Manganese | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Soil | Manganese | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Soil | Mercury | Mercury Analyzer | BKK_EL0128 | 30-Nov-22 | 30-Nov-23 | 12 |
| Soil | Moisture | Electronic Top-Loading Balance | BKK_EN0002 | 8-Feb-23 | 8-Feb-24 | 12 |
| Soil | Nickel | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Soil | Nickel | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Soil | Nickel | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Soil | pH aqueous phase 50% (w/v) | pH meter | BKK_EN0072 | 12-Sep-22 | 12-Mar-24 | 18 |
| Soil | Selenium | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Soil | Selenium | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Soil | Selenium | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |

right solutions.
right partner.

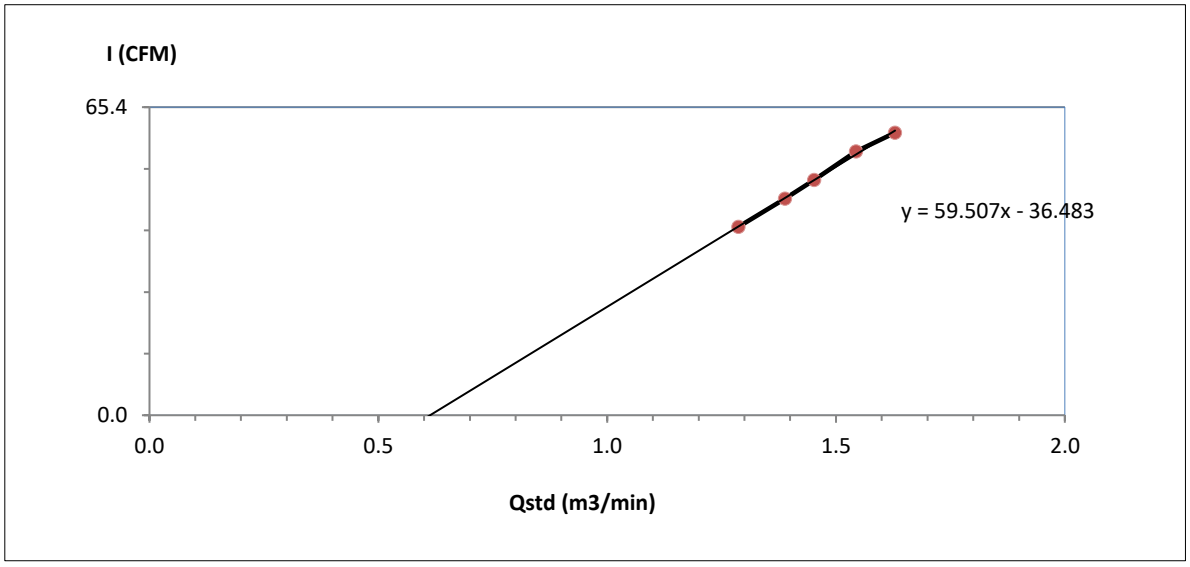
**รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ**

| Sample Name | Parameter | Equipment Name | ID No. | Calibrated Date | Next Cal | Freq. Calibrate (Months) |
|---|---|---|---|---|---|---|
| Soil | Silver | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Soil | Silver | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Soil | Silver | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Soil | Trivalent Chromium | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Soil | Trivalent Chromium | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Soil | Trivalent Chromium | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Soil | Zinc | ICP-OES | BKK_EL0037 | 20-Mar-23 | 19-Sep-24 | 18 |
| Soil | Zinc | Hot Block | BKK_EL0054 | 7-Apr-22 | 7-Oct-23 | 18 |
| Soil | Zinc | Chamber (Cold Room) | BKK_EN0167 | 30-Jun-22 | 30-Dec-23 | 18 |
| Soil | 2,4-D | GC MSMS | BKK_EN0284 | 25-May-23 | 25-Nov-24 | 18 |
| Soil | Organochlorine Pesticide | GC MSMS | BKK_EN0284 | 25-May-23 | 25-Nov-24 | 18 |
| Soil | Conductivity aqueous phase 20% (V | Conductivity meter | BKK_EN0373 | 3-Jan-23 | 3-Jan-24 | 12 |

# High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Rojana Industrial Park Public Co., Ltd | **Barometric Pressure (mm Hg) :** | 757 |
| **Calibrate Location :** | บ้านหัวทุ่ง (A1) | **Temperature ( °C) :** | 31 |
| **Calibrate Date :** | 23-Nov-23 | **High Volume ID :** | BKK_FS0372 |
| **CalibrationSheet No.:** | **C-231123-BKK_FS0372** | **High Volume Model :** | TE-5009X |
| **Calibrator ID:** | RYG_FS0206 | **High Volume S/N :** | 5332 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 1.47433 |
| **Calibrator S/N :** | 1543 | **Calibrator Intercept :** | -0.01503 |

| **Test No.** | **Delta $H_2O$ (inch)** | **$Q_{std}$ ($m^3$/min)** | **I : Chart (CFM)** | **Linear Regression** |
|---|---|---|---|---|
| 1 | 3.6 | 1.2867 | 40 | Slope : 59.5074 |
| 2 | 4.2 | 1.3886 | 46 | Intercept : -36.4833 |
| 3 | 4.6 | 1.4525 | 50 | Correlation Coefficient : 0.9987 |
| 4 | 5.2 | 1.5434 | 56 | |
| 5 | 5.8 | 1.6291 | 60 | |




Calibrated by Mongkon Ph.

( Mr.Mongkon Phalathip )
Field Scientist(1)

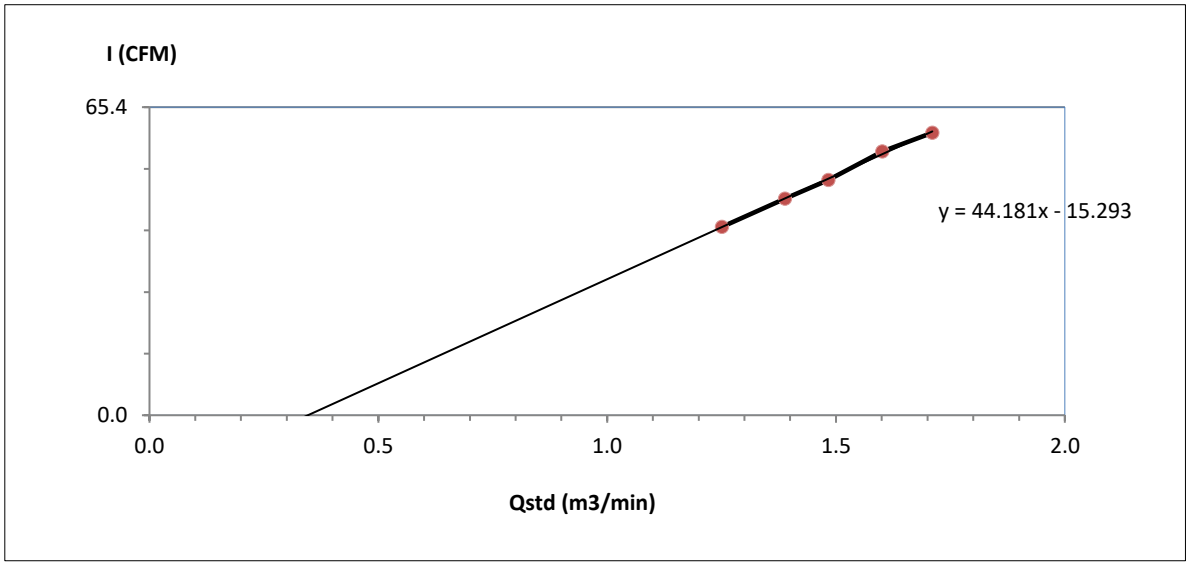
Approved by :

(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

# High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Rojana Industrial Park Public Co., Ltd | **Barometric Pressure (mm Hg) :** | 757 |
| **Calibrate Location :** | วัดหินโค่ง (A2) | **Temperature ( °C) :** | 31 |
| **Calibrate Date :** | 23-Nov-23 | **High Volume ID :** | RYG_FS0664 |
| **CalibrationSheet No.:** | **C-231123-RYG_FS0664** | **High Volume Model :** | TE-5009X |
| **Calibrator ID:** | RYG_FS0206 | **High Volume S/N :** | 6261 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 1.47433 |
| **Calibrator S/N :** | 1543 | **Calibrator Intercept :** | -0.01503 |

| Test No. | Delta $H_2O$ (inch) | $Q_{std}$ ($m^3$/min) | I : Chart (CFM) | Linear Regression |
|---|---|---|---|---|
| 1 | 3.4 | 1.2508 | 40 | Slope : 44.1815 |
| 2 | 4.2 | 1.3886 | 46 | Intercept : -15.2928 |
| 3 | 4.8 | 1.4834 | 50 | Correlation Coefficient : 0.9991 |
| 4 | 5.6 | 1.6011 | 56 | |
| 5 | 6.4 | 1.7106 | 60 | |




Calibrated by Mongkon Ph.

( Mr.Mongkon Phalathip )
Field Scientist(1)

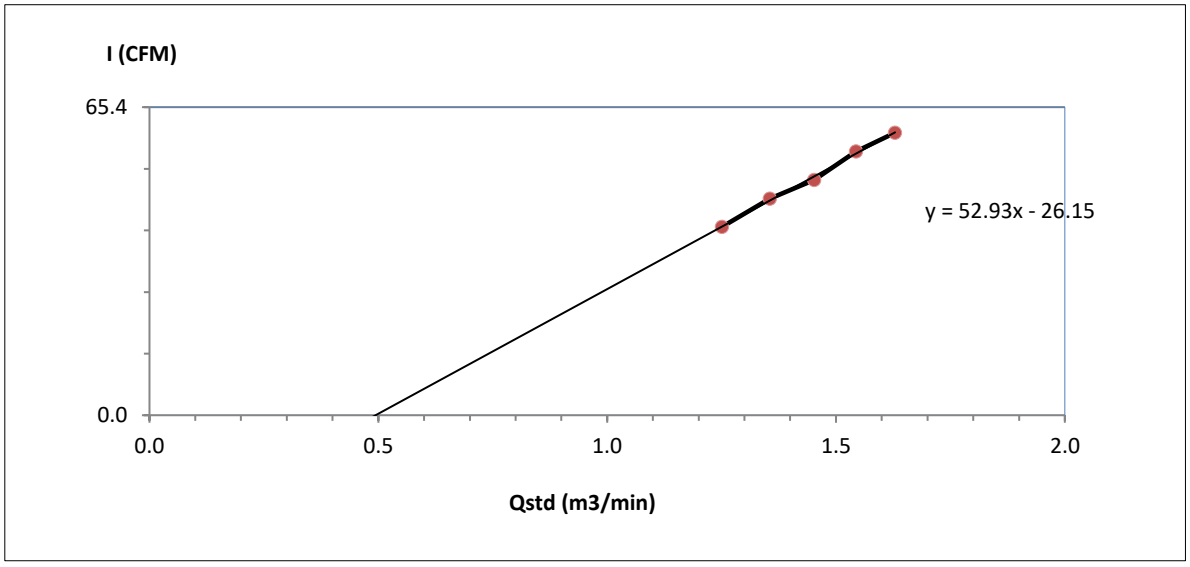
Approved by : _____

(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

# High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Rojana Industrial Park Public Co., Ltd | **Barometric Pressure (mm Hg) :** | 757 |
| **Calibrate Location :** | บ้านซากหิน (A3) | **Temperature ( °C) :** | 31 |
| **Calibrate Date :** | 23-Nov-23 | **High Volume ID :** | RYG_FS0173 |
| **CalibrationSheet No.:** | **C-231123-RYG_FS0173** | **High Volume Model :** | TE-5170D |
| **Calibrator ID:** | RYG_FS0206 | **High Volume S/N :** | 4799 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 1.47433 |
| **Calibrator S/N :** | 1543 | **Calibrator Intercept :** | -0.01503 |

| **Test No.** | **Delta $H_2O$ (inch)** | **$Q_{std}$ ($m^3$/min)** | **I : Chart (CFM)** | **Linear Regression** |
|---|---|---|---|---|
| 1 | 3.4 | 1.2508 | 40 | Slope : 52.9298 |
| 2 | 4.0 | 1.3555 | 46 | Intercept : -26.1500 |
| 3 | 4.6 | 1.4525 | 50 | Correlation Coefficient : 0.9982 |
| 4 | 5.2 | 1.5434 | 56 | |
| 5 | 5.8 | 1.6291 | 60 | |




Calibrated by Mongkon Ph.

( Mr.Mongkon Phalathip )
Field Scientist(1)

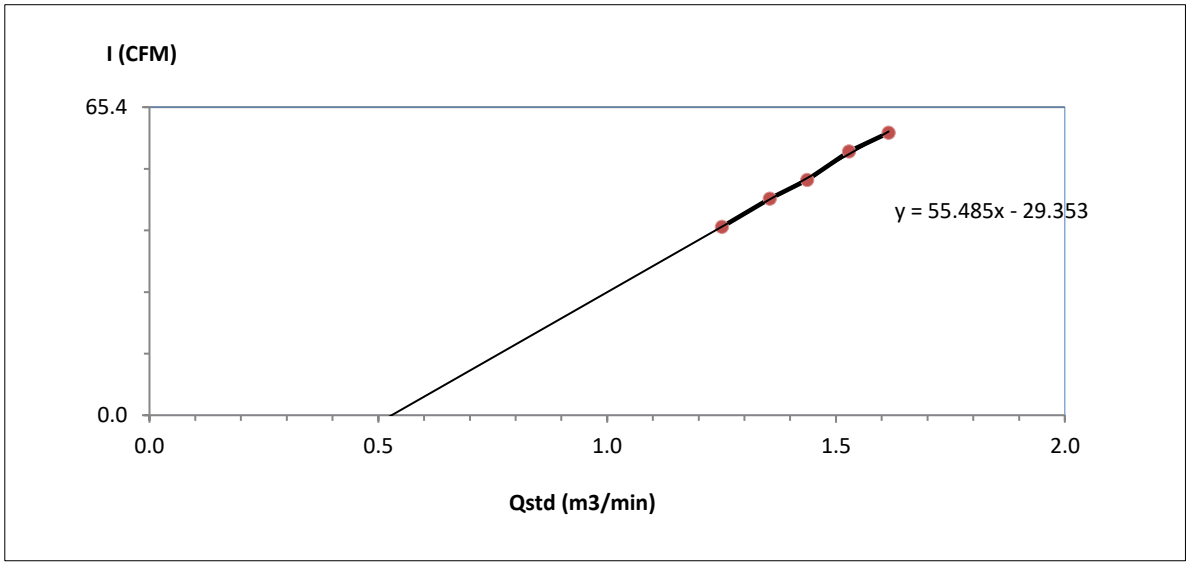
Approved by : _____

(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

# High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Rojana Industrial Park Public Co., Ltd | **Barometric Pressure (mm Hg) :** | 757 |
| **Calibrate Location :** | วัดหนองกรับ (A4) | **Temperature ( °C) :** | 31 |
| **Calibrate Date :** | 23-Nov-23 | **High Volume ID :** | RYG_FS0396 |
| **CalibrationSheet No.:** | **C-231123-RYG_FS0396** | **High Volume Model :** | TE-5170D |
| **Calibrator ID:** | RYG_FS0206 | **High Volume S/N :** | 5688 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 1.47433 |
| **Calibrator S/N :** | 1543 | **Calibrator Intercept :** | -0.01503 |

| **Test No.** | **Delta $H_2O$ (inch)** | **$Q_{std}$ ($m^3$/min)** | **I : Chart (CFM)** | **Linear Regression** |
|---|---|---|---|---|
| 1 | 3.4 | 1.2508 | 40 | Slope : 55.4854 |
| 2 | 4.0 | 1.3555 | 46 | Intercept : -29.3527 |
| 3 | 4.5 | 1.4368 | 50 | Correlation Coefficient : 0.9990 |
| 4 | 5.1 | 1.5286 | 56 | |
| 5 | 5.7 | 1.6151 | 60 | |




Calibrated by Mongkon Ph.

( Mr.Mongkon Phalathip )
Field Scientist(1)

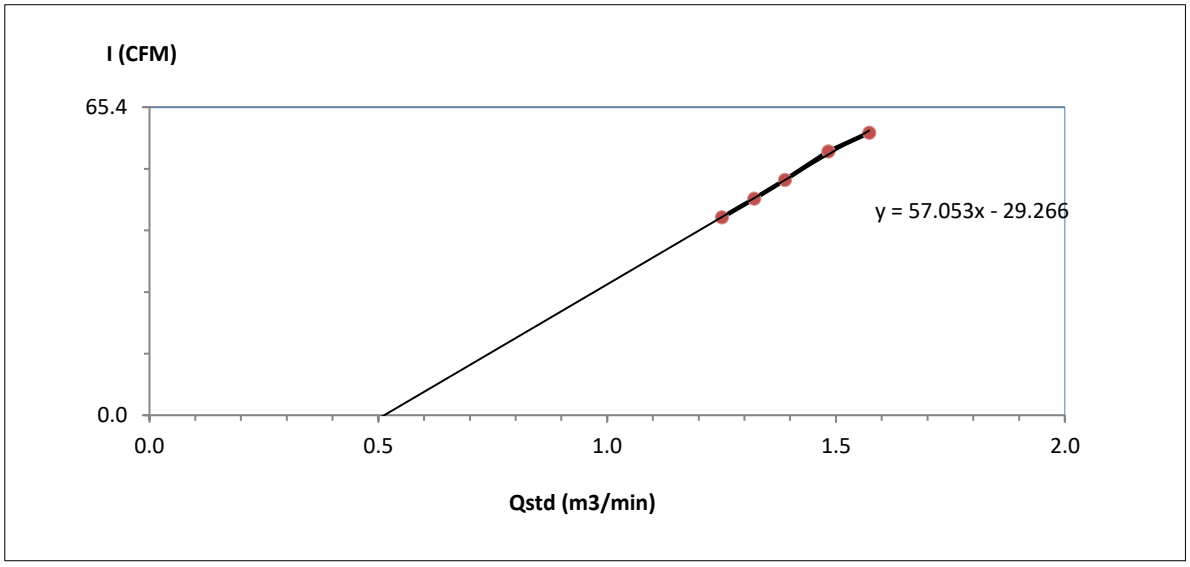
Approved by :

(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

# High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Rojana Industrial Park Public Co., Ltd | **Barometric Pressure (mm Hg) :** | 757 |
| **Calibrate Location :** | บ้านมาบป่าหวาย (A5) | **Temperature ( °C) :** | 31 |
| **Calibrate Date :** | 23-Nov-23 | **High Volume ID :** | RYG_FS0179 |
| **CalibrationSheet No.:** | **C-231123-RYG_FS0179** | **High Volume Model :** | TE-5170D |
| **Calibrator ID:** | RYG_FS0206 | **High Volume S/N :** | 4805 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 1.47433 |
| **Calibrator S/N :** | 1543 | **Calibrator Intercept :** | -0.01503 |

| **Test No.** | **Delta $H_2O$ (inch)** | **$Q_{std}$ ($m^3$/min)** | **I : Chart (CFM)** | **Linear Regression** |
|---|---|---|---|---|
| 1 | 3.4 | 1.2508 | 42 | Slope : 57.0530 |
| 2 | 3.8 | 1.3215 | 46 | Intercept : -29.2659 |
| 3 | 4.2 | 1.3886 | 50 | Correlation Coefficient : 0.9985 |
| 4 | 4.8 | 1.4834 | 56 | |
| 5 | 5.4 | 1.5725 | 60 | |




Calibrated by Mongkon Ph.

( Mr.Mongkon Phalathip )
Field Scientist(1)

Approved by :

(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

**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

REVIEW BY Thanita L.
APPROVED BY D.
NEXT CAL. DATE 09/03/24

# Certificate of Calibration

| | | | |
|---|---|---|---|
| Model Number : | LA130S-F | Certificate No. : | 23BCI0110 |
| Description : | Analytical Balance | Issued Date : | Friday, March 03, 2023 |
| Serial Number : | 25409664 | Reference No. : | 204833 |
| ID No. : | RYG_EN0001 | | |
| Manufacturer : | Sartorius | Page No. : | 1 0f 2 |

Customer Name : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)
616/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.

Calibrated Place : ALS Laboratory Group (Thailand) Co., Ltd.(Balance Room)
616/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.

Calibrated By : Mr.Chonchai Inthana
Calibration Date : Wednesday, March 01, 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 : 150 g Readability : 0.0001 g

*Ambients Conditions:*

| | | | |
|---|---|---|---|
| Temperature : | 24.2 °C | ± | 5.0 °C |
| Humidity : | 60.0 % RH | ± | 10.0 % 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 - 5000g E2,YCS011-522-00 | 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 Intrhana(Technical Manager)

STAMP

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

**Sartorius (Thailand) Co., Ltd.**
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8361-6 Fax: +66 2643-8367, e-mail: service.thailand@sartorius.com

SARTORIUS

# Certificate of Calibration

| | | | |
|---|---|---|---|
| Model Number : | LA130S-F | Certificate No. : | 23BCI0110 |
| Description : | Analytical Balance | Issued Date : | Friday, March 03, 2023 |
| Serial Number : | 25409664 | Reference No. : | 204833 |
| ID No. : | RYG_EN0001 | | |
| Manufacturer : | Sartorius | Page No. : | 2 of 2 |

## 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)
10 g
Tolerance
*0.0001* g

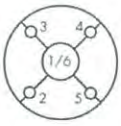
Nominal Value : (High Load)
100 g
Tolerance
*0.0001* g

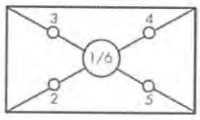
| | |
|---|---|
| 10.0000 | 100.0001 |
| 10.0000 | 100.0002 |
| 10.0001 | 100.0001 |
| 10.0000 | 100.0000 |
| 9.9999 | 100.0002 |
| 10.0000 | 100.0001 |
| 10.0001 | 100.0001 |
| 10.0000 | 100.0001 |
| 9.9999 | 100.0002 |
| 9.9998 | 100.0001 |
| *Standard Deviation* 0.00009 | 0.00006 |

### 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 : 50 g
Tolerance *0.0004* g




| | Difference |
|---|---|
| 1 | – |
| 2 | 0.0000 |
| 3 | -0.0001 |
| 4 | 0.0001 |
| 5 | 0.0000 |
| 6 | - |

### Linearity

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

Tolerance *0.0002* g

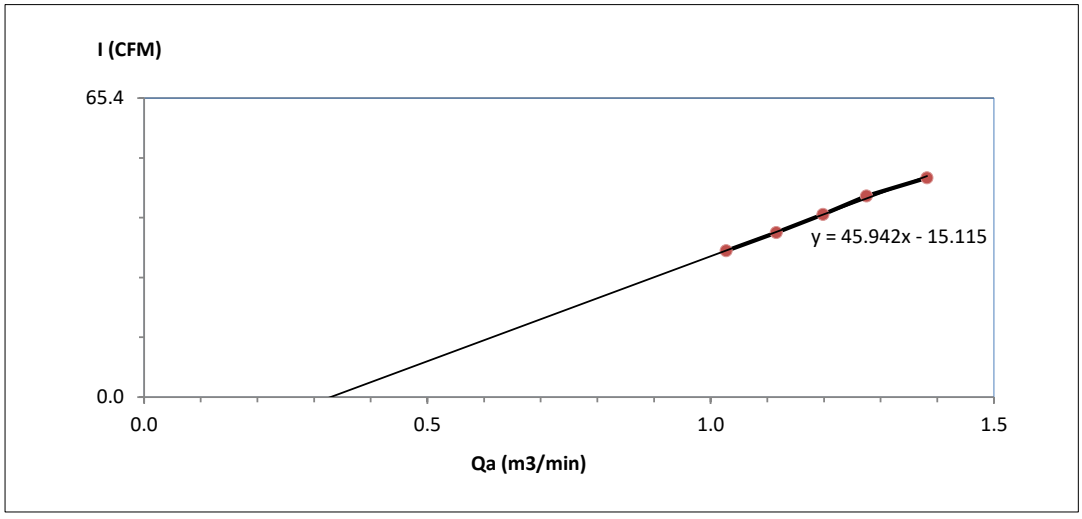
| Nominal Value (g) | Conventional Mass Value (g) | Displayed Value (g) | Deviation (g) | Uncertainty (g) |
|---|---|---|---|---|
| 0.01 | 0.0100 | 0.0100 | 0.0000 | 0.00022 |
| 0.05 | 0.0500 | 0.0500 | 0.0000 | 0.00023 |
| 0.1 | 0.1000 | 0.1000 | 0.0000 | 0.00023 |
| 0.5 | 0.5000 | 0.5000 | 0.0000 | 0.00023 |
| 1 | 1.0000 | 1.0000 | 0.0000 | 0.00023 |
| 2 | 2.0000 | 2.0000 | 0.0000 | 0.00023 |
| 5 | 5.0000 | 5.0000 | 0.0000 | 0.00022 |
| 10 | 10.0000 | 10.0001 | 0.0001 | 0.00024 |
| 20 | 20.0000 | 20.0001 | 0.0001 | 0.00023 |
| 100 | 100.0000 | 100.0002 | 0.0002 | 0.00026 |

End of Report.

# High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Rojana Industrial Park Public Co., Ltd | **Barometric Pressure (mm Hg) :** | 757 |
| **Calibrate Location :** | บ้านหัวทุ่ง (A1) | **Temperature ( °C) :** | 31 |
| **Calibrate Date :** | 23-Nov-23 | **High Volume ID :** | BKK_FS0389 |
| **CalibrationSheet No.:** | **C-231123-BKK_FS0389** | **High Volume Model :** | TE-5009X |
| **Calibrator ID:** | RYG_FS0206 | **High Volume S/N :** | 5329 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 0.92345 |
| **Calibrator S/N :** | 1543 | **Calibrator Intercept :** | -0.0095 |

| Test No. | Delta $H_2O$ (inch) | Qa ($m^3$/min) | I : Chart (CFM) | Linear Regression |
|---|---|---|---|---|
| 1 | 2.2 | 1.027 | 32 | Slope : 45.9419 |
| 2 | 2.6 | 1.116 | 36 | Intercept : -15.1149 |
| 3 | 3.0 | 1.198 | 40 | Correlation Coefficient : 0.9985 |
| 4 | 3.4 | 1.275 | 44 | |
| 5 | 4.0 | 1.382 | 48 | |




Calibrated by Mongkon Ph.

( Mr.Mongkon Phalathip )
Field Scientist(1)

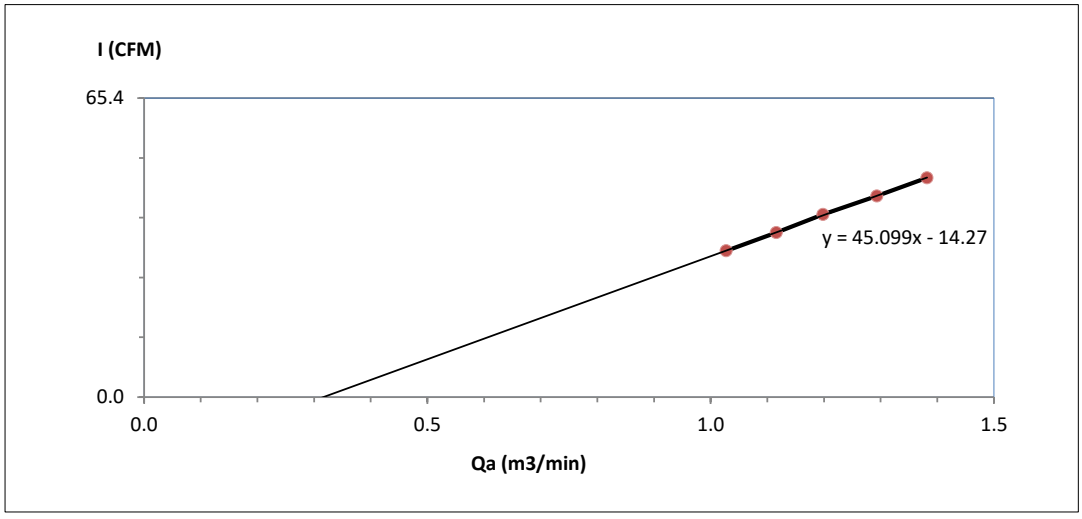
Approved by : _____

(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

# High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Rojana Industrial Park Public Co., Ltd | **Barometric Pressure (mm Hg) :** | 757 |
| **Calibrate Location :** | วัดหินโค่ง (A2) | **Temperature ( °C) :** | 31 |
| **Calibrate Date :** | 23-Nov-23 | **High Volume ID :** | RYG_FS0666 |
| **CalibrationSheet No.:** | **C-231123-RYG_FS0666** | **High Volume Model :** | TE-5009X |
| **Calibrator ID:** | RYG_FS0206 | **High Volume S/N :** | 6265 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 0.92345 |
| **Calibrator S/N :** | 1543 | **Calibrator Intercept :** | -0.0095 |

| Test No. | Delta $H_2O$ (inch) | Qa ($m^3$/min) | I : Chart (CFM) | Linear Regression |
|---|---|---|---|---|
| 1 | 2.2 | 1.027 | 32 | Slope : 45.0988 |
| 2 | 2.6 | 1.116 | 36 | Intercept : -14.2701 |
| 3 | 3.0 | 1.198 | 40 | Correlation Coefficient : 0.9998 |
| 4 | 3.5 | 1.293 | 44 | |
| 5 | 4.0 | 1.382 | 48 | |




Calibrated by Mongkon Ph.

( Mr.Mongkon Phalathip )
Field Scientist(1)

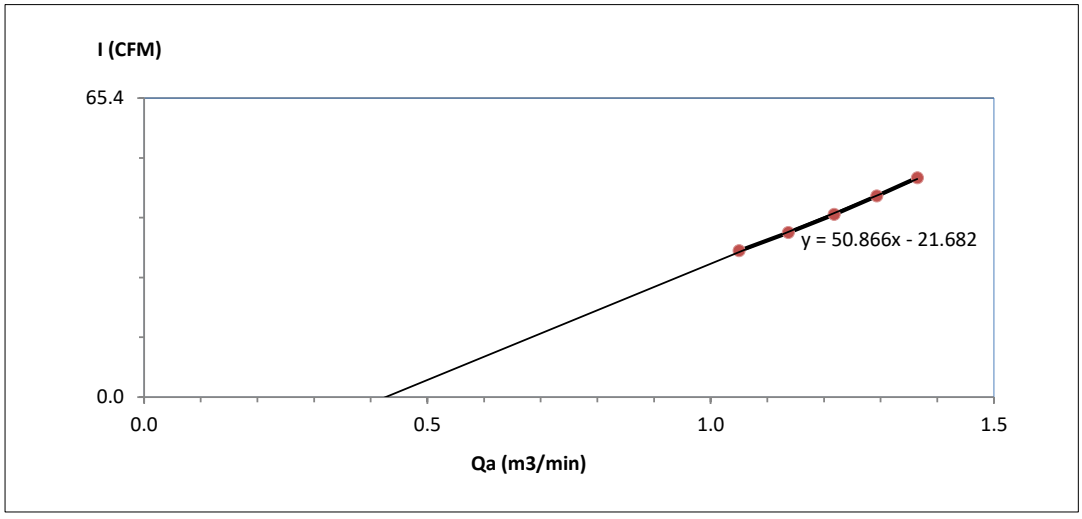
Approved by : _____

(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

# High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Rojana Industrial Park Public Co., Ltd | **Barometric Pressure (mm Hg) :** | 757 |
| **Calibrate Location :** | บ้านซากหิน (A3) | **Temperature ( °C) :** | 31 |
| **Calibrate Date :** | 23-Nov-23 | **High Volume ID :** | RYG_FS0189 |
| **CalibrationSheet No.:** | **C-231123-RYG_FS0189** | **High Volume Model :** | TE-5009X |
| **Calibrator ID:** | RYG_FS0206 | **High Volume S/N :** | 4797 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 0.92345 |
| **Calibrator S/N :** | 1543 | **Calibrator Intercept :** | -0.0095 |

| Test No. | Delta $H_2O$ (inch) | Qa ($m^3$/min) | I : Chart (CFM) | Linear Regression |
|---|---|---|---|---|
| 1 | 2.3 | 1.050 | 32 | Slope : 50.8661 |
| 2 | 2.7 | 1.137 | 36 | Intercept : -21.6816 |
| 3 | 3.1 | 1.218 | 40 | Correlation Coefficient : 0.9992 |
| 4 | 3.5 | 1.293 | 44 | |
| 5 | 3.9 | 1.365 | 48 | |




Calibrated by Mongkon Ph.

