**Title:** Acceptance Test Procedure for the Certification of Cleanrooms  
**ATS-ATP-3400**  
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**Revision:** C  
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1. Purpose

This document provides instruction for the certification of cleanrooms and controlled environments.

2. Scope

This procedure shall be followed by personnel performing cleanroom certifications. Additional testing and or deviation from this SOP shall be agreed upon prior to the start of testing.

Note: Facilities Standard Operating Procedures will be followed per client request.

3. References

1. Institute of Environmental Sciences Contamination Control Division Recommended Practice IES-RP-006.3 “Testing Cleanrooms”
5. Material Safety Data Sheets (MSDS) located immediately outside the cleanroom.

4. Equipment and Materials

Equipment:
1. Airflow Velocity Meter – electronic micromanometer with tube array or equivalent.
2. Aerosol Generator – Laskin nozzle compressed air operated DOP/Emery 3000 generator
3. Aerosol Photometer – sampling flow rate of 1.0 cfm, linear readout.
4. Laser Particle Counter capable of measuring particulate relative to the classification of the room.
5. Light meter
6. Noise meter
7. Temperature and Humidity Meter

5. Safety

1. Wear proper cleanroom gowning attire as specified by facility SOP or as instructed by facility point of contact.

2. Avoid lifting heavy equipment. Wait for help from another employee prior to lifting any heavy equipment.

3. Avoid reaching while working on a ladder. Move the ladder to ensure proper access to your concern. Do not step on the top two rungs of a step ladder.

4. Refer to manufacturer’s safety precautions and Material Safety Data Sheet (MSDS) for appropriate protective equipment and safe handling procedures when using chemicals.

6. Responsibility

1. It is the responsibility of the President to maintain this document and oversee these activities.

2. It is the responsibility of the individual(s) performing this task to follow this procedure.

7. Preliminary Operations

1. Collect all materials and equipment necessary to conduct the certification.

2. Ensure all equipment is within calibration prior to the start of use.

3. Wipe down all equipment in accordance with the facility SOP or use a 70% ethanol, 30% water solution unless otherwise instructed by the facility point of contact.
8. Cleanroom Operational Phases

Testing may be performed at different stages as characterized by the completeness of the cleanroom installation and operational modes as defined below.

Stage 1  As-Built-Facility: A cleanroom which is complete and operating with all services connected and functioning, following initial clean down. There is to be no process equipment or operating personnel within the facility.

Stage 2  At-Rest-Facility: A cleanroom with is complete and operating. The room is to be fully populated with process equipment staged in a non-operational mode. There shall be no operating personnel present.

Stage 3  Operating Facility: A cleanroom in normal operation fully populated with functioning process equipment and operating personnel.

NOTE: At times it will be necessary to take exception to strict compliance with the aforementioned testing stages. Deviation or interaction among the stages may be required due to availability or operational status of the process equipment. These situations shall be identified and acknowledged as part of the contractual agreement.

9. TEST PROCEDURES AND ACCEPTANCE CRITERIA

A. Airflow Velocity, Volume, and Uniformity Tests

1. Purpose

These tests are performed to determine average airflow velocity and uniformity of velocity within a cleanroom or clean zone, and also to determine air supply volume flow rate and volume uniformity. Typically, either airflow velocity or airflow volume testing will be performed, and results will be requested in only one format, average velocity or average volume. The results may also be used to determine the total airflow volume and the subsequent air exchange rate (room air volume changes per hour).
2. Apparatus

Airflow Velocity: An electronic micromanometer with tube array, (VELGRID), or thermal anemometer.

Airflow Volume: An electronic micromanometer with an appropriate airflow hood.

3. Procedure

3.1. Airflow Velocity Test

1) Measurements using electronic manometer and tube array, (VELGRID).

Assemble VELGRID in accordance with the instrument operations manual. Ensure that the manometer multimeter is in the VELGRID mode, and the units are feet per minute (fpm).

