Designation: F 91 – 70 (Reapproved 1996)

Standard Practice for Testing for Leaks in the Filters Associated With Laminar Flow Clean Rooms and Clean Work Stations by Use of a Condensation Nuclei Detector[1]

This standard is issued under the fixed designation F 91; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers the testing of the integrity of high-efficiency particulate air (HEPA) filters installed in laminar flow clean rooms of the ceiling to floor or wall to wall type, and laminar flow clean work stations. The recommended practice may be used to detect faults or voids in the filter media itself or in the joints between the filter and the room or work station structure. The determination of filter media efficiency is not within the scope of this practice.

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.3 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Terminology

2.1 *Definitions:*

2.1.1 *condensation nuclei*—particles within the size range from 0.001 to 0.1-μm radius.

2.1.2 *HEPA filter*—high-efficiency particulate air filter.

2.1.3 *laminar flow*—airflow in which the air confined within the walls of a room or a smaller work station moves as an isovelocity front along parallel flow lines.

2.1.4 *leak*—a gap or void in the filter media, or in the associated gaskets, which permits unfiltered room air to penetrate the clean room or clean work station.

3. Summary of Practice

3.1 This recommended practice takes advantage of the fact that a HEPA filter retains a high percentage of the condensation nuclei found in ordinary room air. In this recommended practice a nuclei counting apparatus is arranged to sample small areas at the filter surface and the joints at the filter edges. The HEPA filter effluent normally shows a low nuclei count (<100 particles/cm^3). When a leaking filter area is encountered, an increase of at least ten-fold in the particle count is noticed within the 2-s response time of the nuclei counter.

4. Apparatus

4.1 *Condensation Nuclei Counter*. [2,3]

4.2 *Plastic Tubing*,[4] ⅜ in. (9.5 mm) in outside diameter; ¼ in. (6.5 mm) in inside diameter; of suitable length, not to exceed 5 ft. (1.5 m).

4.3 *Glass Laboratory Funnel*, 50 mm in outside diameter, 7 mm in stem diameter, 80 mm over-all length.

4.4 *Double-Pole Single-Throw Relay*, 115 V, 8 A.

5. Preparation for Test

5.1 Assemble the apparatus by slipping one end of the plastic hose over the funnel stem, and the other end over the nuclei counter input nipple.

5.2 Turn on the electrical supply to the nuclei counter and allow 30 min warm up time with the input tube sampling the effluent from a HEPA filter.

5.3 Measure the nuclei concentration at the intake to the HEPA filter. A concentration of less than 1000 particles/cm^3 indicates a concentration insufficient for conveniently detecting leaks in the filter or its gaskets.

5.3.1 In the event that a nuclei concentration of less than 1000 particles/cm^3 occurs when sampling a clean work station, move the work station into a room having a less clean ambient such as a room not supplied with filtered air.

5.3.2 In the event that the intake nuclei concentration of less than 1000 particles/cm^3 occurs in a laminar flow room of the ceiling to floor or wall to wall type, make the filter leak test at a time when the room is operating on a full work schedule with the maximum number of occupants.

5.3.3 Should the nuclei concentration level of the input air fail to reach 1000 nuclei/cm^{3}after executing steps 5.3.1 or 5.3.2, set up a nuclei generator using a DPST relay (see 4.4).

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[1] This practice is under the jurisdiction of ASTM Committee E-21 on Space Simulation and Applications of Space Technology and is the direct responsibility of Subcommittee E21.05 on Contamination.

Current edition approved Oct. 2, 1970. Originally issued 1968. Replaces F91 – 68 T. Published December 1970. Originally published as F91 – 68 T. Last previous edition F91 – 60 T.

[2] Rich, T. A., "A Continuous Recorder for Condensation Nuclei," *Geofisica Pura e Applicata*, Milano, Vol 50 1961 III, pp 46–52.

[3] General Electric Co., Schenectady, NY, Model No. 112L482G1 has been found satisfatory.

[4] Tygon tubing or equivalent has been found satisfactory for this purpose.

5.3.3.1 Wire one side of the relay so that in the at-rest condition current flows through the relay field coil, drawing the armature toward the field coil pole piece. This wiring arrangement should provide for the flow of current to be broken by this action of the armature, resulting in its springing back into its original position. The resulting cyclic or buzzer-like action of the relay will generate a large number of nuclei at the arcing contacts which can be used to increase the number of nuclei at the HEPA filter input. In the event that an insufficient number of nuclei are still counted at the filter input, increase the arc nuclei concentration by employing the unused set of contacts on the relay to make and break the secondary circuit of a variable transformer, adjusting to provide moderate visible arcing.

6. Procedure

6.1 Sample the nuclei concentration of the effluent of the HEPA filter at the downstream face of the filter.

6.1.1 Operate the nuclei counter on the most sensitive scale possible.

6.1.2 Use the plastic sampling tube with the funnel tip to scan the entire downstream surface of the filter and the gasketed joints at the filter edges. Scan by traversing the filter face in straight sweeps from left to right and then from right to left shifting the line of travel of the probe tip by the diameter of the funnel after each pass.

6.1.2.1 Maintain the rate of traverse of the sampling probe between 2 and 4 in./s.

6.1.2.2 Have an assistant to the person making the test observe, at all times while the test is in progress, the nuclei concentration meter and quickly report any increase in concentration. Classify an increase of ten times, or more, above the background nuclei count (that is, from 30 nuclei to 300 nuclei/cm^3) as a leak.

6.2 Reported increases in the nuclei level shall require that the test operator backtrack in his traverse procedure and determine the location of the leak.

6.2.1 Remove the funnel from the plastic hose and sample with the hose itself in order to pin-point the location of the leak.

6.2.2 Mark the location of the leak on the filter protecting grill using a grease pencil, and retest the filter after suitable remedial action has been taken.