( Mr.Mongkon Phalathip )
Field Scientist(1)

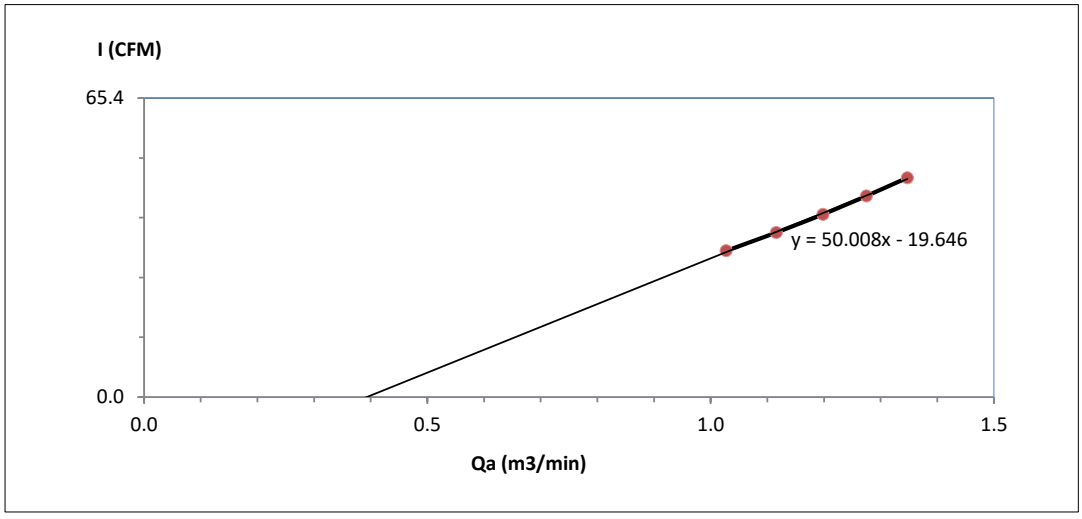
Approved by : _____

(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

# High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Rojana Industrial Park Public Co., Ltd | **Barometric Pressure (mm Hg) :** | 757 |
| **Calibrate Location :** | วัดหนองกรับ (A4) | **Temperature ( °C) :** | 31 |
| **Calibrate Date :** | 23-Nov-23 | **High Volume ID :** | RYG_FS0191 |
| **CalibrationSheet No.:** | **C-231123-RYG_FS0191** | **High Volume Model :** | TE-5009X |
| **Calibrator ID:** | RYG_FS0206 | **High Volume S/N :** | 5330 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 0.92345 |
| **Calibrator S/N :** | 1543 | **Calibrator Intercept :** | -0.0095 |

| Test No. | Delta $H_2O$ (inch) | Qa ($m^3$/min) | I : Chart (CFM) | Linear Regression |
|---|---|---|---|---|
| 1 | 2.2 | 1.027 | 32 | Slope : 50.0084 |
| 2 | 2.6 | 1.116 | 36 | Intercept : -19.6457 |
| 3 | 3.0 | 1.198 | 40 | Correlation Coefficient : 0.9992 |
| 4 | 3.4 | 1.275 | 44 | |
| 5 | 3.8 | 1.347 | 48 | |




Calibrated by Mongkon Ph.

( Mr.Mongkon Phalathip )
Field Scientist(1)

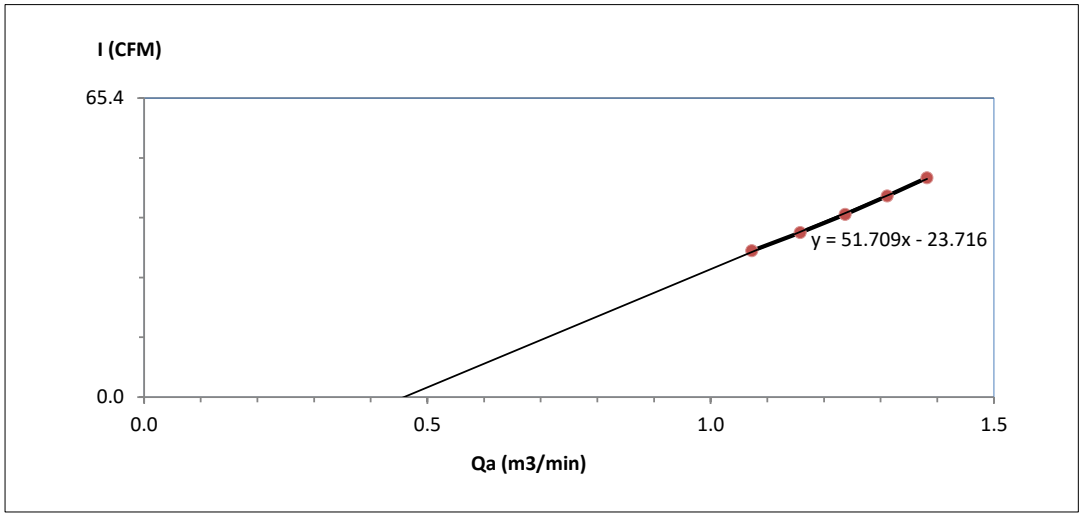
Approved by : _____

(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

# High Volume Air Sampler Calibration Worksheet

| | | | |
|---|---|---|---|
| **Project Site :** | Rojana Industrial Park Public Co., Ltd | **Barometric Pressure (mm Hg) :** | 757 |
| **Calibrate Location :** | บ้านมาบป่าหวาย (A5) | **Temperature ( °C) :** | 31 |
| **Calibrate Date :** | 23-Nov-23 | **High Volume ID :** | RYG_FS0668 |
| **CalibrationSheet No.:** | **C-231123-RYG_FS0668** | **High Volume Model :** | TE-5009X |
| **Calibrator ID:** | RYG_FS0206 | **High Volume S/N :** | 6267 |
| **Calibrator Model :** | TE-5028A | **Calibrator Slope :** | 0.92345 |
| **Calibrator S/N :** | 1543 | **Calibrator Intercept :** | -0.0095 |

| Test No. | Delta $H_2O$ (inch) | Qa ($m^3$/min) | I : Chart (CFM) | Linear Regression |
|---|---|---|---|---|
| 1 | 2.4 | 1.073 | 32 | Slope : 51.7086 |
| 2 | 2.8 | 1.158 | 36 | Intercept : -23.7156 |
| 3 | 3.2 | 1.237 | 40 | Correlation Coefficient : 0.9993 |
| 4 | 3.6 | 1.312 | 44 | |
| 5 | 4.0 | 1.382 | 48 | |




Calibrated by Mongkon Ph.

( Mr.Mongkon Phalathip )
Field Scientist(1)

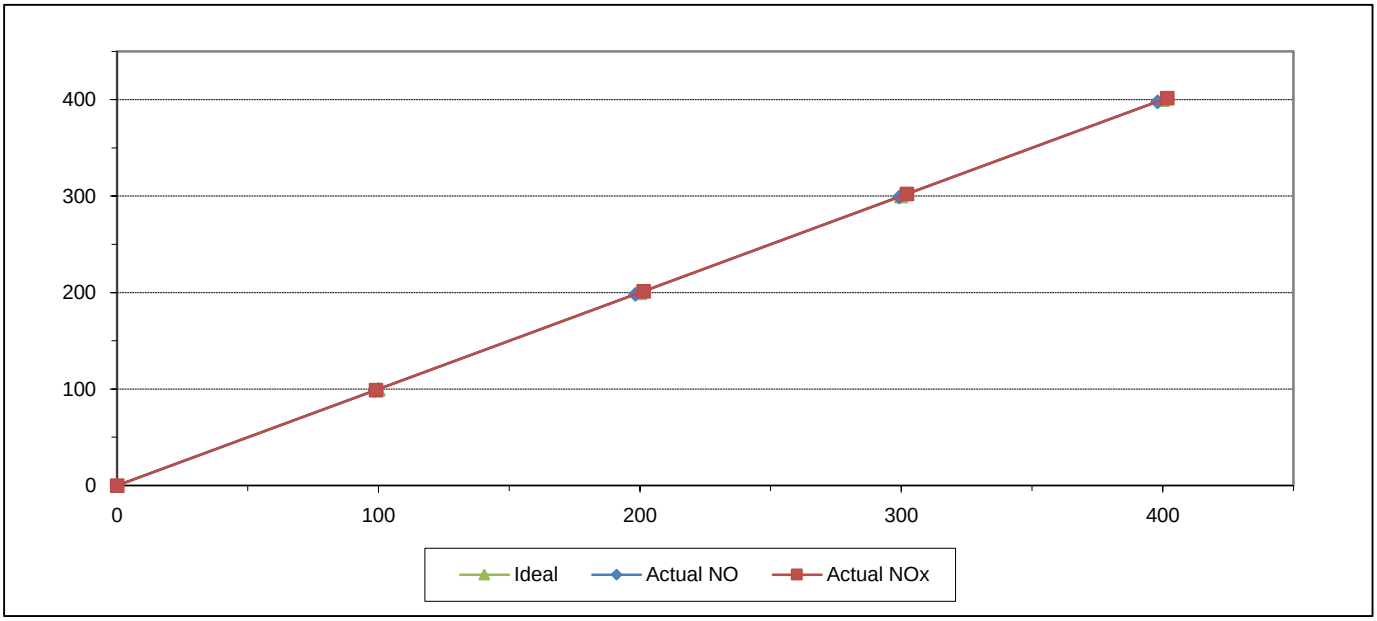
Approved by : _____

(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

# MULTIPOINT CALIBRATION REPORT

| | | | |
|---|---|---|---|
| Calibration Date | 1-Jul-23 | Equipment Name | NOx Analyzer |
| Manufacturer | HORIBA | Model | APNA-370 |
| Serial No. | SUDL58MU | Equipment ID | BKK_FS1090 |
| Calibrator Manufacturer | Teledyne API | Model | 700 |
| Serial No. | 947 | | |
| Std. Gas Concentration (PPM) | 55.88 | Cylinder No. | GN0027222 |
| Cylinder Pressure (psi) | 1800 | Certified By | Airgas Inc. |
| Certified Date | 9-Feb-22 | Expired Date | 9-Feb-30 |

| Point | CALIBRATION RESULTS | | | | | | |
|---|---|---|---|---|---|---|---|
| | Ideal | Actual NO | Error NO | %Error NO | Actual NOx | Error NOx | %Error NOx |
| ZERO | 0.00 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| 1 | 100.00 | 98.70 | -1.30 | -1.30 | 99.10 | -0.90 | -0.90 |
| 2 | 200.00 | 198.30 | -1.70 | -0.85 | 201.50 | 1.50 | 0.75 |
| 3 | 300.00 | 299.30 | -0.70 | -0.23 | 302.20 | 2.20 | 0.73 |
| 4 | 400.00 | 398.00 | -2.00 | -0.50 | 401.70 | 1.70 | 0.42 |
| AVERAGE (%) | | | | -0.56 | | | 0.22 |




Calibrated By

( Mr.Jirawut Sakarn )
Field Environmental Scientist (3)

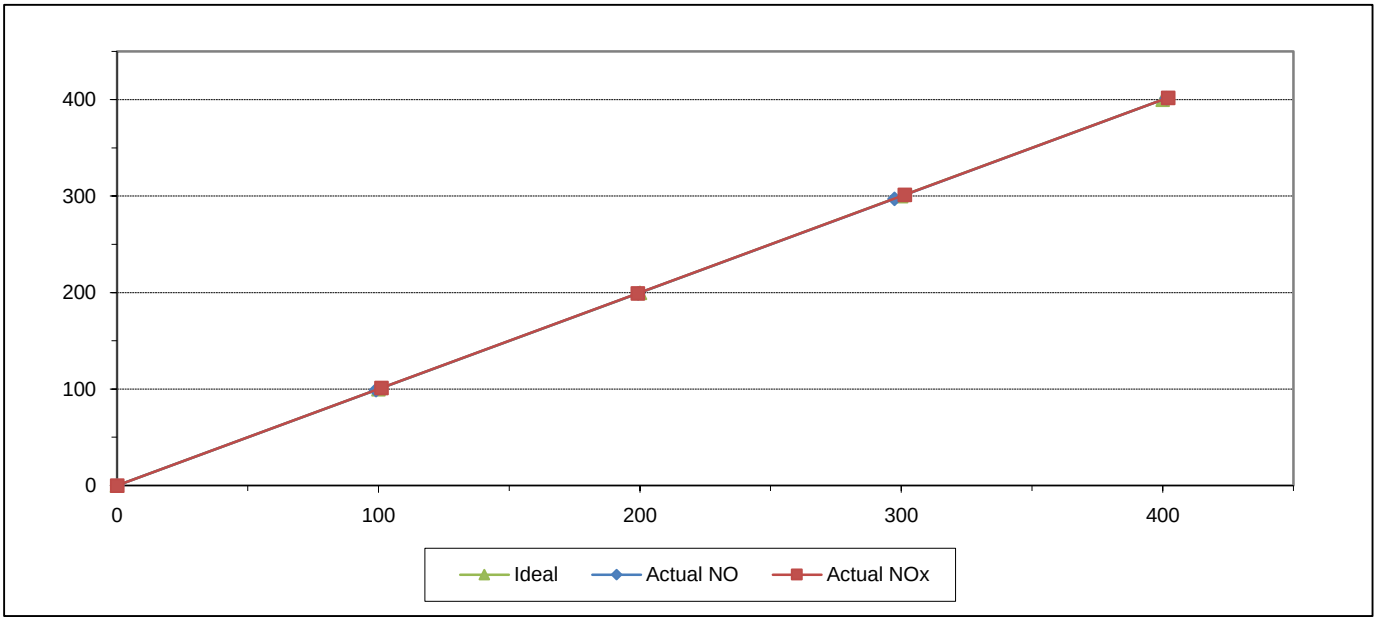
Approved By

( Mr.Sarayuth Jittranont )
Assistant General Manager

# MULTIPOINT CALIBRATION REPORT

| | | | |
|---|---|---|---|
| Calibration Date | 1-Jul-23 | Equipment Name | NOx Analyzer |
| Manufacturer | Teledyne API | Model | 200E |
| Serial No. | 4379 | Equipment ID | BKK_FS0776 |
| Calibrator Manufacturer | Teledyne API | Model | 700 |
| Serial No. | 947 | | |
| Std. Gas Concentration (PPM) | 55.88 | Cylinder No. | GN0027222 |
| Cylinder Pressure (psi) | 1800 | Certified By | Airgas Inc. |
| Certified Date | 9-Feb-22 | Expired Date | 9-Feb-30 |

| Point | CALIBRATION RESULTS | | | | | | |
|---|---|---|---|---|---|---|---|
| | Ideal | Actual NO | Error NO | %Error NO | Actual NOx | Error NOx | %Error NOx |
| ZERO | 0.00 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| 1 | 100.00 | 99.10 | -0.90 | -0.90 | 101.20 | 1.20 | 1.20 |
| 2 | 200.00 | 199.30 | -0.70 | -0.35 | 199.20 | -0.80 | -0.40 |
| 3 | 300.00 | 297.40 | -2.60 | -0.87 | 301.40 | 1.40 | 0.47 |
| 4 | 400.00 | 401.50 | 1.50 | 0.38 | 402.10 | 2.10 | 0.53 |
| AVERAGE (%) | | | | -0.33 | | | 0.38 |




Calibrated By

( Mr.Jirawut Sakarn )
Field Environmental Scientist (3)

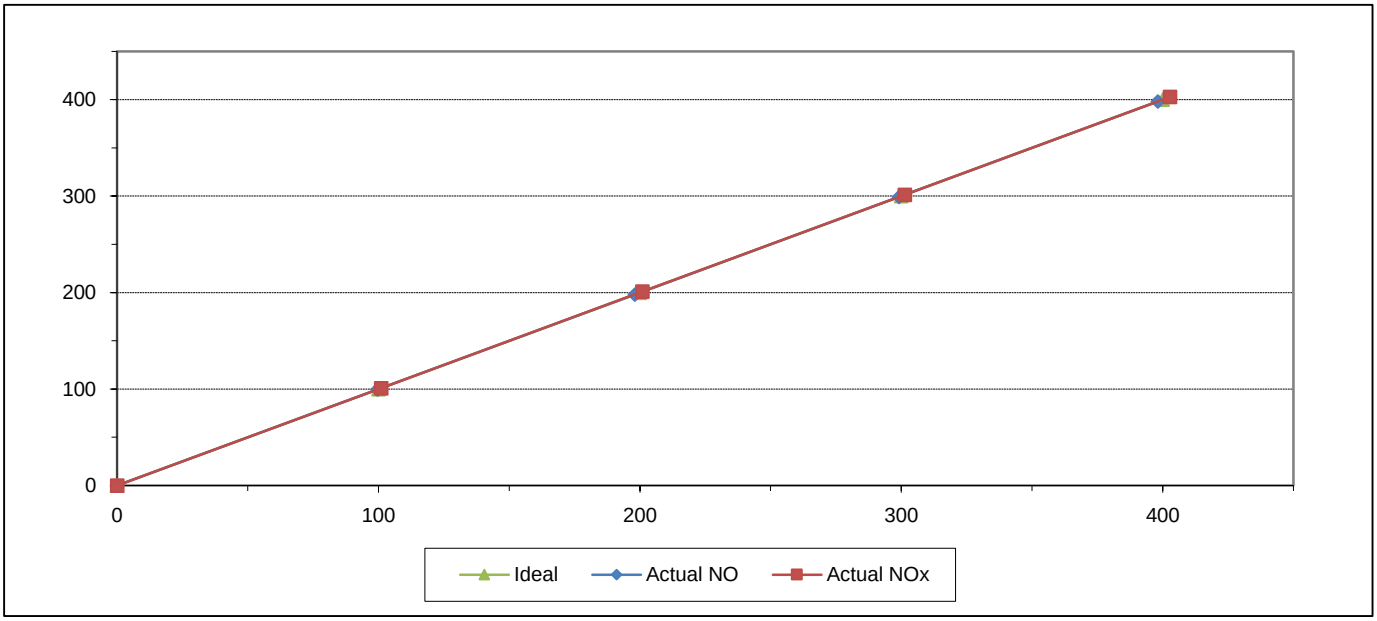
Approved By

( Mr.Sarayuth Jittranont )
Assistant General Manager

# MULTIPOINT CALIBRATION REPORT

| | | | |
|---|---|---|---|
| Calibration Date | 1-Jul-23 | Equipment Name | NOx Analyzer |
| Manufacturer | HORIBA | Model | APNA-370 |
| Serial No. | XLTWRBSJ | Equipment ID | BKK_FS1092 |
| Calibrator Manufacturer | Teledyne API | Model | 700 |
| Serial No. | 947 | | |
| Std. Gas Concentration (PPM) | 55.88 | Cylinder No. | GN0027222 |
| Cylinder Pressure (psi) | 1800 | Certified By | Airgas Inc. |
| Certified Date | 9-Feb-22 | Expired Date | 9-Feb-30 |

| Point | CALIBRATION RESULTS | | | | | | |
|---|---|---|---|---|---|---|---|
| | Ideal | Actual NO | Error NO | %Error NO | Actual NOx | Error NOx | %Error NOx |
| ZERO | 0.00 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| 1 | 100.00 | 99.70 | -0.30 | -0.30 | 101.00 | 1.00 | 1.00 |
| 2 | 200.00 | 198.10 | -1.90 | -0.95 | 201.00 | 1.00 | 0.50 |
| 3 | 300.00 | 299.10 | -0.90 | -0.30 | 301.40 | 1.40 | 0.47 |
| 4 | 400.00 | 398.20 | -1.80 | -0.45 | 402.80 | 2.80 | 0.70 |
| AVERAGE (%) | | | | -0.38 | | | 0.55 |




Calibrated By

( Mr.Jirawut Sakarn )
Field Environmental Scientist (3)

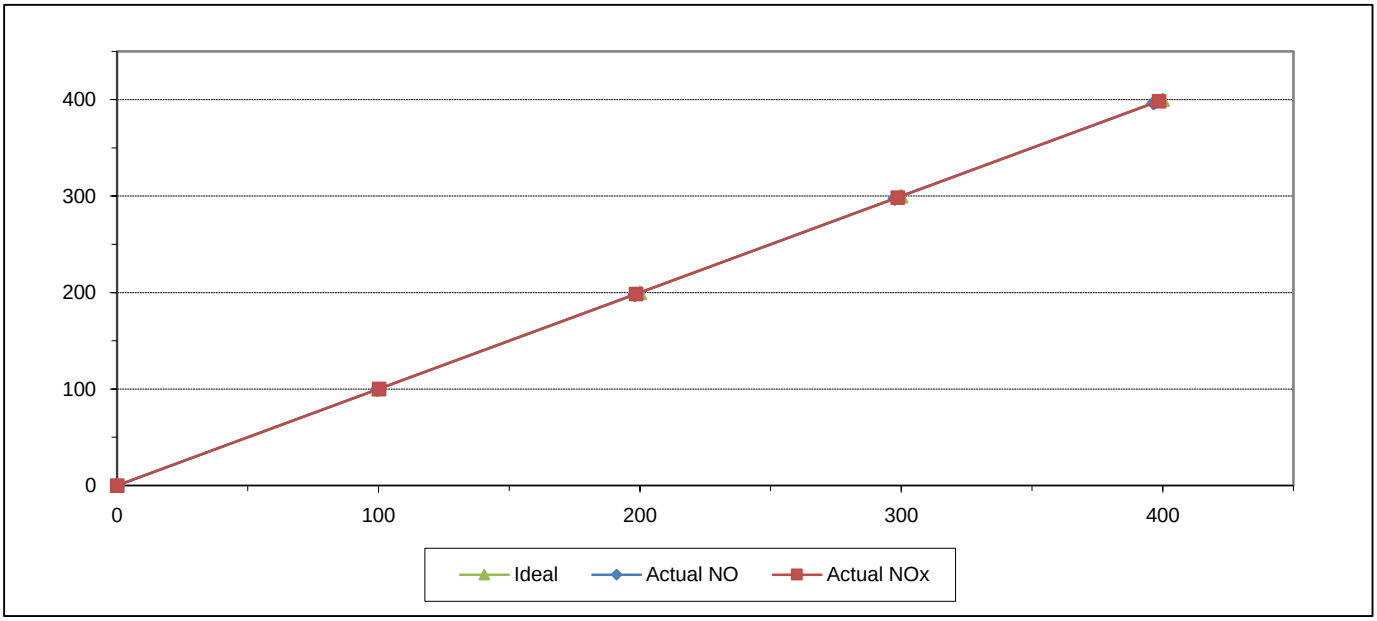
Approved By

( Mr.Sarayuth Jittranont )
Assistant General Manager

# MULTIPOINT CALIBRATION REPORT

| | | | |
|---|---|---|---|
| Calibration Date | 1-Jul-23 | Equipment Name | NOx Analyzer |
| Manufacturer | Teledyne API | Model | T200 |
| Serial No. | 2197 | Equipment ID | RYG_FS0255 |
| Calibrator Manufacturer | Teledyne API | Model | 700 |
| Serial No. | 947 | | |
| Std. Gas Concentration (PPM) | 55.88 | Cylinder No. | GN0027222 |
| Cylinder Pressure (psi) | 1800 | Certified By | Airgas Inc. |
| Certified Date | 9-Feb-22 | Expired Date | 9-Feb-30 |

| Point | CALIBRATION RESULTS | | | | | | |
|---|---|---|---|---|---|---|---|
| | Ideal | Actual NO | Error NO | %Error NO | Actual NOx | Error NOx | %Error NOx |
| ZERO | 0.00 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| 1 | 100.00 | 99.60 | -0.40 | -0.40 | 100.20 | 0.20 | 0.20 |
| 2 | 200.00 | 198.10 | -1.90 | -0.95 | 198.50 | -1.50 | -0.75 |
| 3 | 300.00 | 297.50 | -2.50 | -0.83 | 298.70 | -1.30 | -0.43 |
| 4 | 400.00 | 396.50 | -3.50 | -0.88 | 398.60 | -1.40 | -0.35 |
| AVERAGE (%) | | | | -0.59 | | | -0.25 |




Calibrated By

( Mr.Jirawut Sakarn )
Field Environmental Scientist (3)

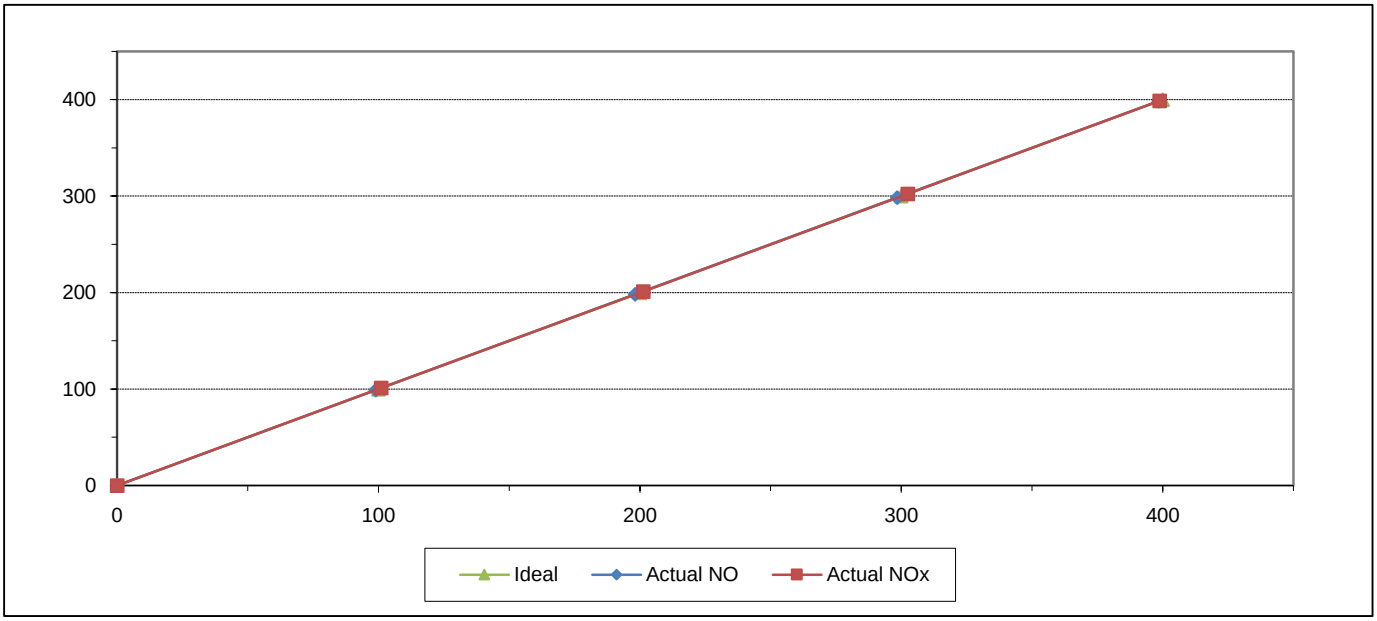
Approved By

( Mr.Sarayuth Jittranont )
Assistant General Manager

# MULTIPOINT CALIBRATION REPORT

| | | | |
|---|---|---|---|
| Calibration Date | 1-Jul-23 | Equipment Name | NOx Analyzer |
| Manufacturer | HORIBA | Model | APNA-370 |
| Serial No. | R26E09EW | Equipment ID | BKK_FS0789 |
| Calibrator Manufacturer | Teledyne API | Model | 700 |
| Serial No. | 947 | | |
| Std. Gas Concentration (PPM) | 55.88 | Cylinder No. | GN0027222 |
| Cylinder Pressure (psi) | 1800 | Certified By | Airgas Inc. |
| Certified Date | 9-Feb-22 | Expired Date | 9-Feb-30 |

| Point | CALIBRATION RESULTS | | | | | | |
|---|---|---|---|---|---|---|---|
| | Ideal | Actual NO | Error NO | %Error NO | Actual NOx | Error NOx | %Error NOx |
| ZERO | 0.00 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| 1 | 100.00 | 99.00 | -1.00 | -1.00 | 101.10 | 1.10 | 1.10 |
| 2 | 200.00 | 198.20 | -1.80 | -0.90 | 201.30 | 1.30 | 0.65 |
| 3 | 300.00 | 298.50 | -1.50 | -0.50 | 302.50 | 2.50 | 0.83 |
| 4 | 400.00 | 398.50 | -1.50 | -0.38 | 398.90 | -1.10 | -0.28 |
| AVERAGE (%) | | | | -0.54 | | | 0.48 |




Calibrated By

( Mr.Jirawut Sakarn )
Field Environmental Scientist (3)