Divide the filter or diffuser face into equal grids of approximately 2’ x 2’. Grid sizes should not exceed 4 sq.ft., but may be smaller. Place the VELGRID probe on the filter or diffuser face in the center of each grid section of the filter face and measure the velocity.

Record the measurements for each filter or diffuser at the corresponding location on a reflective ceiling layout of the cleanroom or clean zone.

2) Measurements using a thermoanemometer

Attach the thermoanemometer test probe to an appropriate equipment stand and set instrument to read feet per minute (fpm).

Divide the area of the filter or diffuser face into equal grids of approximately 2’x 2’ at a measurement plane no more than 6 inches below the supply source. Grid sizes should not exceed 4 sq.ft. Orient
the probe perpendicular to the velocity flow vector to be measured. Measure the velocity at the center of each grid point for a minimum of five seconds, recording the average during this period as the measurement.

Record the measurements for each filter or diffuser at the corresponding location on a reflective ceiling layout of the clean room or clean zone.

3.2. Airflow Volume Test

The filter supply airflow volume is measured by using a flow hood in a manner that includes all of the air issuing from each terminal filter or supply diffuser. The airflow volume test should be performed as follows.

Assemble the flow hood with electronic monometer in accordance with the manufacturer’s operating manual. Ensure that the multimeter is in the flow hood mode and that units are cubic feet per minute.

Place the flow hood opening completely over the filter or diffuser, seating the face of the hood against a flat surface to prevent air bypass and inaccurate readings. Measure the volume flow rate in cfm for each filter or diffuser.

Record the measurements for each filter or diffuser at the corresponding location on a reflective ceiling layout of the cleanroom or clean zone.

3.3. Acceptance

The average airflow velocity, or the average or total airflow volume, for the cleanroom or clean zone should be within +/- 5% of the value specified for the cleanroom or clean zone, or within other tolerance limits set forth by the facility SOP.
The airflow uniformity ranges for each individual filter or diffuser is +/- 20% of the measured average airflow velocity or volume or as specified by the facility SOP.

B. HEPA and ULPA Filter Installation Leak Tests

1. Purpose

These tests are performed to confirm that the HEPA or ULPA filter system is properly installed by verifying the absence of bypass leakage in the installation, and that the filters are free of defects and small leaks. The tests are performed by introducing an aerosol challenge upstream of the filters and scanning immediately downstream of the filters and support frame or sampling in a downstream duct.

2. Apparatus

A total scattering aerosol photometer with a linear or expanded logarithmic scale, or equivalent, that is capable of detecting a 100% upstream concentration with an aerosol concentration of 10 ug/L of polydisperse dioctylphthalate (DOP) particles, or an equivalent fluid that produces the same particle size distribution when generated by a Laskin nozzle generator, or equivalent, and is capable of detecting an aerosol concentration of 1 x 10^{-3} ug/L of the same particles. The photometer is to have an air sampling rate of 1 cfm +/- 10%. Probe diameter is not to exceed 1 inch.

A Laskin nozzle generator or equivalent. The aerosol is to be diluted with air flowing through the cabinet to a concentration not greater than 100 ug/L nor less than 10 ug/L upstream of the HEPA or ULPA filter undergoing the leak test.

3. Procedure

3.1 Aerosol Challenge and Aerosol Photometer Scan
a) Introduce the aerosol into the air supplied to the filter or filters under test in a manner that will produce a uniform challenge concentration over each filter’s surface.

Where construction permits, means should be provided to challenge and test filters one at a time to minimize exposure of the filters to the challenge aerosol.

