World Calibration Centre
for Aerosol Physics

TROPOS

Leibniz Institute for
Tropospheric Research

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| **Project No.** | CPC-2021-1-15 |
| **CPC Model:** | TSI CPC 3750 |
| **CPC Serial Number:** | SN3750204101 |
| **Customer:** | University of Bayreuth |
| **Description:** | Calibration of a Condensation Particle Counter |
| **Date of Calibration:** | November 10, 2021 |

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**Summary of Intercomparison:**

The candidate passed the quality standards of ACTRIS and GAW. The candidate reached 97% efficiency at 40 nm. The Dp50 is at 6.69 nm. The CPC efficiency curve corresponds to the standard of ACTRIS and GAW.

Certificate / Reference: WCCAP

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|---|---|---|---|
| Date of issue: | November 10, 2021 | Signature | |
| Reviewed by: | TROPOS | Name: | Dipl.-Met. Kay Weinhold |

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Table 1. Diagnostic information of candidate

| | Unit | Status |
|---|---|---|
| Participant | | Bayreuth 3750 SN3750204101 |
| CPC Model | | TSI 3750 |
| Firmware | | 2.3.0 |
| Manufacture date | | |
| Last service date | | |
| Arrival date | | |
| Software Version | | |
| Saturator Temperature | °C | 39 |
| Condenser Temperature | °C | 20 |
| Optics Temperature | °C | 40 |
| Cabinet Temperature | °C | 24 |
| Ambient Pressure | mbar | 100.9 |
| Vaccuum Pressure | kPa | 68.5 |
| Inlet Pressure | kPa | 0 |
| Critical Orifice Pressure | kPa | 66.1 |
| Aerosol Nozzle Pressure | kPa | 2.4 |
| Laser Current | mA | 42 |
| Liquid Level | | full |
| Aerosol Flow | L/min | 1 |
| Zero | avg 10 min | 0 |
| Physical inspection | | ok |
| Functional test | | ok |

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Table 2. Calibration and laboratory conditions

| | Information |
|---|---|
| Aerosol electrometer | TSI Electrometer Model 3068, SN 70838596 |
| Particles and gases used for calibration | silver particles and nitrogen |
| Method of particle generation | tube furnace generator |
| Electrometer calibration certificate | September, 2021, calibrated at PTB Braunschweig |
| Corrections of electrometer (i.e. differing flow rate) | Within tolerance range (+/-2%); reference: 4.0 l/min, measured: 4.0 l/min |
| Logging software | LabView 2010; National Instruments; Program „LabCount.vi“ |
| Uncertainty in measured flow rate | 3% |
| Flowmeter used | Gilian Gilibrator 3; SN 21181001005, 2021 |
| Lab Tempreature and Pressure | 23.0°C, 1018 mbar |

Table 2. Efficiency of candidate CPC per diameter against the Electrometer

| Diameter | EL 3068B (#/cm³) | Pulse Output | | Internal Output | | Internal/ Pulse |
|---|---|---|---|---|---|---|
| | | Concentration (#/cm³) | Efficiency (µ) | Concentration (#/cm³) | Efficiency (µ) | |
| 40nm | 1592 | 1539 | 0.97 | 1610 | 1.01 | 1.04 |
| 30nm_2 | 1369 | 1331 | 0.97 | 1379 | 1.01 | 1.04 |
| 30nm | 1211 | 1176 | 0.97 | 1231 | 1.02 | 1.05 |
| 20nm | 1216 | 1171 | 0.96 | 1219 | 1.00 | 1.04 |
| 14nm | 1404 | 1279 | 0.91 | 1335 | 0.95 | 1.04 |
| 11nm | 1228 | 1034 | 0.84 | 1075 | 0.88 | 1.05 |
| 10nm | 1527 | 1201 | 0.79 | 1252 | 0.82 | 1.04 |
| 9nm | 1575 | 1144 | 0.73 | 1194 | 0.76 | 1.04 |
| 8nm | 1402 | 911 | 0.65 | 950 | 0.68 | 1.05 |
| 7nm | 1704 | 921 | 0.54 | 956 | 0.56 | 1.04 |
| 6nm | 1689 | 639 | 0.38 | 665 | 0.39 | 1.03 |
| 5nm | 1216 | 151 | 0.12 | 157 | 0.13 | 1.08 |
| 4nm | 438 | 3 | 0.01 | 3 | 0.01 | 1.00 |

