

1. Revision History

| REVISION | EFFECTIVE DATE | ENGINEERING APPROVAL |
|----------|----------------|--------------------------|
| D | 03/21/03 | <i>David L. Chandler</i> |

SOURCE: RANDY GRATER

| | | |
|-------------------|--------|--|
| August 11, 2002 | Rev. A | Initial release |
| January 27, 2003 | Rev. B | Inserted revision history as Section 4 Old Section 8, new Section 9: changed spec for count ratio from 2-20 to 1.5-20 to reflect realistic range for 3 μ m and 5 μ m particle counts. |
| February 25, 2003 | Rev. C | In Section 9: changed upper range of count ratio between channels from 20 to 30 to reflect normal variations in particle populations. |
| March 18, 2003 | Rev. D | Revised Section 9: Reduced the number of channels to check in ambient air to the first three. |

2. Purpose

Operation Qualification (OQ) provides a detailed check list for verifying the proper operation of each feature of the particle counter. This includes verifying that the instrument operates within specified tolerances and limits.

3. Scope

This procedure is intended for use in performing the OQ of the CI-550 optical particle counter. Most of the OQ testing will be performed by the user, but copies of the calibration certificate and count efficiency testing should be included with this document to cover those parts of operational testing that cannot be practicably performed by the user. Because the CI-550 serves a wide range of applications, this document should be reviewed, and those portions unrelated to the intended application can be marked as N/A (not applicable).

4. Application

This procedure is intended for use by the owner of the equipment to document the Operational Qualification of this instrument.

[END OF COVER SHEET; WORK SHEET FOLLOWS]

OQ APPROVAL WORK SHEET

NAME: _____

SIGNATURE: _____

DATE: _____

LOCATION: _____

FOR: CI-550, S/N _____

5. Calibration documentation

(Particle counter calibration requires specialized equipment and training. Most facilities are not equipped to verify the particle calibration or count efficiency.)

Calibration and count efficiency verification supplied by:

- Climet metrology/instrument services department
 third party service: _____

| DOCUMENT | PRESENT (Y/N) | INITIAL | DATE |
|----------------------------|---------------|---------|------|
| Calibration certificate | | | |
| Count efficiency statement | | | |

6. Battery and charger qualification

(If battery has not already been installed, install battery at this time.)

| | OPERATION | OK (Y/N) | INITIAL | DATE |
|---|--|----------|---------|------|
| 1 | Plug unit into AC: charger STATUS light comes on | | | |
| 2 | Allow unit to charge battery. (Depending on battery charge, may require up to 2.5 hours to reach full charge.) After battery is fully charged, the CHARGER STATUS light will flash continuously. | | | |
| 3 | After battery is completely charged, press POWER button to turn unit on. The CHARGER STATUS light goes off when unit is on | | | |
| 4 | Unplug particle counter. Remove the dust cap. Attach the zero count filter (from accessories) to the inlet. Press {START} key. Battery charge holds at 4.5 hours for ≥ 1 minutes. | | | |

7. Airflow regulation qualification

(Plug unit into AC power to preserve battery life during the following tests.)

| | OPERATION | OK (Y/N) | INITIAL | DATE |
|---|--|----------|---------|------|
| 1 | <p>FLOW STABILITY</p> <p>Remove dust cap from inlet. From main display (particle count) screen, press {START} key. Check lower left corner of particle count window; verify that flow reads 1.00 CFM, ± 0.02 CFM.</p> | | | |
| 2 | <p>FLOW REGULATION WITH FLOW RESTRICTION</p> <p>Place zero count filter (from accessories) on inlet; verify that flow stabilizes at 1.00 CFM, ± 0.02 CFM after a second or so.</p> | | | |
| 3 | <p>FLOW REGULATION WITH RESTRICTION REMOVED</p> <p>Remove filter from inlet. Verify that flow returns to stable 1 CFM flow (± 0.02 CFM) after a second or so.</p> | | | |
| 4 | <p>BLOWER PROTECTION</p> <p>Place dust cap over inlet to block flow. After 2 ½ minutes blower will shut off to protect the blower when inlet is blocked.</p> | | | |

8. Memory and printer qualification

| | OPERATION | OK (Y/N) | INITIAL | DATE |
|---|---|----------|---------|------|
| 1 | <p>MEMORY RETENTION:</p> <p>(Note date and time. If not current, refer to manual and set correct date and time.)</p> <p>Turn unit off momentarily, then power unit back on. Verify the time and date have been retained, i.e., memory back-up is working properly.</p> | | | |
| 2 | <p>PRINTER-DISPLAY AGREEMENT</p> <p>Enable End of Sample (EOS) printouts. (SET-UP-PRINT END OF SAMPLE)</p> <p>Set the sample volume to 1 cubic foot (1 minute). (SET-UP-VOLUME-1-CUBIC FOOT-EXIT)</p> <p>Set number of samples to 1. (SET-UP-STOP AFTER N-1-EXIT)</p> <p>Press START. After EOS printout, compare counts on tape with counts on display. Counts should be the same.</p> | | | |

| | | OK (Y/N) | INITIAL | DATE |
|---|--|----------|---------|------|
| 3 | <p>MEMORY-DISPLAY-PRINTER AGREEMENT</p> <p>Access data in memory by pressing REPORT-ALL DATA. The first data set will be from the last sample. It should match the counts of the printout taken above.</p> | | | |
| 4 | <p>DATA DUMP</p> <p>Press REPORT-ALL DATA-PRINT. Printer will print all samples stored in memory.</p> | | | |
| 5 | <p>CLEAR MEMORY</p> <p>Press REPORT-CLEAR DATA-YES to clear memory. Press ALL DATA and verify stored data has been cleared.</p> | | | |