Where construction dictates that multiple filters must be exposed to the challenge aerosol simultaneously, the aerosol should be introduced at a location that will provide uniform concentration to all of the filters.

b) Measure the concentration of the challenge aerosol immediately upstream of the filters under test, using a photometer whose sensitivity is adjusted to a baseline of 100 ug/L in accordance with the manufacturer’s instructions or calibration curve. A reading of 10% to 20% (which corresponds to 10 to 20 ug/L of air) on the photometer should be obtained for correct challenge concentration. Adjust the sensitivity, gain, or span for a reading of 100%, or full scale while sampling the upstream aerosol.

c) Scan the entire face of each filter for leaks, using slightly overlapping strokes of the probe. Also scan the perimeter of each filter to locate leaks in the bond between the filter pack and the frame and leaks in the seal between the frame and the grid structure. The probe should be held immediately downstream of the filter and support frame face during scanning. The scanning rate should not exceed 2 inches per second.

Any indication of a leak in excess of 0.01% of the upstream challenge aerosol concentration or the agreed upon limit for the filter being scanned should be cause for sustained residence time of the probe at the leak location. The size and location of the leak are identified by the position of the probe that maintains the maximum sustained reading on the photometer.
Report all leaks exceeding 0.01% of the upstream challenge aerosol concentration or as otherwise agreed upon by the customer and ATS. Record the size and location of the leaks on a reflective ceiling layout of the cleanroom or cleanzone.

d) Repairs for HEPA and ULPA filters may be performed providing the total size of the repairs do not block or restrict more than 3% of the filters face area and that the lesser dimension of any repair does not exceed 1.5 inches or as otherwise agreed upon by the customer and ATS. Repairs to filter installation leaks will be made in accordance with procedures acceptable to the customer and ATS. After the repair is complete and suitable cure time has been allowed for the patch to set, check for leaks in the vicinity of the repair.

3.2 Acceptance

Acceptance for the air-generated aerosol challenge and aerosol photometer filter scan test shall be in accordance with the facility SOP or as agreed upon by the customer and ATS.

C. Airborne Particle Count Test

1. Purpose

This test is performed to determine that the completed as-built, at-rest, or operating facility can meet the ISO 14644, (FED-STD-209), air cleanliness class specified by the customer.

2. Apparatus

A laser particle counter, Met One Model A2400 or equivalent, with a minimum of two particle size ranges, (0.5 and 5.0 micron), and a minimum count ratio of 2:1.

3. Procedure

a) Verify that all components of the cleanroom system which contribute to its operation are complete and functioning in accordance with the requirements of
the type of cleanroom and the operational mode under test as agreed upon by the customer and ATS.

b) Establish a test point grid at the working level that will satisfy user requirements and determine the number of sample locations that satisfy the specified cleanliness class. Determination of the number, location, and grid pattern of sampling points should be based on the specified cleanliness class and the grid specifications of ISO 14644 (FED-STD-209).

c) Perform the airborne particle test by operating the laser particle counter in accordance with the manufacturer’s operational manual at the predetermined sampling locations. Ensure that the measurements are made under ambient conditions and that no upstream challenge has been induced.

d) Reporting for the airborne particle count challenge should include the following:

1) Particle size range
2) The volume of air sampled
3) The particle counts
4) The time
5) The sampling point locations

e) Acceptance

To verify that the air in the cleanroom or clean zone has met the specified cleanliness class, the average particle concentration at each sample location should fall at or below the class limit, and the mean of these averages should fall at or below the class with a 95% confidence limit as described in ISO 14644 (FED-STD-209).
D. Room Pressurization Test

1. Purpose

The purpose of this test is to verify the capability of the cleanroom system to maintain the specified pressure differential between the cleanroom and its surroundings. This test is to be performed after the facility has met the acceptance criteria for airflow velocity or volume as agreed upon by the customer and ATS.

2. Apparatus

Apparatus for the room pressurization test should consist of an electronic micromanometer, inclined manometer, or mechanical differential pressure gauge.

3. Procedure

a) Ensure that all doors are closed inside the cleanroom. Measure and record the pressure differential between the cleanroom and anteroom (if present), and between the anteroom and the external environment. If there is no anteroom present, measure and record the pressure differential between the cleanroom and the external environment.

