

SECTION 13 60 19
CLEANROOM CERTIFICATION

PART 1 - GENERAL

1.1 CONDITIONS AND REQUIREMENTS

- A. Clean Zone requirements are specified in Sections 01 50 13 and 13 60 13.
- B. Cleanroom cleaning procedures are specified in Section 13 60 16.
- C. Testing and balancing of mechanical systems are specified in Mechanical Specification Divisions.

1.2 DESCRIPTION OF WORK

- A. Employ and pay for the services of a qualified Cleanroom Testing and Certification Agency, as a subcontractor to perform specified services:
 - 1. The Cleanroom Testing and Certification Agency shall be independent from the Cleanroom Contractor, system manufacturers and installers.
 - 2. Cleanroom testing and certification shall be a separate activity from other services which may be offered by the Cleanroom Testing and Certification Agency.
 - 3. The Cleanroom Testing and Certification Agency and the Cleanroom Air Systems Testing and Balancing Agency shall be different companies.
 - 4. Employment of the independent subcontractor shall in no way relieve the Contractor's obligation to perform the Contract work.
- B. Certification shall certify that the completed construction of the scheduled cleanroom areas complies with the air cleanliness classification required in accordance with International Organization for Standardization (ISO) 14644.
- C. Test methods used for characterizing the performance of cleanrooms shall be in accordance with ISO 14644:
 - 1. Specific tests and the acceptance criteria shall comply as specified.
 - 2. Institute of Environmental Sciences and Technology IEST-RP-CC006.3, "Testing Cleanrooms", is also an acceptable standard if the Certification Agency requests in writing to the Owner:
 - a. Desired test(s) substitution(s).
 - b. Reasons for the substitutions.
 - c. Verification that test substitutions are equal to or more stringent than' the specified ISO Test.

1.3 REFERENCES

- A. ISO 1644-4 Cleanrooms and Associated Controlled Environments and ISO 14644, Cleanrooms and Associated Controlled Environments Parts 1 through 4.

International Organization for Standardization
Geneva, Switzerland
www.iso.org
- B. IES-RP-CC-006, Testing Cleanrooms and IES-RP-CC-001, HEPA and ULPA Filters.

Institute of Environmental Sciences
940 East Northwest Highway
Mount Prospect, IL 60056
- C. NEBB Procedural Standards for Certified Testing of Cleanrooms.

National Environmental Balancing Bureau (NEBB)
8575 Grovemont Circle

Gaithersburg, MD 20877

- D. Federal Standard 209E, Airborne Particulate Cleanliness Class for Cleanrooms and Clean Zones:

General Services Administration
Specifications Activity
Printed Materials Supply
Bldg. 197, Naval Weapons Plant
Washington,DC 20407

- E. ESD Association Standards.

Electrostatic Discharge Association
200 Liberty Plaza
Rome, NY 13440

- F. NEBB, Procedural Standards for Measuring Sound and Vibration.

National Environmental Balancing Bureau (NEBB)
8575 Grovemont Circle
Gaithersburg, MD 20877

1.4 QUALITY ASSURANCE

- A. Certification Agency shall be N.E.B.B. (National Environmental Balancing Bureau) Certified.
- B. The Certification Agency shall have been in business a minimum of 15 years specializing in cleanroom testing and certifying work.
- C. Cleanroom Testing and Certification Agency shall supervise all tests and shall provide competent test technicians to conduct all tests in the presence of the Owner's authorized representative:
1. Test technicians shall have a minimum of four years uninterrupted service, devoted exclusively to the Testing and Certification of Cleanroom Facilities, or shall be directly supervised by a test technician with these qualifications.
- D. Tests shall be performed after initial operating and balancing adjustments have been satisfactorily completed:
1. A copy of the Air Balancing Report shall be provided by the Contractor to the Testing and Certification Agency, and this report shall satisfy requirements that the facility is ready for "Cleanroom Certification" testing.
- E. Instrumentation to be used shall be in accordance with the descriptions given in each test procedure, and shall have a demonstrated accuracy and sensitivity suitable for the test procedure:
1. Instruments shall be properly calibrated according to the manufacturer's recommendations, and shall be so certified by Cleanroom Testing and Certification Agency at the time of the test.
- F. No certification testing shall be initiated or conducted without notifying the Owner's authorized representative.

