



**Comparative Test – EdgeGARD® Hood And  
Common Horizontal Laminar Flow Hood**

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**BAKER FOUNDATIONS**

## PURPOSE

*To determine the relative cleanliness capability of the EdgeGARD® Hood and the common variety of Horizontal Laminar Flow Hood under a variety of conditions, namely:*

- 1. While the Hoods are empty and operating.*
- 2. While the Hoods are "at rest" but with some commonly used piece of equipment installed within the work area.*
- 3. While work is actually being performed within the work area.*



## EQUIPMENT USED

EdgeGARD® Hood - Model EG-3220.

Gra-Lab Timer.

Dynac Model 101 with Model C-102-D  
Electromechanical Counter - single and  
decade channels.

Alnor Thermoanemometer - type 8500.

Bausch & Lomb stereo microscope.

The EdgeGARD® Hood was converted to a common horizontal flow cabinet by sealing the slots with duct tape and readjusting the air flow to achieve conditions called for in FS-209.

## PROCEDURE

### Leak Test

The EdgeGARD® Hood was tested for leaks by setting the Dynac 101 at 0.5 $\mu$  threshold so that all particles above that size would register. The audible alarm switch was turned "ON" to signal any count.

The perimeter of the filter was probed, twice, to check the validity of the filter seal.

The filter was then "Face Probed", starting at one corner 4" in from the seal, a serpentine path, vertically and 7" apart was followed with the probe (5 passes). Then starting at another corner a serpentine path of 3 passes 8 apart was made horizontally, see Fig. 1. The hood proved to be tight.

### Air Balance

EdgeGARD® Hood - The Alnor anemometer 8500 was used to adjust the velocity of air through the final filter. With the step switch set on the 3rd position and the return air damper within 1/8" from closed position, an average velocity of

102 F.P.M. was achieved 6" from the filter face, see Fig. 2.

Figure 3 indicates the air velocity measured at the slot the anemometer probe was actually touching both sides of each slot.

### Air Balance

Common Laminar Flow Hood - For the tests on the common laminar flow hood ordinary duct tape was used to block the EdgeGARD® Hood slots. After the tape was applied the air was balanced by simply opening the damper over the prefilter until an average velocity of 102 F.P.M. was achieved, see Fig. 4.

### Dust Counts

General - The ambient count was attempted several times over the two weeks required for this test, in all cases ambient counts were too high for the dust counter to deal with. It is estimated that the ambient was in excess of

750,000 particles per cu. ft. throughout the tests. Variations at this high level were not considered significant to the result.

The probe of the Dynac 101 was mounted on a stand slightly higher than 3" above the work surface so that measurements at a uniform height could be made just above the level of the stage on the microscope. Throughout the tests the probe was maintained at that level.

Since the Dynac counter samples at the rate of one tenth of a cu. ft. of air per minute, each test was run for periods of 5 minutes and with the setting unchanged the 5 minute intervals were run sequentially. The purpose was to acquire a large enough sample so that we had some confidence in the counts at the low end and by this method the average of three counts was substantially the same as a 15 minute count which totaled 1-1/2 cu. ft. of air sampled.

A series of counts was planned as follows:

1. Both cabinets empty. Counts to be taken at a point 3" in from the front edge of the work surface and (a) counts to be taken at a point 6" in from the front edge of the work surface.
2. Both cabinets with microscope located at the center of the workspace and 3" in from the front of the work surface and (a) both cabinets with microscope located at the center and 6" in from the front of the work surface.
3. Both cabinets with microscope located at the center and 3" back from the front as in (2) above, and in addition, activity by an operator simulating a common inspection job. To simulate the activity of a cabinet in actual use, small steel plates were used and these plates were picked from the work surface at one side of the microscope, set up on the stage, adjusted by hand, several times the microscope was adjusted and the plate was removed and placed upon the work surface. This entire activity was repeated once each minute during all of the activity tests.

## Test Counts

**Cabinets Empty** - With the probe at 3" in from the front, the EdgeGARD® showed an average count above 0.5μ of 2 particles per cu. ft. When the probe was placed 6" in from the front, no counts were obtained.

Under like conditions the common laminar flow cabinet showed 140 particles per cu. ft. when the probe was 3" in from the front and the total count dropped to 24 particles per cu. ft. when the probe was moved back to 6" from the front.

### *Microscope Installed, Cabinets At Rest*

The EdgeGARD® averaged no more than 50 total particles at the highest reading and no particles over 3μ were found when the probe was 3" from the front.

When the probe was moved 6" in from the front, the highest average was 10 particles per cu. ft. and none over 3μ dia.