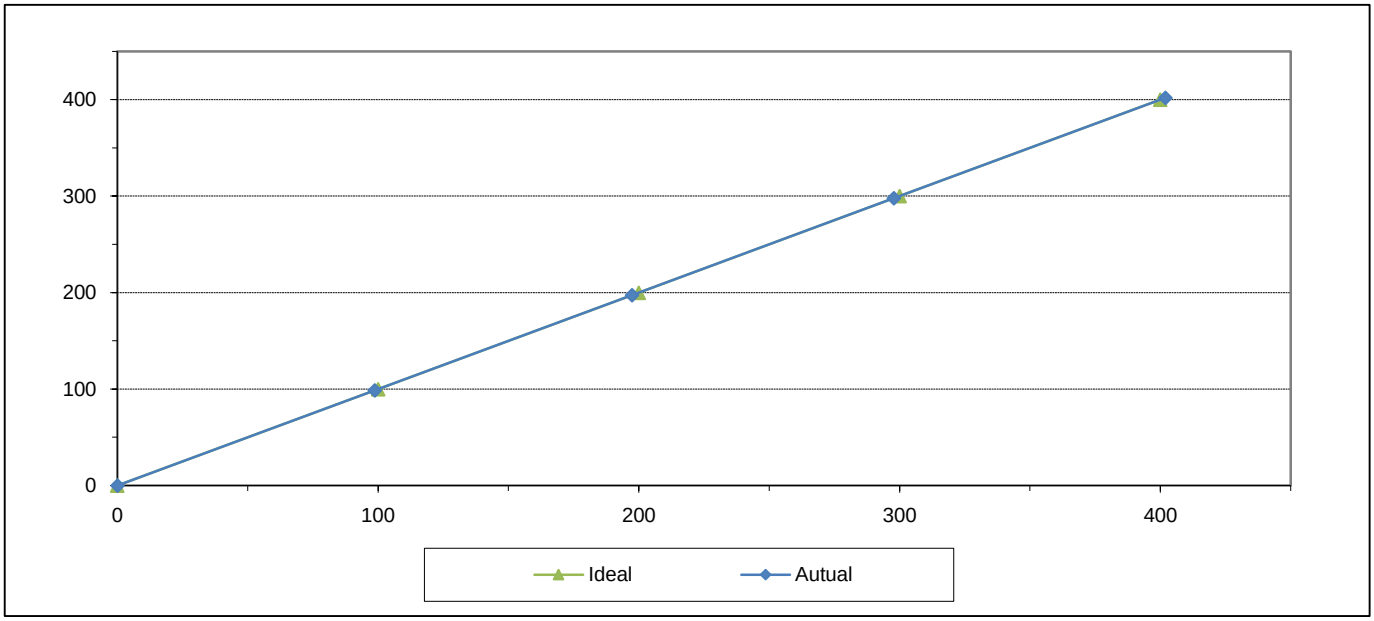
Approved By

( Mr.Sarayuth Jittranont )
Assistant General Manager

# MULTIPOINT CALIBRATION REPORT

| | | | |
|---|---|---|---|
| Calibration Date | 2-Jul-23 | Equipment Name | SO2 Analyzer |
| Manufacturer | HORIBA | Model | APSA-370 |
| Serial No. | XGYYV1AU | Equipment ID | BKK_FS1089 |
| Calibrator Manufacturer | Teledyne API | Model | 700 |
| Serial No. | 947 | | |
| Std. Gas Concentration (PPM) | 56.3 | Cylinder No. | GN0027222 |
| Cylinder Pressure (psi) | 1800 | Certified By | Airgas Inc. |
| Certified Date | 9-Feb-22 | Expired Date | 9-Feb-30 |

| Point | CALIBRATION RESULTS | | | |
|---|---|---|---|---|
| | Ideal | Autual | Error | %Error |
| ZERO | 0.00 | 0.10 | 0.10 | 0.10 |
| 1 | 100.00 | 98.80 | -1.20 | -1.20 |
| 2 | 200.00 | 197.40 | -2.60 | -1.30 |
| 3 | 300.00 | 297.80 | -2.20 | -0.73 |
| 4 | 400.00 | 402.00 | 2.00 | 0.50 |
| AVERAGE (%) | | | | -0.53 |




Calibrated By

( Mr.Jirawut Sakarn )
Field Environmental Scientist (3)

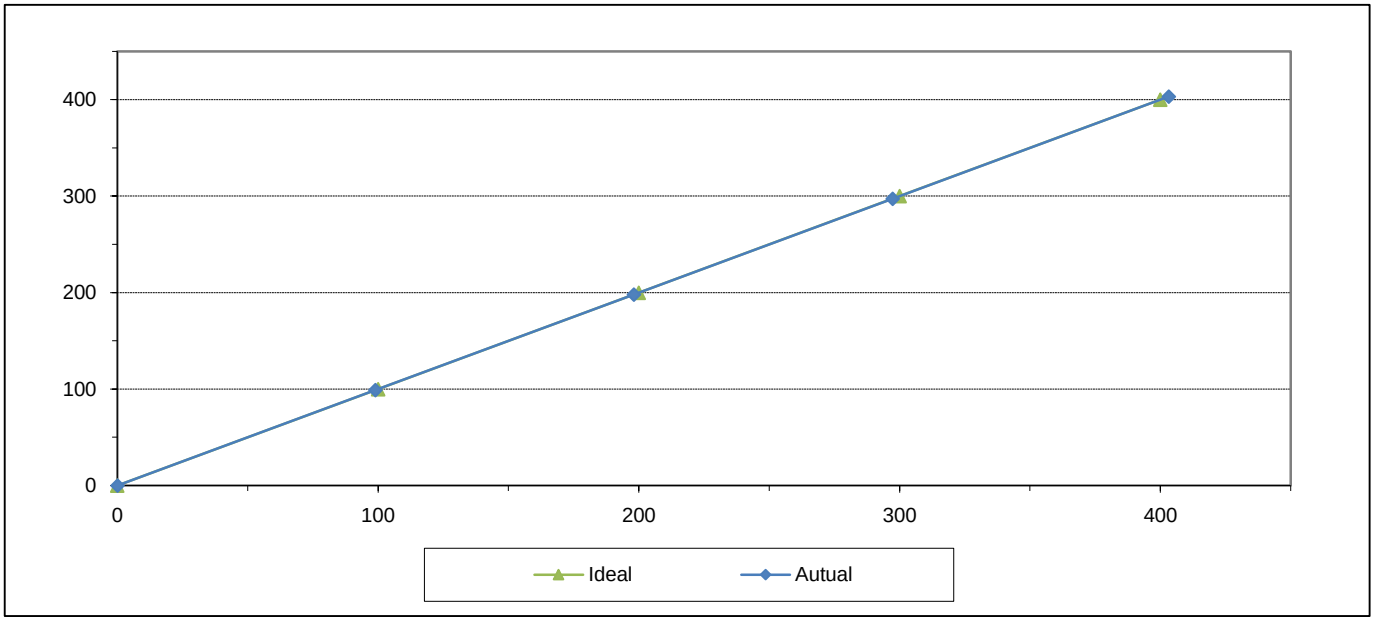
Approved By

( Mr.Sarayuth Jittranont )
Assistant General Manager

# MULTIPOINT CALIBRATION REPORT

| | | | |
|---|---|---|---|
| Calibration Date | 2-Jul-23 | Equipment Name | SO2 Analyzer |
| Manufacturer | Teledyne API | Model | 100E |
| Serial No. | 3469 | Equipment ID | BKK_FS0775 |
| Calibrator Manufacturer | Teledyne API | Model | 700 |
| Serial No. | 947 | | |
| Std. Gas Concentration (PPM) | 56.3 | Cylinder No. | GN0027222 |
| Cylinder Pressure (psi) | 1800 | Certified By | Airgas Inc. |
| Certified Date | 9-Feb-22 | Expired Date | 9-Feb-30 |

| Point | CALIBRATION RESULTS | | | |
|---|---|---|---|---|
| | Ideal | Autual | Error | %Error |
| ZERO | 0.00 | 0.10 | 0.10 | 0.10 |
| 1 | 100.00 | 99.00 | -1.00 | -1.00 |
| 2 | 200.00 | 198.10 | -1.90 | -0.95 |
| 3 | 300.00 | 297.30 | -2.70 | -0.90 |
| 4 | 400.00 | 403.20 | 3.20 | 0.80 |
| AVERAGE (%) | | | | -0.39 |




Calibrated By

( Mr.Jirawut Sakarn )
Field Environmental Scientist (3)

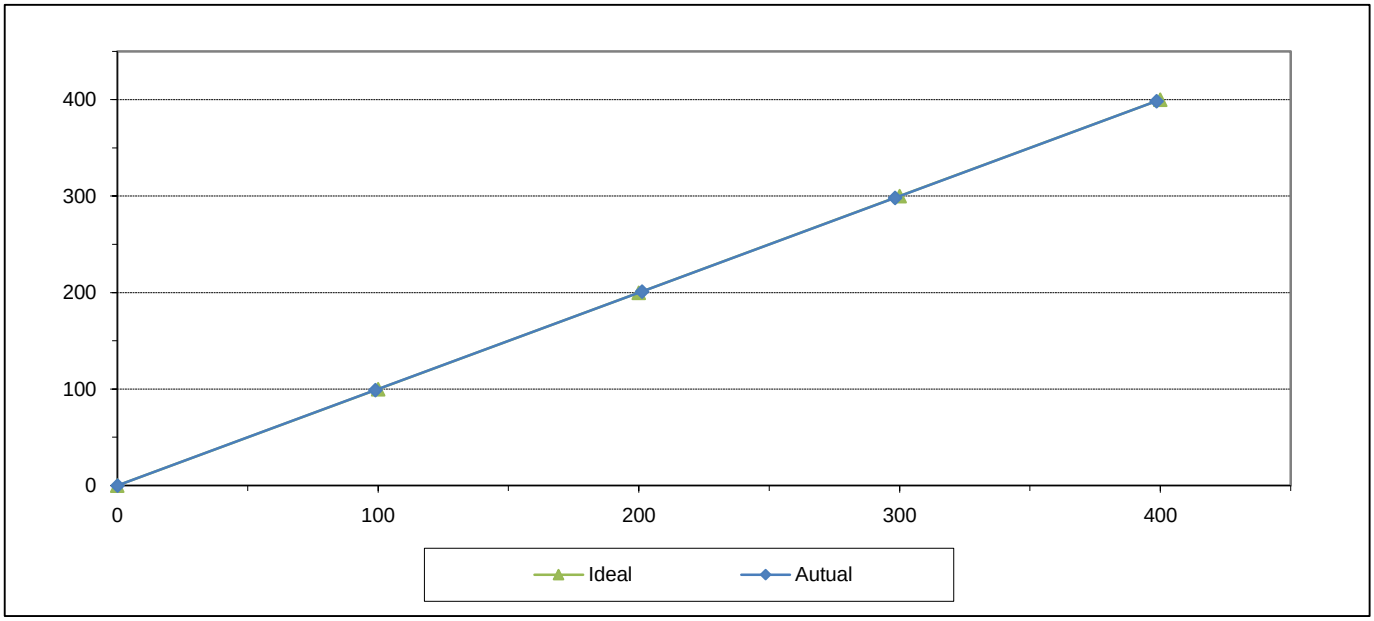
Approved By

( Mr.Sarayuth Jittranont )
Assistant General Manager

# MULTIPOINT CALIBRATION REPORT

| | | | |
|---|---|---|---|
| Calibration Date | 2-Jul-23 | Equipment Name | SO2 Analyzer |
| Manufacturer | HORIBA | Model | APSA-370 |
| Serial No. | PFDW4YU4 | Equipment ID | BKK_FS0788 |
| Calibrator Manufacturer | Teledyne API | Model | 700 |
| Serial No. | 947 | | |
| Std. Gas Concentration (PPM) | 56.3 | Cylinder No. | GN0027222 |
| Cylinder Pressure (psi) | 1800 | Certified By | Airgas Inc. |
| Certified Date | 9-Feb-22 | Expired Date | 9-Feb-30 |

| Point | CALIBRATION RESULTS | | | |
|---|---|---|---|---|
| | Ideal | Autual | Error | %Error |
| ZERO | 0.00 | 0.05 | 0.05 | 0.05 |
| 1 | 100.00 | 99.00 | -1.00 | -1.00 |
| 2 | 200.00 | 201.30 | 1.30 | 0.65 |
| 3 | 300.00 | 298.30 | -1.70 | -0.57 |
| 4 | 400.00 | 398.60 | -1.40 | -0.35 |
| AVERAGE (%) | | | | -0.24 |




Calibrated By

( Mr.Jirawut Sakarn )
Field Environmental Scientist (3)

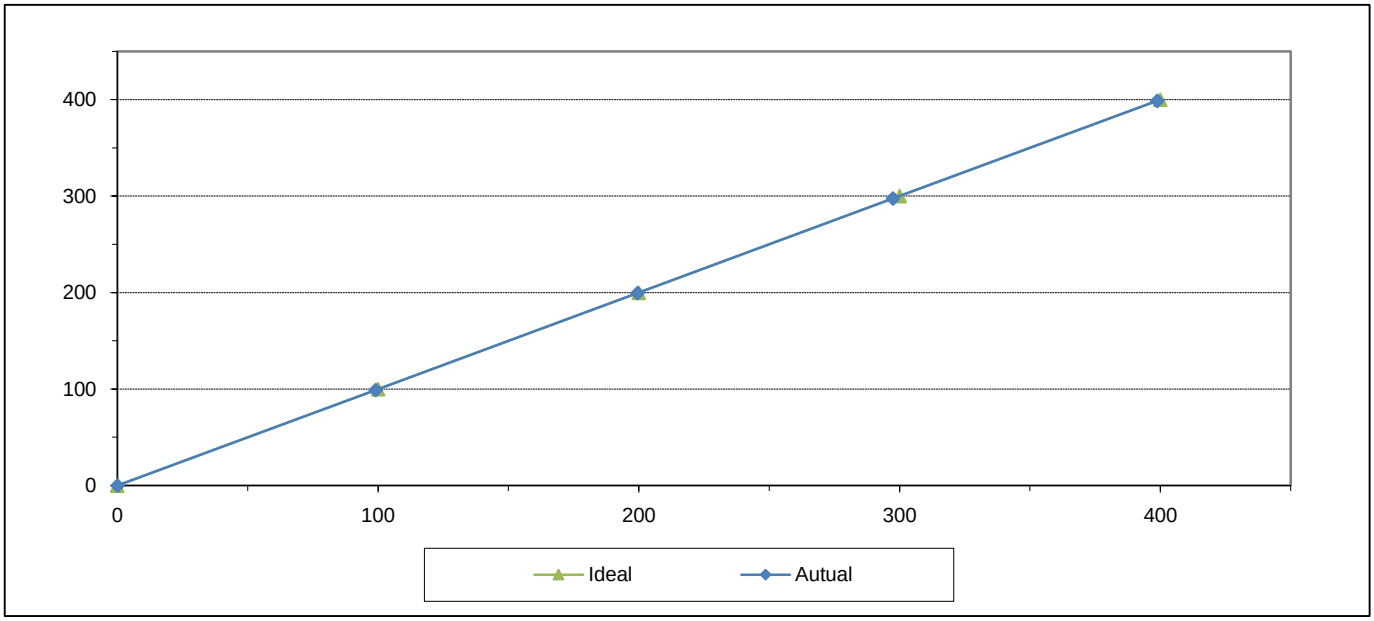
Approved By

( Mr.Sarayuth Jittranont )
Assistant General Manager

# MULTIPOINT CALIBRATION REPORT

| | | | |
|---|---|---|---|
| Calibration Date | 2-Jul-23 | Equipment Name | SO2 Analyzer |
| Manufacturer | Teledyne API | Model | T100 |
| Serial No. | 1772 | Equipment ID | RYG_FS0254 |
| Calibrator Manufacturer | Teledyne API | Model | 700 |
| Serial No. | 947 | | |
| Std. Gas Concentration (PPM) | 56.3 | Cylinder No. | GN0027222 |
| Cylinder Pressure (psi) | 1800 | Certified By | Airgas Inc. |
| Certified Date | 9-Feb-22 | Expired Date | 9-Feb-30 |

| Point | CALIBRATION RESULTS | | | |
|---|---|---|---|---|
| | Ideal | Autual | Error | %Error |
| ZERO | 0.00 | 0.05 | 0.05 | 0.05 |
| 1 | 100.00 | 99.10 | -0.90 | -0.90 |
| 2 | 200.00 | 199.50 | -0.50 | -0.25 |
| 3 | 300.00 | 297.50 | -2.50 | -0.83 |
| 4 | 400.00 | 398.80 | -1.20 | -0.30 |
| AVERAGE (%) | | | | -0.45 |




Calibrated By

( Mr.Jirawut Sakarn )
Field Environmental Scientist (3)

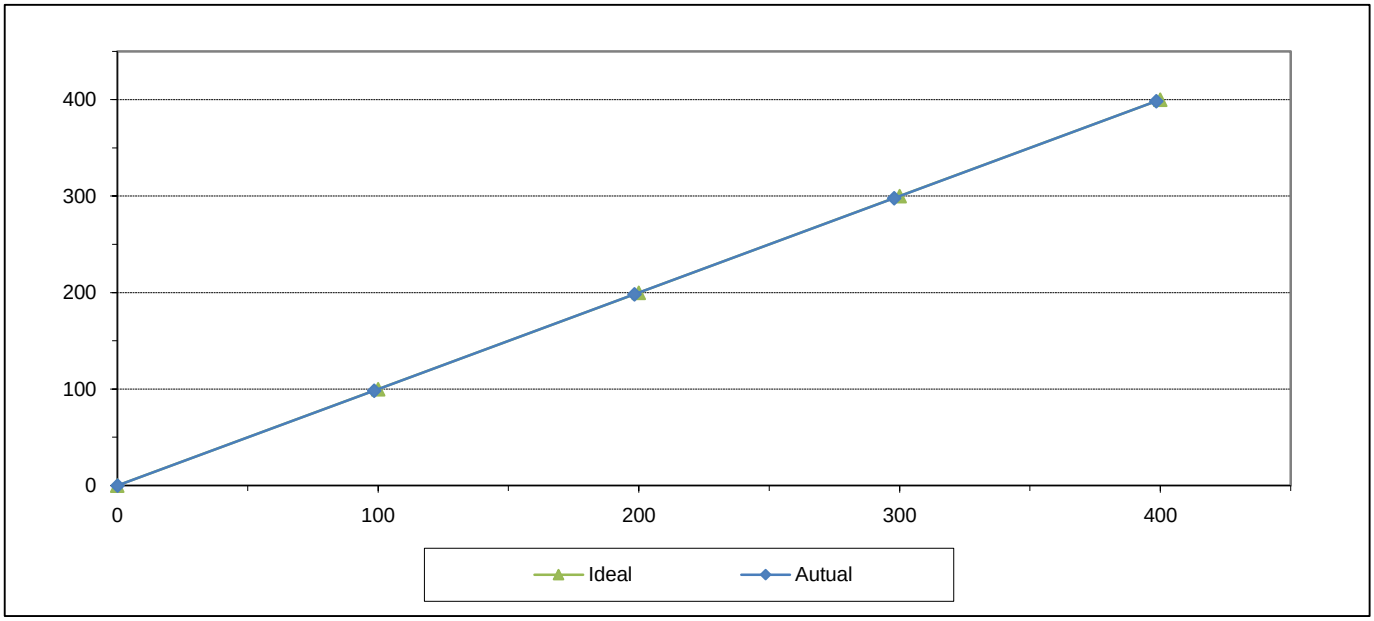
Approved By

( Mr.Sarayuth Jittranont )
Assistant General Manager

# MULTIPOINT CALIBRATION REPORT

| | | | |
|---|---|---|---|
| Calibration Date | 2-Jul-23 | Equipment Name | SO2 Analyzer |
| Manufacturer | HORIBA | Model | APSA-370 |
| Serial No. | 6BVW9P1K | Equipment ID | BKK_FS1091 |
| Calibrator Manufacturer | Teledyne API | Model | 700 |
| Serial No. | 947 | | |
| Std. Gas Concentration (PPM) | 56.3 | Cylinder No. | GN0027222 |
| Cylinder Pressure (psi) | 1800 | Certified By | Airgas Inc. |
| Certified Date | 9-Feb-22 | Expired Date | 9-Feb-30 |

| Point | CALIBRATION RESULTS | | | |
|---|---|---|---|---|
| | Ideal | Autual | Error | %Error |
| ZERO | 0.00 | 0.10 | 0.10 | 0.10 |
| 1 | 100.00 | 98.50 | -1.50 | -1.50 |
| 2 | 200.00 | 198.30 | -1.70 | -0.85 |
| 3 | 300.00 | 297.90 | -2.10 | -0.70 |
| 4 | 400.00 | 398.50 | -1.50 | -0.38 |
| AVERAGE (%) | | | | -0.67 |




Calibrated By

( Mr.Jirawut Sakarn )
Field Environmental Scientist (3)

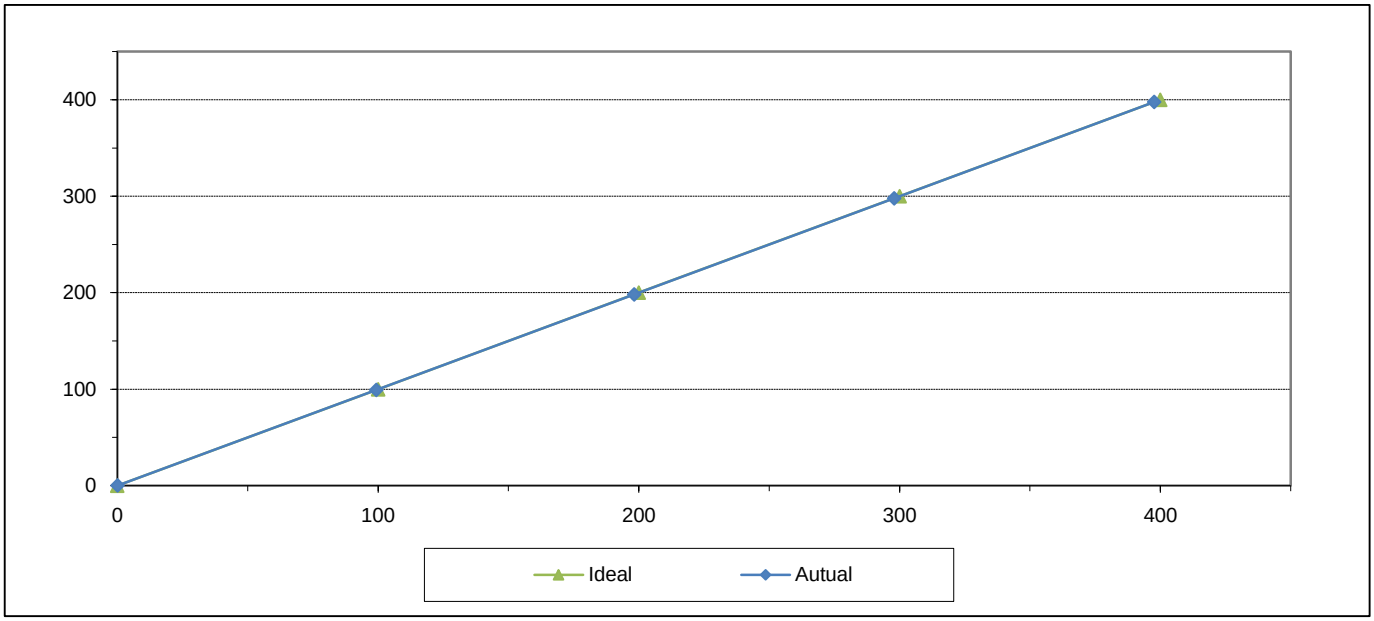
Approved By

( Mr.Sarayuth Jittranont )
Assistant General Manager

# MULTIPOINT CALIBRATION REPORT

| | | | |
|---|---|---|---|
| Calibration Date | 1-Jul-23 | Equipment Name | O3 Analyzer |
| Manufacturer | Teledyne API | Model | T400 |
| Serial No. | 3435 | Equipment ID | BKK_FS1073 |
| O3 Generator Manufacturer | Tanabyte | Model | SA2-734 |
| Serial No. | 115 | | |

| Point | CALIBRATION RESULTS | | | |
|---|---|---|---|---|
| | Ideal | Autual | Error | %Error |
| ZERO | 0.00 | 0.10 | 0.10 | 0.10 |
| 1 | 100.00 | 99.30 | -0.70 | -0.70 |
| 2 | 200.00 | 198.20 | -1.80 | -0.90 |
| 3 | 300.00 | 297.90 | -2.10 | -0.70 |
| 4 | 400.00 | 397.70 | -2.30 | -0.58 |
| AVERAGE (%) | | | | -0.56 |




Calibrated By

( Mr.Jirawut Sakarn )
Field Environmental Scientist (3)

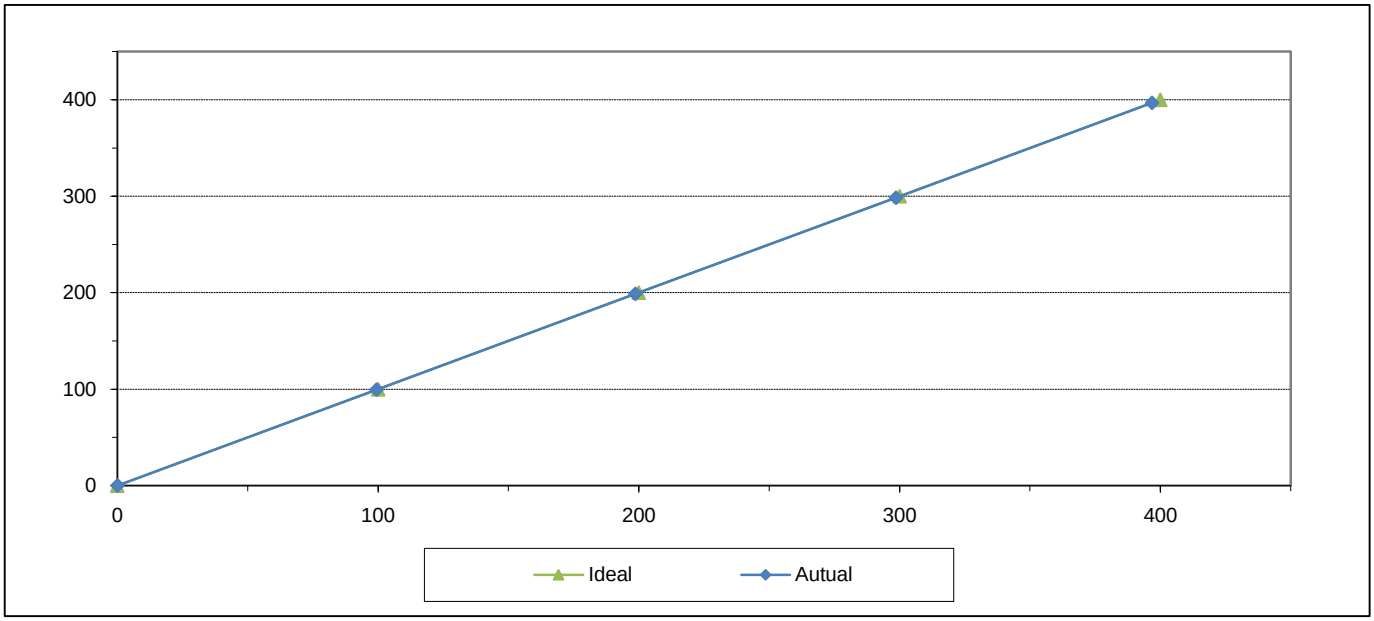
Approved By

( Mr.Sarayuth Jittranont )
Assistant General Manager

# MULTIPOINT CALIBRATION REPORT

| | | | |
|---|---|---|---|
| Calibration Date | 1-Jul-23 | Equipment Name | O3 Analyzer |
| Manufacturer | Teledyne API | Model | T400 |
| Serial No. | 3452 | Equipment ID | BKK_FS1074 |
| O3 Generator Manufacturer | Tanabyte | Model | SA2-734 |
| Serial No. | 115 | | |

| Point | CALIBRATION RESULTS | | | |
|---|---|---|---|---|
| | Ideal | Autual | Error | %Error |
| ZERO | 0.00 | 0.10 | 0.10 | 0.10 |
| 1 | 100.00 | 99.40 | -0.60 | -0.60 |
| 2 | 200.00 | 198.70 | -1.30 | -0.65 |
| 3 | 300.00 | 298.60 | -1.40 | -0.47 |
| 4 | 400.00 | 396.80 | -3.20 | -0.80 |
| AVERAGE (%) | | | | -0.48 |




Calibrated By

( Mr.Jirawut Sakarn )
Field Environmental Scientist (3)

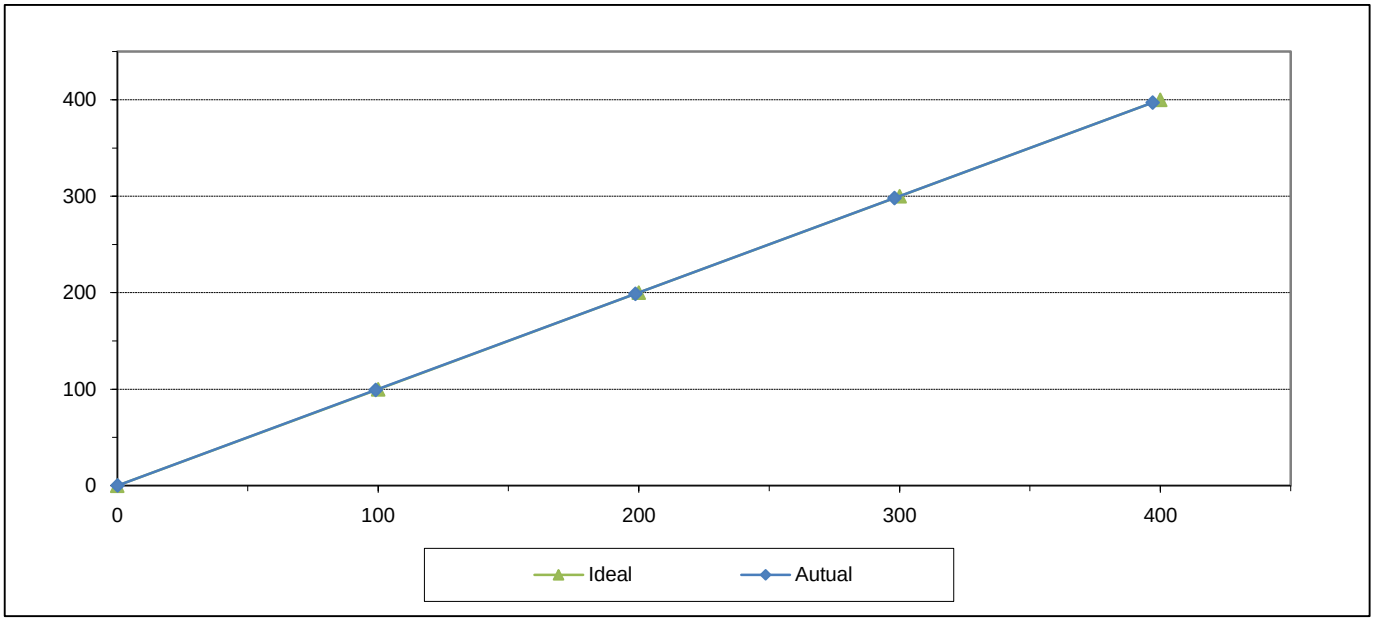
Approved By

( Mr.Sarayuth Jittranont )
Assistant General Manager

# MULTIPOINT CALIBRATION REPORT

| | | | |
|---|---|---|---|
| Calibration Date | 1-Jul-23 | Equipment Name | O3 Analyzer |
| Manufacturer | Teledyne API | Model | 400E |
| Serial No. | 1747 | Equipment ID | BKK_FS0732 |
| O3 Generator Manufacturer | Tanabyte | Model | SA2-734 |
| Serial No. | 115 | | |

| Point | CALIBRATION RESULTS | | | |
|---|---|---|---|---|
| | Ideal | Autual | Error | %Error |
| ZERO | 0.00 | 0.12 | 0.12 | 0.12 |
| 1 | 100.00 | 99.10 | -0.90 | -0.90 |
| 2 | 200.00 | 198.70 | -1.30 | -0.65 |
| 3 | 300.00 | 298.10 | -1.90 | -0.63 |
| 4 | 400.00 | 397.10 | -2.90 | -0.72 |
| AVERAGE (%) | | | | -0.56 |