1.5 SUBMITTALS

- A. Information to be submitted with Bid or Work Proposals:
1. Submit qualifications and references of the proposed Testing and Certification Agency, supervisor, and personnel.
 2. Submit a list of cleanroom projects similar in size, general scope, and cleanliness classes to this Project.
 3. Submit program of test procedures and specimen copy of each of the typical report forms and charts proposed for use for the Project.
 4. Submit complete list of instruments proposed to be used, organized in appropriate categories, with data sheets for each indicating:
 - a. Manufacturer and model number.

- b. Size, capacity, and sensitivity range.
 - c. Serial number.
 - d. Latest calibration date and method of calibration employed.
- B. Certification Testing Submittals:
1. Submit a schedule for performing all tests specified, indicating the duration of the testing period for each room identified in the Schedule of Required Classifications.
 2. After completion and acceptance of all required tests, the Cleanroom Testing and Certification Agency shall compile all of the test and certification data and shall submit three copies of the completed report to the Owner and Architect for approval:
 - a. The report shall include a signed and dated certificate, stating compliance with the specified performance criteria.
 - b. The report submitted shall include signatures and seal of the Supervisor.
 - c. Contents of completed report shall be in accordance with the NEBB *Procedural Standards for Certified Testing of Cleanrooms*. The Cleanroom Certification report shall include, but is not limited to the following items:
 - 1) Tabulate all test data on 8-1/2 inch by 11 inch sheets bound in a report. Identify all test data by grid location. Grids shall be reviewed with the Owner and Architect prior to award of Contract.
 - 2) Drawings: Include prints of the Cleanroom Floor Plans and Reflected Ceiling Plans made from the contract drawings with testing and certification locations shown on the drawings. (Sample Test Report Forms may be found in Chapter 13--*Sample Test Report Forms* in the NEBB *Procedural Standards for Certified Testing of Cleanrooms*).
 - 3) Test Equipment: Furnish a complete list of all test equipment used in performing the work with serial numbers and verification of the latest calibration dates. All equipment will be reviewed with the Owner and Architect prior to commencement of certification test work.
 - 4) Furnish in the report, a written statement, signed by the Supervisor, stating that all work has been performed in accordance with the requirements of this section unless specifically noted otherwise in the report.
 - 5) Include a description of all tests performed, including the purpose, instrumentation, procedures, results, and analysis of the data. Data shall be presented and graphically displayed on NEBB forms to permit full understanding of all tests by the Owner and Architect.
 3. Submit reports of all initial tests and retesting required after corrective measures have been taken.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. The certification Agency shall provide all materials and testing equipment and instruments to perform the certification work and required submittals.
- B. Refer to Sections 13 60 13 and 13 60 16 for Clean Zone and Protocol requirements for working in the clean zones.
- C. The Contractor shall supply the Certification Agency with any required protocol requirements such as apparel and cleaning materials.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION

- A. Prior to the start of Cleanroom Certification Testing, the Testing and Certification Agency shall verify that the work of the Air and Water Balancing Subcontractor has been completed:

1. In addition, the Testing and Certification Agency shall verify that all construction Contract work has been completed within the clean space.
2. Prior to the start of Airborne Particle Monitoring, the Cleanroom shall be cleaned to the satisfaction of the Testing and Certification Agency:
 - a. All Pre-Certification requirements and procedures have been completed and the Certification Agency has provided the Owner and Architect written notification that pre-testing procedures have been completed and the testing schedule is ready to be initiated.
 - b. Final Cleanroom Cleaning and Project Commissioning shall be completed prior to start of Certification Activities.

3.2 TEST PROCEDURES - GENERAL

- A. The Testing and Certification Agency shall report the location of all sample points on an accurate grid diagram which represents the actual ceiling layout.
- B. Discrepancies with acceptance criteria shall be promptly reported to the Owner's authorized representative, who shall approve the Cleanroom Contractor's defect resolution strategy.
- C. The Testing and Certification Agency shall observe all temperature and humidity sequencing testing by the Air Balancing Subcontractor.
- D. All work shall be scheduled and coordinated to accommodate phased completion.