Under this set of conditions the common Laminar Flow Cabinet averaged 22,500 at 3" and 19,800 particles per cu. ft. at 6". With a corresponding increase in all other size particles up to 4μ and over.

This was the worst particle count condition found. In some cases two or three extra checks were made to verify that the counts were actually as high as shown.

### *Microscope Installed Activity in Cabinet*

With the microscope and probe located 3" in from the front of the EdgeGARD®, the highest count or total particles was 58 and the highest average count was 44 particles per cu. ft.

When the microscope and probe were moved back to 6" from the front of the work surface, the highest single count was 30 particles per cu. ft. and the highest average count was 23 particles per cu. ft.

Counts at 3" in the common Laminar Flow Unit showed 190 total particles over 0.5μ dia. with particles over 4μ at 10 particles per cu. ft.

Moving back to 6" from the front of the laminar flow cabinet, the count increased to an average 544 per cu. ft. and 12 over 4μ.

## CONCLUSIONS

Several interesting and unexpected results were apparent upon studying the tables and resulting curves on this series of counts, and several predictable conditions were confirmed.

When the two hoods are empty, with proper air flow, even in an extremely dirty ambient, they both provided counts within the limits of Spec. FS-209. The EdgeGARD® was slightly lower, this might have been due to the fact that the EdgeGARD® slots would intercept stray drafts in the room around the cabinet, while the Laminar Flow unit has no such provision.

With both cabinets at rest but with the installation of the microscope in the air stream, the EdgeGARD® still maintained a count well within the limits of Class 100 FS-209. In this instance, however, the common Laminar Flow unit counts were all well above the limits of even a Class 10,000 FS-209 count.

We found also in this condition (cabinet at rest, microscope installed) with the microscope interrupting the air stream and causing partial vacuums and turbulent air that drafts in the room had a very severe effect on total particle counts when the counts were generally below 10 or 15. For example, in the count on the EdgeGARD® series with the microscope 3" from the front, two of the counts of 2 $\mu$  and over and one count of 1 $\mu$  and over, an 8' long x 4' wide sheet of hardboard was dropped at a distance of 8' from the right hand side of the cabinet. This created a high velocity puff of high count ambient air each time it was dropped and had the effect of raising the counts from a level of 4, 8 and 16 up to levels as high as

38, 50, 52 particles per cu. ft.

When the microscope was moved back to 6" from the front, even with drafts in the area, a good series of counts only averaged 10 particles per cu. ft. and 1 particle over 2 $\mu$ .

We believe that the critical area of any work should, therefore, be located not closer than 6" from the front of the work surface to gain the full effect of the EdgeGARD® and provide the cleanest possible location for a critical operation.

The common Laminar Flow unit at rest with microscope installed showed very little difference in magnitude of dust count when the microscope was located at 3" in or at 6" in, both conditions were well above the Class 10,000 FS-209.

When a tool or other body interrupts the air stream in this type of unit, these tests show that the common Laminar Flow cabinet is not only not a Class 100 area, it is not even Class 10,000.

Storage is not advisable in this condition, and even though the bench is running it is not advisable to leave it unattended without an adequate closure.

The series which was run with activity in both cabinets again revealed that the EdgeGARD® would maintain its cleanliness well within the Class 100 specifications. Again the counts indicated that when the microscope was 6" in from the front, the count in the critical area was about half of the count at the 3" location. All counts, however, stayed well below Class 100.