If the clean space is subdivided into more than one room, measure the pressure differentials between the innermost room and the next room in order. Continue until the last room has been measured against the external environment.

b) Report all measured values to the nearest 0.01 in. water gauge or as otherwise agreed upon. Record the locations at which the measurements were made on a reflective layout of the clean spaces.

c) Acceptance levels for the room pressurization tests are agreed upon by the customer and ATS prior to testing.
E. Lighting Intensity Test

1. Purpose

The purpose of this test is to verify that the specified lighting levels and lighting uniformity within the cleanroom have been met.

2. Apparatus

A portable photoelectric illumination meter approved for field measurements in accordance with the current edition of the Illuminating Engineering Society (IES) Lighting Handbook and adjusted for measurements in accordance with the manufacturer’s instructions.

3. Procedure

a) Ensure that a preliminary operating period of at least 100 hours for fluorescent lighting, or 20 hours for incandescent lighting, has preceded this test so that proper seasoning of the lighting fixtures has been attained. Make all measurements after the room has operated the amount of time necessary for temperature stabilization.

b) Make lighting level measurements at the working level above the floor in accordance with the field measurement procedures outlined in the IESNA Lighting Handbook, or as outlined in the facility SOP.

c) Report lighting intensity levels and locations on a diagram of the cleanroom. Calculate the overall average lighting level in accordance with the IESNA procedures, or as specified by the facility SOP.

d) Acceptance of the overall lighting intensity levels shall agreed upon by the customer and ATS.

F. Noise Level Test

1. Purpose
The purpose of this test is to measure the airborne sound pressure levels produced by the basic cleanroom mechanical and electrical systems within the room and in adjacent external occupied areas, and to verify that the performance meets the customer’s specifications.

2. Apparatus

   a) A sound level meter with a range of at least 50 to 100 db, and an “A” weighting scale calibrated in accordance with the manufacturer’s instructions.

   b) A sound-level calibrator.

3. Procedure

   a) Divide the work zone entrance plane into a grid of equal areas. The areas should not exceed 430 ft². Measure and record the sound pressure level at the center of each grid.

   b) Report noise intensity levels and locations on a diagram of the cleanroom.

   c) Acceptance of overall noise intensity levels for the cleanroom shall be agreed upon by the customer and ATS.

G. Temperature and Humidity Test

1. Purpose

   The purpose of these tests is to demonstrate the capability of the cleanroom air-handling system to maintain air temperature and moisture levels within the control limits and over the time period specified by the facility requirements.

2. Apparatus
Temperature: Thermometers, resistance temperature devices (RTD’s), high-grade Type T (copper/constantan) thermocouples, thermistors, or other known temperature sensors used with readout devices calibrated to standards and capable of indicating a change in temperature of 0.1 Celsius degree or equivalent.

Humidity: Dielectric thin-film-capacitor humidity sensors with a range of 10% to 95% relative humidity. Humidity sensors should be calibrated to known standards and be capable of indicating a change in relative humidity of 1%.

3. Procedure

3.1. Temperature Test

This test is performed following completion of airflow uniformity tests and adjustment of air conditioning controls.

a) Allow the air-conditioning system to operate for 24 hours before testing. Measure the temperature at a minimum of one location for each temperature control zone. Place the sensor at the designated location at work-level height. Allow sufficient time for the sensor to stabilize.

b) Report temperature readings and locations on a diagram of the cleanroom.

c) Acceptance of temperature readings for the cleanroom shall be agreed upon by the customer and ATS.

3.2 Humidity Test

This test is performed following completion of airflow uniformity tests and adjustment of air conditioning controls.

a) Locate the humidity sensor at the corresponding temperature location. Allow sufficient time for the sensor to stabilize.
b) Report humidity readings and locations on a diagram of the cleanroom.

c) Acceptance of humidity readings for the cleanroom shall be agreed upon by the customer and ATS.

H. Additional Testing

Additional tests may be performed as agreed upon between the customer and ATS. All additional tests are to be in accordance with Reference 1.