3.3 ON-SITE PRE-INSTALLATION TESTING OF HEPA FILTERS

- A. This Testing Requirement is based on IEST Recommended Practices.
- B. A random selection of 1 out of 10 HEPA filters shall be tested individually for leaks by full Polystyrene Latex Spheres (PSL) challenge and scan with a discrete particle counter.
 1. Testing shall be performed in a suitably isolated and clean area.
- C. Each filter to be tested shall be clamped into a holding fixture which provides complete access to the downstream face of the filters and upstream plenum for supplying the air and PSL aerosol mixture to the filter.
 1. The upstream plenum shall have two sample ports, one on each side and the 100 percent reading shall be taken at the lower of the two to assure sufficient concentration.
- D. Filter shall be tested at an average flow rate equal to operating design flow rate within +20 percent.
 1. A shielded hot-wire anemometer (0.43 fps-4.9 fps) face velocity profile, 12 IN downstream of filter face shall establish the average velocity across the face of the filter pack.
 2. Velocity shall be uniform within these limits without evidence of "dead spots".
- E. Aerosol Test challenge shall be PSL aerosol generated by an aerosol generator.
 1. The aerosol light scattering droplet size distribution shall be listed in IES-RP-CC006.3.
 2. Aerosol Generator Criteria:
 - a. PSL size range 0.1 to 0.5 μm
 - b. PSL output 7.2x10¹⁰ per minute
 - c. Output flow rate 8.0 cfm
 - d. Dry compressed air or N₂ 8 cfm@ 80 - 100 psig
 - e. Remote control option 115 VAC, 2A
- F. Upstream concentration to the test filter shall be sufficiently high as to achieve acceptable practical scan rates.
- G. The test instrument shall be a discrete particle counter.
 1. Measuring Limits/Range: Particle concentrations to 3.5 x 10⁷ per cubic meter.
 2. Sensitivity/Resolution: Less than 0.1 micron with less than 10% sizing resolution
 3. Uncertainty of Measurement: 20% plus or minus of concentration error at the size setting
 4. Calibration interval: 12 months maximum

5. Counting efficiency: (50 plus or minus 20)% at minimum size threshold and (100 plus or minus 10)% for particles greater than or equal to 1.5 times the minimum threshold size..
 6. Probe size shall be dependent upon the actual filter velocity.
- H. Scanning shall be accomplished by passing the probe over the filter in slightly overlapping strokes so that the entire area of the filter is scanned.
1. A separate pass shall be made around the periphery of the filter and the adhesive bond between the filter pack and the rigid frame.
 2. Factory repair patches shall be double checked.
 3. Probe shall be a maximum of 1 IN from the filter face.
 4. Scanning method shall conform to IEST-RP-CC006.
- I. A leak indicated by a repeatable steady particle count greater than 0.01 percent of the upstream concentration is defined as a significant leak.
- J. Filters that are found to have leaks after floor testing shall be repaired providing:
1. The size of the repair(s) is less than 5 percent of the filter face area.
 2. One dimension of any repair is limited to 1-1/2 IN maximum.
- K. The Testing and Certification Agency shall keep a daily record of the defective filters found during on-site testing.
1. Defective filters shall be re-boxed immediately, before being repaired, until such time that the problem is identified.
 2. The integrity of the filters is the responsibility of the Contractor.

3.4 CLEANROOM PERFORMANCE TESTING

- A. The following tests in Section 3.5 shall be required for rooms listed in the Schedule of Classifications Section 3.6.
- B. Certified Tester may use ISO or IEST Testing Criteria, using the stringent testing procedure providing acceptability of the requirements.
- C. All Testing shall be applicable to 'As-Built' 'At-Rest' or 'Operational' Operational State; and 'Non-unidirectional' or 'Unidirectional' Airflow. Refer to Section 3.6 for required criteria.