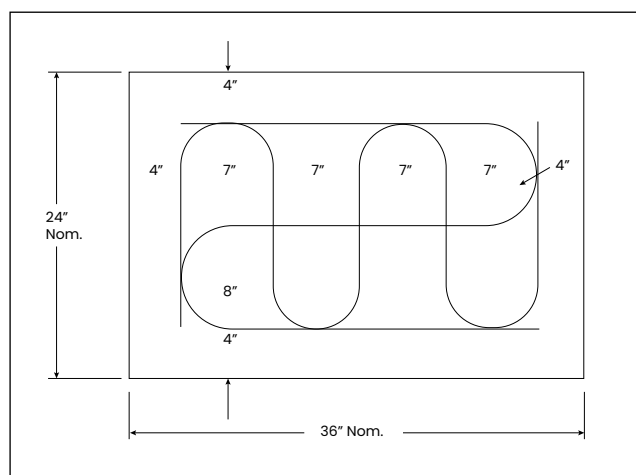


Figure 1. Face scan pattern, filter leak test

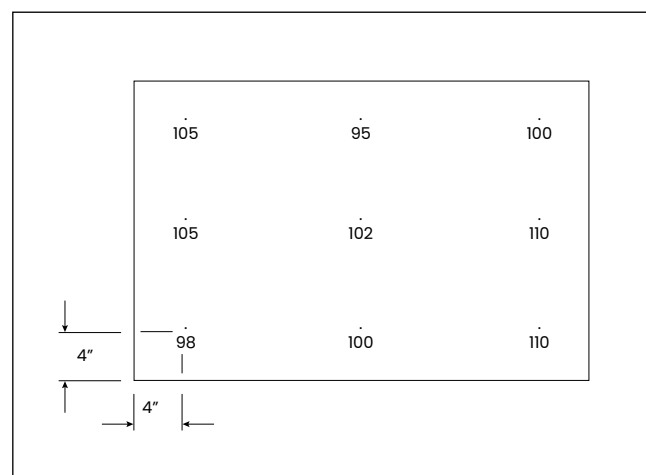


Figure 2. EdgeGARD® air velocity measurements 6" from face of filter

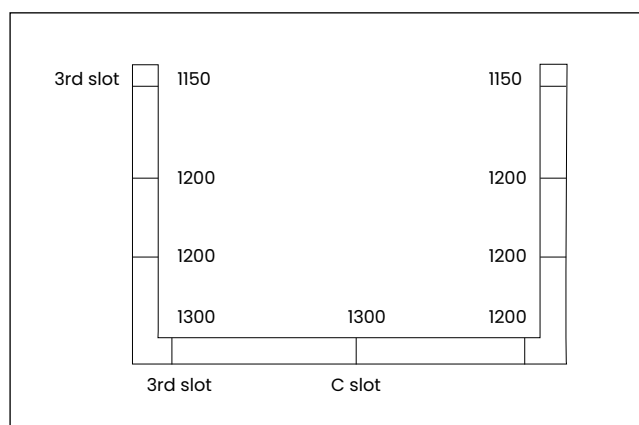
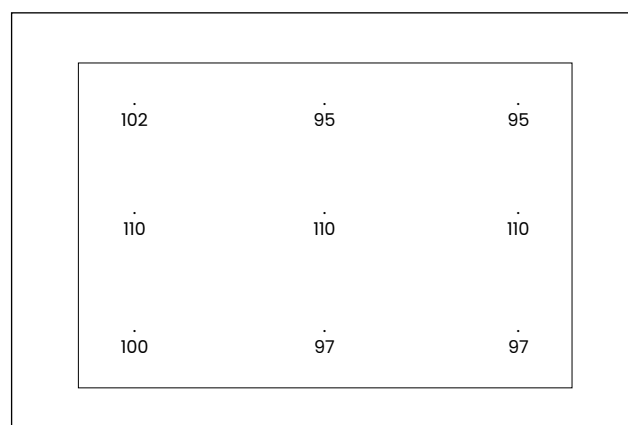


Figure 3. Air velocity at EdgeGARD® slots

Laminar flow cabinet air velocity measurements,  
6" from face

|                    | EdgeGARD® Hood |    | Laminar Flow |       |
|--------------------|----------------|----|--------------|-------|
| Empty 3"           | 3"             | 6" | 3"           | 6"    |
| 4μ & over          | 0              | 0  | 0            | 0     |
| 3μ & over          | 0              | 0  | 0            | 0     |
| 2μ & over          | 0              | 0  | 6            | 0     |
| 1μ & over          | 0              | 0  | 56           | 4     |
| 0.5μ & over        | 2              | 0  | 140          | 24    |
|                    |                |    |              |       |
| Microscope at Rest | 3"             | 6" | 3"           | 6"    |
| 4μ & over          | 0              | 0  | 1396         | 788   |
| 3μ & over          | 0              | 0  | 2698         | 1730  |
| 2μ & over          | 26             | 1  | 4992         | 4230  |
| 1μ & over          | 33             | 0  | 7953         | 9430  |
| 0.5μ & over        | 13             | 10 | 22530        | 19870 |
|                    |                |    |              |       |
| Operator Working   | 3"             | 6" | 3"           | 6"    |
| 4μ & over          | 0              | 0  | 10           | 12    |
| 3μ & over          | 1              | 2  | 16           | 32    |
| 2μ & over          | 5              | 3  | 16           | 36    |
| 1μ & over          | 7              | 13 | 20           | 48    |
| 0.5μ & over        | 44             | 23 | 190          | 544   |

Each of these counts has been plotted on Log-Log charts along with the curves for Dust Count Classifications in FS-209. An examination of these curves will add much to this commentary.

