

## SPECIAL SPECIFICATION

### SECTION 01112-S

#### CLEANROOM CERTIFICATION AND ACCEPTANCE

##### PART 1 - GENERAL

###### 1.01 SECTION INCLUDES

- A. This section provides the services required by a “Certifying Agency” to measure and record the cleanroom conditions and resolve all nonconforming areas prior to attesting that the cleanroom is complete and ready for SNL’s occupancy. Refer to Section 1.05 Performance Requirements for a list of tests to be conducted.
- B. The field Engineer for the Certifying Agency shall visit the job site a minimum of once every two weeks for one day’s duration each during the period that construction work is being performed on the finished cleanroom for knowledge of the installation, inspections, and completion of construction. The cost of the time and associated expense for these visits shall be included in the proposal.
- C. ULPA Filter Repair and Replacement: If defective ULPA filters are identified during the course of work, the Certifying Agency shall immediately notify the Contractor and SNL’s Representative, and repair or replacement shall be performed under the direction of the Contractor with approval from the SNL’s Representative.

###### 1.02 RELATED WORK

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Requirements of the following Project Specification Sections apply to this section:
  - 1. Section 01110S – Cleanroom Construction Protocol
  - 2. Section 01111S – Cleanroom Construction and Cleaning Procedures
  - 3. Section 07140S – Fluid-Applied Waterproofing
  - 4. Section 13038S – Cleanroom Doors
  - 5. Section 13039S – Cleanroom Resilient Flooring
  - 6. Section 13020S – Cleanroom Ceiling Grid System (Gasketed)

7. Section 13036S – Cleanroom Wall System
  8. Section 13037S – Cleanroom Access Flooring
  9. Section 15950S – Testing, Adjusting and Balancing
  10. Section 15766S – Fan Filter Units (FFU)
  11. Section 15869S – Terminal ULPA Filter Diffuser
  12. Section 16501S – Ionization
  13. Section 16441 – Electrical Lighting and Appliance Panelboards
- C. CAUTION! Use of this Section without including all of the above-listed items will result in omission of basic requirements.
- D. In the event of conflict regarding requirements for the referenced cleanroom testing and certification between this section and any other section, the provisions of this section shall govern.

### 1.03 REFERENCES

- A. ISO Standards:
1. 14644-1 : Cleanrooms and Associated Controlled Environments  
(including Part 1: Classification of Air Cleanliness).
  2. 14644-3 : Metrology and Test Methods (including Annex A, B, and C)
  3. 14644-4 : Design, Construction and Start-Up
  4. 14644-6 : Terms and Definitions
    - a. Institute of Environmental Sciences and Technology (IEST)  
940 East Northwest Highway  
Mount Prospect, IL 60056
- B. IES-RP-CC006.2 -Testing Cleanrooms
- C. IES-RP-CC-002.1 -Laminar Flow Clean Air Device
- D. IES-RP-CC-013-86T -Equipment Calibration or Validation Procedures
- E. IES-RP-CC-001-86 -HEPA Filters

- F. “Procedural Standards for Certified Testing of Cleanrooms”:
  - 1. National Environmental Balancing Bureau (NEBB)  
8224 Old Courthouse Road  
Vienna, VA 22180
  
- G. ESD Association Standard ESD-S-7,1-1994
  - 1. Electrostatic Discharge Association  
200 Liberty Plaza  
Rome, NY 13440
  
- H. SEMI S2 Safety Guidelines for Semiconductor Manufacturing Equipment. Semi I78 0998 Electrostatic compatibility guide to assessment and control of ESD and Electrostatic attraction for equipment.
  - 1. SEMI  
805 East Middlefield Rd.  
Mountainview, CA 94043-4080
  
- I. NEBB, Procedural Standards for Measuring Sound and Vibration
  - 1. National Environmental Balancing Bureau (NEBB)  
8224 Old Courthouse Rd  
Vienna, VA 22180

1.04 DEFINITIONS

- A. Cleanroom Types:
  - 1. UNIDIRECTIONAL AIRFLOW (laminar)  
  
Controlled airflow through the entire cross-section of a clean zone with a steady velocity and approximately parallel streamlines.
  
  - 2. NON-UNIDIRECTIONAL AIRFLOW (turbulent)  
  
Air distribution where the supply air entering the clean zone mixes with the internal air by means of induction.
  
- B. Occupancy States:
  - 1. As-Built  
  
Condition where the installation is complete with all services connected and functioning but with no production equipment, materials, or personnel present.

2. At-Rest

Condition where the installation is complete with equipment installed and operating in a manner agreed upon by the customer and supplier, but no personnel present.