3.5 SCHEDULE OF ACCEPTANCE CRITERIA

- A. In addition to the general basic cleanliness requirements in ISO 14644, comply with the following criteria:

| ISO TEST NO. | CERTIFICATION TEST | <u>Gown Room X131</u> Ref. Section 3.6 | <u>Main Clean Aisle X121A</u> Ref. Section 3.6 | <u>E-Beam X131A</u> Ref. Section 3.6 | <u>Litho Bay X121D</u> Ref. Section 3.6 | <u>Fab Bay X121B</u> Ref. Section 3.6 | <u>Wipe-Down X121</u> Ref. Section 3.6 |
|--------------|---|--|--|--|--|--|--|
| | CLASS | ISO-6 (CL1000 Fed. 209) | ISO-6 (CL1000 Fed. 209) | ISO-7 (CL10K Fed. 209) | ISO-5 (CL100 Fed. 209) | ISO-6 (CL 1000 Fed. 209) | ISO-7 (CL 10K Fed. 209) |
| B.1 | Airborne Particle Count Test | ISO Class 6 ISO 14644-1 | ISO Class 6 ISO 14644-1 | ISO Class 7 ISO 14644-1 | ISO Class 5 ISO 14644-1 | ISO Class 6 ISO 14644-1 | ISO Class 7 ISO 14644-1 |
| B.4 | Airflow Test | 120 Air Changes / Hr. (min) ISO 14644-1, -2 | 100 Air Changes / Hr. (min) ISO 14644-1, -2 | 32 Air Changes / Hr. (min) ISO 14644-1, -2 | 240 Air Changes / Hr. (min) ISO 14644-1, -2 | 120 Air Changes / Hr. (min) ISO 14644-1, -2 | 60 Air Changes / Hr. ISO 14644-1, -2 |
| B.5 | Air Pressure Difference Test | Refer Mechanical Drawings – Airflow Diagrams ISO 14644-1, -2 | Refer Mechanical Drawings – Airflow Diagrams ISO 14644-1, -2 | Refer Mechanical Drawings – Airflow Diagrams ISO 14644-1, -2 | Refer Mechanical Drawings – Airflow Diagrams ISO 14644-1, -2 | Refer Mechanical Drawings – Airflow Diagrams ISO 14644-1, -2 | Refer Mechanical Drawings – Airflow Diagrams ISO 14644-1, -2 |
| B.6 | Installed Filter System Leakage Test | B.6.1.3 | B.6.1.3 | B.6.1.3 | B.6.1.3 | B.6.1.3 | B.6.1.3 |
| B.7 | Airflow Direction Test and Visualization | Unidirectional ISO 14644-2 | Unidirectional ISO 14644-2 | Non-unidirectional ISO 14644-2 | Unidirectional ISO 14644-2 | Non-unidirectional ISO 14644-2 | Non-unidirectional ISO 14644-2 |
| B.8 | Temperature Test | Refer Mechanical Drawings – Airflow Diagrams 20° ± 2° C ISO 7726 | Refer Mechanical Drawings – Airflow Diagrams 20° ± 2° C ISO 7726 | Refer Mechanical Drawings – Airflow Diagrams 20° ± 1° C ISO 7726 | Refer Mechanical Drawings – Airflow Diagrams 20° ± 2° C ISO 7726 | Refer Mechanical Drawings – Airflow Diagrams 20° ± 2° C ISO 7726 | Refer Mechanical Drawings – Airflow Diagrams 20° ± 2° C ISO 7726 |
| B.9 | Humidity Test | Refer Mechanical Drawings – Airflow Diagrams 40% ± 10% ISO 7726 | Refer Mechanical Drawings – Airflow Diagrams 40% ± 10% ISO 7726 | Refer Mechanical Drawings – Airflow Diagrams 40% ± 10% ISO 7726 | Refer Mechanical Drawings – Airflow Diagrams 40% ± 2% ISO 7726 | Refer Mechanical Drawings – Airflow Diagrams 40% ± 10% ISO 7726 | Refer Mechanical Drawings – Airflow Diagrams NR ISO 7726 |
| B.10 | Electrostatic Test | Wall System Floor System B.10.2.1.1 B.10.2.1.2 | Wall System Floor System B.10.2.1.1 B.10.2.1.2 | Wall System Floor System B.10.2.1.1 B.10.2.1.2 | Wall System Floor System B.10.2.1.1 B.10.2.1.2 | Wall System Floor System B.10.2.1.1 B.10.2.1.2 | Wall System Floor System B.10.2.1.1 B.10.2.1.2 |
| B.11 | Particle | NR | NR | NR | NR | NR | NR |