When viewing these curves you will notice that below 10 particles per cu. ft. a dotted line is shown in all cases. Statistically, it is impossible with such small numbers to be meaningful, therefore, a 10 particles count could just as easily be 5 or 8 or some other single digit.

**The EdgeGARD® Hood excels on all counts.**

## ADDENDUM

### **Dynac Model M-101 Automatic Particle Counter**

The Dynac Model M-101 Automatic Particle Counter is a light scattering counter, digital in its operation with two channels to which the data is fed simultaneously. One channel is factory preset to count all particles 0.5 and over. The other channel can be adjusted to change the lower threshold from 0.5 to 5 $\mu$  particle sizes.

This unit is provided with outputs so that either one or both of the channels can be connected to a variety of accessory counters to either display or print readouts.

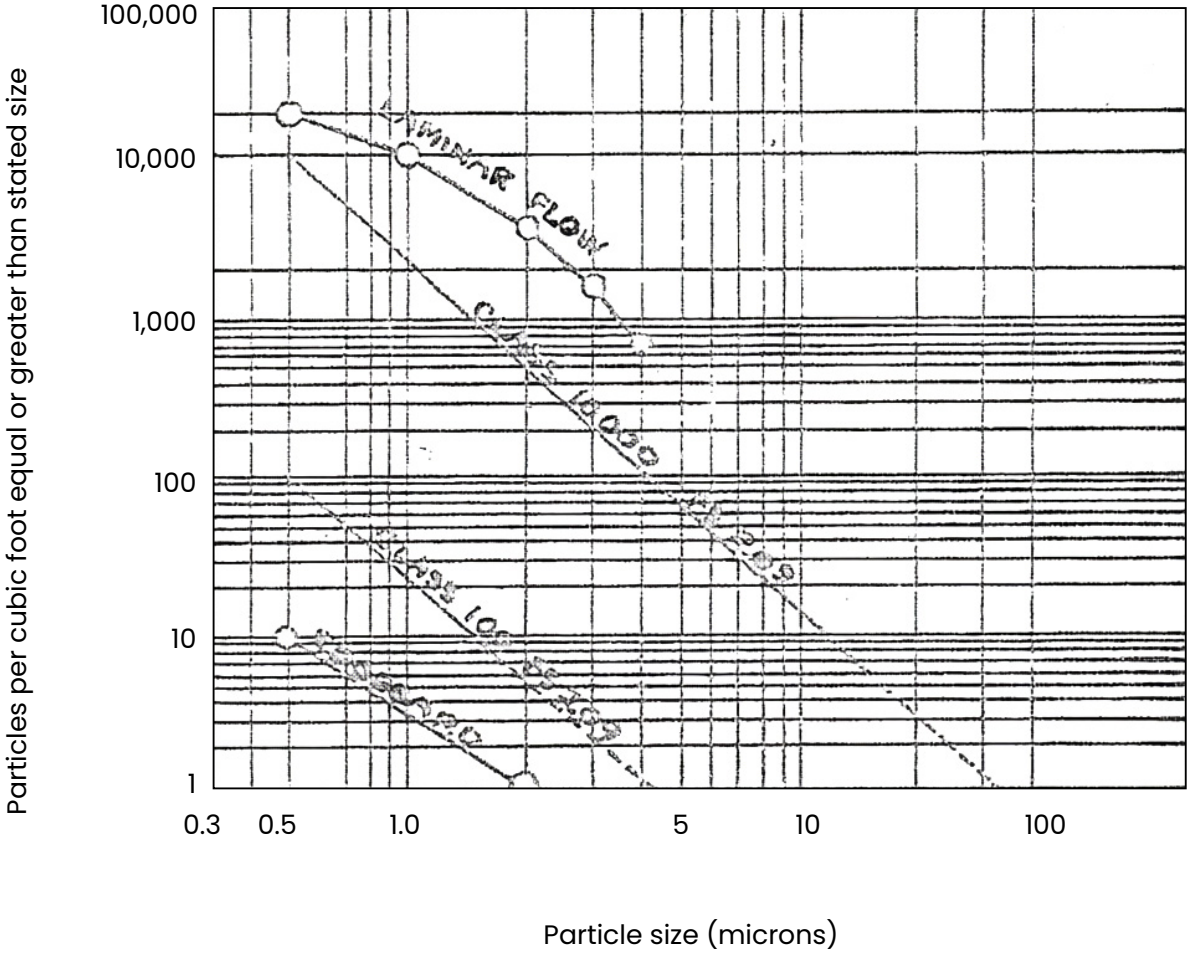
For the purpose of this series of tests the Model C-102-D Dual Channel Electromagnetic counter was used. This counter has a recommended upper limit of 100,000 particles per cu. ft. Thus, the ambient air, which was approximately 750,000 particles per cu. ft. could

not be readout, although the Dynac M-101 was actually counting the particles.