Calibrated By

( Mr.Jirawut Sakarn )
Field Environmental Scientist (3)

Approved By

( Mr.Sarayuth Jittranont )
Assistant General Manager

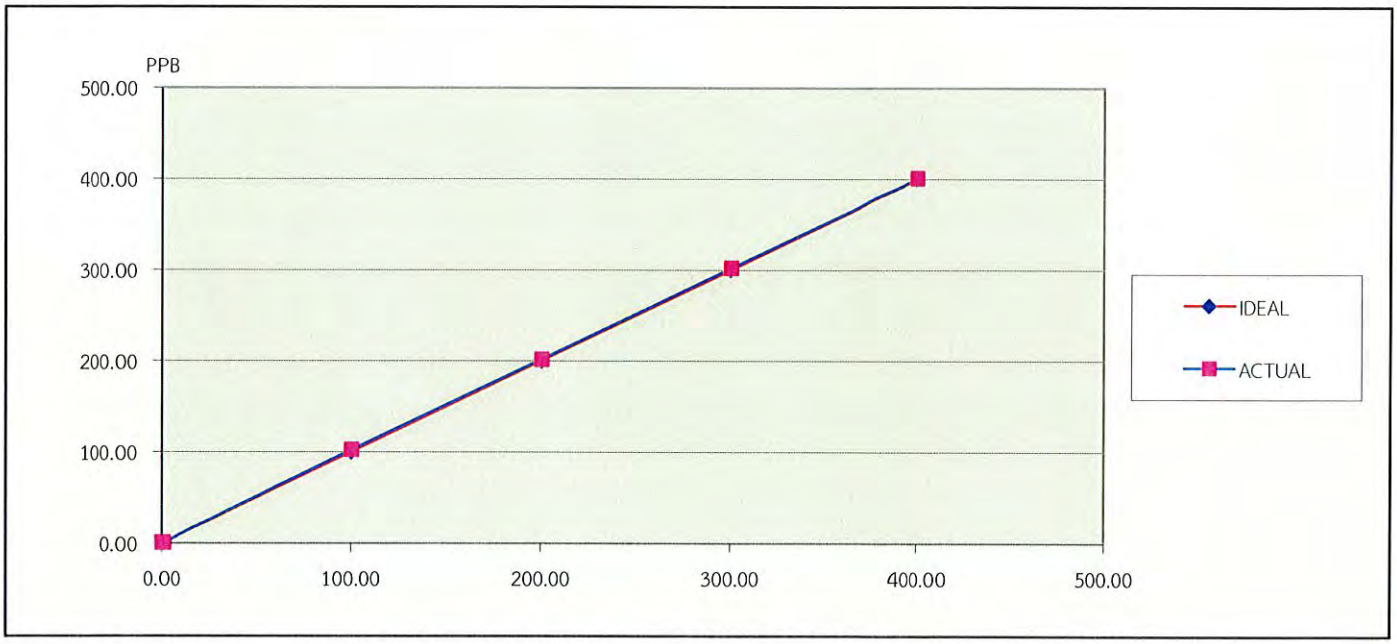
JNAC
JIRANATEE ASSOCIATES CO.,LTD

# TEST REPORT

| | | | | | |
|---|---|---|---|---|---|
| EQRIPMENT NAME : Ozone Analyzer | | | | | |
| MANUFACTURER : HORIBA | MODEL | : APOA-370 | SERIAL NO | : 635RSBRR |
| STANDARD GAS CONCENTRATION (PPM) | : - | PPM | CYLINDER NO | : - |
| CYLINDER PRESSURE (PSI) | : - | PSI | CERTIFIED DATE | : - |
| CERTIFIED BY | : Ozone Primary | | EXPIRED DATE | : - |

## TEST RESULTS

| POINT NO | TEST RESULTS | | | |
|---|---|---|---|---|
| | IDEAL | ACTUAL | ERROR | %ERROR |
| ZERO | 0.00 | 0.0000 | 0.20 | - |
| 1 | 100.00 | 102.0000 | 2.0 | 2.00 |
| 2 | 200.00 | 201.1000 | 1.1 | 0.55 |
| 3 | 300.00 | 301.4000 | 1.4 | 0.47 |
| 4 | 400.00 | 400.4000 | 0.4 | 0.10 |
| AVERAGE (%) | | | | 0.78 |




TEST BY : วีรกมล ศุภลิขเดชิน DATE : 5/4/66

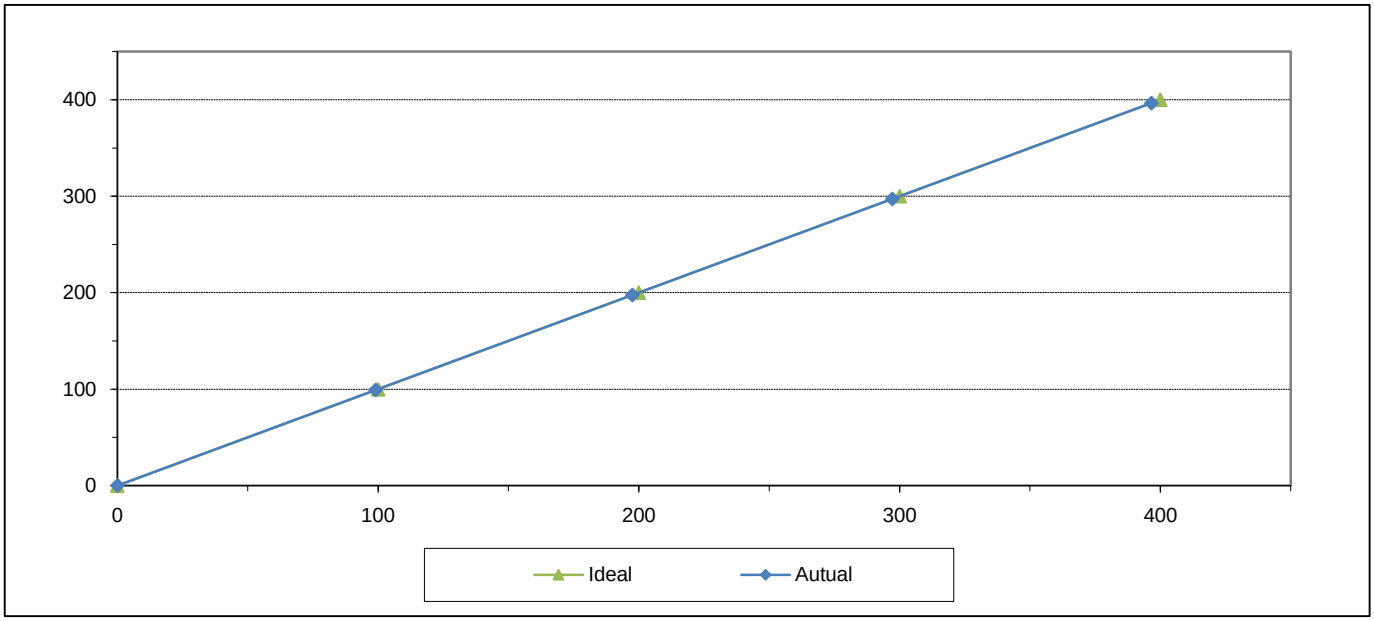
CHECKED BY : [illegible] DATE : 5/4/66

ต้องการข้อมูลทางด้านเทคนิคเพิ่มเติม : เจ้าหน้าที่ฝ่ายบริการหลังการขาย , โทร 02-868-0812 # 15-16 , E-Mail : Engineer@jiranatee.com
เลขที่ 63/14-15 , 67/35-36 ถนน ซอยเพชรเกษม 7,7/1 เพชรเกษม แขวงวัดท่าพระ เขตบางกอกใหญ่ กรุงเทพฯ 10600 โทร 02-868-0812-13 โทรสาร 02-868-1889

# MULTIPOINT CALIBRATION REPORT

| | | | |
|---|---|---|---|
| Calibration Date | 1-Jul-23 | Equipment Name | O3 Analyzer |
| Manufacturer | Teledyne API | Model | 400E |
| Serial No. | 3002 | Equipment ID | BKK_FS0761 |
| O3 Generator Manufacturer | Tanabyte | Model | SA2-734 |
| Serial No. | 115 | | |

| Point | CALIBRATION RESULTS | | | |
|---|---|---|---|---|
| | Ideal | Autual | Error | %Error |
| ZERO | 0.00 | 0.10 | 0.10 | 0.10 |
| 1 | 100.00 | 99.10 | -0.90 | -0.90 |
| 2 | 200.00 | 197.50 | -2.50 | -1.25 |
| 3 | 300.00 | 297.20 | -2.80 | -0.93 |
| 4 | 400.00 | 396.60 | -3.40 | -0.85 |
| AVERAGE (%) | | | | -0.77 |




Calibrated By

( Mr.Jirawut Sakarn )
Field Environmental Scientist (3)

Approved By

( Mr.Sarayuth Jittranont )
Assistant General Manager

JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd
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*Accredited calibration laboratory*
*ISO/IEC 17025:2017*
*NSC-TISI-TIS 17025*
*CALIBRATION 0367*

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

REVIEW BY Marakorn P.
APPROVED BY
NEXT CAL. DATE 20/12/24

| Certificate Number |
|---|
| CC-015-66 |

# CERTIFICATE OF CALIBRATION



**MEASUREMENT ITEM** : Cup anemometer
**MANUFACTURER** : Novalynx
**MODEL/TYPE** : Sensor: WS-02FA
Data logger: 110-WS-25DL-D
**SERIAL NUMBER** : Sensor: WSD-A5980
Data logger: A5980
**ID NUMBER** : RYG_FS0649
**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** : 16 Jun 2023
**MEASUREMENT DATE** : 20 Jun 2023
**ISSUE DATE** : 20 Jun 2023

**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 (24.4) °C, (41.8) %RH and (1011.5) hPa.

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

***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'*

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

JNAC JIRANATE ASSOCIATES CO.,

**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 |
| --- |
| CC-015-66 |



## 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) |
| --- | --- | --- | --- | --- | --- |
| 1.023 | 24.30 | 24.40 | 0.9 | -0.1 | 0.31 |
| 2.025 | 24.50 | 24.40 | 1.9 | -0.1 | 0.31 |
| 2.999 | 24.40 | 24.40 | 2.9 | -0.1 | 0.31 |
| 4.109 | 24.34 | 24.40 | 4.0 | -0.1 | 0.31 |
| 5.03 | 24.32 | 24.40 | 4.9 | -0.1 | 0.31 |
| 6.01 | 24.32 | 24.40 | 5.9 | -0.1 | 0.31 |
| 7.05 | 24.24 | 24.40 | 7.0 | -0.1 | 0.31 |
| 8.17 | 24.14 | 24.40 | 8.0 | -0.2 | 0.31 |
| 9.10 | 24.20 | 24.40 | 9.0 | -0.1 | 0.31 |
| 10.08 | 24.10 | 24.40 | 9.9 | -0.1 | 0.31 |
| 11.14 | 24.20 | 24.40 | 11.0 | -0.1 | 0.31 |
| 12.13 | 24.10 | 24.40 | 12.0 | -0.2 | 0.31 |
| 13.19 | 24.14 | 24.40 | 13.0 | -0.2 | 0.31 |
| 14.23 | 24.10 | 24.40 | 14.0 | -0.2 | 0.31 |
| 15.33 | 24.10 | 24.40 | 15.1 | -0.2 | 0.31 |
| 16.29 | 24.10 | 24.40 | 16.1 | -0.2 | 0.32 |

**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.

Jiranatee Associates Co., Ltd.

JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd
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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 |
|---|
| CD-015-66 |

# CERTIFICATE OF CALIBRATION



**MEASUREMENT ITEM** : Wind Direction Sensor
**MANUFACTURER** : Novalynx
**MODEL/TYPE** : Sensor: WS-02FA
Data logger: 110-WS-25DL-D
**SERIAL NUMBER** : Sensor: WSD-A5980
Data logger: A5980
**ID NUMBER** : RYG_FS0649
**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** : 16 Jun 2023
**MEASUREMENT DATE** : 20 Jun 2023
**ISSUE DATE** : 20 Jun 2023

***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'*

**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 (24.3)°C, (47.4) %RH and (1010.9) hPa.

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

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

JNAC JIRANATE ASSOCIATES CO.

**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 |
| --- |
| CD-015-66 |



**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 | $D^{6}_{std}$ | $D^{7}_{uuc}$ | Error | *U (k=2)* |
| --- | --- | --- | --- | --- |
| m/s | Degree (°) | Degree (°) | Degree (°) | Degree (°) |
| 5.02 | 0.000 | 0 | 0 | 1.0 |
| | 45.000 | 43 | -2 | 1.0 |
| | 90.000 | 87 | -3 | 1.0 |
| | 135.000 | 133 | -2 | 1.0 |
| | 180.000 | 180 | 0 | 1.0 |
| | 225.000 | 226 | 1 | 1.0 |
| | 270.000 | 272 | 2 | 1.0 |
| | 315.000 | 318 | 3 | 1.0 |

**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.

Jiranatee Associates Co., Ltd.

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

NSC - TISI - TIS 17025
CALIBRATION 0367

# CERTIFICATE OF CALIBRATION

Certificate No. : CT-025-66


**Equipment Name:** Data Logger with Temperature sensor
**Manufacturer:** Novalynx
**Model:** 110-WS-25DL-D
**Serial No.:** A5980
**ID No.:** RYG_FS0649

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

**Received date:** 16 Jun 2023
**Calibration date:** 20 Jun 2023
**Issue date:** 22 Jun 2023

**Reference Used During Calibration**
1.Standard Temperature Probe Model: STS-100 A500, Serial No.: 667682-09, Due date: 28 Mar 2024
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-0038-23, Certificate number: ER-0092-22

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

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

JIRANATE ASSOCIATES CO.,

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

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

JIRANATEE ASSOCIATES CO.,LTD.
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NSC - TISI - TIS 17025
CALIBRATION 0367



**Result of Calibration:-** ☑ Without Adjustment ☐ With Adjustment

**Calibration Range:** 20-40 °C

**Function:**

This equipment was connected with temperature sensor Model: HMP60 S/N: V1920214.

Dimension : Diameter 12 mm. Length 80 mm.

| Immersion Depth (mm) | Standard Reading (°C) | UUC Reading (°C) | Error (°C) | Uncertainty (°C) |
|---|---|---|---|---|
| 70 | 20.057 | 20.0 | -0.1 | 0.099 |
| 70 | 25.051 | 24.9 | -0.2 | 0.099 |
| 70 | 30.044 | 29.8 | -0.2 | 0.099 |
| 70 | 35.039 | 34.8 | -0.2 | 0.099 |
| 70 | 40.034 | 39.7 | -0.3 | 0.099 |

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.

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# CERTIFICATE OF CALIBRATION

Calibration No. : RH-08062023


Measurement Item : Relative humidity with data logger
Manufacturer : Novalynx
Model/Type : 110-WS-25DL-D
Serial Number : A5980
ID No. : RYG_FS0649
Customer : ALS laboratory group (Thailand) Co., Ltd.
: 104 Phatthanakan 40, Phatthanakan 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 chilled mirror hygrometer model: 1860-3 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: 20926-601. Due date: Sep 26, 2024.

Measurement Date : Jun 20, 2023
Issued Date : Jun 22, 2023

Measurement Results:
This equipment was connected with Indoor air quality probe and Displayed (UR) on display. Model: HMP60, Serial number: V1920214.
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 | 20.04 | 19.3 | -0.7 | 0.52 |
| 50 | 50.25 | 49.5 | -0.8 | 0.52 |
| 80 | 80.33 | 80.5 | 0.2 | 0.52 |

Performed by
☐ Mr. Sorawit Thachalad
☑ Miss Jittraporn Lertsomphol
☐ Miss Ruangrumpai Phoommit

JIRANATE ASSOCIATES CO., LTD.

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

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

JIRANATEE ASSOCIATES CO.,LTD.

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*NSC-TISI-TIS 17025*
*CALIBRATION 0367*

*Pressure measurement laboratory*
*Calibration services department.*

NSC - TISI - TIS 17025
CALIBRATION 0367

# CERTIFICATE OF CALIBRATION

**Certificate No.** : CP-009-66



**MEASUREMENT ITEM** : Digital barometer
**MANUFACTURER** : Novalynx
**MODEL/TYPE** : Sensor: 110-WS-25BP
Data logger: 110-WS-25DL-D
**SERIAL NUMBER** : Sensor: BP-A5980
Data logger: A5980
**ID NUMBER** : RYG_FS0649
**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** : 16 Jun 2023
**MEASUREMENT DATE** : 20 Jun 2023
**ISSUE DATE** : 20 Jun 2023

***Calibration procedure:***
*The pressure calibration was done by In-house calibration method as WI-CL-003 according to comparison method with Digital pressure calibrator based on DKD-R 6-1*

***Traceability:***
*The measurement results are traceable to the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MP-0205-22*

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

**CONDITION OF THIS RESULT OF CALIBRATION:**

1. Reference Standard Instrument:

| Instrument | Model | Serial No. | Certificate No. | Due Date |
|---|---|---|---|---|
| Absolute Pressure Transducer | CPG2500 | 4100126P | MP-0205-22 | 02 Dec 2023 |

1. Calibration effort for calibration sequence C
2. The UUC* was installed in vertical orientation above reference standard instrument and center of UUC* was used as the reference level.
3. Calibration conditions:
4. Condition : ☑ Normal ☐ Abnormal
   Pressure transmitting medium : Air
   $\rho_{FI}$ (20°C, 1 bar) : 1.19 kg/m$^3$
   $H_{amb}$ : (55±15) %
   $t_{amb}$ : (23±3) °C
   $p_{amb}$ : (1010±10) mbar
5. The certificate is valid only to the item calibrated on date and place of calibration

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

JNAC JIRANATE ASSOCIATES CO.

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

Jiranatee Associates Co., Ltd.

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

JIRANATEE ASSOCIATES CO.,LTD.

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*Accredited calibration laboratory*
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*NSC-TISI-TIS 17025*
*CALIBRATION 0367*

*Pressure measurement laboratory*
*Calibration services department.*

NSC - TISI - TIS 17025
CALIBRATION 0367

# CERTIFICATE OF CALIBRATION

**Certificate No.** : CP-009-66



**MEASUREMENT RESULTS** : ☑ Without adjustment ☐ With adjustment

**CALIBRATION IN THE RANGE OF** : 950 mbar to 1050 mbar

The results of calibration and associated measurement uncertainties are reported in the table below.

| STD (mbar) | UUC* (mbar) | Error (mbar) | Uncertainty (k=2) (mbar) |
|---|---|---|---|
| 950.13 | 950.8 | 0.6 | 0.84 |
| 970.04 | 970.4 | 0.4 | 0.60 |
| 990.10 | 990.3 | 0.2 | 0.46 |
| 1010.08 | 1010.1 | 0.0 | 0.37 |
| 1030.10 | 1029.8 | -0.3 | 0.50 |
| 1050.08 | 1049.5 | -0.5 | 0.73 |

**Note**: UUC* Unit Under Calibration
: To convert the result in report unit to Pa should be multiply by 100

***End of certificate***

JNAC
JIRANATE ASSOCIATES CO.,

Jiranatee Associates Co., Ltd.

# SITHIPORN ASSOCIATES CO.,LTD.
# CALIBRATION LABORATORY

451-451/1 Sirinthorn Rd.,Bangbumru, Bangplud Bangkok 10700 THAILAND.
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NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : ACC23005


# Calibration Certificate

| | |
|---|---|
| **Equipment :** | SOUND CALIBRATOR |
| **Manufacturer :** | RION |
| **Model :** | NC-75 |
| **Serial No.:** | 35002736 |
| **ID No.:** | RYG_FS0496 |
| **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 :** | 06 JANUARY 2023 |
| **Calibration Date :** | 17 JANUARY 2023 |
| **Date of Issue :** | 19 JANUARY 2023 |

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

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :** T. Petch.

( Thanakul Petchurai )

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## Continuation of Calibration Certificate

**Cert. No. : ACC23005**
**Job No. : VC66AC0024**


**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).

**Result of calibration :**

**1. Sound pressure level**

| Specified sound pressure level (dB) | Measured value (dB) | Deviated value (dB) | Uncertainty (dB) | Tolerance limit (dB) |
|---|---|---|---|---|
| 94 | 93.98 | -0.02 | 0.14 | 0.40 |

**2. Frequency**

| Specified Frequency (Hz) | Measured value (Hz) | Deviated value ( % ) | Uncertainty ( % ) | Tolerance limit ( % ) |
|---|---|---|---|---|
| 1000 | 1000.0 | 0.0 | 0.1 | 1.0 |

**3. Total distortion**

| Measured value ( % ) | Uncertainty ( % ) | Tolerance limit ( % ) |
|---|---|---|
| 0.35 | 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**

# SITHIPORN ASSOCIATES CO.,LTD.
# CALIBRATION LABORATORY

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NSC-TISI-TIS 17025
CALIBRATION 0394

**Cert. No. : ACL23075**
**Pages : 1 of 8**

# Calibration Certificate

| | |
|---|---|
| **Equipment :** | SOUND LEVEL METER |
| **Manufacturer :** | RION |
| **Model :** | NL-52A / Microphone UC-59 / Preamplifier NH-25 |
| **Serial No.:** | 00920833 / 22193 / 22222 |
| **ID No.:** | - |
| **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 :** | 06 JANUARY 2023 |
| **Calibration Date :** | 23-24 JANUARY 2023 |
| **Date of Issue :** | 25 JANUARY 2023 |

REVIEW BY Nanakorn P.
APPROVED BY
NEXT CAL. DATE 23/1/24

**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.

# Continuation of Calibration Certificate

**Cert. No. : ACL23075**
**Job No. : VC66AC0029**
**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).

## Continuation 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 | ✓ | - | 0.3 | 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 |

**Result of calibration :**

**1. Absolute sensitivity**

| Reference Acoustic Signal ( dB ) | Measured Value ( dB ) | Deviation ( dB ) | Acceptance Limit ( dB ) |
|---|---|---|---|
| 93.9 (93.95) | 94.0 | 0.0 | ±0.3 |

**2. Self-generated noise**

2.1 Normal test

| Measured Value ( dB ) |
|---|
| 13.1 |

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

| Frequency Weighting | Measured value ( dB ) |
|---|---|
| A - weight | 8.7 |
| C - weight | 14.2 |
| Flat | 19.7 |

**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 | 0.1 | 0.1 | 0.1 | ± 1.0 |
| 1000 | 0.2 | 0.2 | 0.2 | ± 0.7 |
| 8000 | -0.3 | -0.3 | -0.3 | + 1.5, - 2.5 |

**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 | 0.0 | -0.1 | ±1.0 |
| 125 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 250 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 500 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 1000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 2000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 8000 | 0.0 | 0.1 | 0.1 | + 1.5, - 2.5 |
| 16000 | 0.0 | -1.2 | -1.2 | + 2.5, -16.0 |

**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 | ± 0.1 |

**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 | ±0.8 |
| 136.0 | 136.0 | 0.0 | ±0.8 |
| 135.0 | 135.0 | 0.0 | ±0.8 |
| 134.0 | 134.0 | 0.0 | ±0.8 |
| 133.0 | 133.0 | 0.0 | ±0.8 |
| 132.0 | 132.0 | 0.0 | ±0.8 |
| 131.0 | 131.0 | 0.0 | ±0.8 |
| 129.0 | 129.0 | 0.0 | ±0.8 |
| 124.0 | 124.0 | 0.0 | ±0.8 |
| 119.0 | 119.0 | 0.0 | ±0.8 |
| 114.0 | 114.0 | 0.0 | ±0.8 |
| 109.0 | 109.0 | 0.0 | ±0.8 |
| 104.0 | 104.0 | 0.0 | ±0.8 |
| 99.0 | 99.0 | 0.0 | ±0.8 |
| 94.0 | 94.0 | 0.0 | ±0.8 |
| 89.0 | 89.0 | 0.0 | ±0.8 |
| 84.0 | 84.0 | 0.0 | ±0.8 |
| 79.0 | 79.0 | 0.0 | ±0.8 |
| 74.0 | 74.0 | 0.0 | ±0.8 |
| 69.0 | 69.0 | 0.0 | ±0.8 |
| 64.0 | 64.0 | 0.0 | ±0.8 |
| 59.0 | 59.0 | 0.0 | ±0.8 |
| 54.0 | 53.9 | -0.1 | ±0.8 |
| 49.0 | 49.0 | 0.0 | ±0.8 |
| 44.0 | 44.0 | 0.0 | ±0.8 |
| 39.0 | 38.9 | -0.1 | ±0.8 |
| 34.0 | 33.9 | -0.1 | ±0.8 |
| 30.0 | 29.9 | -0.1 | ±0.8 |
| 29.0 | 28.9 | -0.1 | ±0.8 |
| 28.0 | 27.9 | -0.1 | ±0.8 |
| 27.0 | 26.9 | -0.1 | ±0.8 |
| 26.0 | 25.9 | -0.1 | ±0.8 |
| 25.0 | 24.9 | -0.1 | ±0.8 |

**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 | ±0.8 |

**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 | 136.1 | -0.3 | ±2.0 |

| 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 | ±1.0 |
| Negative half cycle | 135.4 | 135.2 | -0.2 | ±1.0 |

**11. Overload indication**

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

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**

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# CALIBRATION LABORATORY

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NSC-TISI-TIS 17025
CALIBRATION 0394



# Calibration Certificate

| | |
|---|---|
| **Equipment :** | SOUND LEVEL METER |
| **Manufacturer :** | RION |
| **Model :** | NL-52A / Microphone UC-59 / Preamplifier NH-25 |
| **Serial No.:** | 01120936 / 21737 / 22325 |
| **ID No.:** | - |
| **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 :** | 24 JANUARY 2023 |
| **Calibration Date :** | 26-30 JANUARY 2023 |
| **Date of Issue :** | 31 JANUARY 2023 |

REVIEW BY Wanakorn P.
APPROVED BY
NEXT CAL. DATE 26/1/24

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

( Thanakul Petchurai )

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# Continuation of Calibration Certificate

**Cert. No. : ACL23087**
**Job No. : VC66AC0030**
**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).

**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 | ✓ | - | 0.3 | 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 |

**Result of calibration :**

**1. Absolute sensitivity**

| Reference Acoustic Signal ( dB ) | Measured Value ( dB ) | Deviation ( dB ) | Acceptance Limit ( dB ) |
|---|---|---|---|
| 93.9 (93.95) | 94.0 | 0.0 | ±0.3 |

**2. Self-generated noise**

2.1 Normal test

| Measured Value ( dB ) |
|---|
| 13.4 |

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

| Frequency Weighting | Measured value ( dB ) |
|---|---|
| A - weight | 8.7 |
| C - weight | 14.4 |
| Flat | 19.9 |

**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 | 0.0 | 0.0 | 0.0 | ± 1.0 |
| 1000 | 0.0 | 0.0 | 0.0 | ± 0.7 |
| 8000 | -0.7 | -0.7 | -0.7 | + 1.5, - 2.5 |

**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 | ±1.0 |
| 125 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 250 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 500 | 0.0 | 0.0 | -0.1 | ±1.0 |
| 1000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 2000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 8000 | 0.0 | 0.0 | 0.0 | + 1.5, - 2.5 |
| 16000 | 0.0 | -1.3 | -1.2 | + 2.5, -16.0 |

**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 | ± 0.1 |

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

| Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|
| 137.0 | 137.1 | 0.1 | ±0.8 |
| 136.0 | 136.1 | 0.1 | ±0.8 |
| 135.0 | 135.1 | 0.1 | ±0.8 |
| 134.0 | 134.1 | 0.1 | ±0.8 |
| 133.0 | 133.1 | 0.1 | ±0.8 |
| 132.0 | 132.1 | 0.1 | ±0.8 |
| 131.0 | 131.0 | 0.0 | ±0.8 |
| 129.0 | 129.1 | 0.1 | ±0.8 |
| 124.0 | 124.0 | 0.0 | ±0.8 |
| 119.0 | 119.1 | 0.1 | ±0.8 |
| 114.0 | 114.0 | 0.0 | ±0.8 |
| 109.0 | 109.0 | 0.0 | ±0.8 |
| 104.0 | 104.1 | 0.1 | ±0.8 |
| 99.0 | 99.1 | 0.1 | ±0.8 |
| 94.0 | 94.0 | 0.0 | ±0.8 |
| 89.0 | 89.0 | 0.0 | ±0.8 |
| 84.0 | 84.0 | 0.0 | ±0.8 |
| 79.0 | 79.0 | 0.0 | ±0.8 |
| 74.0 | 74.0 | 0.0 | ±0.8 |
| 69.0 | 69.0 | 0.0 | ±0.8 |
| 64.0 | 64.0 | 0.0 | ±0.8 |
| 59.0 | 59.0 | 0.0 | ±0.8 |
| 54.0 | 54.0 | 0.0 | ±0.8 |
| 49.0 | 49.0 | 0.0 | ±0.8 |
| 44.0 | 44.0 | 0.0 | ±0.8 |
| 39.0 | 39.0 | 0.0 | ±0.8 |
| 34.0 | 34.0 | 0.0 | ±0.8 |
| 30.0 | 30.0 | 0.0 | ±0.8 |
| 29.0 | 28.9 | -0.1 | ±0.8 |
| 28.0 | 27.9 | -0.1 | ±0.8 |
| 27.0 | 27.0 | 0.0 | ±0.8 |
| 26.0 | 25.9 | -0.1 | ±0.8 |
| 25.0 | 24.9 | -0.1 | ±0.8 |

**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 | ±0.8 |

**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 | 136.3 | -0.1 | ±2.0 |

| 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 | ±1.0 |
| Negative half cycle | 135.4 | 135.2 | -0.2 | ±1.0 |

**11. Overload indication**

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

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**

# SITHIPORN ASSOCIATES CO.,LTD.
# CALIBRATION LABORATORY

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


NSC-TISI-TIS 17025
CALIBRATION 0394

**Cert. No. : ACL23078**
**Pages : 1 of 8**

# Calibration Certificate

| | |
|---|---|
| **Equipment :** | SOUND LEVEL METER |
| **Manufacturer :** | RION |
| **Model :** | NL-42/ Microphone UC-52 / Preamplifier NH-24 |
| **Serial No.:** | 00296515 / 179119 / 87526 |
| **ID No.:** | RYG_FS0432 |
| **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 :** | 24 JANUARY 2023 |
| **Calibration Date :** | 25-26 JANUARY 2023 |
| **Date of Issue :** | 27 JANUARY 2023 |

REVIEW BY Wnakorn P.
APPROVED BY
NEXT CAL. DATE 25/1/24

**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.

# Continuation of Calibration Certificate

**Cert. No. : ACL23078**
**Job No. : VC66AC0031**
**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).

**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 |

**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 ) |
|---|
| 14.6 |

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 | 17.7 |
| Flat | 23.4 |

**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 | 0.0 | 0.0 | 0.0 | ± 1.5 |
| 1000 | -0.1 | -0.1 | -0.1 | ± 1.0 |
| 8000 | -0.4 | -0.3 | -0.3 | ±5.0 |

**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 | 0.0 | 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 | 0.0 | ±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 |

**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 | 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 |

**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 | 136.2 | -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 | 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 |

**11. Overload indication**

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

# SITHIPORN ASSOCIATES CO.,LTD.
# CALIBRATION LABORATORY

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NSC-TISI-TIS 17025
CALIBRATION 0394

**Cert. No. : ACL23320**
**Pages : 1 of 8**

# Calibration Certificate

| | |
|---|---|
| **Equipment :** | SOUND LEVEL METER |
| **Manufacturer :** | RION |
| **Model :** | NL-42/ Microphone UC-52 / Preamplifier NH-24 |
| **Serial No.:** | 00597167 / 179118 / 87525 |
| **ID No.:** | RYG_FS0437 |

**Condition As Found :** GOOD

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

REVIEW BY Nanakorn P.
APPROVED BY
NEXT CAL. DATE 19/10/24

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

**Received Date :** 11 OCTOBER 2023
**Calibration Date :** 19-20 OCTOBER 2023
**Date of Issue :** 24 OCTOBER 2023

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

( Thanakul Petchurai )


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# Continuation of Calibration Certificate

**Cert. No. : ACL23320**
**Job No. : VC67AC0011**
**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-0009-23 | 07-FEB-24 |
| Waveform Generator | 33511B | MY52302742 | EF-0010-23 | 07-FEB-24 |
| Digital Multimeter | 33461A | MY53220104 | EEL.BP 30/0266 | 13-FEB-24 |
| Digital Multimeter | 33461A | MY53220076 | EEL.BP 29/0266 | 13-FEB-24 |
| Digital Multimeter | 34461A | MY60024273 | EEL.BP 31/0266 | 14-FEB-24 |
| Programmable Attenuator | MAT-1070 | 62100114 | EF-0011-23 | 08-FEB-24 |
| Condenser Microphone | 4180 | 2977900 | AA-1001-23 | 14-FEB-24 |
| Measuring Amplifier | NA-42KAI | 34560495 | AA-3002-23 | 14-FEB-24 |

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).