| ISO TEST NO. | CERTIFICATION TEST | <u>Gown Room X131</u> Ref. Section 3.6 | <u>Main Clean Aisle X121A</u> Ref. Section 3.6 | <u>E-Beam X131A</u> Ref. Section 3.6 | <u>Litho Bay X121D</u> Ref. Section 3.6 | <u>Fab Bay X121B</u> Ref. Section 3.6 | <u>Wipe-Down X121</u> Ref. Section 3.6 |
|--------------|------------------------------|---|---|---|--|--|---|
| | CLASS | ISO-6 (CL1000 Fed. 209) | ISO-6 (CL1000 Fed. 209) | ISO-7 (CL10K Fed. 209) | ISO-5 (CL100 Fed. 209) | ISO-6 (CL 1000 Fed. 209) | ISO-7 (CL 10K Fed. 209) |
| | Deposition Test | | | | | | |
| B.12 | Recovery Test | NR | NR | NR | NR | NR | NR |
| | | ISO 14644-2 | ISO 14644-2 | ISO 14644-2 | ISO 14644-2 | ISO 14644-2 | ISO 14644-2 |
| B.13 | Containment Leak Test | NR | NR | NR | NR | NR | NR |
| | | ISO 14644-1, -2 | ISO 14644-1, -2 | ISO 14644-1, -2 | ISO 14644-1, -2 | ISO 14644-1, -2 | ISO 14644-1, -2 |
| -- | Vibration | VC-C | VC-C | VC-C | VC-E | VC-C | VC-C |
| | | IEST 6.11 | IEST 6.11 | IEST 6.11 | IEST 6.11 | IEST 6.11 | IEST 6.11 |
| -- | Noise Level Test | NC-50-60 | NC-50-60 | NC-25-35 | NC-50-60 | NC-50-60 | NC-50-60 |
| | | IEST 6.7.2.c. | IEST 6.7.2.c. | IEST 6.7.2.c. | IEST 6.7.2.c. | IEST 6.7.2.c. | IEST 6.7.2.c. |
| | | IEST 6.7.3.a. | IEST 6.7.3.a. | IEST 6.7.3.a. | IEST 6.7.3.a. | IEST 6.7.3.a. | IEST 6.7.3.a. |
| | | IEST 6.7.3.a. | IEST 6.7.3.a. | IEST 6.7.3.a. | IEST 6.7.3.a. | IEST 6.7.3.a. | IEST 6.7.3.a. |

3.6 SCHEDULE OF REQUIRED CLASSIFICATIONS

| ISO CLASSIFICATIONS | | | | |
|---------------------|------------------|------------|-----------------|----------------------------|
| ROOM NUMBER | ROOM NAME | CLASS | OCCUPANCY STATE | UNI-DIRECTIONAL OCC. STATE |
| X131 | GOWN ROOM | ISO-6/1000 | As-Built | No |
| X121A | MAIN CLEAN AISLE | ISO-6/1000 | As-Built | No |
| X121 | WIPE-DOWN | ISO-7/10K | As-Built | No |
| X131A | E-BEAM Cleanroom | ISO-7/10K | As-Built | No |
| X121D | LITHO BAY | ISO-5/100 | As-Built | Yes |
| X121B | FAB BAY | ISO-6/1000 | As-Built | No |
| | | | | |

3.7 FINAL GASKETING LEAKAGE TEST

- A. While performing Final HEPA Filter Installation Leak Test, scan ceiling grids for leakage at gasketing, perimeter ceiling angle condition, and at any fixture mounted through the HEPA filters, with particle counter using the same procedures as in the Final HEPA Filter Installation Leak Test.
1. Notify the Owner and Architect in advance of this Work and allow the Owner's authorized representative to witness test.
 2. Report all locations of ceiling grid leakage to Clean Zone Director for immediate defect resolution.
- B. Retest all locations of leaks after defects have been corrected.

END OF SECTION

