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Standard Test Method for Size-Differentiated Counting of Particles and Fibers Released from Clean Room Wipers Using Optical and Scanning Electron Microscopy[1]

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INTRODUCTION

Techniques for determining the number of particles and fibers that can potentially be released from wiping materials consist of two steps. The first step is to separate the particles and fibers from the wiper and capture them in a suitable medium for counting, and the second step is to quantify the number and size of the released particles and fibers.

The procedure used in this test method to separate particles and fibers from the body of the wiper is designed to simulate conditions that the wiper would experience during typical use. Therefore, the wiper is immersed in a standard low-surface-tension cleaning liquid (such as a surfactant/water solution or isopropyl alcohol/water solution) and then subjected to mechanical agitation in that liquid. The application of moderate mechanical energy to a wiper immersed in a cleaning solution is effective in removing most of the particles that would be released from a wiper during typical clean room wiping. This test method assumes the wiper is not damaged by chemical or mechanical activity during the test.

Once the particles have been released from the wiper into the cleaning solution, they can be collected and counted. The collection of the particles is accomplished through filtration of the particle-laden test liquid onto a microporous membrane filter. The filter is then examined using both optical and scanning electron microscopy where particles are analyzed and counted. Microscopy was chosen over automated liquid particle counters for greater accuracy in counting as well as for morphological identification of the particles.

The comprehensive nature of this technique involves the use of a scanning electron microscope (SEM) to count particles distributed on a microporous membrane filter and a stereo-binocular optical microscope to count large fibers. Computer-based image analysis and counting is used for fields where the particle density is too great to be accurately determined by manual counting.

Instead of sampling aliquots, the entire amount of the liquid containing the particles and fibers in suspension is filtered through a microporous membrane filter. The filtering technique is crucial to the procedure for counting particles. Because only a small portion of the filter will actually be counted, the filtration must produce a random and uniform distribution of particles on the filter. After filtration, the filter is mounted on an SEM stub and examined using the optical microscope for uniformity of distribution. Large fibers are also counted during this step. Once uniformity is determined and large fibers are counted, the sample stub is transferred to the SEM and examined for particles. A statistically valid procedure for counting is described in this test method. The accuracy and precision of the resultant count can likewise be measured.

This test method offers the advantage of a single sample preparation for the counting of both particles and fibers. It also adds the capability of computerized image analysis, which provides accurate recognition and sizing of particles and fibers. Using different magnifications, particles from 0.5 to 1000 µm or larger can be counted and classified by size. This procedure categorizes three classes of particles and fibers: small particles between 0.5 and 5 µm; large particles greater than 5 µm but smaller than 100 µm; and large particles and fibers equal to or greater than 100 µm. The technique as described in this test method uses optical microscopy to count large particles and fibers greater than 100 µm and SEM to count the other two classes of particles. However, optical microscopy can be employed as a substitute for SEM to count the large particles between 5 and 100 μm^2.

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