## Continuation of Calibration Certificate

**Cert. No. : ACL23320**
**Job No. : VC67AC0011**
**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 |

Note : Pass/Fail evaluation for each parameter,
will be considered together from the acceptance limit and the Maximum-permitted uncertainty of measurement.

**Result of calibration :**

## 1. Absolute sensitivity

| Reference Acoustic Signal ( dB ) | Measured Value ( dB ) | Deviation ( dB ) | Acceptance Limit ( dB ) |
|---|---|---|---|
| 93.9 (93.98) | 93.9 | 0.0 | ±0.3 |

## 2. Self-generated noise

2.1 Normal test

| Measured Value ( dB ) |
|---|
| 14.6 |

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

| Frequency Weighting | Measured value ( dB ) |
|---|---|
| A - weight | 11.2 |
| C - weight | 17.5 |
| Flat | 23.1 |

## 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 | 1.3 | 1.4 | 1.4 | ±5.0 |

**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 | -0.1 | ±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 | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| A - weight | 94.0 | 94.0 | 0.0 | ± 0.2 |
| C - weight | 94.0 | 94.0 | 0.0 | ± 0.2 |
| Flat | 94.0 | 94.0 | 0.0 | ± 0.2 |

5.2 Time weighting at 1 kHz

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

**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 | 63.9 | -0.1 | ± 1.1 |
| 59.0 | 59.0 | 0.0 | ± 1.1 |
| 54.0 | 53.9 | -0.1 | ± 1.1 |
| 49.0 | 48.9 | -0.1 | ± 1.1 |
| 44.0 | 43.9 | -0.1 | ± 1.1 |
| 39.0 | 38.9 | -0.1 | ± 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 | 24.9 | -0.1 | ± 1.1 |

**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 | 133.1 | 0.1 | ±3.0 |
| One | 136.4 | 136.1 | -0.3 | ±3.0 |

| Number of cycle in test signal | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|---|
| Continuous | 133.0 | 133.1 | 0.1 | ±2.0 |
| Positive half cycle | 135.4 | 135.2 | -0.2 | ±2.0 |
| Negative half cycle | 135.4 | 135.2 | -0.2 | ±2.0 |

**11. Overload indication**

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

# SITHIPORN ASSOCIATES CO.,LTD.
# CALIBRATION LABORATORY

451-451/1 Sirinthorn Rd.,Bangbumru, Bangplud Bangkok 10700 THAILAND.
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NSC-TISI-TIS 17025
CALIBRATION 0394

**Cert. No. : ACL23088**
**Pages : 1 of 8**

# Calibration Certificate

| | |
|---|---|
| **Equipment :** | SOUND LEVEL METER |
| **Manufacturer :** | RION |
| **Model :** | NL-52A / Microphone UC-59 / Preamplifier NH-25 |
| **Serial No.:** | 01120937 / 21845 / 22326 |
| **ID No.:** | - |
| **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 :** | 24 JANUARY 2023 |
| **Calibration Date :** | 26-30 JANUARY 2023 |
| **Date of Issue :** | 31 JANUARY 2023 |

REVIEW BY Nathakorn P
APPROVED BY
NEXT CAL. DATE 26/1/24

**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.

## Continuation of Calibration Certificate

**Cert. No. : ACL23088**
**Job No. : VC66AC0030**
**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).

**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 | ✓ | - | 0.3 | 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 |

Cert. No. : ACL23088
Job No. : VC66AC0030
Pages : 4 of 8

**Result of calibration :**

**1. Absolute sensitivity**

| Reference Acoustic Signal ( dB ) | Measured Value ( dB ) | Deviation ( dB ) | Acceptance Limit ( dB ) |
|---|---|---|---|
| 93.9 (93.95) | 94.0 | 0.0 | ±0.3 |

**2. Self-generated noise**

2.1 Normal test

| Measured Value ( dB ) |
|---|
| 14.6 |

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 | 14.9 |
| Flat | 20.4 |

**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 | 0.1 | 0.1 | 0.1 | ± 1.0 |
| 1000 | 0.2 | 0.2 | 0.2 | ± 0.7 |
| 8000 | -0.4 | -0.4 | -0.4 | + 1.5, - 2.5 |

**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 | ±1.0 |
| 125 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 250 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 500 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 1000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 2000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 8000 | 0.0 | 0.1 | 0.1 | + 1.5, - 2.5 |
| 16000 | 0.0 | -1.2 | -1.2 | + 2.5, -16.0 |

**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 | ± 0.1 |

**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 | ±0.8 |
| 136.0 | 136.0 | 0.0 | ±0.8 |
| 135.0 | 135.0 | 0.0 | ±0.8 |
| 134.0 | 134.0 | 0.0 | ±0.8 |
| 133.0 | 133.0 | 0.0 | ±0.8 |
| 132.0 | 132.0 | 0.0 | ±0.8 |
| 131.0 | 131.0 | 0.0 | ±0.8 |
| 129.0 | 129.0 | 0.0 | ±0.8 |
| 124.0 | 124.0 | 0.0 | ±0.8 |
| 119.0 | 119.0 | 0.0 | ±0.8 |
| 114.0 | 114.0 | 0.0 | ±0.8 |
| 109.0 | 109.0 | 0.0 | ±0.8 |
| 104.0 | 104.0 | 0.0 | ±0.8 |
| 99.0 | 99.0 | 0.0 | ±0.8 |
| 94.0 | 94.0 | 0.0 | ±0.8 |
| 89.0 | 89.0 | 0.0 | ±0.8 |
| 84.0 | 84.0 | 0.0 | ±0.8 |
| 79.0 | 79.0 | 0.0 | ±0.8 |
| 74.0 | 74.1 | 0.1 | ±0.8 |
| 69.0 | 69.0 | 0.0 | ±0.8 |
| 64.0 | 64.0 | 0.0 | ±0.8 |
| 59.0 | 59.0 | 0.0 | ±0.8 |
| 54.0 | 54.0 | 0.0 | ±0.8 |
| 49.0 | 49.0 | 0.0 | ±0.8 |
| 44.0 | 44.0 | 0.0 | ±0.8 |
| 39.0 | 39.0 | 0.0 | ±0.8 |
| 34.0 | 34.0 | 0.0 | ±0.8 |
| 30.0 | 30.0 | 0.0 | ±0.8 |
| 29.0 | 29.0 | 0.0 | ±0.8 |
| 28.0 | 28.0 | 0.0 | ±0.8 |
| 27.0 | 27.0 | 0.0 | ±0.8 |
| 26.0 | 26.0 | 0.0 | ±0.8 |
| 25.0 | 24.9 | -0.1 | ±0.8 |

**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 | ±0.8 |

**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 | 136.3 | -0.1 | ±2.0 |

| 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 | ±1.0 |
| Negative half cycle | 135.4 | 135.2 | -0.2 | ±1.0 |

**11. Overload indication**

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

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**

# SITHIPORN ASSOCIATES CO.,LTD.
# CALIBRATION LABORATORY

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NSC-TISI-TIS 17025
CALIBRATION 0394



# Calibration Certificate

| | |
|---|---|
| **Equipment :** | SOUND LEVEL METER |
| **Manufacturer :** | RION |
| **Model :** | NL-42/ Microphone UC-52 / Preamplifier NH-24 |
| **Serial No.:** | 00900074 / 188467 / 01736 |
| **ID No.:** | RYG_FS0495 |
| **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 :** | 06 JANUARY 2023 |
| **Calibration Date :** | 13-18 JANUARY 2023 |
| **Date of Issue :** | 19 JANUARY 2023 |

REVIEW BY Nanakorn P.
APPROVED BY
NEXT CAL. DATE 13/1/24

**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.

# Continuation of Calibration Certificate

**Cert. No. : ACL23045**
**Job No. : VC66AC0024**


**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).

**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 |

**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 | 9.9 |
| C - weight | 16.8 |
| Flat | 22.8 |

**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 | 0.4 | 0.4 | 0.4 | ± 1.5 |
| 1000 | 0.1 | 0.1 | 0.1 | ± 1.0 |
| 8000 | -2.0 | -1.9 | -1.9 | ±5.0 |

**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 | -0.1 | -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 |

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

| Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|
| 137.0 | 137.1 | 0.1 | ± 1.1 |
| 136.0 | 136.1 | 0.1 | ± 1.1 |
| 135.0 | 135.1 | 0.1 | ± 1.1 |
| 134.0 | 134.1 | 0.1 | ± 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 | 129.1 | 0.1 | ± 1.1 |
| 124.0 | 124.0 | 0.0 | ± 1.1 |
| 119.0 | 119.1 | 0.1 | ± 1.1 |
| 114.0 | 114.1 | 0.1 | ± 1.1 |
| 109.0 | 109.1 | 0.1 | ± 1.1 |
| 104.0 | 104.1 | 0.1 | ± 1.1 |
| 99.0 | 99.1 | 0.1 | ± 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 | 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 |

**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 |

**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**

# SITHIPORN ASSOCIATES CO.,LTD.
# CALIBRATION LABORATORY

451-451/1 Sirinthorn Rd.,Bangbumru, Bangplud Bangkok 10700 THAILAND.
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NSC-TISI-TIS 17025
CALIBRATION 0394

**Cert. No. : ACL23076**
**Pages : 1 of 8**

# Calibration Certificate

| | |
|---|---|
| **Equipment :** | SOUND LEVEL METER |
| **Manufacturer :** | RION |
| **Model :** | NL-52A / Microphone UC-59 / Preamplifier NH-25 |
| **Serial No.:** | 00920834 / 22194 / 22223 |
| **ID No.:** | - |
| **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 :** | 06 JANUARY 2023 |
| **Calibration Date :** | 23-24 JANUARY 2023 |
| **Date of Issue :** | 25 JANUARY 2023 |

REVIEW BY Nathakorn P.
APPROVED BY
NEXT CAL. DATE 23/1/24

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :** T. Petchurai.

( 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.

# Continuation of Calibration Certificate

**Cert. No. : ACL23076**
**Job No. : VC66AC0029**
**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).

## Continuation of Calibration Certificate

**Cert. No. : ACL23076**
**Job No. : VC66AC0029**
**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 | ✓ | - | 0.3 | 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 |

**Result of calibration :**

**1. Absolute sensitivity**

| Reference Acoustic Signal ( dB ) | Measured Value ( dB ) | Deviation ( dB ) | Acceptance Limit ( dB ) |
|---|---|---|---|
| 93.9 (93.95) | 94.0 | 0.0 | ±0.3 |

**2. Self-generated noise**

2.1 Normal test

| Measured Value ( dB ) |
|---|
| 13.4 |

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

| Frequency Weighting | Measured value ( dB ) |
|---|---|
| A - weight | 8.7 |
| C - weight | 14.6 |
| Flat | 20.2 |

**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 | 0.1 | 0.1 | 0.1 | ± 1.0 |
| 1000 | 0.2 | 0.2 | 0.2 | ± 0.7 |
| 8000 | -0.2 | -0.1 | -0.1 | + 1.5, - 2.5 |

**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 | ±1.0 |
| 125 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 250 | 0.0 | 0.0 | -0.1 | ±1.0 |
| 500 | 0.0 | 0.0 | -0.1 | ±1.0 |
| 1000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 2000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 8000 | 0.0 | 0.0 | 0.0 | + 1.5, - 2.5 |
| 16000 | 0.0 | -1.3 | -1.2 | + 2.5, -16.0 |

**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 | ± 0.1 |

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

| Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|---|---|---|---|
| 137.0 | 137.1 | 0.1 | ±0.8 |
| 136.0 | 136.1 | 0.1 | ±0.8 |
| 135.0 | 135.1 | 0.1 | ±0.8 |
| 134.0 | 134.1 | 0.1 | ±0.8 |
| 133.0 | 133.0 | 0.0 | ±0.8 |
| 132.0 | 132.0 | 0.0 | ±0.8 |
| 131.0 | 131.0 | 0.0 | ±0.8 |
| 129.0 | 129.0 | 0.0 | ±0.8 |
| 124.0 | 124.0 | 0.0 | ±0.8 |
| 119.0 | 119.1 | 0.1 | ±0.8 |
| 114.0 | 114.0 | 0.0 | ±0.8 |
| 109.0 | 109.0 | 0.0 | ±0.8 |
| 104.0 | 104.1 | 0.1 | ±0.8 |
| 99.0 | 99.0 | 0.0 | ±0.8 |
| 94.0 | 94.0 | 0.0 | ±0.8 |
| 89.0 | 89.0 | 0.0 | ±0.8 |
| 84.0 | 84.0 | 0.0 | ±0.8 |
| 79.0 | 79.0 | 0.0 | ±0.8 |
| 74.0 | 74.0 | 0.0 | ±0.8 |
| 69.0 | 69.0 | 0.0 | ±0.8 |
| 64.0 | 64.0 | 0.0 | ±0.8 |
| 59.0 | 59.0 | 0.0 | ±0.8 |
| 54.0 | 54.0 | 0.0 | ±0.8 |
| 49.0 | 49.0 | 0.0 | ±0.8 |
| 44.0 | 44.0 | 0.0 | ±0.8 |
| 39.0 | 39.0 | 0.0 | ±0.8 |
| 34.0 | 34.0 | 0.0 | ±0.8 |
| 30.0 | 30.0 | 0.0 | ±0.8 |
| 29.0 | 29.0 | 0.0 | ±0.8 |
| 28.0 | 28.0 | 0.0 | ±0.8 |
| 27.0 | 27.0 | 0.0 | ±0.8 |
| 26.0 | 26.0 | 0.0 | ±0.8 |
| 25.0 | 25.0 | 0.0 | ±0.8 |

**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 | ±0.8 |

**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 | 136.3 | -0.1 | ±2.0 |

| 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 | ±1.0 |
| Negative half cycle | 135.4 | 135.2 | -0.2 | ±1.0 |

**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 | ±0.1 |

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**

# SITHIPORN ASSOCIATES CO.,LTD.
# CALIBRATION LABORATORY

451-451/1 Sirinthorn Rd.,Bangbumru, Bangplud Bangkok 10700 THAILAND.
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NSC-TISI-TIS 17025
CALIBRATION 0394



# Calibration Certificate

| | |
|---|---|
| **Equipment :** | SOUND LEVEL METER |
| **Manufacturer :** | RION |
| **Model :** | NL-42/ Microphone UC-52 / Preamplifier NH-24 |
| **Serial No.:** | 00296516 / 180412 / 88182 |
| **ID No.:** | RYG_FS0433 |
| **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 :** | 24 JANUARY 2023 |
| **Calibration Date :** | 25-26 JANUARY 2023 |
| **Date of Issue :** | 27 JANUARY 2023 |

REVIEW BY Nnakorn P.
APPROVED BY
NEXT CAL. DATE 25/1/24

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :** T. Petchurai

( 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.

# Continuation of Calibration Certificate

**Cert. No. : ACL23079**
**Job No. : VC66AC0031**


**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).

**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 |

**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 | 0.0 | 0.1 | 0.1 | ± 1.5 |
| 1000 | -0.1 | -0.1 | -0.1 | ± 1.0 |
| 8000 | 0.4 | 0.5 | 0.4 | ±5.0 |

**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 | 0.0 | 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 |

**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 | 38.9 | -0.1 | ± 1.1 |
| 34.0 | 33.9 | -0.1 | ± 1.1 |
| 30.0 | 29.8 | -0.2 | ± 1.1 |
| 29.0 | 28.8 | -0.2 | ± 1.1 |
| 28.0 | 27.8 | -0.2 | ± 1.1 |
| 27.0 | 26.9 | -0.1 | ± 1.1 |
| 26.0 | 25.8 | -0.2 | ± 1.1 |
| 25.0 | 24.8 | -0.2 | ± 1.1 |

**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 | 128.0 | 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 | 136.3 | -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 |

**11. Overload indication**

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

# SITHIPORN ASSOCIATES CO.,LTD.
# CALIBRATION LABORATORY

451-451/1 Sirinthorn Rd.,Bangbumru, Bangplud Bangkok 10700 THAILAND.
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NSC-TISI-TIS 17025
CALIBRATION 0394

**Cert. No. : ACL23074**
**Pages : 1 of 8**

# Calibration Certificate

| | |
|---|---|
| **Equipment :** | SOUND LEVEL METER |
| **Manufacturer :** | RION |
| **Model :** | NL-52A / Microphone UC-59 / Preamplifier NH-25 |
| **Serial No.:** | 00920832 / 22192 / 22221 |
| **ID No.:** | - |
| **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 :** | 06 JANUARY 2023 |
| **Calibration Date :** | 23-24 JANUARY 2023 |
| **Date of Issue :** | 25 JANUARY 2023 |

REVIEW BY Nathakorn P.
APPROVED BY
NEXT CAL. DATE 23/1/24

**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.

# Continuation of Calibration Certificate

**Cert. No. : ACL23074**
**Job No. : VC66AC0029**


**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).

**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 | ✓ | - | 0.3 | 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 |

**Result of calibration :**

**1. Absolute sensitivity**

| Reference Acoustic Signal ( dB ) | Measured Value ( dB ) | Deviation ( dB ) | Acceptance Limit ( dB ) |
|---|---|---|---|
| 93.9 (93.95) | 94.0 | 0.0 | ±0.3 |

**2. Self-generated noise**

2.1 Normal test

| Measured Value ( dB ) |
|---|
| 14.3 |

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

| Frequency Weighting | Measured value ( dB ) |
|---|---|
| A - weight | 8.7 |
| C - weight | 14.3 |
| Flat | 19.9 |

**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 | 0.0 | 0.0 | 0.0 | ± 1.0 |
| 1000 | 0.1 | 0.1 | 0.1 | ± 0.7 |
| 8000 | -0.5 | -0.5 | -0.4 | + 1.5, - 2.5 |

**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 | ±1.0 |
| 125 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 250 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 500 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 1000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 2000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 8000 | 0.0 | 0.1 | 0.1 | + 1.5, - 2.5 |
| 16000 | 0.0 | -1.2 | -1.2 | + 2.5, -16.0 |

**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 | ± 0.1 |

**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 | ±0.8 |
| 136.0 | 136.0 | 0.0 | ±0.8 |
| 135.0 | 135.0 | 0.0 | ±0.8 |
| 134.0 | 134.0 | 0.0 | ±0.8 |
| 133.0 | 133.0 | 0.0 | ±0.8 |
| 132.0 | 132.0 | 0.0 | ±0.8 |
| 131.0 | 131.0 | 0.0 | ±0.8 |
| 129.0 | 129.0 | 0.0 | ±0.8 |
| 124.0 | 124.0 | 0.0 | ±0.8 |
| 119.0 | 119.0 | 0.0 | ±0.8 |
| 114.0 | 114.0 | 0.0 | ±0.8 |
| 109.0 | 109.0 | 0.0 | ±0.8 |
| 104.0 | 104.0 | 0.0 | ±0.8 |
| 99.0 | 99.0 | 0.0 | ±0.8 |
| 94.0 | 94.0 | 0.0 | ±0.8 |
| 89.0 | 89.0 | 0.0 | ±0.8 |
| 84.0 | 84.0 | 0.0 | ±0.8 |
| 79.0 | 79.0 | 0.0 | ±0.8 |
| 74.0 | 74.0 | 0.0 | ±0.8 |
| 69.0 | 69.0 | 0.0 | ±0.8 |
| 64.0 | 64.0 | 0.0 | ±0.8 |
| 59.0 | 59.0 | 0.0 | ±0.8 |
| 54.0 | 53.9 | -0.1 | ±0.8 |
| 49.0 | 49.0 | 0.0 | ±0.8 |
| 44.0 | 44.0 | 0.0 | ±0.8 |
| 39.0 | 39.0 | 0.0 | ±0.8 |
| 34.0 | 33.9 | -0.1 | ±0.8 |
| 30.0 | 29.9 | -0.1 | ±0.8 |
| 29.0 | 28.9 | -0.1 | ±0.8 |
| 28.0 | 27.9 | -0.1 | ±0.8 |
| 27.0 | 27.0 | 0.0 | ±0.8 |
| 26.0 | 25.9 | -0.1 | ±0.8 |
| 25.0 | 24.9 | -0.1 | ±0.8 |

**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 | ±0.8 |

**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 | 136.0 | -0.4 | ±2.0 |

| 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 | ±1.0 |
| Negative half cycle | 135.4 | 135.2 | -0.2 | ±1.0 |

**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 | ±0.1 |

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**

# SITHIPORN ASSOCIATES CO.,LTD.
# CALIBRATION LABORATORY

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NSC-TISI-TIS 17025
CALIBRATION 0394

**Cert. No. : ACL23089**
**Pages : 1 of 8**

# Calibration Certificate

| | | |
|---|---|---|
| **Equipment :** | SOUND LEVEL METER | |
| **Manufacturer :** | RION | |
| **Model :** | NL-52A / Microphone UC-59 / Preamplifier NH-25 | |
| **Serial No.:** | 01120938 / 21888 / 22327 | |
| **ID No.:** | - | |
| **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 :** | 24 JANUARY 2023 | |
| **Calibration Date :** | 26-30 JANUARY 2023 | |
| **Date of Issue :** | 31 JANUARY 2023 | |

REVIEW BY Nanakorn P.
APPROVED BY
NEXT CAL. DATE 26/1/24

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :** T. Petchurai

( 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.

# Continuation of Calibration Certificate

**Cert. No. : ACL23089**
**Job No. : VC66AC0030**
**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).

**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 | ✓ | - | 0.3 | 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 |

**Result of calibration :**

**1. Absolute sensitivity**

| Reference Acoustic Signal ( dB ) | Measured Value ( dB ) | Deviation ( dB ) | Acceptance Limit ( dB ) |
|---|---|---|---|
| 93.9 (93.95) | 94.0 | 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 | 9.9 |
| C - weight | 15.1 |
| Flat | 20.7 |

**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 | 0.0 | 0.0 | 0.0 | ± 1.0 |
| 1000 | 0.1 | 0.1 | 0.1 | ± 0.7 |
| 8000 | 0.0 | 0.0 | 0.0 | + 1.5, - 2.5 |

**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 | ±1.0 |
| 125 | 0.1 | 0.1 | 0.0 | ±1.0 |
| 250 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 500 | 0.0 | 0.1 | 0.0 | ±1.0 |
| 1000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 2000 | 0.0 | 0.1 | 0.0 | ±1.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 8000 | 0.0 | 0.1 | 0.1 | + 1.5, - 2.5 |
| 16000 | 0.0 | -1.2 | -1.2 | + 2.5, -16.0 |

**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 | ± 0.1 |

**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 | ±0.8 |
| 136.0 | 136.0 | 0.0 | ±0.8 |
| 135.0 | 135.0 | 0.0 | ±0.8 |
| 134.0 | 134.0 | 0.0 | ±0.8 |
| 133.0 | 133.0 | 0.0 | ±0.8 |
| 132.0 | 132.0 | 0.0 | ±0.8 |
| 131.0 | 131.0 | 0.0 | ±0.8 |
| 129.0 | 129.0 | 0.0 | ±0.8 |
| 124.0 | 124.0 | 0.0 | ±0.8 |
| 119.0 | 119.0 | 0.0 | ±0.8 |
| 114.0 | 114.0 | 0.0 | ±0.8 |
| 109.0 | 109.0 | 0.0 | ±0.8 |
| 104.0 | 104.0 | 0.0 | ±0.8 |
| 99.0 | 99.0 | 0.0 | ±0.8 |
| 94.0 | 94.0 | 0.0 | ±0.8 |
| 89.0 | 89.0 | 0.0 | ±0.8 |
| 84.0 | 84.0 | 0.0 | ±0.8 |
| 79.0 | 79.0 | 0.0 | ±0.8 |
| 74.0 | 74.0 | 0.0 | ±0.8 |
| 69.0 | 69.0 | 0.0 | ±0.8 |
| 64.0 | 64.0 | 0.0 | ±0.8 |
| 59.0 | 59.0 | 0.0 | ±0.8 |
| 54.0 | 54.0 | 0.0 | ±0.8 |
| 49.0 | 49.0 | 0.0 | ±0.8 |
| 44.0 | 44.0 | 0.0 | ±0.8 |
| 39.0 | 39.0 | 0.0 | ±0.8 |
| 34.0 | 34.0 | 0.0 | ±0.8 |
| 30.0 | 29.9 | -0.1 | ±0.8 |
| 29.0 | 28.9 | -0.1 | ±0.8 |
| 28.0 | 27.9 | -0.1 | ±0.8 |
| 27.0 | 26.9 | -0.1 | ±0.8 |
| 26.0 | 25.9 | -0.1 | ±0.8 |
| 25.0 | 24.9 | -0.1 | ±0.8 |

**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 | ±0.8 |

**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 | 99.0 | 0.0 | 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 | 135.4 | -1.0 | ±2.0 |

| 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 | ±1.0 |
| Negative half cycle | 135.4 | 135.1 | -0.3 | ±1.0 |

**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 | ±0.1 |

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**

DKSH

NSC-TISI-TIS 17025
Calibration 0087

# Certificate of Calibration

| | | | |
|---|---|---|---|
| **Equipment:** | SPECTROPHOTOMETER | Certificate No.: | C06220464 |
| Model: | DR6000 | Issued Date: | 27 September 2022 |
| Serial No. (or ID.): | 1627845 (RYG_EN0037) | Job No.: | KSPR2212224 |
| Manufacturer: | HACH | Page: | 1 of 3 |
| Condition: | In Condition | | |

**Customer:** ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)
616/10 Moo 5 T.Maenam Khu,
A.Pluakdaeng, Rayong 21140, Thailand.

REVIEW BY N.Bamrat
APPROVED BY D.
NEXT CAL. DATE 27/3/24

| | | | | | | |
|---|---|---|---|---|---|---|
| **Environment Condition:** | Temperature | 23.1 | °C | ± | 0.6 | °C |
| | Humidity | 65.4 | %RH | ± | 3.2 | %RH |

**Calibration Place:** ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch) ( Wet Chemistry )
616/10 Moo 5 T.Maenam Khu,
A.Pluakdaeng, Rayong 21140, Thailand.

