.1Airborne Particle Count

PURPOSE: To measure the particle levels in the cleanroom in order to maintain compliance of ISO 14644-1 1999 Section(s) 1, 2, 3, & 4, Annex(s) B, C, D, & E in accordance to ISO 14644-2:2000

INSTRUMENTATION: Particle Counter - Calibration documents on equipment used for certification are attached to the report.

PROCEDURES: Divide the Cleanroom work zone into grids of equal proportion and plot the sample locations according to room class and standard used to classify the cleanroom. Place the particle counter probe and take samples perpendicular to the airflow at working height. Record and report data for each considered particle size for the designated classification. The following procedure is listed in 14644-3:2005 Annex B.

Install the particle counter intake at the specified sampling location, and set up the flow rate at 1.0 CFM for a duration of one minute per location. Select the particle size threshold(s) in accordance with ISO 14644-1:1999. A sampling probe should be selected to permit close to isokinetic sampling in areas with unidirectional flow. The sample probe velocity should not differ from sampled air velocity by more than 20 %. If this Is not possible, set the sampling probe inlet facing Into the predominant direction of the airflow; in locations where sampled airflow being sampled is not controlled or predictable (e.g. non-unidirectional airflow; the inlet of the sampling probe shall be directed vertically upward. The transit tube from the sample probe inlet to the particle counter sensor should be as short as possible. For sampling of particles larger than and equal to $1_{\mu m}$, the transit tube length should not exceed the manufacturer's recommended length and diameter.

ACCEPTANCE: The average particle concentration at each sample location should fall at or below class limit, and the mean of these averages should fall at or below the class limit. Under certain circumstances a 95% confidence limit is computed.

.2HEPA Filter Leak Test with Ambient Air

PURPOSE: To verify that all HEPA filters, filter housing and mounting frames located in the Cleanroom are free from leakage when operating at the manufacturers recommended airflow velocities.

INSTRUMENTATION: Particle Counter – Calibration documents for equipment used for testing will be attached to the certification report.

PROCEDURES: The two-stage approach of this in situ filter leak test method provides accuracy and speed:

1) The clean side of the filter should be scanned for a potential teak. During scanning with a DPC, detection of more than the observed acceptable counts C_a, in sample acquisition time T_s indicates the potential

presence of a leak. In this case, the second stage should be performed. If there are no indications of potential leaks, further investigations are not necessary. The determinations of C_a and T_s are described in ISO 14644-3:2005 Section B.6.3.6.

2) The probe should be returned to the place of maximum particle count under each potential leak and a stationary re-measurement should be performed. During the stationary re-measurement with the DPC, detection of more than the observed acceptable counts (C_a) in sustained residence time T_r indicates the presence of a leak. The determinations of C_a and T_r are described in ISO 14644-3:2005 Section B.6-3.6.

ACCEPTANCE: Ambient air should not exceed 0.01 percent of the upstream concentration at any point, however, upstream ambient air may be too clean to leak test within a reasonable amount of time. Filter integrity requirements are no leaks or repairs are acceptable.

.3HEPA Filter Air Flow Velocity

PURPOSE: To determine the volume of air delivered through each HEPA filter and to calculate the average airflow, uniformity range and room air exchange rate, within the Cleanroom.

INSTRUMENTATION: Calibration documents for equipment used for testing will be included in the certification reports.

PROCEDURES:

1. ISO 14644-3:2005 section B-4.3.3

   Supply airflow rate calculated from filter face velocity

   Evaluation of the supply airflow rate without a flow hood may be done with an anemometer downstream of each final filter. The supply airflow rate is determined from the airflow velocity multiplied by the area of exit. A curtain may be used to exclude disturbances to the unidirectional airflow.

   For the number of measuring points and the calculation of supply airflow rate, refer to B.4.2.3 and B.4,2.4, respectively.
   If it is impossible to divide the plane info grid cells of equal areas, the average air velocity weighted by area may be substituted.

2. ISO 14644-3:2005 section B.4.2.2

   Supply airflow velocity

The airflow velocity should be measured at approximately 150 mm to 300 mm from the filter face. The number of measuring points should be sufficient to determine the supply airflow rate in cleanrooms and clean zones, and should be the square root of 10 times of area in square meters but no less than 4. At least one point should be measured for each filter outlet or fan-filter unit. A curtain may be used to exclude disturbances to the unidirectional airflow.
The measuring time at each position should be also sufficient to ensure a repeatable reading. Time-averaged values of measured velocities should be recorded for multiple locations.