3. Operational

Condition where the installation is functioning in the specified manner, with the specified number of personnel present and working in the manner agreed upon.

C. Certifying Agency: The Cleanroom Certifying company or agency.

D. Balancing Agency: The air testing a balancing company or agency.

E. HEPA Filter: Generic term that covers types of HEPA, i.e. ULPA, Ultra, 14EPA, etc.

F. Protocol Manager: The person vested with authority to enforce compliance to clean build protocols

1.05 PERFORMANCE REQUIREMENTS

A. The certifying agency shall perform all tests listed below. These tests shall be conducted for a Unidirectional airflow (laminar) and As-built cleanroom occupancy state.

1. Cleanroom Classification Test
2. Installed Filter Leakage Test
3. Air Flow Test
4. Air Flow Visualization Test
5. Air Pressure Difference Test
6. Temperature and Humidity Test
7. Electrostatic Discharge Test
8. Floor Conductivity Test
9. Vibration Test

10. Sound Pressure Level Test
11. Lighting Level Test
12. Electromagnetic Interference Test

1.06 SUBMITTALS

- A. Submittals shall be provided in accordance with Section 01300 – Submittals, and the requirements of this section. The following are required with the proposal:
  1. Qualifications of all Field Technicians, the Field Engineer, the Project Director, and the Certifying Agency.
  2. Documentation that the Certifying Agency, the Field Engineer, and the Project Director have met all qualification requirements of the NEBB.
  3. Written presentation outlining the testing and certification procedures and sequence to be performed.
  4. Description of all instrumentation and test equipment to be used, as well as calibration documentation.
  5. Sample of all field reports, charts, and forms proposed to document the field measured conditions.
  6. Sequence of test procedures to be used.
- B. After completion and acceptance of all required tests, the Certifying Agency shall compile the test and certification data and shall submit copies of the complete report to the SNL's Representative for review and approval. The report submitted shall include a signed and dated certificate.
- C. Contents of the completed report shall be in accordance with IES-RP-CC-006-84-T. The completed report shall include, but is not limited to, the following items:
  1. Report: Tabulate all test data on 8-1/2 x 11-inch sheets bound in a report. Identify all test data by grid location. Grids shall be reviewed with the SNL's Representative prior to award of Contract.
  2. Drawings: Print of the 1/8-inch scale Cleanroom Floor Plans and Reflected Ceiling Plans made from the contract drawings with testing and certification locations shown on the drawings. Drawings shall be titled, "Testing and Certification Drawings."

3. Test Equipment: Complete list of all test equipment used in performing the work with serial numbers and verification of the latest calibration date. All equipment will be reviewed with the SNL's Representative prior to commencement of work.
4. Guarantee: Written statement signed by the Project Director and Certification Firm and person in charge of on-site work stating that all work has been performed in accordance with these specifications unless approved by the SNL's Representative and specifically noted otherwise in report.
5. Description of all tests performed, including the purpose, instrumentation, procedure, results, and analysis of the data. Data shall be presented and graphically displayed in an approved form by the SNL's Representative to permit full understanding of all tests. Include the date tests were taken and the names of field technicians performing the tests.
6. Five copies of the completed Certification Report, submitted for review and acceptance by the SNL's Representative.
7. Description of the operating condition of all clean areas.

#### 1.07 QUALITY ASSURANCE

- A. All cleanroom air systems shall be tested and certified by a qualified firm specializing in cleanroom certification. The Certifying Agency shall work closely with all construction trades as required to complete construction of the cleanrooms in accordance with the Construction Documents.
- B. Firms or agencies proposing on this service shall have been in business a minimum of five (5) years specializing in cleanroom testing and certifying work. A list shall be available upon request of projects similar in size, complexity, and cleanliness classification to this project that the firm has completed. Include the project name, description of mechanical system, range of services provided, and the name and phone number of the design consultant and the SNLr who were responsible for final acceptance of the service.
- C. The Certifying Agency's Project Director shall have a minimum of two years of experience testing and certifying cleanrooms as a field Engineer or field technician. He shall supervise all field technicians assigned to complete the testing and certifying of the work, and shall be responsible for all on-site testing and data acquisition. No field tests shall be taken without the Field Engineer's presence.

- D. All Certifying Agency Field Technicians shall have completed previous training in cleanroom operations and certifying procedures, shall have worked in this capacity on at least one other similar project, and shall only perform field work under direct supervision of the Field Engineer.
- E. A sample of all field data reports, charts, and forms used by the Certifying Agency shall be submitted with the proposal. In addition, a sample test report of a similar project shall be available for inspection by the SNL's Representative to verify the Certifying Agency's expertise in data collection, interpretation, and documentation.
- F. Reference standards for all field tests shall be the Institute of Environmental Sciences (IES) IES-RP-CC-006-84T, Recommended Practice for Testing Cleanrooms and the Procedural Standards for Certified Testing of Cleanrooms, National Environmental Balancing Bureau.