**Calibration By:** Mr. Chattuphon Foithong

**Calibration Date:** 27 September 2022

**The Method used:** In house method, CAL-WI-24, base on ASTM E 275-08 and ASTM E 387-04

**Traceability:** This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Starna Scientific Limited.

The standard for Wavelength Certificate No. 91418 and 91435
The standard for Photometric Certificate No. 91441 and 101088
The standard for Stray light Certificate No. 101041 and 101040
The standard for Spectral resolution Certificate No. 101037

(Mr. Chattuphon Foithong)
Person in charge

(Mr. Thalerngkeat Poungngam)
Authorized signatory

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

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

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

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2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

## Calibration Results:

### Without Adjustment

**Wavelength Accuracy (nm), The spectral bandwidth of Std at 2 nm and UUC at 2 nm**

| Standard Wavelength | Unit Under Calibration | Correction | Uncertainty |
|---|---|---|---|
| 418.61 | 418.4 | 0.21 | 0.14 |
| 536.66 | 536.7 | -0.04 | 0.14 |
| 637.98 | 638.3 | -0.32 | 0.14 |
| 748.48 | 748.8 | -0.32 | 0.14 |
| 807.03 | 807.4 | -0.37 | 0.13 |

**Photometric Accuracy (Absorbance)**

| Wavelength | Standard absorbance | Unit Under Calibration | Correction | Uncertainty |
|---|---|---|---|---|
| 420 nm | 0.0000 | 0.000 | 0.0000 | 0.0045 |
| | 0.5605 | 0.563 | -0.0025 | 0.0045 |
| | 0.7334 | 0.737 | -0.0036 | 0.0045 |
| | 1.0534 | 1.057 | -0.0036 | 0.0045 |
| 440 nm | 0.0000 | 0.000 | 0.0000 | 0.0045 |
| | 0.5503 | 0.553 | -0.0027 | 0.0045 |
| | 0.7179 | 0.720 | -0.0021 | 0.0045 |
| | 1.0312 | 1.034 | -0.0028 | 0.0045 |
| 465 nm | 0.0000 | 0.000 | 0.0000 | 0.0045 |
| | 0.5024 | 0.506 | -0.0036 | 0.0045 |
| | 0.6693 | 0.672 | -0.0027 | 0.0045 |
| | 0.9604 | 0.964 | -0.0036 | 0.0045 |
| 546.1 nm | 0.0000 | 0.000 | 0.0000 | 0.0045 |
| | 0.5168 | 0.519 | -0.0022 | 0.0045 |
| | 0.6903 | 0.691 | -0.0007 | 0.0045 |
| | 0.9904 | 0.992 | -0.0016 | 0.0045 |
| 590 nm | 0.0000 | 0.000 | 0.0000 | 0.0045 |
| | 0.5525 | 0.554 | -0.0015 | 0.0045 |
| | 0.7175 | 0.718 | -0.0005 | 0.0045 |
| | 1.0301 | 1.031 | -0.0009 | 0.0045 |
| 635 nm | 0.0000 | 0.000 | 0.0000 | 0.0045 |
| | 0.5367 | 0.538 | -0.0013 | 0.0045 |
| | 0.6847 | 0.685 | -0.0003 | 0.0046 |
| | 0.9823 | 0.983 | -0.0007 | 0.0045 |

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

## Calibration Results:

### Without Adjustment

**Photometric Accuracy (Absorbance)**

| Wavelength | Standard absorbance | Unit Under Calibration | Correction | Uncertainty |
|---|---|---|---|---|
| 235 nm | 0.0000 | 0.000 | 0.0000 | 0.0080 |
| | 0.7423 | 0.744 | -0.0017 | 0.0083 |
| 257 nm | 0.0000 | 0.000 | 0.0000 | 0.0080 |
| | 0.8609 | 0.861 | -0.0001 | 0.0084 |
| 313 nm | 0.0000 | 0.000 | 0.0000 | 0.0080 |
| | 0.2895 | 0.292 | -0.0025 | 0.0080 |
| 350 nm | 0.0000 | 0.000 | 0.0000 | 0.0080 |
| | 0.6381 | 0.638 | 0.0001 | 0.0080 |

**Stray light ***

| Standard: cut-off | UUC: Wavelength (nm) | UUC: Transmission (%T) | Absorbance ( A) |
|---|---|---|---|
| 260.67 +/- 0.11 nm | 260.7 | 2.1 | 1.678 |
| 391.94 +/- 0.11 nm | 391.9 | 1.7 | 1.770 |

**Spectral Resolution ***

| Nominal Concentration 0.02 % v/v | Peak | Trough | Ratio | SBW |
|---|---|---|---|---|
| Standard Wavelength ( nm ) | 268.60 | 266.63 | 1.39 | 2.00 |
| UUC: Wavelength (nm) | 268.2 | 266.1 | | |
| Std Absorbance ( A) | 0.4810 | 0.3176 | | |
| Absorbance ( A) | 0.373 | 0.268 | | |

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

**The End of Certificate**

บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด
DKSH Technology Limited
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# ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2212224

ชนิดเครื่องมือ: SPECTROPHOTOMETER รุ่น: DR6000 หมายเลขเครื่อง: 1627845

| ตรวจสอบ (รับ) 27 Sep 2022 | | รายการตรวจเช็ค | ตรวจสอบ (ส่ง) 27 Sep 2022 | | หมายเหตุ |
|---|---|---|---|---|---|
| ปกติ | ไม่ปกติ | | ปกติ | ไม่ปกติ | |
| | | ***General*** | | | |
| ☑ | ☐ | 1. ความสมบูรณ์เครื่อง | ☑ | ☐ | |
| ☑ | ☐ | 2. ความสะอาด ( ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง) | ☑ | ☐ | |
| ☑ | ☐ | 3. สวิทช์ ปิด – เปิด เครื่อง (On-Off Swicth) | ☑ | ☐ | |
| ☑ | ☐ | 4. ปุ่มกด (Keypad) | ☑ | ☐ | |
| ☑ | ☐ | 5. หน้าจอ (Display, Screen Contrast) | ☑ | ☐ | |
| | | ***Spectrophotometer*** | | | |
| ☐ | ☐ | 6. แรงดันไฟฟ้า (Battery Backup) >= 2.5 VDC | ☐ | ☐ | |
| ☐ | ☐ | 7. ตัวหมุนเลือกความยาวคลื่น (Wavelength Control) | ☐ | ☐ | |
| ☑ | ☐ | 8. ความยาวคลื่น (Wavelength Check) | ☑ | ☐ | 656.1 ได้ 656.1 nm |
| ☑ | ☐ | 9. แหล่งกำเนิดแสง (UV < 3,000 hour) | ☑ | ☐ | |
| ☑ | ☐ | 10. แหล่งกำเนิดแสง (Visible < 5,000 hour) | ☑ | ☐ | |
| ☑ | ☐ | 11. ช่องวัดหลายตัวอย่าง (Carousel Module) | ☑ | ☐ | |
| | | ***pH Meter and Conductivity Meter*** | | | |
| ☐ | ☐ | 12. อิเล็คโทรด ( Electrode and Connection Cable ) | ☐ | ☐ | |
| ☐ | ☐ | 13. ระดับสารละลายใน Electrode (Level KCl ) | ☐ | ☐ | |
| ☐ | ☐ | 14. ฝาปิดกันปลาย Electrode (Dust Protection Hood) | ☐ | ☐ | |
| ☐ | ☐ | 15. ขาจับอิเล็คโทรด (Stand) | ☐ | ☐ | |
| | | ***Turbidimeter*** | | | |
| ☐ | ☐ | 16. ค่าความขุ่นที่ต่ำสุด (No Sample) | ☐ | ☐ | |
| ☐ | ☐ | 17. ระดับการส่องสว่างของแสง (>= 2.5 ไม่เกิน 3.0) | ☐ | ☐ | |
| | | ***Automatic titrator*** | | | |
| ☐ | ☐ | 18. สภาพ Piston Burettes | ☐ | ☐ | |
| ☐ | ☐ | 19. Function Rinsing and Dosing | ☐ | ☐ | |
| ☐ | ☐ | 20. ระบบท่อสายยางและอุปกรณ์ประกอบ | ☐ | ☐ | |

เพิ่มเติม/ข้อแนะนำ : _____

Mr. Chattuphon Foithong

Service Engineer

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

NSC-TISI-TIS17025
CALIBRATION 0008

**Cert.No.:** 22CH1733
**Page.:** 1 of 3

# Certificate of Calibration

| | |
|---|---|
| **Equipment :** | pH Meter |
| **Manufacturer :** | Mettler Toledo |
| **Model :** | SevenExcellence |
| **Serial No. :** | B834291445 |
| **ID No. :** | RYG_EN0152 |
| **Condition As-Received:** | Used Item |
| **Received Date :** | 21 December 2022 |
| **Calibration Date :** | 22 December 2022 |
| **Reference :** | 2212-0602DSC-1 |
| **Submitted by :** | ALS Laboratory Group (Thailand) Co.,Ltd.<br>Rayong Branch<br>616/10 Moo 5 T.Maenam Khu,<br>A.Pluakdaeng, Rayong 21140, Thailand |
| **Ambient Temperature :** | (25 ± 2.5) °C |
| **Relative Humidity :** | (50 ± 15) % |
| **Calibration Procedure :** | In - house method :<br>- CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)<br>- CP-CH8 by comparison with standard thermometer |

REVIEW BY .....
APPROVED BY .....
NEXT CAL. DATE 22/12/23 ~~22/06/24~~

**Calibrated by :** Warakorn Lerngagtrakul

**Approved by :** .....
Approved Signatory

(✓) Malee Butkruea
( ) Saithip Meangmai
( ) Warakorn Lerngagtrakul

**Issue Date :** 26 December 2022

**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.

**Condition of this calibration result**

1. Reference Standard Instrument : -

| Instrument | Serial No. | ID No. | Cert. No. | Due Date |
|---|---|---|---|---|
| 1) Document Process Calibrator | 54030049 | 130RC116 | 22E2769 | 24 Aug 2023 |
| 2) Ref. Standard Thermometer | 4982054 | 110RC044 | 22I1306 | 27 Oct 2023 |

This certification is traceable to the International System of Unit maintained at:-
- Traceable to National Institute of Metrology (Thailand), NIMT

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

| Buffer Solution | Manufacturer | Lot No. | Exp. date |
|---|---|---|---|
| pH 4.008 | CPA chem | 826588 | 09 July 2024 |
| pH 6.987 | CPA chem | 823322 | 20 June 2023 |
| pH 10.008 | CPA chem | 826590 | 09 July 2023 |

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

**Calibration Results**

**Function : mV Measurement**

**Performing standard curve by Fluke at pH (4,7,10)**

| Unit Under Calibration | Nominal Value | Standard Voltage Input | Actual Reading | | Uncertainty of Measurement ( ±mV ) | Coverage factor *k* |
|---|---|---|---|---|---|---|
| | pH | mV | mV | pH | | |
| pH Meter | 4.000 | 177.48 | 177.3 | 4.000 | 0.058 | 2.00 |
| S/N.: B834291445 | 7.000 | 0.00 | -0.1 | 7.000 | 0.058 | 2.00 |
| | 10.000 | -177.48 | -177.5 | 10.000 | 0.058 | 2.00 |

Malu

**Calibration Results**

**Function : pH Measurement**

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

| Unit Under Calibration | Standard pH Buffer Solution | Actual pH Reading | Actual mV Reading ( mV ) | Uncertainty of pH measurement ( ± ) | Coverage factor *k* |
|---|---|---|---|---|---|
| pH Electrode | 4.008 | 4.011 | 185.2 | 0.0052 | 2.06 |
| S/N.: 1475518 | 6.987 | 6.990 | 10.4 | 0.0088 | 2.00 |
| | 10.008 | 10.014 | -166.5 | 0.0072 | 2.00 |

**Function : Temperature Measurement**

**( * ) Without adjustment**

This equipment was connected with Temperature Probe;

- Model : InLab Expert Pro-ISM
- Serial No. : 1475518

Dimension of probe;

- Length : 120 mm.
- Diameter : 12 mm.
- Immersion Depth : 100 mm.

| Calibration Point ( °C ) | Standard Temperature ( °C ) | UUC* Reading ( °C ) | Error ( °C ) | Uncertainty of measurement ( ± °C ) | Coverage factor *k* |
|---|---|---|---|---|---|
| 25.0 | 25.001 | 24.9 | -0.101 | 0.13 | 2.00 |

**Remark : - UUC* = Unit Under Calibration**

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

**-o0o-**

Malu.

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
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TEL. 0-2717-3000-24 FAX. 0-2719-9484

NSC-TISI-TIS17025
CALIBRATION 0008

# Certificate of Calibration

**Certificate No. :** 22E4098
**Page :** 1 of 2

| | |
|---|---|
| **Equipment :** | pH Meter |
| **Manufacturer:** | Mettler Toledo |
| **Model :** | SevenExcellence |
| **Serial No.:** | B834291445 |
| **ID No.:** | RYG_EN0152 |
| **Condition As-Received:** | Used Item |
| **Received Date:** | 21 December 2022 |
| **Calibration Date:** | 23 December 2022 |
| **Reference:** | 2212-0602DSC |
| **Ambient Temperature:** | ( 23 ± 2 ) °C |
| **Relative Humidity:** | ( 50 ± 10 ) % |

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.

**Submitted by:** ALS Laboratory Group (Thailand) Co.,Ltd. Rayong Branch
616/10 Moo 5, T.Maenam Khu, A.Pluakdaeng,
Rayong 21140, Thailand

**Procedure used:** Calibration were conducted using In-house calibration Procedure CP-E17 According to direct measurement method with Multi-Product Calibrator.

**Condition of this result of calibration**

1.Reference standards instuments :

| Instrument | Model | Serial No. | Certificate No. | Due Date |
|---|---|---|---|---|
| 1) Multi-Product Calibrator | 5500A | 6315011 | 22E1431 | 05 May 2023 |

2.This result of calibration was made on requested at the point specified by customer.

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

4.This Certification is traceable to the International System of Unit maintained at:-

-National Institute of Metrology Thailand (NIMT)

**Calibrated by :** Wutchareeporn Wongchutikrane
**Issue Date :** 26 December 2022

**Approved Signatory :**
[✓] Phalinee Prabpaipal
[ ] Nuntawat Khamchai
[ ] Pornthippa Tameyakul

B 0304803

**Result of calibration :-** (*) Without adjustment ( ) After adjustment

**Function:** DC voltage measuremer **Range:** 2000 mV

| Standard Value ( mV ) | UUC* Reading ( mV ) | Error ( mV ) | Uncertainty ( ± μV ) |
|---|---|---|---|
| -200.0000 | -200.0 | 0.0 | 72 |
| -150.0000 | -150.0 | 0.0 | 69 |
| -100.0000 | -100.0 | 0.0 | 65 |
| -50.0000 | -50.0 | 0.0 | 62 |
| 0.0000 | 0.0 | 0.0 | 58 |
| 50.0000 | 50.0 | 0.0 | 62 |
| 100.0000 | 100.0 | 0.0 | 65 |
| 150.0000 | 150.0 | 0.0 | 69 |
| 200.0000 | 199.9 | -0.1 | 72 |

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

***UUC= Unit Under Calibration.**

**-o0o-**

# Metrological Center

SCI ECO Services Company Limited

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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.com


NSC-TISI-TIS 17025
CALIBRATION 0244

**Certificate No. T230116**



# Certificate of Calibration

| | | |
|---|---|---|
| Equipment | : | Chamber ( Cooling Room ) |
| Manufacturer | : | MODULAR |
| Model | : | IREVCOHCOO |
| Serial No. | : | C00351459 |
| Customer Code | : | RYG_EN0184 |
| ID No. | : | T1939A5 |
| Customer | : | ALS Laboratory Group (Thailand) Co.,Ltd. ( Rayong Branch)<br>616/10 Moo 5 T.Maenam Khu,<br>A.Pluakdaeng, Rayong 21140 |
| Customer Location | : | Laboratory |
| Date of Receipt | : | 23 January 2023 |
| Calibrated By | : | Atiphong Rongrat ( Technician ) |
| Approved By | : | _____ / Boonchai Suriyawong (Site Calibration Manager) |
| Date of Issue | : | 07 FEB 2023 |

REVIEW BY .....
APPROVED BY .....
NEXT CAL. DATE 25/07/24.

**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.**

**Certificate No. T230116**



# Calibration Report

**Equipment** : **Chamber ( Cooling Room )**
**Date of Calibration** : **25 January 2023**
**Environment** : **Temperature : 23.4-24.9 °C**
**Line Voltage : 221.4-230.2 V**
**Relative Humidity : 55 - 65 %RH**

**Condition of this results of calibration :**

1. Thisequipment was calibrated by insert 16 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 | TN141-TN150 | T222123 | 5 October 2023 |
| TC | TYPE T | TN151-TN160 | T222123 | 5 October 2023 |
| DATA LOGGER | 34970A | T150 | T222123 | 5 October 2023 |

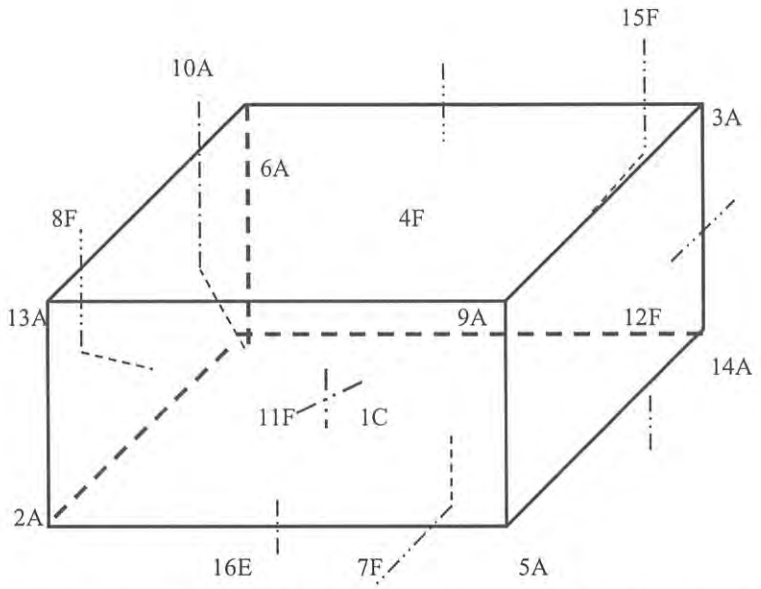
3. This certificate is traceable to :
   National Institute of Metrology ( Thailand ) through Metrological Center ( NSC-TISI-TIS 17025 CALIBRATION 0244.)
4. Condition of calibrated item : good
   Equipment Description :
   Time Constant 1 Hour - Minute At 3 °C
   Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
   ☐ Close
   ☒ Not Available
5. Adjustment :
   ( X ) without adjustment ( ) after adjustment

**Approved By.** _____

**Certificate No. T230116**



# Calibration Report




C = Centre , F = Centre of Face , A = Corner , E = Centre of Edge

| | | |
|---|---|---|
| 1C | = TN141 | |
| 2A | = TN142 | |
| 3A | = TN143 | |
| 4F | = TN144 | |
| 5A | = TN145 | |
| 6A | = TN146 | |
| 7F | = TN147 | |
| 8F | = TN148 | |
| 9A | = TN149 | |
| 10A | = TN150 | |
| 11F | = TN151 | |

| | |
|---|---|
| 12F | = TN152 |
| 13A | = TN153 |
| 14A | = TN154 |
| 15F | = TN155 |
| 16E | = TN156 |

**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. T230116**



# Calibration Report

## Measurement Results

| | Average Standard Reading at each position (°C) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Calibration Point** | **TN141** | **TN142** | **TN143** | **TN144** | **TN145** | **TN146** | **TN147** | **TN148** | **TN149** | **TN150** | **TN151** | **TN152** |
| **3.0** | 3.03 | 3.16 | 3.15 | 3.19 | 3.45 | 3.47 | 3.21 | 3.35 | 3.54 | 3.45 | 3.24 | 3.34 |
| | **TN153** | **TN154** | **TN155** | **TN156** | | | | | | | | |
| | 3.28 | 3.22 | 3.28 | 3.21 | | | | | | | | |

| Chamber ( Cooling Room ) | | | Temperature Distribution | | | |
|---|---|---|---|---|---|---|
| Setting (°C) | Reading (°C) | | Stability (+°C) | Uniformity (°C) | Uncertainty (±°C) | Coverage Factor *k* |
| | Min , Max | Average | | | | |
| **3.0** | 2.8 , 4.1 | 3.5 | 1.20 | 1.20 | 1.90 | 2.07 |

**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.** _____

**TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)**

**CORPORATE SERVICES 3 : EQUIPMENT CALIBRATION AND TESTING SERVICES**

534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250

TEL. 0-2717-3000 FAX. 0-2719-9484



# Certificate of Testing

| | |
|---|---|
| **Equipment :** | DO Meter |
| **Manufacturer :** | YSI |
| **Model :** | 5000-115V |
| **Serial No. :** | 15E102796 |
| **ID No. :** | RYG_EN0032 |
| **Received Date :** | 21 July 2023 |
| **Test Date :** | 24 July 2023 |
| **Reference :** | 2307-0713DSC-1 |
| **Submitted by :** | ALS Laboratory Group (Thailand) Co.,Ltd.<br>Rayong Branch<br>616/10 Moo 5, T.Maenam Khu, A.Pluakdaeng,<br>Rayong 21140, Thailand |
| **Laboratory Condition :** | Temperature ( 25 ± 5 ) °C<br>Humidity (50 ± 20) % |
| **Test Procedure :** | In - house method : CP-CH9<br>by Comparison Technique with Azide Modification Method |
| **Tested by :** | Walalak Sirithean |
| **Approved by :** | Saithip<br>Approved Signatory |

REVIEW BY N.Bamkit
APPROVED BY
NEXT CAL. DATE 24/01/25

( ) Malee Butkruea
(✓) Saithip Meangmai
( ) Warakorn Lerngagtrakul

**Issue Date :** 26 July 2023

B 0320211

**Condition of this result of calibration**

1. Reference Standard Instruments :
   This certification is traceable to the International System of Unit through the reference standards laboratory of Industrial Calibration Center,Technology Promotion Association (Thailand-Japan).

| Instruments | Serial No. | ID No. | Certificate No. | Due Date |
|---|---|---|---|---|
| 1) Burette | - | 130BU10 | 23CG1172 | 22 Mar 2025 |
| 2) Balance | 1126143764 | 140RC004 | 22MM50 | 20 Sep 2023 |

2. Standard Material :-

| Material | Manufacturer | Lot.No. | Assay |
|---|---|---|---|
| Sodium Thiosulfate pentahydrate | Merck | AM1763316 | 100.2% |

**Result :** **Dissolved Oxygen Meter Adjustment With Air 100 %**

**Dissolved Oxygen Probe No.:** 15E100464

| **Titration Method (Azide Modification Method)** (mg/L) | **DO Meter Reading** (mg/L) | **Standard Deviation** (mg/L) |
|---|---|---|
| 8.18 | 8.17 | 0.0055 |

This report was certified only for the instrument we tested.It is allowable to use for study the system efficiency,The environmental impact control and present to organization it may concerned Intend to use for advertising and referral purpose is prohibited.This report may not be reproduced other in full,without written approval of the laboratory

-o0o-

a 1172155

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-29 FAX. 0-2719-9484

NSC-TISI-TIS17025
CALIBRATION 0008

**Cert. No.:** 23LM125


# Certificate of Calibration

| | |
|---|---|
| **Equipment :** | DO Meter with Sensor |
| **Manufacturer :** | YSI |
| **Model :** | 5000-115V |
| **Serial No. :** | 15E102796 |
| **ID No. :** | RYG_EN0032 |
| **Submitted by :** | ALS Laboratory Group (Thailand) Co.,Ltd.<br>Rayong Branch<br>616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng,<br>Rayong 21140 Thailand |
| **Location :** | TPA On Site Calibration Laboratory |
| **Received Order :** | 25 July 2023 |
| **Calibrated Date :** | 27 July 2023 |
| **Ambient Temperature :** | ( 26 ± 10 ) °C |
| **Relative Humidity :** | ( 50 ± 30 ) % |
| **AC Line Voltage :** | ( 220 ± 22 ) V |
| **Calibrated by :** | Preecha Hlahib |
| **Approved by :** | Approved Signatory |

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

**Issue Date :** 31 July 2023

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

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

A 0053616

**Equipment :** DO Meter with Sensor **Cert. No.:** 23LM125

**Condition As-Received :** Used Item 

**Reference :** 2307-0713DSC-2

**Procedure Used :-**

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer ( IPRT ) into Temperature Bath.

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

| Instrument | Serial No. | Cert. No. | Traceable | Due Date |
|---|---|---|---|---|
| 1) Digital Thermometer | 2188080 | 22I1285 | TPA | 21 Oct 2023 |

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

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

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

**Function :** Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 1228475367

| Calibration Point ( °C ) | Immersion Depth ( mm ) | Standard Temperature ( °C ) | UUC* Reading ( °C ) | Error ( °C ) | Uncertainty ( ± °C ) | Coverage Factor *k* |
|---|---|---|---|---|---|---|
| 20.00 | 100 | 20.011 | 19.91 | -0.101 | 0.15 | 2.00 |

**UUC* :** Unit Under Calibration

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

**-o0o-**

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-29 FAX. 0-2719-9484

NSC-TISI-TIS17025
CALIBRATION 0008

**Cert. No.:** 23TM962


# Certificate of Calibration

| | |
|---|---|
| **Equipment :** | Low Temp. Incubator |
| **Manufacturer :** | Memmert |
| **Model :** | IPP750 |
| **Serial No. :** | V818.0084 |
| **ID No. :** | RYG_EN0154 |
| **Submitted by :** | ALS Laboratory Group (Thailand) Co.,Ltd.<br>(Rayong Branch)<br>616/10 Moo 5 T. Maenam Khu,<br>A. Pluakdaeng, Rayong 21140 Thailand |
| **Location :** | BOD Room |
| **Received Order :** | 29 May 2023 |
| **Calibration Date :** | 29 May 2023 |
| **Ambient Temperature :** | ( 26 ± 10 ) °C |
| **Relative Humidity :** | ( 50 ± 30 ) % |
| **Calibrated by :** | Man Pattanapongpaiboon |
| **Approved by :** | Approved Signatory |

REVIEW BY N.Bamrit
APPROVED BY D. Lui
NEXT CAL. DATE 29/11/24

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

**Issue Date :** 7 June 2023

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

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

A 0054967

**Equipment :** Low Temp. Incubator
**Condition As-Received :** Used Item
**Reference :** 2305-0898OC-2

**Cert. No.:** 23TM962


**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**

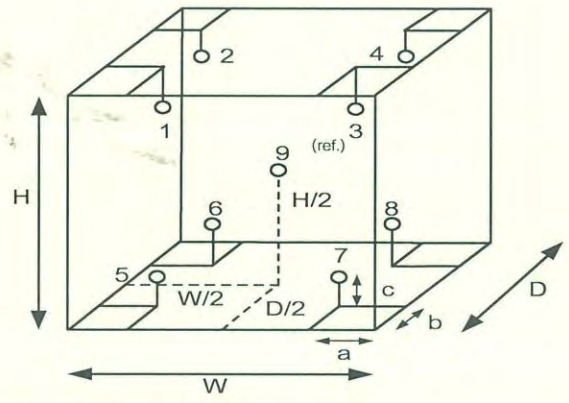
1. Reference standard instrument:-

| Instrument | Model | Serial No. | Cert. No. | Due Date |
|---|---|---|---|---|
| 1 ) Data Acquisition | 34972A | MY57013711 | 22LM93 | 02 Jul 2023 |

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 ) | 23 | 23 |
| REL.Humid. ( % ) | 54 | 56 |
| AC Supply ( Volt ) | 223 | 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-10 |
| 7 | 18-18RTD-07 |
| 8 | 22-18RTD-08 |
| 9 (ref.) | 18-18RTD-09 |

**Probe Installation Details :**

| | | |
|---|---|---|
| a = | 10 | cm |
| b = | 10 | cm |
| c = | 10 | cm |

**Dimension of Chamber :**

| | | |
|---|---|---|
| D = | 0.60 | m |
| W = | 1.0 | m |
| H = | 1.2 | m |
| Capacity = | 0.75 | $m^3$ |

a 1165130

**Equipment :** Low Temp. Incubator
**Condition As-Received :** Used Item
**Reference :** 2305-0898OC-2
**Result of Calibration :-** ( * ) Without Adjustment
**Function of UUC* :** Temperature Source
**Fresh air setting :** Close

**Cert. No.:** 23TM962


| Calibration Point ( °C ) | UUC* Setting ( °C ) | UUC* Reading ( °C ) | Temperature stability ( ± °C ) | Temperature uniformity ( °C ) | Overall Variation ( °C ) | Coverage Factor *k* |
|---|---|---|---|---|---|---|
| 20.0 | 20.0 | 20.0 | 0.019 | 0.72 | 1.0 | 2 |

| Calibration Point ( °C ) | Measured Temperature ( °C ) Position | | | | | | | | | Uncertainty ( ±°C ) |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 (ref.) | |
| 20.0 | 19.547 | 19.780 | 19.487 | 19.529 | 19.408 | 20.139 | 20.112 | 20.406 | 20.116 | 0.30 |

**Average* :** The average of 30 values in each position.
**Temperature stability :** One-half of the greatest maximum difference of measured temperature at any one sensor.
**Temperature uniformity :** The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.
**Overall Variation :** The Difference of the maximum and minimum measured temperatures throughout observation.
**UUC* :** Unit Under Calibration
Note : The reported uncertainty of measurement was included stability and excluded uniformity .

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

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**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

REVIEW BY Thanitall.
APPROVED BY D.
NEXT CAL. DATE 01/03/24

# Certificate of Calibration

| | | | |
|---|---|---|---|
| Model Number : | MSE224S-100-DU | Certificate No. : | 23BCI0112 |
| Description : | Analytical Balance | Issued Date : | Friday, March 03, 2023 |
| Serial Number : | 0026207038 | Reference No. : | 204833 |
| ID No. : | RYG_EN0002 | | |
| Manufacturer : | Sartorius | Page No. : | 1 0f 2 |

Customer Name : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)
616/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.

Calibrated Place : ALS Laboratory Group (Thailand) Co., Ltd.(Balance Room)
616/10 Moo 5 T.Maenam Khu, A.Pluakdaeng, Rayong.21140, Thailand.

Calibrated By : Mr.Chonchai Inthana
Calibration Date : Wednesday, March 01, 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 : 220 g Readability : 0.0001 g

*Ambients Conditions:*

| | | | |
|---|---|---|---|
| Temperature : | 23.6 ºC | ± | 5.0 ºC |
| Humidity : | 60.0 % RH | ± | 10.0 % 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 - 5000g E2,YCS011-522-00 | 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.
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Mr.chonchai Intrhana(Technical Manager)

STAMP

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

**Sartorius (Thailand) Co., Ltd.**
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8361-6 Fax: +66 2643-8367, e-mail: service.thailand@sartorius.com

SARTORIUS

# Certificate of Calibration

| | | | |
|---|---|---|---|
| Model Number : | MSE224S-100-DU | Certificate No. : | 23BCI0112 |
| Description : | Analytical Balance | Issued Date : | Friday, March 03, 2023 |
| Serial Number : | 0026207038 | Reference No. : | 204833 |
| ID No. : | RYG_EN0002 | | |
| Manufacturer : | Sartorius | Page No. : | 2 of 2 |

## Calibration Results : Without Adjustment

### Repeatability

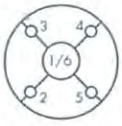
*The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.*

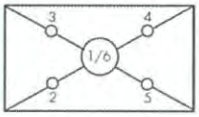
| Nominal Value : (Low Load) 20 g | Tolerance 0.0001 g | Nominal Value : (High Load) 200 g | Tolerance 0.0001 g |
|---|---|---|---|
| 20.0000 | 199.9999 | | |
| 20.0000 | 200.0000 | | |
| 20.0000 | 199.9999 | | |
| 20.0000 | 200.0000 | | |
| 20.0000 | 199.9999 | | |
| 20.0000 | 199.9999 | | |
| 19.9999 | 200.0000 | | |
| 20.0000 | 200.0000 | | |
| 20.0000 | 199.9999 | | |
| 20.0000 | 200.0000 | | |
| *Standard Deviation* | 0.00003 | | 0.00005 |

### 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 : 100 g
Tolerance *0.0004* g




| | Difference |
|---|---|
| 1 | _ |
| 2 | -0.0001 |
| 3 | -0.0001 |
| 4 | 0.0001 |
| 5 | 0.0002 |
| 6 | - |

### Linearity

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

Tolerance *0.0002* g

| Nominal Value (g) | Conventional Mass Value (g) | Displayed Value (g) | Deviation (g) | Uncertainty (g) |
|---|---|---|---|---|
| 0.01 | 0.0100 | 0.0100 | 0.0000 | 0.00014 |
| 0.05 | 0.0500 | 0.0500 | 0.0000 | 0.00014 |
| 0.1 | 0.1000 | 0.1000 | 0.0000 | 0.00014 |
| 0.5 | 0.5000 | 0.5000 | 0.0000 | 0.00014 |
| 1 | 1.0000 | 1.0000 | 0.0000 | 0.00014 |
| 5 | 5.0000 | 5.0000 | 0.0000 | 0.00014 |
| 10 | 10.0000 | 10.0001 | 0.0001 | 0.00014 |
| 20 | 20.0000 | 20.0000 | 0.0000 | 0.00024 |
| 50 | 50.0000 | 50.0000 | 0.0000 | 0.00015 |
| 100 | 100.0000 | 99.9999 | -0.0001 | 0.00019 |
| 200 | 200.0000 | 200.0000 | 0.0000 | 0.00032 |

End of Report.