3. ISO 14644-3:2005 B.4.2.4

Supply airflow rate measured by filter face velocity

The results of the airflow velocity test carried out in accordance with B. 4.2.2 can be used to calculate the total supply airflow rate as follows:

$$Q=\sum(U_c \times A_c)$$

Q is the total airflow rate;

U_c is the airflow velocity at each cell centre;

A_c is the cell area which is defined as the installation area divided by the number of measuring points;

$\sum$ is the summation for all cells.

ACCEPTANCE: The average airflow velocity or the average or total airflow volume for the cleanroom of clean zone should be within ± of the value specified for the cleanroom or clean zone, or within other tolerance limits agreed upon by the buyer and seller.

.4TEMPERATURE

PURPOSE: To verify the capability of the Cleanroom air handling equipment to maintain temperature within design specification.

INSTRUMENTATION: Calibration documents for equipment used in testing are included in the certification report.

1. **PROCEDURES:** This test is recommended for areas where temperature and moisture levels are primarily controlled for purposes of worker comfort rather than process or equipment requirements. When processes require strict temperature control, a more comprehensive test is performed.
2. Allow room to operate for 24 hours before testing.

3. ISO 14644-3:2005 Section B.8.2.2 Comprehensive temperature test This test is recommended for areas having strict environmental control specifications. This test should be performed at least 1 hour after the air-conditioning system has been operated and the conditions have been stabilized. The work zone should be divided into a grid of equal areas. Individual testing areas should be selected by agreement between the customer and supplier. The number of measuring locations should be at least two-The temperature probe should be positioned at work-level height and at a distance of no less than 300 mm from the ceiling, walls, or floor of the installation. The probe position should be selected with due consideration of the presence of heat sources. Measurements should be performed as appropriate for the purpose of application and the measurement time should be at least 5 min with one value recorded at least every minute.

ACCEPTANCE: Temperature and uniformity requirements are a matter for agreement between the buyer and the seller.

.5Humidity

PURPOSE: To verify that the system humidity control of the Cleanroom is working at the acceptance level. Humidity control is necessary to:

3. Prevent corrosion and/or oxidation.
4. Prevent condensation on work surfaces.
5. Reduce static electricity.
6. Provide personnel comfort.
7. Prevent product contamination.
8. Compensate for hygroscopic materials.
9. Control microbial growth.

INSTRUMENTATION: Calibration documents for equipment used for testing are included in the certification report.

PROCEDURES: ISO 14644-3:2005 Section B.9.2 Procedure for humidity test
The test is performed following completion of the airflow uniformity tests and the adjustment of air-conditioning system controls. This test should be performed with the air-conditioning system fully operational and when stable conditions have been achieved. The humidity sensor should be located at least at one location for each humidity control zone, and sufficient time should be allowed for the sensor to stabilize. Measurements should be performed as appropriate for the purpose of application after the sensor

has stabilized,-and the measurement time should be at least 5 min. The measurement points, frequency, intervals and period for data recording should be agreed between the customer and the supplier. The humidity test should be performed in conjunction with the temperature test.

ACCEPTANCE: Humidity and uniformity requirements are 20 – 80 % RH.

.6Room Pressurization

PURPOSE: To verify that a differential pressure should be maintained between the rooms sufficient to assure airflow outward progressively from the cleanest spaces to the least clean during normal operation and during periods of temporary upsets in air balance, as when a door connecting two (2) rooms is suddenly opened.

INSTRUMENTATION: Calibration documents for equipment used in testing are included in certification report.

PROCEDURES: ISO 14644-3:2005 Section B.5.2 Procedure for air pressure difference test. It is advisable to confirm that the supply air volume and installation balancing are within specifications before commencing the measurement of differential pressure between rooms or between rooms and outside areas. With all doors closed, the pressure difference between the cleanroom and any surrounding environment should be measured and recorded. If the installation is subdivided into more than one cleanroom, the pressure differences between the innermost room and the next adjacent room should be measured. The measurement should be continued until the pressure difference between the last enclosure and surrounding ancillary environment and against the external environment is measured. The pressures being measured are very small and incorrect measurement techniques can easily give erroneous readings. The following should be considered:

a) installation of permanent measuring points is recommended;
b) take measurements near to the middle of the cleanroom and away from any supply air inlets or return air outlet devices which may influence the local pressure at the measuring point.

ACCEPTANCE: Pressurization and uniformity requirements are .02-.09 inches of water gauge.