#### 1.08 PROJECT CONDITIONS

- A. Certification shall not proceed until all other work on the cleanroom has been completed and the commencement of certification work has been approved.
- B. Condition of Cleanrooms Prior to Testing:
  - 1. The HVAC system installation for the cleanroom, including all of the exhaust systems and makeup air system associated with the cleanroom operation, shall have been completed, including all air and water side testing, adjusting, and balancing.
  - 2. All fans shall have been balanced in-place and an acceptance report submitted.
  - 3. All floor tiles shall have been in place, and all wall penetrations shall have been sealed to airflow.

#### 1.09 WARRANTY

- A. The service to be furnished by the Certifying Agency shall be considered complete and accepted when the Certification Report has been approved by the SNL's Representative.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

#### A. Certification Agencies:

1. Air Filtration Management, Inc. (AFM)  
P.O. Box 26  
Bethlehem, PA 18016-0269
2. Protocol Inc.  
6650 SW Redwood Lane  
Suite 160  
Portland, OR 97224
3. Certification and Calibration Services, Inc. (CCS)  
3201 Fair Oak Dr.  
Rowlett, TX 75089

B. The Certifying Agency shall supply materials, tools, equipment, cleanroom garments, and instrumentation required to perform the cleanroom system testing and certification as described in this section.

C. Once the cleanroom has been installed, only a polystyrene latex (PSL) aerosol of 0.26 micron shall be used.

### 2.02 EQUIPMENT

A. All test equipment used in the certification procedures shall be state-of-the-art. Calibration of equipment shall be traceable to NBS Standards within the previous nine months.

B. The equipment for the following tests shall comply, at a minimum, with the standards set forth in ISO 14644-3, Annex C – Test Instrumentation:

- Cleanroom Classification Test
- Installed Filter Leakage Test
- Air Flow Test
- Air Flow Visualization Test
- Air Pressure Difference Test
- Temperature and Humidity Test
- Electrostatic Discharge Test

C. Airborne noise measurements shall be made in the cleanroom areas. Measurement equipment shall conform to ANSI S14, “Specifications for Type 1 Sound Level Meters” and to ANSI S1.11, “Specifications for Octave, Half-Octave, and Third-

Octave Band Filter Sets.” Measurement equipment shall be calibrated with an acoustical calibrator conforming to ANSI 1.40, “Specifications for Acoustical Calibrators.”

- D. Vibration measurements shall be taken to characterize the process floor vibration levels. Vibration test equipment shall be accurate to within 1 dB. Test equipment calibration records shall be made with accelerometers with a minimum sensitivity of 01 volt/g. Vibration data shall be analyzed with an adjustable resolution Fourier Transform analyzer.
- E. Lighting tests for foot-candle levels and uniformity measurements shall be taken with a Simpson Illumination Level Meter.
- F. Floor conductivity tests shall measure and record resistance through portions of the conductive floor system. Tests shall be taken with a Biddle Mark IV test kit.

### PART 3 - EXECUTION

#### 3.01 PREPARATION

- A. The Certifying Agency shall supervise and conduct all tests in the presence of the Contractor’s Field Superintendent or his assigned Cleanroom Inspector.
- B. The as-built facility tests shall be performed after the air systems balancing agency and piping systems balancing agency have made their initial operating and balancing adjustments and are satisfied that the installation is ready for acceptance certification testing. Final clean down and commissioning procedures shall also be completed.
- C. All cleanroom re-circulation fans, makeup fans, process fume exhaust systems, and automatic control loops shall be in operation during tests. All mechanical systems and all fans related to the cleanroom system shall be certified to be operating normally and delivering design airflow.
- D. Certification reports shall be reviewed and approved by the SNL’s Representative before the cleanrooms are complete.
- E. Tests described below are not identified necessarily in their sequence. The sequence of test procedures shall be as stated in the Proposal.

#### 3.02 FIELD TESTING AND CERTIFYING PROCEDURES

Measurement procedures will be performed in accordance with ISO 14644 and IEST RP-006.2 Testing Cleanrooms. All testing shall be conducted in the “as-built” occupancy state.

A. Cleanroom Classification Test:

Perform this test to verify that facility can achieve intended air cleanliness level.

1. Scope of measurement: All cleanroom spaces (ULPA filter installed spaces).  
Number of points per ISO 14644-1 for each area classification.
2. Measuring procedure: Per ISO 14644-3, Annex B1.
3. Tolerance: Meets requirement of specification for each area.