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
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TEL. 0-2717-3000-27 FAX. 0-2719-9484

NSC-TISI-TIS17025
CALIBRATION 0008

**Cert. No.:** 22TM1492
**Page :** 1 of 3

# Certificate of Calibration

| | |
|---|---|
| **Equipment :** | Hot Air Oven |
| **Manufacturer :** | Memmert |
| **Model :** | UM 400 |
| **Serial No. :** | b495.0899 |
| **ID No. :** | RYG_EN0006 |
| **Submitted by :** | ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)<br>616/10 Moo 5, T. Maenam Khu,<br>A. Pluakdaeng,<br>Rayong 21140, Thailand |
| **Location :** | Oven Room |
| **Received Order :** | 20 October 2022 |
| **Calibration Date :** | 20 October 2022 |
| **Ambient Temperature :** | ( 26 ± 10 ) °C |
| **Relative Humidity :** | ( 50 ± 30 ) % |
| **Calibrated by :** | Preecha Hlahib |

REVIEW BY Thanitall.
APPROVED BY D-
NEXT CAL. DATE 20/04/24

**Approved by :** Malu.
Approved Signatory

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

**Issue Date :** 2 November 2022

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

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

**Equipment :** Hot Air Oven

**Condition As-Received :** Used Item

**Reference :** 2210-0376OC-1

**Cert. No.:** 22TM1492



**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 | 34970A | MY44035217 | 21LM30 | 23 Dec 2022 |

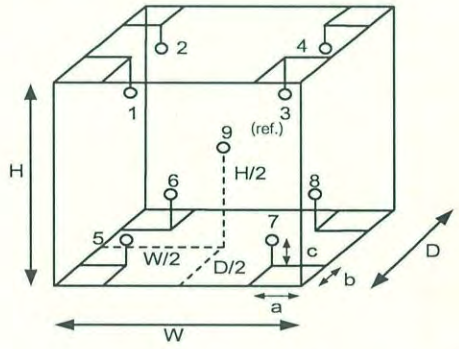
2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

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

**Function of UUC* :** Temperature Source

**Fresh air setting :** Close

| Environment during calibration | | |
|---|---|---|
| | Beginning | Finished |
| Temp. ( °C ) | 28 | 29 |
| REL.Humid. ( % ) | 43 | 47 |
| AC Supply ( Volt ) | 220 | 221 |




| Position : | Ref. Std. ID No.: |
|---|---|
| 1 | 18-10RTD-01 |
| 2 | 18-10RTD-02 |
| 3 | 18-10RTD-03 |
| 4 | 18-10RTD-04 |
| 5 | 18-10RTD-05 |
| 6 | 18-10RTD-06 |
| 7 | 18-10RTD-07 |
| 8 | 18-10RTD-08 |
| 9 (ref.) | 18-10RTD-09 |

**Probe Installation Details :**

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

**Dimension of Chamber :**

| | | |
|---|---|---|
| D = | 0.33 | m |
| W = | 0.40 | m |
| H = | 0.40 | m |
| Capacity = | 0.053 | $m^3$ |

Malu .

**Equipment :** Hot Air Oven **Cert. No.:** 22TM1492

**Condition As-Received :** Used Item 

**Reference :** 2210-0376OC-1

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

**Function of UUC* :** Temperature Source

**Fresh air setting :** Close

| Calibration Point ( °C ) | UUC* Setting ( °C ) | UUC* Reading ( °C ) | Temperature stability ( ± °C ) | Temperature uniformity ( °C ) | Overall Variation ( °C ) | Uncertainty ( ±°C ) | Coverage Factor *k* |
|---|---|---|---|---|---|---|---|
| 70.0 | 70.0 | 70.0 | 0.079 | 0.47 | 0.77 | 0.42 | 2 |

| Calibration Point ( °C ) | Measured Temperature ( °C ) Position | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 (ref.) |
| 70.0 | 70.262 | 69.995 | 70.079 | 70.177 | 70.664 | 70.039 | 70.688 | 70.149 | 70.328 |

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

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

**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 observatior

**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 .

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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NSC-TISI-TIS17025
CALIBRATION 0008

**Cert. No.:** 22TM1491
**Page :** 1 of 3

# Certificate of Calibration

| | |
|---|---|
| **Equipment :** | Water Bath |
| **Manufacturer :** | Memmert |
| **Model :** | WNB22 |
| **Serial No. :** | L513.0648 |
| **ID No. :** | RYG_EN0061 |
| **Submitted by :** | ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)<br>616/10 Moo 5, T. Maenam Khu,<br>A. Pluakdaeng,<br>Rayong 21140, Thailand |
| **Location :** | Wet Chemistry Lab |
| **Received Order :** | 20 October 2022 |
| **Calibration Date :** | 20 October 2022 |
| **Ambient Temperature :** | ( 26 ± 10 ) °C |
| **Relative Humidity :** | ( 50 ± 30 ) % |
| **Calibrated by :** | Preecha Hlahib |

REVIEW BY Thanitall.
APPROVED BY
NEXT CAL. DATE 20/04/24

**Approved by :**

Approved Signatory

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

**Issue Date :** 2 November 2022

**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.

**Equipment :** Water Bath **Cert. No.:** 22TM1491

**Condition As-Received :** Used Item 

**Reference :** 2210-0376OC-4

**Procedure Used :-**

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

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

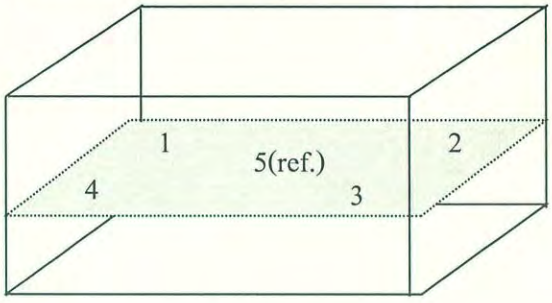
| Instrument | Model | Serial No. | Cert. No. | Due Date |
|---|---|---|---|---|
| 1 ) Data Acquisition | 34970A | MY44035217 | 21LM30 | 23 Dec 2022 |

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

| | Environmental | | AC Voltage Supply |
|---|---|---|---|
| | ( °C ) | ( %R.H. ) | ( Volt ) |
| **Beginning of Calibration** | 24 | 53 | 222 |
| **Finished of Calibration** | 24 | 50 | 221 |




Front

| Position : | Ref. Std. S/N.: |
|---|---|
| 1 | N37P300726 |
| 2 | N37P300727 |
| 3 | N37P300728 |
| 4 | N37P300729 |
| 5(ref.) | N37P300730 |

**Equipment :** Water Bath
**Condition As-Received :** Used Item
**Reference :** 2210-0376OC-4
**Result of Calibration :-** ( * ) Without Adjustment
**Function of UUC* :** Temperature Source

**Cert. No.:** 22TM1491


| Calibration point ( °C ) | UUC* Setting ( °C ) | UUC* Reading ( °C ) | Average* Standard Reading ( °C ) Position | | | | |
|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 (ref.) |
| 85.0 | 85.0 | 85.0 | 84.527 | 84.563 | 84.628 | 84.516 | 84.580 |

| Calibration point ( °C ) | Uniformity ( °C ) | Stability ( ± °C ) | Uncertainty ( ± °C ) | Coverage Factor *k* |
|---|---|---|---|---|
| 85.0 | 0.12 | 0.081 | 0.18 | 2 |

**Average* :** The average of 30 values in each position.
**Uniformity :** The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.
**Stability :** One-half of the greatest maximum difference of measured temperature at any one probe.
**UUC* :** Unit Under Calibration
**Note :** The reported uncertainty of measurement was included stability and excluded uniformity.

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

**-o0o-**

Malu -

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

NSC-TISI-TIS17025
CALIBRATION 0008

**Cert. No.:** 22TM1517
**Page :** 1 of 3

# Certificate of Calibration

| | |
|---|---|
| **Equipment :** | Hot Air Oven |
| **Manufacturer :** | Memmert |
| **Model :** | UFE 500 |
| **Serial No. :** | G511.1572 |
| **ID No. :** | RYG_EN0010 |
| **Submitted by :** | ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)<br>616/10 Moo 5 T. Maenam Khu,<br>A. Pluakdaeng,<br>Rayong 21140 Thailand |
| **Location :** | Oven Room |
| **Received Order :** | 20 October 2022 |
| **Calibration Date :** | 20 October 2022 |
| **Ambient Temperature :** | ( 26 ± 10 ) °C |
| **Relative Humidity :** | ( 50 ± 30 ) % |
| **Calibrated by :** | Man Pattanapongpaiboon |

REVIEW BY Thanitall.
APPROVED BY D.
NEXT CAL. DATE 20/04/24

**Approved by :** Malu.

Approved Signatory

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

**Issue Date :** 2 November 2022

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

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

**Equipment :** Hot Air Oven

**Condition As-Received :** Used Item

**Reference :** 2210-0376OC-2

**Cert. No.:** 22TM1517



**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 | 34972A | MY49023932 | 22LM97 | 29 Jul 2023 |

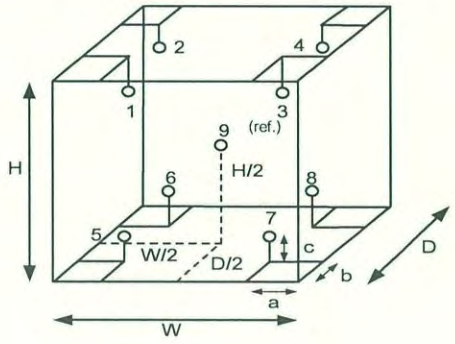
2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

**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. ( % ) | 54 | 59 |
| AC Supply ( Volt ) | 223 | 225 |




**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 | $m^3$ |

| | Ref. Std. ID No.: @ Calibration Point | |
|---|---|---|
| Position : | ( 180 ) °C | ( 104 ) °C |
| 1 | 21-16TC-01 | 20-16RTD-01 |
| 2 | 21-16TC-02 | 20-16RTD-02 |
| 3 | 21-16TC-03 | 20-16RTD-03 |
| 4 | 21-16TC-04 | 20-16RTD-04 |
| 5 | 21-16TC-05 | 22-16RTD-05 |
| 6 | 21-16TC-06 | 20-16RTD-06 |
| 7 | 21-16TC-07 | 20-16RTD-07 |
| 8 | 21-16TC-08 | 22-16RTD-08 |
| 9 (ref.) | 21-16TC-09 | 22-16RTD-09 |

Malu.

**Equipment :** Hot Air Oven
**Condition As-Received :** Used Item
**Reference :** 2210-0376OC-2
**Result of Calibration :-** ( * ) Without Adjustment
**Function of UUC* :** Temperature Source
**Fresh air setting :** Close



| 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 | 0.076 | 0.52 | 0.60 | 0.42 | 2 |
| 180.0 | 180.0 | 180.0 | 0.13 | 0.88 | 1.2 | 1.1 | 2 |

| Calibration Point ( °C ) | Measured Temperature ( °C ) Position | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 (ref.) |
| 104.0 | 103.768 | 103.734 | 103.723 | 103.800 | 104.215 | 104.131 | 104.132 | 103.740 | 103.747 |
| 180.0 | 179.723 | 179.359 | 179.439 | 179.489 | 180.361 | 180.114 | 180.131 | 180.243 | 179.605 |

**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-**

Malee .

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TEL. 0-2717-3000-24 FAX. 0-2719-9484

NSC-TISI-TIS17025
CALIBRATION 0008

# Certificate of Calibration

**Certificate No. :** 23T1766
**Page :** 1 of 2

**Equipment :** Digital Thermometer With Sensor
**Manufacturer:** Testo
**Model :** 106
**Serial No.:** 51366062/1220
**ID No.:** RYG_FS0541
**Condition As-Received:** Used Item
**Received Date:** 04 October 2023
**Calibration Date:** 10 October 2023 to 11 October 2023
**Reference:** 2310-0110DSC
**Ambient Temperature:** ( 25 ± 3 ) °C
**Relative Humidity:** ( 50 ± 20 ) %

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**Submitted by:** ALS Laboratory Group (Thailand) Co.,Ltd. Rayong Branch
616/10 Moo 5, T.Maenam Khu, A.Pluakdaeng, Rayong 21140, Thailand

**Procedure used:** Calibration were conducted using in-house calibration procedure CP-T01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into liquid bath temperature controller. The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1.Reference standards instruments :

| Instrument | Model | Serial No. | Certificate No. | Due Date |
|---|---|---|---|---|
| 1) Black Stack Thermometer | 1560 | 8C454 | 23I600 | 30 May 2024 |
| 2) PRT Scanner Module | 2562 | A01303 | 23I600 | 30 May 2024 |
| 3) Industrial Platinum Resistance Thermometer | 5627-12 | 571971 | 23I600 | 30 May 2024 |

2.The 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 maintained through:-

-Technology Promotion Association (Thailand-Japan), NSC-ONSC Accredited No. Calibration 0008

REVIEW BY Pitthaya Th.
APPROVED BY Supt S.
NEXT CAL. DATE 10/10/24.

**Calibrated by :** Wasinee Sawatdee
**Issue Date :** 12 October 2023

**Approved Signatory :**
[ ] Phalinee Prabpaipal
[ ] Chatchawan Khunpiluek
[✓] Wanlop Larpkern

B 0326169

**Result of Calibration:-** Without Adjustment

**Function:** Temperature measurement

Dimension of probe : Diameter 3 mm., Length 55 mm. Sheath material : Stainless Steel

| Immersion Depth ( mm.) | Standard Temperature ( °C ) | UUC* Reading ( °C ) | Error ( °C ) | Uncertainty of Measurement ( ±°C ) |
|---|---|---|---|---|
| 50 | 25.0033 | 25.0 | -0.0033 | 0.12 |
| 50 | 30.0036 | 30.0 | -0.0036 | 0.12 |
| 50 | 40.0039 | 40.1 | 0.0961 | 0.12 |

**UUC*** : Unit Under Calibration

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

-o0o-

DKSH

# Certificate of Calibration

| | | | |
|---|---|---|---|
| **Equipment:** | Block Digestion Unit | Certificate No.: | C29230010 |
| Model: | KT-20s | Issued Date: | 18 March 2023 |
| Serial No. (or ID.): | 5720210009/5770200073 | Job No.: | KSPR2304362 |
| Manufacturer: | Gerhardt | Page: | 1 of 4 |
| Condition: | In Condition | Digestion Block: | 20 holes. |

**Customer:** ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)
616/10 Moo 5 T.Maenam Khu, A.Pluakdaeng,
Rayong 21140, Thailand.

REVIEW BY N.Bamrit
APPROVED BY
NEXT CAL. DATE 15/03/24

**Environment Condition:**

| | | | |
|---|---|---|---|
| Temperature: | 25 °C | ± | 0.5 °C |
| Humidity: | 65 %RH | ± | 3.7 %RH |
| Voltage: | 231 VAC | ± | 3.1 VAC |

**Calibration Place:** ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)
( Wet Chemistry Lab )
616/10 Moo 5 T.Maenam Khu, A.Pluakdaeng,
Rayong 21140, Thailand.

**Calibration By:** Mr. Nakarin Ruenros

**Calibration Date:** 15 March 2023

**The Method used:** In house method, base on by comparison with standard

**Traceability:** This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through N.M. Technical Center Laboratory (NTL) Certificate No.: TC22/0080

(Mr. Nakarin Ruenros)
Person in charge

(Mr. Udon Srichana)
Authorized signatory

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

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

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

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

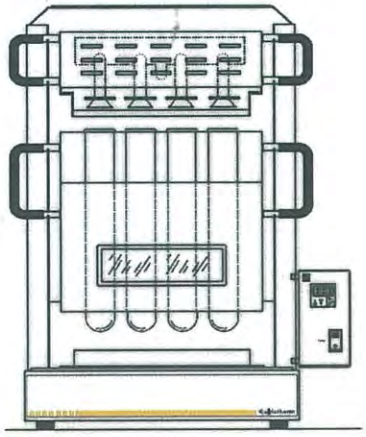
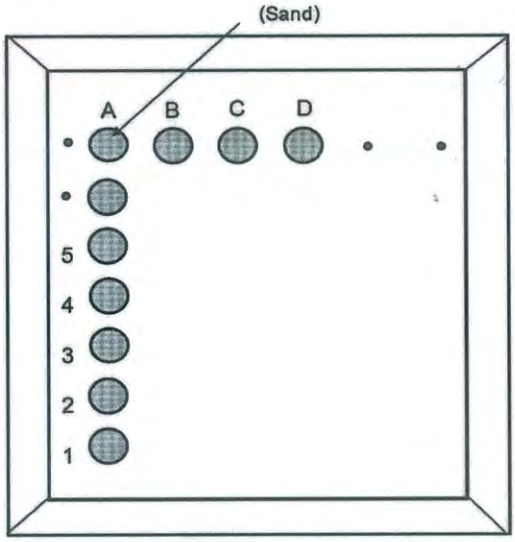


Fig. 1.: Front view




Location of standard

Fig. 2.: Digestion block

## Definitions

***Indicating Temperature***: The average reading of indicating device which forms the integral part of the Digestion block.

***Measured Temperature***: The average reading of working standard at any positions or location.

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2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

## Calibration Results:

### Before adjustment

| Locations | Desired (°C) | Setting (°C) | Indicating (°C) | Measured Temperature (°C) | Correction of UUC. (°C) | Uncertainty (± °C) |
|---|---|---|---|---|---|---|
| A1 | 380 | 380 | 380 | 375.1 | -4.9 | 1.5 |
| A2 | | | | 374.3 | -5.7 | 1.5 |
| A3 | | | | 374.6 | -5.4 | 1.5 |
| A4 | | | | 376.3 | -3.7 | 1.5 |
| A5 | | | | 373.2 | -6.8 | 1.5 |
| B1 | | | | 374.4 | -5.6 | 1.5 |
| B2 | | | | 374.3 | -5.7 | 1.5 |
| B3 | | | | 374.6 | -5.4 | 1.5 |
| B4 | | | | 375.2 | -4.8 | 1.5 |
| B5 | | | | 375.1 | -4.9 | 1.5 |
| C1 | | | | 373.5 | -6.5 | 1.5 |
| C2 | | | | 372.8 | -7.2 | 1.5 |
| C3 | | | | 372.1 | -7.9 | 1.5 |
| C4 | | | | 372.2 | -7.8 | 1.5 |
| C5 | | | | 374.5 | -5.5 | 1.5 |
| D1 | | | | 374.7 | -5.3 | 1.5 |
| D2 | | | | 375.3 | -4.7 | 1.5 |
| D3 | | | | 375.5 | -4.5 | 1.5 |
| D4 | | | | 375.8 | -4.2 | 1.5 |
| D5 | | | | 375.1 | -4.9 | 1.5 |

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2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

## Calibration Results:

### After adjustment

| Locations | Desired (°C) | Setting (°C) | Indicating (°C) | Measured Temperature (°C) | Correction of UUC. (°C) | Uncertainty (± °C) |
|---|---|---|---|---|---|---|
| A1 | 380 | 380 | 380 | 379.0 | -1.0 | 1.5 |
| A2 | | | | 378.7 | -1.3 | 1.5 |
| A3 | | | | 379.4 | -0.6 | 1.5 |
| A4 | | | | 379.2 | -0.8 | 1.5 |
| A5 | | | | 379.2 | -0.8 | 1.5 |
| B1 | | | | 379.8 | -0.2 | 1.5 |
| B2 | | | | 379.2 | -0.8 | 1.5 |
| B3 | | | | 379.5 | -0.5 | 1.5 |
| B4 | | | | 378.9 | -1.1 | 1.5 |
| B5 | | | | 379.1 | -0.9 | 1.5 |
| C1 | | | | 379.1 | -0.9 | 1.5 |
| C2 | | | | 377.7 | -2.3 | 1.5 |
| C3 | | | | 378.4 | -1.6 | 1.5 |
| C4 | | | | 378.2 | -1.8 | 1.5 |
| C5 | | | | 378.0 | -2.0 | 1.5 |
| D1 | | | | 379.5 | -0.5 | 1.5 |
| D2 | | | | 378.7 | -1.3 | 1.5 |
| D3 | | | | 379.7 | -0.3 | 1.5 |
| D4 | | | | 379.5 | -0.5 | 1.5 |
| D5 | | | | 379.4 | -0.6 | 1.5 |

**The End of Certificate**

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# ใบตรวจสอบสภาพเครื่องควบคุมอุณหภูมิ

เลขที่ใบงาน: KSPR2304362

ชนิดเครื่องมือ: Block Digestion Unit รุ่น: KT-20s

หมายเลขเครื่อง: 5720210009/5770200073

| ตรวจสอบ (รับ) 15 Mar 2023 | | รายการตรวจเช็ค | ตรวจสอบ (ส่ง) 15 Mar 2023 | | หมายเหตุ |
|---|---|---|---|---|---|
| ปกติ | ไม่ปกติ | | ปกติ | ไม่ปกติ | |
| | | ***General*** | | | |
| ☑ | ☐ | 1. สายไฟ | ☑ | ☐ | |
| ☑ | ☐ | 2. การทำงาน Main Switch | ☑ | ☐ | |
| ☑ | ☐ | 3. การทำงาน Selector Key | ☑ | ☐ | |
| ☑ | ☐ | 4. การแสดงผล Display | ☑ | ☐ | |
| ☑ | ☐ | 5. สภาพ Hole | ☑ | ☐ | |
| ☐ | ☐ | 6. สภาพฝาปิด | ☐ | ☐ | ไม่มี |
| ☑ | ☐ | 7. สภาพตัวเครื่อง | ☑ | ☐ | |
| ☑ | ☐ | 8. สภาวะแวดล้อม ณ สถานที่ตั้งเครื่อง | ☑ | ☐ | |

ข้อแนะนำ : _____

_____

_____

Mr. Nakarin Ruenros

Service Engineer

บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร 10260
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TEL. 0-2717-3000-29 FAX. 0-2719-9484

NSC-TISI-TIS17025
CALIBRATION 0008

**Cert.No.:** 23CG3704


# Certificate of Calibration

| | |
|---|---|
| **Equipment :** | Burette |
| **Capacity :** | 50 mL |
| **Serial No. :** | - |
| **ID. No. :** | RYG_EN0216 |
| **Manufacturer :** | Witeg |
| **Made in :** | Germany |
| **Submitted by :** | ALS Laboratory Group (Thailand) Co.,Ltd.<br>Rayong Branch<br>616/10 Moo 5, T.Maenam Khu<br>A.Pluakdaeng, Rayong 21140 Thailand |
| **Ambient Temperature :** | (20 ± 2.5) °C |
| **Relative Humidity :** | (50 ± 10) % |
| **Barometric Pressure :** | 756 mmHg |
| **Calibration Procedure :** | ASTM E 542 - 01 |
| **Calibrated by :** | Srisuda Khamtha |

REVIEW BY N.Bamrit
APPROVED BY D.
NEXT CAL. DATE 25/09/24.
OSP. 02/10/23.

**Approved by :**

Approved Signatory

( ) Ponpan Paipim
(√) Srisuda Khamtha
( ) Sa-ngeunkam Wongsa

**Issue Date :** 28 September 2023

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

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

**Equipment :** Burette
**Received Date :** 19 September 2023
**Condition As-Received :** Used Item
**Calibration Date :** 25 September 2023
**Reference :** 2309-0635DSC-31

**Cert.No.:** 23CG3704


**Condition of this result of calibration**

1. Reference Standard Instruments :

| Instruments | Model | Serial No. | ID. No. | Certificate No. | Traceability | Due date |
|---|---|---|---|---|---|---|
| 1) Balance | MS204TS | C226356983 | 140RC010 | TH2068-012 | METTLER | 29 Sep 2023 |
| 2) Thermo-Hygrograph | THDX-CE | 00016540 | 140EC001 | 23H1275 | TPA | 09 June 2024 |
| 3) Thermometer | - | 1594592 | 140EC010 | 23I158 | TPA | 12 Feb 2024 |

   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 |
|---|---|---|---|
| 10 | 10.0224 | 0.0082 | 2.00 |
| 20 | 20.0064 | 0.0085 | 2.00 |
| 30 | 29.9931 | 0.0089 | 2.00 |
| 40 | 39.9910 | 0.0094 | 2.00 |
| 50 | 49.9806 | 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-

a 1182477

**Bara Scientific Co., Ltd.**
968 U Chu Liang Building Floor7 Rama4 Road
Silom Bangrak Bangkok Thailand 10500
Tel : 02-6324300 Fax : 02-6375496-7
www.barascientific.com

NSC-TISI-TIS 17025
CALIBRATION 0209

# Certificate of Calibration



| | |
|---|---|
| **Certificate No.** | BSCC-UV-367/23 |
| **Equipment** | UV/Vis Spectrophotometer |
| **Model** | UV-1800 |
| **Manufacturer** | Shimadzu |
| **Serial No.** | A11454908533CD |
| **ID No.** | BKK_EN0018 |
| **Date of receipt** | 15 September 2023 |
| **Date of calibration** | 15 September 2023 |
| **Date of issue** | 22 September 2023 |

REVIEW BY ....Siriluk P.....
APPROVED BY .....
NEXT CAL. DATE 15/9/2024

| | |
|---|---|
| **Customer name** | ALS Laboratory Group (Thailand) Co., Ltd. |
| **Address** | 104 Soi Phattanakan 40, Phattanakan Road, Phattanakan, Suan Luang, Bangkok 10250 |
| **Temperature** | (23.4 - 24.7) °C (On site) |
| **Humidity** | (55.5 - 61.2) %RH (On site) |
| **Equipment condition** | Good Operation |
| **Calibration Location** | Organic Prep |
| **Calibration Procedure** | In-house method WI-UV-702-01 based on ASTM E275-01 |
| **Traceability** | Wavelength Accuracy is traceable to certificate No. 95917 and 95918<br>Photometric Accuracy is traceable to certificate No. 95937 and 95924<br>Stray Light is traceable to certificate No. 95908<br>The above certificate are traceble to SI unit through Starna Scientific Ltd.<br>(UKAS accredited calibration laboratory NO. 0659) |
| **Calibrated by** | Mr.Wanchana Janloey |

Approved by

**Mr.Kanchit Choothep**
Technical Manager

The above results are valid exclusively for the calibrated item(s) as mention in this report / certificate.
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THAILAND
NSC-TISI-TIS 17025
CALIBRATION 0209

# Certificate of Calibration

**Certificate No.** **BSCC-UV-367/23**



**Calibration Results:**

**1.Wavelength Accuracy**

| Certified Wavelength (nm) | UUC (nm) | Error (nm) | Uncertainty (±nm) |
|---|---|---|---|
| 241.70 | 241.67 | -0.03 | 0.18 |
| 334.02 | 334.03 | 0.01 | 0.18 |
| 418.53 | 418.59 | 0.06 | 0.18 |
| 572.99 | 573.14 | 0.15 | 0.18 |
| 879.41 | 879.21 | -0.20 | 0.18 |

**2.Photometric Accuracy (UV)**

| Wavelength (nm) | Certified Absorbance (A) | UUC (A) | Error (A) | Uncertainty (±A) |
|---|---|---|---|---|
| 235 | 0.0000 | 0.0000 | 0.0000 | 0.0075 |
| | 0.7467 | 0.7460 | -0.0007 | 0.0075 |
| 257 | 0.0000 | 0.0000 | 0.0000 | 0.0075 |
| | 0.8662 | 0.8646 | -0.0016 | 0.0075 |
| 313 | 0.0000 | 0.0000 | 0.0000 | 0.0075 |
| | 0.2904 | 0.2908 | 0.0004 | 0.0075 |
| 350 | 0.0000 | 0.0001 | 0.0001 | 0.0075 |
| | 0.6429 | 0.6415 | -0.0014 | 0.0075 |

*CNR = Customer not request

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# Certificate of Calibration

**Certificate No.** **BSCC-UV-367/23** Number of Page(s) 3 of 3

**Calibration Results:**

**3.Photometric Accuracy (Visible)**

| Wavelength (nm) | Certified Absorbance (A) | UUC (A) | Error (A) | Uncertainty (±A) |
|---|---|---|---|---|
| 420.0 | 0.0000 | 0.0000 | 0.0000 | 0.0042 |
| | 0.5783 | 0.5793 | 0.0010 | 0.0042 |
| | 0.7628 | 0.7624 | -0.0004 | 0.0042 |
| | 1.0206 | 1.0216 | 0.0010 | 0.0042 |
| 440.0 | 0.0000 | 0.0000 | 0.0000 | 0.0042 |
| | 0.5621 | 0.5625 | 0.0004 | 0.0042 |
| | 0.7455 | 0.7452 | -0.0003 | 0.0042 |
| | 0.9985 | 0.9989 | 0.0004 | 0.0042 |
| 465.0 | 0.0000 | 0.0000 | 0.0000 | 0.0042 |
| | 0.5227 | 0.5229 | 0.0002 | 0.0042 |
| | 0.6880 | 0.6873 | -0.0007 | 0.0042 |
| | 0.9487 | 0.9486 | -0.0001 | 0.0042 |
| 546.1 | 0.0000 | 0.0000 | 0.0000 | 0.0042 |
| | 0.5207 | 0.5211 | 0.0004 | 0.0042 |
| | 0.6973 | 0.6960 | -0.0013 | 0.0042 |
| | 0.9959 | 0.9944 | -0.0015 | 0.0042 |
| 590.0 | 0.0000 | 0.0000 | 0.0000 | 0.0042 |
| | 0.5544 | 0.5538 | -0.0006 | 0.0042 |
| | 0.7253 | 0.7236 | -0.0017 | 0.0042 |
| | 1.0942 | 1.0925 | -0.0017 | 0.0042 |
| 635.0 | 0.0000 | 0.0000 | 0.0000 | 0.0042 |
| | 0.5616 | 0.5612 | -0.0004 | 0.0042 |
| | 0.6927 | 0.6909 | -0.0018 | 0.0042 |
| | 1.0881 | 1.0866 | -0.0015 | 0.0042 |

*CNR = Customer not request

**4.Stray Light***

| Standard cut-off wavelenght (nm) | Unit Under Calibration(UUC) | | |
|---|---|---|---|
| | Wavelength (nm) | Transmission (%T) | Absorbance (A) |
| 200.96±0.11nm | 200.55 | 0.9770 | 2.0104 |

The Stray light transmission reference is less than 1.0%T and Stray light absorbance reference is greater than 2.00A
***Stray Light not NSC-ONSC Accredited.**

The measurement uncertainty is base on a standard uncertainty multiplied by a coverage factor k=2 providing a level of confidence of approximately 95%.

*****End of Certificate*****

The above results are valid exclusively for the calibrated item(s) as mention in this report / certificate.
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**7700 Series ICP-MS**
**Preventive Maintenance Checklist – Standard**

Agilent Technologies

Agilent Preventive Maintenance provides factory recommended service for your analytical systems to assure reliable operation and the accuracy of your results. Delivered by highly-trained and certified service engineers using genuine Agilent parts and supplies, Agilent Preventive Maintenance provides everything you need to reduce unplanned downtime and keep your systems operating at their peak.