Table 3. Linearity of candidate CPC against the Electrometer

| EL 3068B (#/cm³) | Pulse Output | | Internal Output | | Internal/ Pulse |
|---|---|---|---|---|---|
| | Concentration (#/cm³) | Efficiency (µ) | Concentration (#/cm³) | Efficiency (µ) | |
| 1959 | 1897 | 0.97 | 1976 | 1.01 | 1.04 |
| 4257 | 4091 | 0.96 | 4287 | 1.01 | 1.05 |
| 8350 | 7833 | 0.94 | 8323 | 1.00 | 1.06 |
| 12226 | 11324 | 0.93 | 12174 | 1.00 | 1.08 |
| 21100 | 18901 | 0.90 | 20872 | 0.99 | 1.10 |
| 28852 | 24758 | 0.86 | 28075 | 0.97 | 1.13 |
| 41999 | 34681 | 0.83 | 40915 | 0.97 | 1.17 |
| 48722 | 39532 | 0.81 | 47542 | 0.98 | 1.21 |
| 61953 | 48273 | 0.78 | 60510 | 0.98 | 1.26 |

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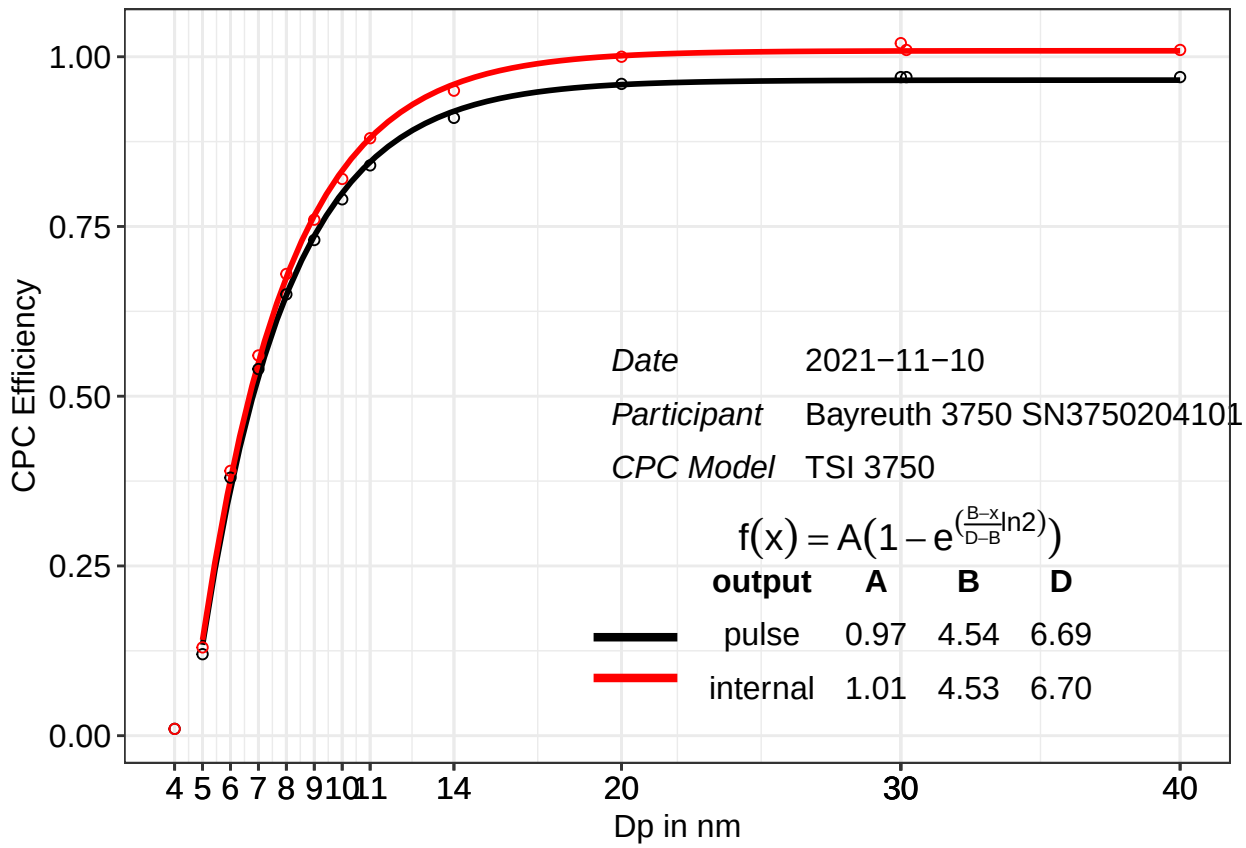