B. Installed Filter Leakage Test:

1. Scope of measurements: All installed ULPA filters including verifying that ceiling system, which includes blank pans, sprinkler pans, lighting fixtures and entire perimeter joint between grid and walls. is leak-free.
2. Measurement procedure: Per ISO 14644-3, Annex B6 using aerosol challenge method with PSL.
3. Tolerance: No leaks as defined by a guaranteed efficiency of filters at 99.9995 percent for particles @ MPPS. Any leaks shall be recorded and re-tested after replacement or repair. Repairs shall be limited according to IES-RP-CC-006.2 to a total of 3% or less of the filter face and patches shall be limited to 1.5 in one direction. The filter manufacturer or supplier shall correct deficiencies found as directed by the Certifying Agency.

C. Airflow Test:

1. Scope of measurements: All installed ULPA filters.
2. Measurement procedure: Per ISO 14644-3, Annex B4
3. Tolerance: Average velocity per specification standards. Deviation shall not to exceed 15% – **0%**.

D. Air Flow Visualization (parallelism) Test

1. Scope of measurements: @ 100% filter coverage cleanroom bays.
2. Measurement procedure: Per ISO 14644-3, Annex B – Tracer Thread Method using strips of non-shedding FloViz streamers of a length 24 inches less than the raised floor-to-ceiling distance attached to ceiling grid.
3. Tolerance: Unidirectional vertical flow path that are within 20 degrees of vertical in any direction.

E. Air Pressure Difference Test:

1. Scope of measurement: Measure pressure differences between adjacent cleanroom (filters) spaces and cleanroom spaces and surrounding non-clean spaces (no filters).
2. Measuring procedure: Per ISO 14644-3, Annex B5
3. Tolerance: Meets requirement of specification.

F. Temperature and Humidity Test:

1. Scope of measurement: Take temperature and humidity reading in each cleanroom bay and in support labs (north support labs and slab on grade labs).
2. Measuring procedure: Per ISO 14644-3, Annex B9 (Temperature) and B10 (Humidity).
3. Tolerance: Meets requirement of specification.

G. Electro-Static Discharge Test (in Cleanrooms):

1. Scope of measurement: Test 20% of all raised floor panels, 20% of wall panels, and 20% of all 2x2 ESD rubber flooring. Both electrostatic and Ion generator (ionizer) test shall be conducted for the items listed above.
2. Measuring procedure: Per ISO 14644-3, Annex 11.
3. Tolerance: Meets requirements of specifications.

H. Floor Conductivity Test

This test shall be carried out according to the procedure as outlined in NFPA 99 Chapter 3 at bay & chase cleanroom and support labs. Test points shall be as designated by SNL's rep. or Contractor.

I. Vibration Test

One test will be performed on the cleanroom raised floor understructure and a support labs at points designated by the SNLr or Contractor.

J. Sound Pressure Level Test:

1. Scope of measurement: Number of points per IEST RP-006.2 Testing Cleanrooms Section 6.10 Noise Level Test.
2. Measuring procedure: Per IEST RP-006.2 Testing Cleanrooms Section 6.10 Noise Level Test.
3. Tolerance: Meets requirement of specification.

K. Lighting Level Test:

1. Scope of measurement: Number of points per IEST RP-006.2 Testing Cleanrooms Section 6.9 Lighting Level Test.
2. Measuring procedure: Per IEST RP-006.2 Testing Cleanrooms Section 6.9 Lighting Level Test, measured at 30" above raised floor.
3. Tolerance: Meets requirement of specification.

L. Electromagnetic Interference (EMI) Test:

Electromagnetic field measurements shall be taken in areas required by the SNL and Contractor. A search coil with a dynamic range of 0.1 to 4,000 miligauss and a band width of 30 to 500 Hz shall be used. Readings shall be taken in 3 axis on a 4 foot grid on a place 60 inches above the Raised floor. The source of readings exceeding 1.0 milligauss shall be determined.

### 3.03 ACCEPTANCE CRITERIA

A. Verification Procedures:

1. At the beginning of all field certification procedures, the Certifying Agency shall demonstrate to the SNL's Representative each of the tests performed in the course of field data collection, using instruments from the original readings.
2. The Project Director shall present and review all field data with the SNL's Representative to ensure that a full understanding is transferred to the SNL's staff of the base operating condition of the cleanrooms at completion of construction.

B. Documentation:

1. The Project Director shall oversee any changes or corrections required of the final report, then stamp the final sets signifying his approval of the final certification log.

2. The Certifying Agency shall deliver five complete sets of all certification data and logs in bound form to the SNL's Representative.

END OF SECTION