For more information about Agilent Technologies services please visit our web site using the following URL http://www.chem.agilent.com/en-us/products/services/pages/default.aspx

## Customer Information

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

## Service Engineer's Responsibilities

- Only complete/printout pages that relate to the system or module being serviced.
- Complete empty fields with the relevant information.
- Complete the relevant checkboxes in the checklist using a "X" or tick mark "✓" in the checkbox.
- Complete Not Applicable check boxes to indicate services not delivered, as needed.
- Complete the PM service in the order of the tasks listed.
- Complete the Service Review section together with the customer.

REVIEW BY Supakwan N.
APPROVED BY Sawitr N.
NEXT CAL. DATE 11/06/2024


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## System Information

| | |
|---|---|
| **Instrument system name and ID** | 7700x ICP-MS |
| **Instrument system site and location** | ALS Laboratory Group (Thailand) Co., Ltd |
| **List system component product numbers** | **List the serial numbers of each component** |
| 1. G3281A | 1. JP12091612 |
| 2. G3292A | 2. 4N1220700 |
| 3. AIX 500 | 3. US02129SA520 |
| 4. | 4. |
| 5. | 5. |
| 6. | 6. |
| 7. | 7. |

| ICP-MS configuration table | Circle the type or write in the type if other |
|---|---|
| Nebulizer | MicroMist \| Micro Flow \| Mira Mist \| other |
| Spray Chamber | Quartz \| PFA \| other |
| Torch | Quartz \| Demountable \| other |
| Sampling Cone | Ni \| Pt \| other |
| Skimmer Cone | Ni \| Pt \| Ni plated \| other |

## Preparation

- ☑ Discuss any specific issues with the customer prior to starting.
- ☑ Review the instrument logbook.
- ☑ Save instrument control settings before starting the procedure.
- ☑ Perform general inspection of system for cleanliness
- ☑ Check for proper installation of safety-related parts, assemblies , sensors etc
- ☑ Check for required firmware updates and verify with customers if they would like it installed.
- ☑ Begin system vent.


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## Inspect and clean system while venting

- ☑ Perform a general inspection of the system.
- ☐ Look for any obvious external damage or problems.
- ☑ Check mechanical pumps for evidence of excessive fluid leaks.
- ☑ Inspect vacuum hoses, pump exhaust tubes and power cord for excessive wear.
- ☑ Inspect Shield plate contacts. Clean if needed.
- ☑ Inspect the tape lining on the peristaltic pump clamp; replace the tape if worn (5043-0030).
- ☐ Check electronics for dust accumulation, clean if necessary.

## Mechanical vacuum pumps

- ☑ Drain and replace mechanical pump fluid.
- ☑ Verify proper oil recycling function of mechanical pumps, the gas ballast valve must be open.
- ☑ Replace the oil mist filter.
- ☑ Inspect and clean or replace the inlet filter (P/N 5190-0145 for E2M18, P/N SR03700237 for DS402)
- ☑ Verify proper oil recycling function of mechanical pumps, the gas ballast valve must be open when connected to an Edwards E2M18.

## Cooling water system

- ☐ Drain cooling fluid
- ☑ Remove, clean and reinstall metal mesh filter.
- ☑ Re fill Polyclear cooling fluid (G3292-80010)
- ☑ Clean the Air filter and the Condenser by compressed air or vacuum cleaner

## Ion lens cleaning

- ☑ Remove extraction/omega lenses and clean all lenses.
- ☐ Remove ORS cell, plate bias and deflect lens, clean all lenses.
- ☑ Replace octopole. Reinstall all lenses and the ORS cell and close analyzer.

## Auto Sampler ASX500 Series

- ☑ Clean external surfaces of the Autosampler, this will protect the service technician from potential chemical burns
- ☐ Z-Axis Inspection Inspect the Z-axis PEEK drive cable for kinks or slight bends. Power off the autosampler and manually move the Z-drive up and down using the rotor on the rear of the instrument. Inspect the Z-axis drive cable for kinks or slight bends o If the movement is rough and hard to move then replace Z-axis drive cable (P/N G3286-80331) or Z-axis drive assembly (P/N G3286-80330)


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☑ Pump Tubing Replacement

Replace peristaltic pump tubing. Replace all tubing that goes from the rinse station to the pump and from the pump to the waste/rinse bottles

☑ QC Testing

Using customer's racks and the Agilent software move the sample probe to the 4 outermost corners and ensure that the probe is centered in the vial

☑ Final Inspection

Check that all components are tight

## Auto Sampler I-AS N/A

- ☐ Clean external surfaces of the Autosampler, this will protect the service technician from potential chemical burns
- ☐ Pump Tubing Replacement

  Replace peristaltic pump tubing. Replace all tubing that goes from the rinse station to the pump and from the pump to the waste/rinse bottles.
- ☐ QC Testing

  Using customer's tray and move the sample probe to the sample vial 1, wash vial and rinse port and ensure that the probe is centered in the vial.

## ISIS

☑ Replace ISIS valve seal (P/N G3138-65117)

☑ Inspect the tape lining on the peristaltic pump clamp; replace the tape if worn (5043-0030).

☑ QC test

Verify the function of valve and Peripump. Make sure that there is no leak from the valve and pump tubing connections.


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## Restore Instrument

- ☑ Pump system down.
- ☑ Perform the system post check.
  - ☑ Check quadrupole matching.
  - ☑ Perform octopole matching.
  - ☑ Verify good gas control function by changing the flow and observing the meter readings, perform an automatic offset adjustment for the MFC's.
  - ☑ Verify in Tune (using the customer's last tune) that changes in lens voltage result in the expected sensitivity change.
  - ☑ Perform Startup including performance report and an Autotune. Print the Autotune report and attach it to this checklist.
  - ☑ Check the instrument status and record the measurements in the status table. (Use "Record Log" in "Maintenance LogBook" with G7200B software, Use Performance report with G7201A/B software)
  - ☑ Record the EM and discriminator Voltages in the results table.
  - ☑ Run 10 minute stability test with tune solution. Check the result of RSD is below 4%.

### Guidance

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

## Service Review

- ☑ Attach available reports/printouts of all tests to this documentation.
- ☑ Make an entry in the MassHunter Maintenance Log Book recording the PM activities.
- ☑ Update/reset instrument maintenance counters as appropriate
- ☑ Affix the PM sticker to the system or instrument logbook based on the customer's request.
- ☑ Complete the Service Engineer Comments section below if there are additional comments
- ☑ Review the service and any test results with the customer.
- ☑ If the Instrument firmware was updated, record the details of the change in the Service Engineer's Comments box below or if necessary, in the customer's IQ records.


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## 7700 Series ICP-MS Status Results Table

☐ Check this box if you have run a performance report to record the meter readings. Print out the report and attach it to this checklist, instead of completing the table.

| Measurement | Standby Mode | Analysis Mode No Gas Mode | Analysis Mode $H_2$ Gas @ 4ml/min | Analysis Mode He Gas @ 4ml/min |
|---|---|---|---|---|
| IF/BK Press | 2.65 Pa | 242 Pa | - Pa | 242 Pa |
| TMP Revolution | 100 % | 100 % | - % | 100 % |
| Analyzer Press | $8.59\times10^{-5}$ Pa | $2.35\times10^{-4}$ Pa | - Pa | $3.25\times10^{-4}$ Pa |
| Water RF/WC/IF | ❶ | 1.50 L/min | | |
| Water Temperature | | 22.1 °C | | |
| Inlet Temp | 25.0 °C | 29.9 °C | | |
| Internal Temp | 25.0 °C | 46.0 °C | | |
| RF Power | | 1551 Watts | | |
| RF Reflect | | 5 Watts | | |
| Plasma Freq. | | 26.78 MHz | | |
| Carrier Gas (BP) | | 441 kPaG | | |
| Ar Gas Tank Press | | 569 kPaG | | |
| Carrier Gas | | 1.00 L/min | | |
| MU./Dil. Gas | | 0.10 L/min | | |
| Plasma Gas | | 15.00 L/min | | |
| Aux Gas | | 0.90 L/min | | |
| S/C Temperature | | 2.0 °C | | |
| OP Gas Tank Press*1 | - kPaG | - kPaG | | |
| Optional Gas *1 | | - % | | |

❶ Do not fill in the shaded cells in the table. There are no measurements for these combinations.

**Notes:**


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## 7700 Series ICP-MS Test Results Table

| Test Description | Expected Test Result | Actual Test Result |
|---|---|---|
| Analog HV Voltage | Not applicable | 1768 V |
| Pulse HV Voltage | Not applicable | 1496 V |
| Discriminator Voltage | Not applicable | 4.5 mV |

## 7700 Series ICP-MS Parts List Table

| Part Description | Part Number | Product/Model # where used | Quantity Consumed |
|---|---|---|---|
| 1L Rough Pump Oil | 6040-0834 | 7700 ICP-MS | 2 |
| Oil Mist Filter Kit for E2M18 | 3162-1056 | 7700 ICP-MS | 1 |
| Oil Mist Filter for DS402 | 9499342M002 | 7700 ICP-MS | - |
| Graphite Gasket for Sample Cone (3pk) | G3280-67009 | 7700 ICP-MS | 1 |
| 7700 Octopole | G3280-67045 | 7700 ICP-MS | 1 |
| Polyclear cooling fluid | G3292-80010 | G1879B/G3292A | 1 |
| Rinse / Drain tubing | G3286-80117 | ASX-500 | 1 |
| Tubing / connection kit for drain | G3286-80118 | ASX-500 | 1 |
| Peristaltic pump tubing set | G3160-65326 | I-AS | - |
| Drain tubing to rinse bottle and drain bottle | G3160-65328 | I-AS | - |
| Rotor seal for Valve (ISIS) | G3138-65117 | ISIS | 1 |
| **Additional parts may be required from engineers stock:** | | | |
| Inlet Filter E2M18 | 5190-0145 | 7700 ICP-MS | - |
| Inlet Filter DS402 | SR03700237 | 7700 ICP-MS | - |
| Peristaltic pump tape (30m roll) | 5043-0030 | 7700 ICP-MS | - |
| Polishing Paper Kit (#400/#1200, 5 sheets each) | G1833-65404 | 7700 ICP-MS | - |
| Cotton Swabs, ultra-fine conical bud shape at both ends (100/pk) | 9300-2574 | 7700 ICP-MS | - |
| Alumina Powder | 8660-0791 | 7700 ICP-MS | - |
| lint-free-paper | 05980-60051 | 7700 ICP-MS | - |
| Z-Axis Drive PEEK Cable (Anti-Kink) | G3286-80331 | ASX-500 | - |
| Z-Axis Drive Assembly (PEEK, Anti-Kink) | G3286-80330 | ASX-500 | - |


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## Service Engineer Comments (optional)

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

.

## Other Important Customer Web Links

- How to get information on your product: Literature Library - http://www.agilent.com/chem/library
- Need to know more? - www.agilent.com/chem/education
- Need technical support, FAQs? - www.agilent.com/chem/techsupp
- Need supplies? - www.agilent.com/chem/supplies

## Service Completion

Service request number 600 6142623 Date service completed 12 JUNE 2023

Agilent signature _____ Customer signature Supakwan N.

Document part number: G3280-90078

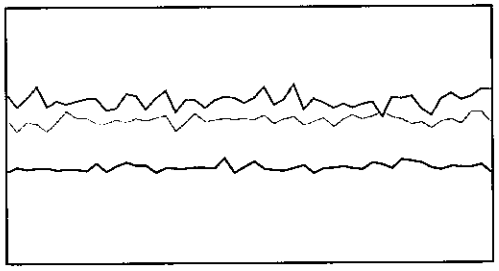

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# Tune Report

| | |
|---|---|
| **Operator Name** | Supakwan Mak |
| **Acq/Data Batch** | C:\Agilent\ICPMH\1\UserTune.b |
| **Acq. Date-Time** | 6/12/2023 4:05:12 PM |
| **Report Comment** | PM 12 June 2023 |
| **Instrument Name** | G3281A JP12091612 |

[No Gas]

**Sensitivity**



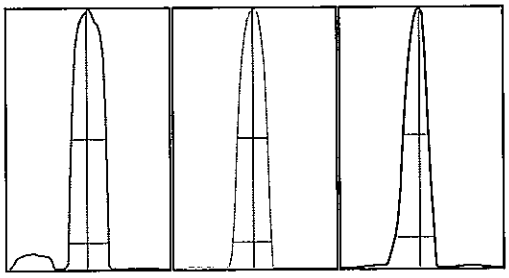
| Mass | Range | Count | RSD% | Background |
|---|---|---|---|---|
| 7 | 10000 | 6340 | 4.494 | 2.100 |
| 89 | 50000 | 27817 | 3.328 | 3.600 |
| 205 | 50000 | 18565 | 3.537 | 9.600 |

| | |
|---|---|
| Sampling Period [sec] | 0.311 |
| Integration Time [sec] | 0.1 |

**Oxide/Doubly Charged Ratio**

| | |
|---|---|
| Oxide | 156 / 140 1.492 % |
| Doubly Charged | 70 / 140 1.508 % |

**Resolution/Axis**



| Mass | Peak Height | Axis | W-50% | W-10% |
|---|---|---|---|---|
| 7 | 6337.66 | 7.00 | 0.64 | 0.730 |
| 89 | 27561.94 | 89.00 | 0.55 | 0.710 |
| 205 | 19016.73 | 205.00 | 0.46 | 0.726 |

| | |
|---|---|
| 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 | 1.80 V | Nebulizer Pump | 0.10 rps | Plasma Gas | 15.0 L/min |
| Sample Depth | 8.0 mm | S/C Temp | 2 °C | | |

**Lens Parameters**

| | | | | | |
|---|---|---|---|---|---|
| Extract 1 | 0.0 V | Omega Lens | 6.4 V | Deflect | 11.8 V |
| Extract 2 | -145.0 V | Cell Entrance | -30 V | Plate Bias | -40 V |
| Omega Bias | -90 V | Cell Exit | -50 V | | |

**Cell Parameters**

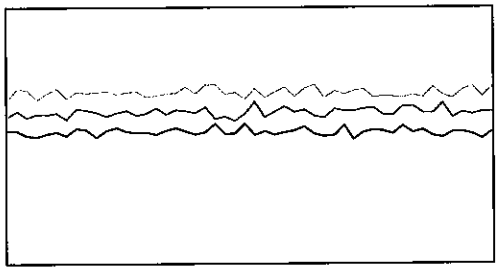
| | | | | | |
|---|---|---|---|---|---|
| Use Gas | No | 3rd Gas Flow | --- | Energy Discrimination | 5.0 V |
| He Flow | 0.0 mL/min | OctP Bias | -8.0 V | | |

# Tune Report

| | | | | | |
|---|---|---|---|---|---|
| H2 Flow | --- | OctP RF | 190 V | | |
| **QP Parameters** | | | | | |
| Mass Gain | 145 | Axis Gain | 1.0021 | QP Bias | -3.0 V |
| Mass Offset | 124 | Axis Offset | 0.12 | | |
| **Hardware Settings** | | | | | |
| **Torch** | | | | | |
| Torch H | -0.4 mm | Torch V | 0.0 mm | | |
| **EM** | | | | | |
| Discriminator | 4.5 mV | Analog HV | 1748 V | Pulse HV | 1496 V |

**[He]**

**Sensitivity**



| Mass | Range | Count | RSD% | Background |
|---|---|---|---|---|
| 59 | 20000 | 11826 | 2.752 | 7.200 |
| 89 | 20000 | 13367 | 2.527 | 5.800 |
| 205 | 50000 | 25671 | 2.706 | 13.300 |

| | |
|---|---|
| Sampling Period [sec] | 0.31 |
| Integration Time [sec] | 0.1 |

**Oxide/Doubly Charged Ratio**

| | |
|---|---|
| Oxide | 156 / 140 1.166 % |
| Doubly Charged | 70 / 140 1.586 % |

**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 | 1.80 V | Nebulizer Pump | 0.10 rps | Plasma Gas | 15.0 L/min |
| Sample Depth | 8.0 mm | S/C Temp | 2 °C | | |

**Lens Parameters**

| | | | | | |
|---|---|---|---|---|---|
| Extract 1 | 0.0 V | Omega Lens | 7.4 V | Deflect | 3.6 V |
| Extract 2 | -200.0 V | Cell Entrance | -90 V | Plate Bias | -115 V |
| Omega Bias | -90 V | Cell Exit | -70 V | | |

**Cell Parameters**

| | | | | | |
|---|---|---|---|---|---|
| Use Gas | Yes | 3rd Gas Flow | --- | Energy Discrimination | 3.0 V |
| He Flow | 4.5 mL/min | OctP Bias | -21.0 V | | |
| H2 Flow | --- | OctP RF | 200 V | | |

**QP Parameters**

| | | | | | |
|---|---|---|---|---|---|
| Mass Gain | 145 | Axis Gain | 1.0021 | QP Bias | -18.0 V |
| Mass Offset | 124 | Axis Offset | 0.12 | | |

**Hardware Settings**

**Torch**

| | | | |
|---|---|---|---|
| Torch H | -0.4 mm | Torch V | 0.0 mm |

# Tune Report

**EM**

| | | | | | |
|---|---|---|---|---|---|
| Discriminator | 4.5 mV | Analog HV | 1748 V | Pulse HV | 1496 V |

# 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** | : | **13 September 2023** |
| **Calibrated By** | : | **Sanee Musikawan ( Site Calibration Manager )** |
| **Approved By** | : | _____ **/ Sujjar Naknakred ( Site Calibration Manager )** |
| **Date of Issue** | : | 26 SEP 2023 |

REVIEW BY Tattaporn C.
APPROVED BY Sawitree N.
NEXT CAL. DATE 22/03/25

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.

# Metrological Center

SCI ECO Services Company Limited

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

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## Calibration Report

**Equipment** : **HEATING BLOCK**
**Date of Calibration** : **22 September 2023**
**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 20 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 | TN21-TN30 | T230014 | 17 January 2024 |
| TC | TYPE T | TN31-TN40 | T230014 | 17 January 2024 |
| DATA LOGGER | 34970A | T151 | T230014 | 17 January 2024 |

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 20 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

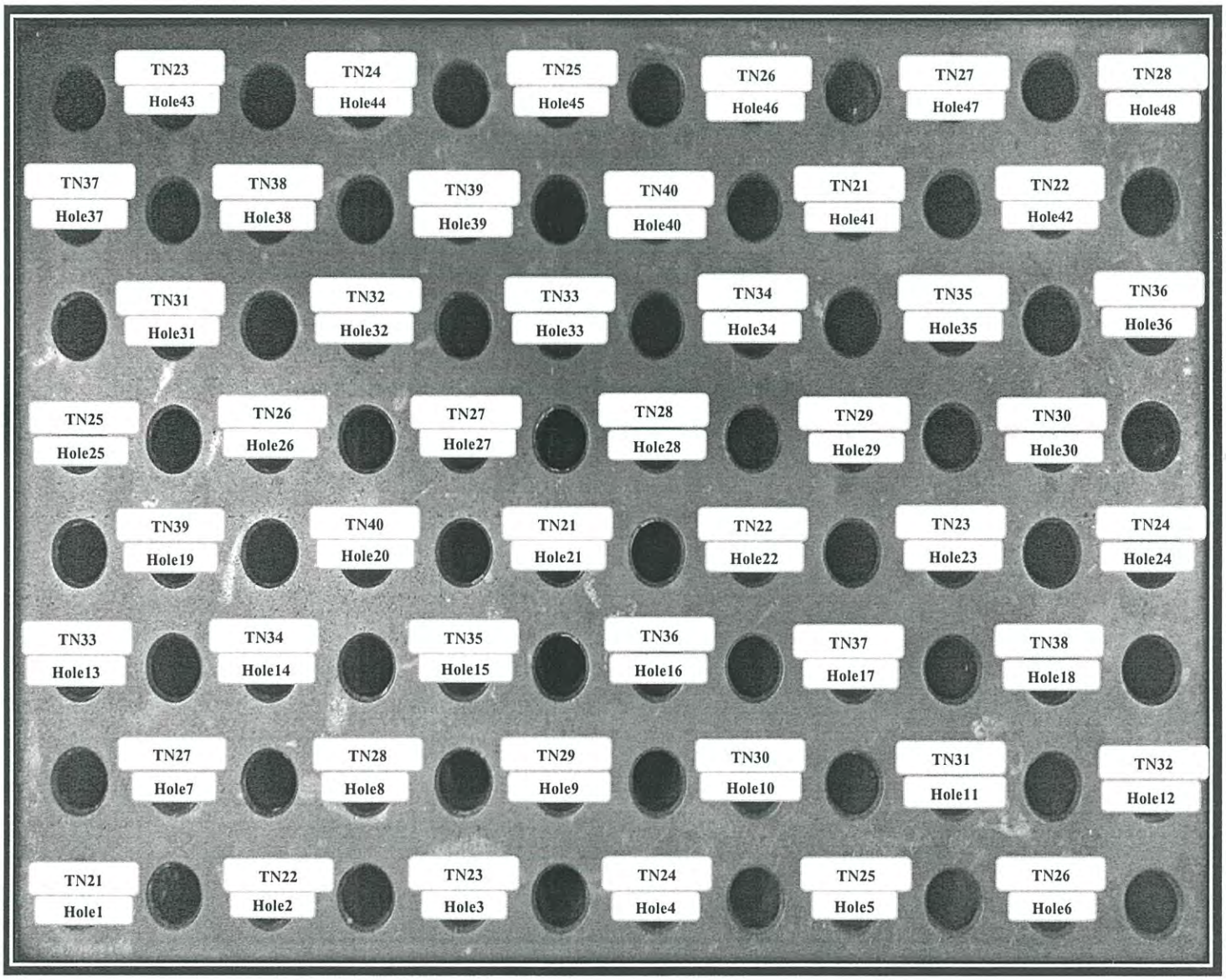
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110

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




## Calibration Report




FRONT CONTROL

**Approved By.** _____

# Metrological Center

SCI ECO Services Company Limited

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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** | | **TN21** | **TN22** | **TN23** | **TN24** | **TN25** | **TN26** |
| CAL POINT | Max | 95.01 | 94.41 | 95.20 | 95.41 | 94.51 | 95.17 |
| 95 | Min | 94.57 | 93.95 | 94.75 | 94.92 | 94.00 | 94.72 |
| | Average | 94.79 | 94.18 | 94.98 | 95.17 | 94.26 | 94.95 |
| **R2 Hole7-Hole12** | | **TN27** | **TN28** | **TN29** | **TN30** | **TN31** | **TN32** |
| | Max | 95.36 | 95.43 | 95.19 | 95.16 | 95.35 | 94.97 |
| | Min | 94.94 | 94.95 | 94.72 | 94.71 | 94.90 | 94.57 |
| | Average | 95.15 | 95.19 | 94.96 | 94.94 | 95.13 | 94.77 |
| **R3 Hole13-Hole18** | | **TN33** | **TN34** | **TN35** | **TN36** | **TN37** | **TN38** |
| | Max | 95.37 | 95.50 | 95.22 | 95.21 | 95.33 | 95.31 |
| | Min | 94.99 | 95.09 | 94.78 | 94.82 | 94.88 | 94.96 |
| | Average | 95.18 | 95.30 | 95.00 | 95.02 | 95.11 | 95.13 |
| **R4 Hole19-Hole24** | | **TN39** | **TN40** | **TN21** | **TN22** | **TN23** | **TN24** |
| | Max | 95.59 | 94.42 | 94.52 | 94.24 | 94.63 | 94.67 |
| | Min | 95.21 | 94.06 | 94.13 | 93.88 | 94.28 | 94.27 |
| | Average | 95.40 | 94.24 | 94.33 | 94.06 | 94.45 | 94.47 |
| **R5 Hole25-Hole30** | | **TN25** | **TN26** | **TN27** | **TN28** | **TN29** | **TN30** |
| | Max | 95.19 | 95.38 | 92.93 | 95.30 | 95.14 | 95.03 |
| | Min | 94.83 | 95.03 | 92.56 | 94.95 | 94.79 | 94.70 |
| | Average | 95.01 | 95.20 | 92.75 | 95.12 | 94.96 | 94.87 |
| **R6 Hole31-Hole36** | | **TN31** | **TN32** | **TN33** | **TN34** | **TN35** | **TN36** |
| | Max | 94.63 | 94.90 | 94.77 | 94.31 | 94.24 | 93.87 |
| | Min | 94.24 | 94.55 | 94.44 | 93.98 | 93.92 | 93.56 |
| | Average | 94.43 | 94.72 | 94.60 | 94.14 | 94.08 | 93.71 |
| **R7 Hole37-Hole42** | | **TN37** | **TN38** | **TN39** | **TN40** | **TN21** | **TN22** |
| | Max | 94.30 | 94.44 | 94.04 | 93.81 | 94.89 | 95.35 |
| | Min | 93.95 | 94.05 | 93.67 | 93.48 | 94.39 | 94.90 |
| | Average | 94.13 | 94.24 | 93.86 | 93.65 | 94.64 | 95.12 |
| **R8 Hole43-Hole48** | | **TN23** | **TN24** | **TN25** | **TN26** | **TN27** | **TN28** |
| | Max | 95.99 | 95.63 | 95.28 | 95.29 | 95.45 | 94.87 |
| | Min | 95.57 | 95.15 | 94.82 | 94.84 | 94.99 | 94.48 |
| | Average | 95.78 | 95.39 | 95.05 | 95.07 | 95.22 | 94.68 |

**Approved By.** _____

# Metrological Center

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## Calibration Report

**Measurement Results**

| Calibration Point | | Average Standard Reading at each position (°C) | | | | | |
|---|---|---|---|---|---|---|---|
| **R1 Hole1-Hole6** | | **TN21** | **TN22** | **TN23** | **TN24** | **TN25** | **TN26** |
| CAL POINT | Max | 105.23 | 104.32 | 105.43 | 105.25 | 104.44 | 105.27 |
| 105 | Min | 104.94 | 103.95 | 105.15 | 105.04 | 104.11 | 104.96 |
| | Average | 105.09 | 104.13 | 105.29 | 105.15 | 104.28 | 105.12 |
| **R2 Hole7-Hole12** | | **TN27** | **TN28** | **TN29** | **TN30** | **TN31** | **TN32** |
| | Max | 105.30 | 105.12 | 105.18 | 105.22 | 105.12 | 105.16 |
| | Min | 105.11 | 104.92 | 104.96 | 105.00 | 104.92 | 104.97 |
| | Average | 105.20 | 105.02 | 105.07 | 105.11 | 105.02 | 105.06 |
| **R3 Hole13-Hole18** | | **TN33** | **TN34** | **TN35** | **TN36** | **TN37** | **TN38** |
| | Max | 105.37 | 105.63 | 105.02 | 104.80 | 104.69 | 105.19 |
| | Min | 105.17 | 105.37 | 104.75 | 104.59 | 104.50 | 105.00 |
| | Average | 105.27 | 105.50 | 104.88 | 104.69 | 104.60 | 105.09 |
| **R4 Hole19-Hole24** | | **TN39** | **TN40** | **TN21** | **TN22** | **TN23** | **TN24** |
| | Max | 105.31 | 104.43 | 106.41 | 104.71 | 105.63 | 105.82 |
| | Min | 105.08 | 104.22 | 106.15 | 104.41 | 105.37 | 105.56 |
| | Average | 105.19 | 104.33 | 106.28 | 104.56 | 105.50 | 105.69 |
| **R5 Hole25-Hole30** | | **TN25** | **TN26** | **TN27** | **TN28** | **TN29** | **TN30** |
| | Max | 104.95 | 106.26 | 103.34 | 105.78 | 105.59 | 105.87 |
| | Min | 104.67 | 105.96 | 103.08 | 105.56 | 105.36 | 105.68 |
| | Average | 104.81 | 106.11 | 103.21 | 105.67 | 105.48 | 105.77 |
| **R6 Hole31-Hole36** | | **TN31** | **TN32** | **TN33** | **TN34** | **TN35** | **TN36** |
| | Max | 104.75 | 104.86 | 104.80 | 105.20 | 104.50 | 104.39 |
| | Min | 104.54 | 104.63 | 104.59 | 105.00 | 104.32 | 104.18 |
| | Average | 104.65 | 104.75 | 104.69 | 105.10 | 104.41 | 104.28 |
| **R7 Hole37-Hole42** | | **TN37** | **TN38** | **TN39** | **TN40** | **TN21** | **TN22** |
| | Max | 104.30 | 104.90 | 104.85 | 104.65 | 104.88 | 104.85 |
| | Min | 104.09 | 104.72 | 104.66 | 104.49 | 104.63 | 104.52 |
| | Average | 104.19 | 104.81 | 104.75 | 104.57 | 104.76 | 104.68 |
| **R8 Hole43-Hole48** | | **TN23** | **TN24** | **TN25** | **TN26** | **TN27** | **TN28** |
| | Max | 105.71 | 105.85 | 105.39 | 105.61 | 105.42 | 105.19 |
| | Min | 105.45 | 105.61 | 105.14 | 105.27 | 105.18 | 104.94 |
| | Average | 105.58 | 105.73 | 105.27 | 105.44 | 105.30 | 105.07 |

**Approved By.** _____

# Metrological Center

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# Calibration Report

**Measurement Results:**

| HEATING BLOCK | | | Temperature Distribution | |
|---|---|---|---|---|
| Setting (°C) | Reading (°C) | | Stability (±°C) | Uncertainty (±°C) |
| | Min , Max | Average | | |
| 100.0 | 100.3 , 100.5 | 100.4 | 0.26 | 0.81 |
| 107.0 | 107.0 , 107.1 | 107.1 | 0.19 | 0.78 |

* 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

SCI ECO Services Company Limited

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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 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 Sirilut 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.

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** : **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

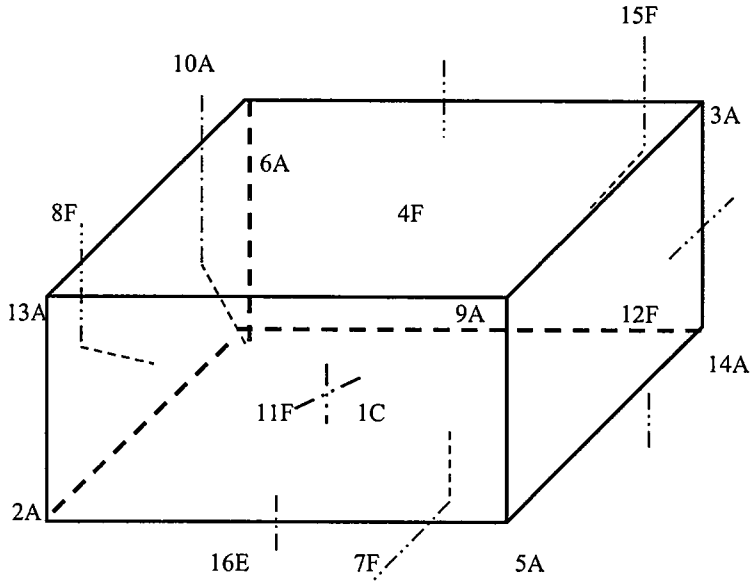
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.

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.**_____

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

**Measurement Results:**

| | Average Standard Reading at each position (°C) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Calibration Point** | **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.**