Fig. 1. Counting efficiency of candidate CPC against aerosol electrometer 3068 SN 70838596; silver particles between 5 nm and 40 nm were used for calibration.

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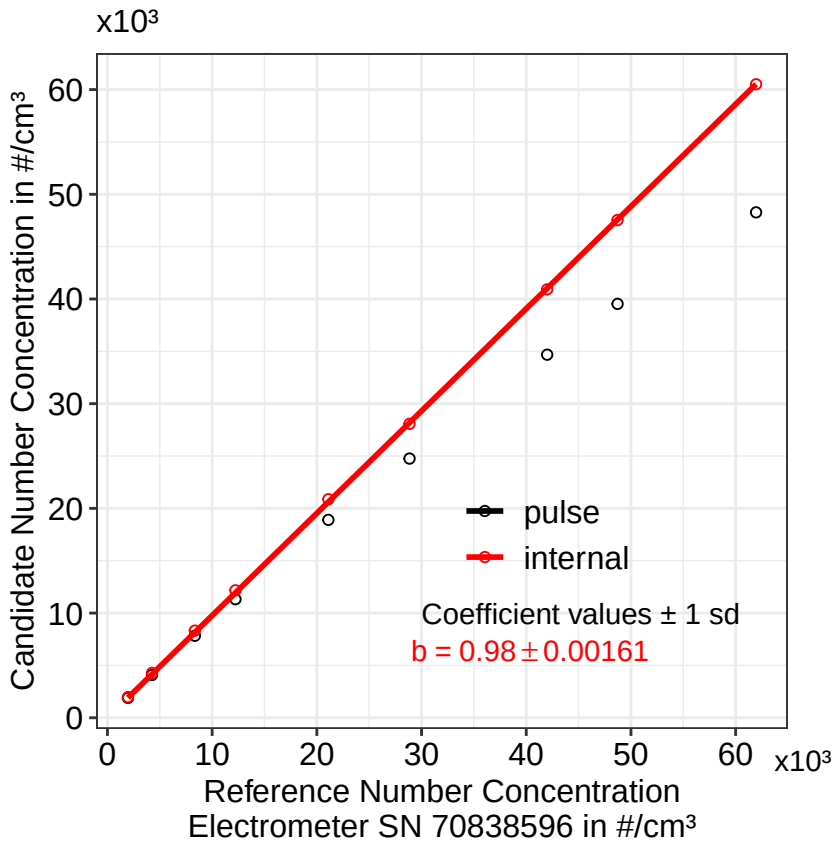


Fig. 2. Linearity for candidate CPC against aerosol electrometer 3068 SN 70838596; silver particles with a diameter of 30 nm were used for number concentrations between 2000 particles per cm³ and 60000 particles per cm³.

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| **Date of issue:** | *November 10, 2021* |
| Reference: | TSI electrometer, model 3068, SN 70838596 |
| Reviewed: | TROPOS/Kay Weinhold |

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