9. Counting operation qualification

| | OPERATION | OK (Y/N) | INITIAL | DATE |
|---|---|----------|---------|------|
| 1 | <p>SAMPLE DURATION VERIFIED</p> <p>Press START. Verify that the 1 cubic foot sample takes 60 seconds, not counting the delay period.</p> | | | |
| 2 | <p>NORMAL PARTICLE DISTRIBUTION VERIFIED</p> <p>Take a one cubic foot sample in an area that has fewer than 1 million particles per cubic foot.</p> <p>In TOTAL COUNT MODE, the 0.3 μm count is typically 5 to 25 times the 0.5 μm counts, which are typically 5 to 25 times greater than the 1 μm counts.</p> <p>This is not an absolute test. The ratio of counts may vary from one environment to another, due to variations in the population of particles. If one or more channels do not quite meet the criteria, but are reasonably close, those values should be accepted as normal for the environment where the particle counter is being tested.</p> <p>If any of the larger channels fail to count, snap your fingers over the inlet to provide larger particles. You should register a few counts on all channels.</p> | | | |
| 3 | <p>TOTAL COUNT MODE</p> <p>Press SET-UP to enter the set-up screen. If TOTAL in the DISPLAY section is not green, press it to enable the TOTAL COUNT mode. PRINT END OF SAMPLE should be green; if not, press to enable. Take a single sample with inlet uncovered. Counts should increase progressively up to the end of sample.</p> | | | |

| | | | | |
|---|--|--|--|--|
| 4 | <p>CONCENTRATION COUNT MODE</p> <p>Enter setup menu and press COUNT/CF in the DISPLAY section of the setup menu. Take another sample. Displayed counts will increase and decrease from second to second, but after a few seconds, the counts will be similar to the final count recorded in TOTAL COUNT mode; COUNT/CF provides a moment-to-moment picture of the changing concentration in the area.</p> | | | |
| 5 | <p>ZERO COUNT VERIFICATION</p> <p>Place counter in TOTAL COUNT mode. (Refer to procedure 3 in this section.) Place a filter over the inlet. Take a sample to clean out the sensor, then take a second sample. Two or fewer counts should be registered, demonstrating that the sensor is clean and will not produce significant background counts that could skew room readings.</p> | | | |

10. Alarms qualification

| | OPERATION | OK (Y/N) | INITIAL | DATE |
|---|--|----------|---------|------|
| 1 | <p>BEEP ON COUNT (BOC)</p> <p>Go to the ALARMS menu in the setup menu and press BEEP ON COUNT so that it is green. Place a filter over the inlet and then press the START key on the main screen. You should hear chirping that dies off as the sensor cleans up, showing that the alarm beeps for each particle passing through the sensor. (If there are no counts, momentarily remove the filter.)</p> | | | |
| 2 | <p>BEEP ON ALARM</p> <p>Return to the ALARMS menu and press BEEP ON ALARM, so that it is green, and the BEEP ON COUNT key so that it is yellow. From the previous EOS printout, select a particle size for which to set an alarm level. Press the key for the particle size for which you are going to set an alarm, and set the alarm for roughly ¼ the counts that appeared on the last ambient air print out for that channel. Return to the main count screen, and press START. Sample with the filter off. The alarm will continue to beep, once the counts for that channel exceed the alarm level set. Press the flashing RESET ALARM key to silence the alarm. After the sample is over, go to the alarms menu and clear the alarm.</p> | | | |

11. Disk drive qualification

| | OPERATION | OK (Y/N) | INITIAL | DATE |
|---|---|----------|---------|------|
| 1 | <p>DRIVE OPERATION</p> <p>While not sampling, insert a blank floppy disk into the drive. Open the inlet to ambient air. Enable the on-board printer to print end of sample data. Press the {START} key. Leave the printer/disk drive door open. Verify that at the end of the sample the disk drive light momentarily flashes indicating that data is stored to the disk.</p> | | | |
| 2 | <p>DRIVE DATA STORAGE</p> <p>Press {STOP} key. Remove the disk from the disk drive. Insert the disk into a Windows® based PC and open the file with Windows® Notepad. (The file extension is .DAT.) Verify that the data in the file includes a line of labels separated by commas and a line of data separated by commas.</p> | | | |
| 3 | <p>DRIVE DATA ACCURACY</p> <p>Verify that number to the right of the 8th comma matches the counts >0.5 µm on most recent printout of the on-board printer.</p> | | | |

[END OF OQ TESTING]