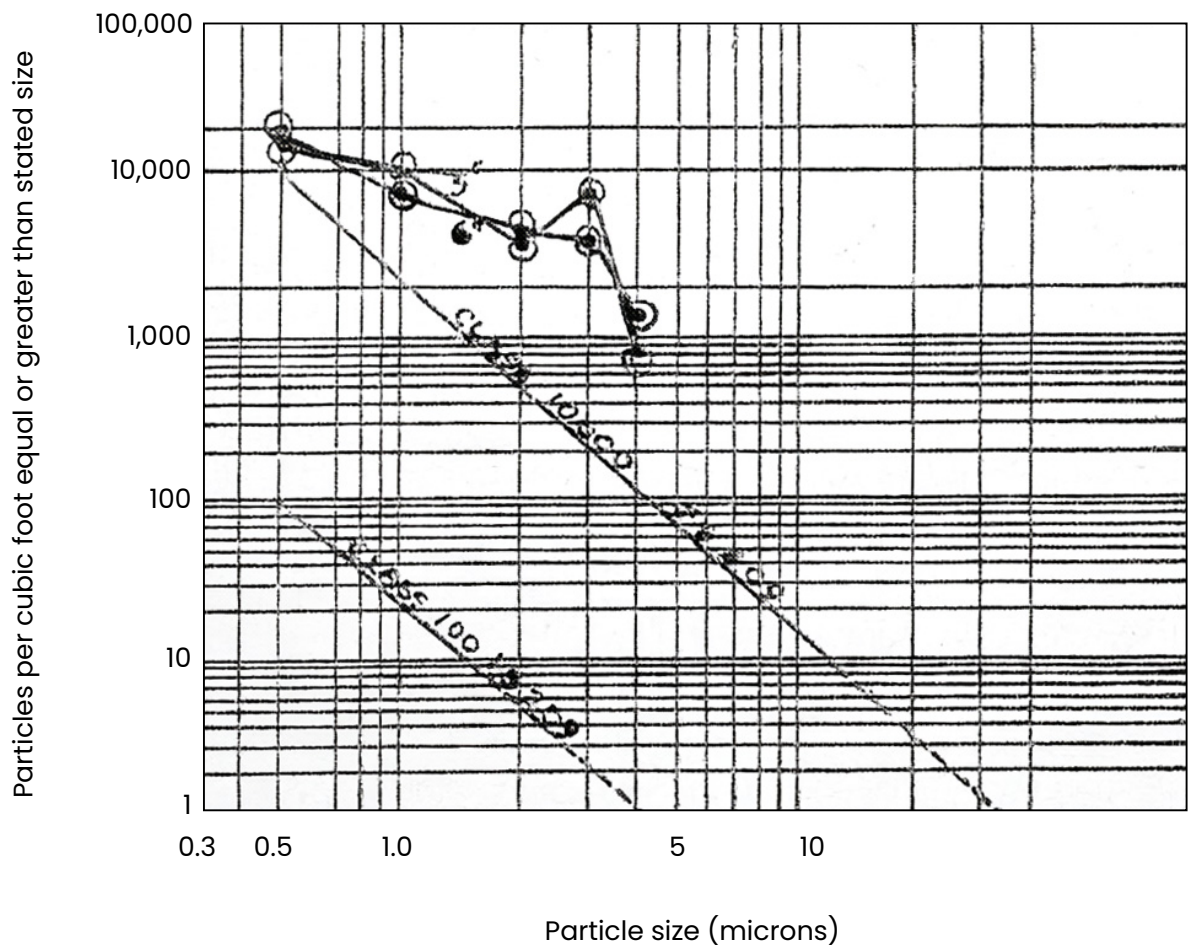
The estimated number of particles was arrived at by sampling the ambient air and at the same time adjusting the potentiometer (reset timer) on the factory preset channel until a uniform, regular signal showed on the visual alarm. This provides an approximation of the particles being counted between each reset of the timer and a simple multiplication provided the 750,000 particles per cu. ft. estimate for the ambient air condition.

There are faster counters available for use with the Dynac Monitor which easily handle counts to 2,500,000, if required. Normally, this speed of counter is unnecessary in the clean bench business.

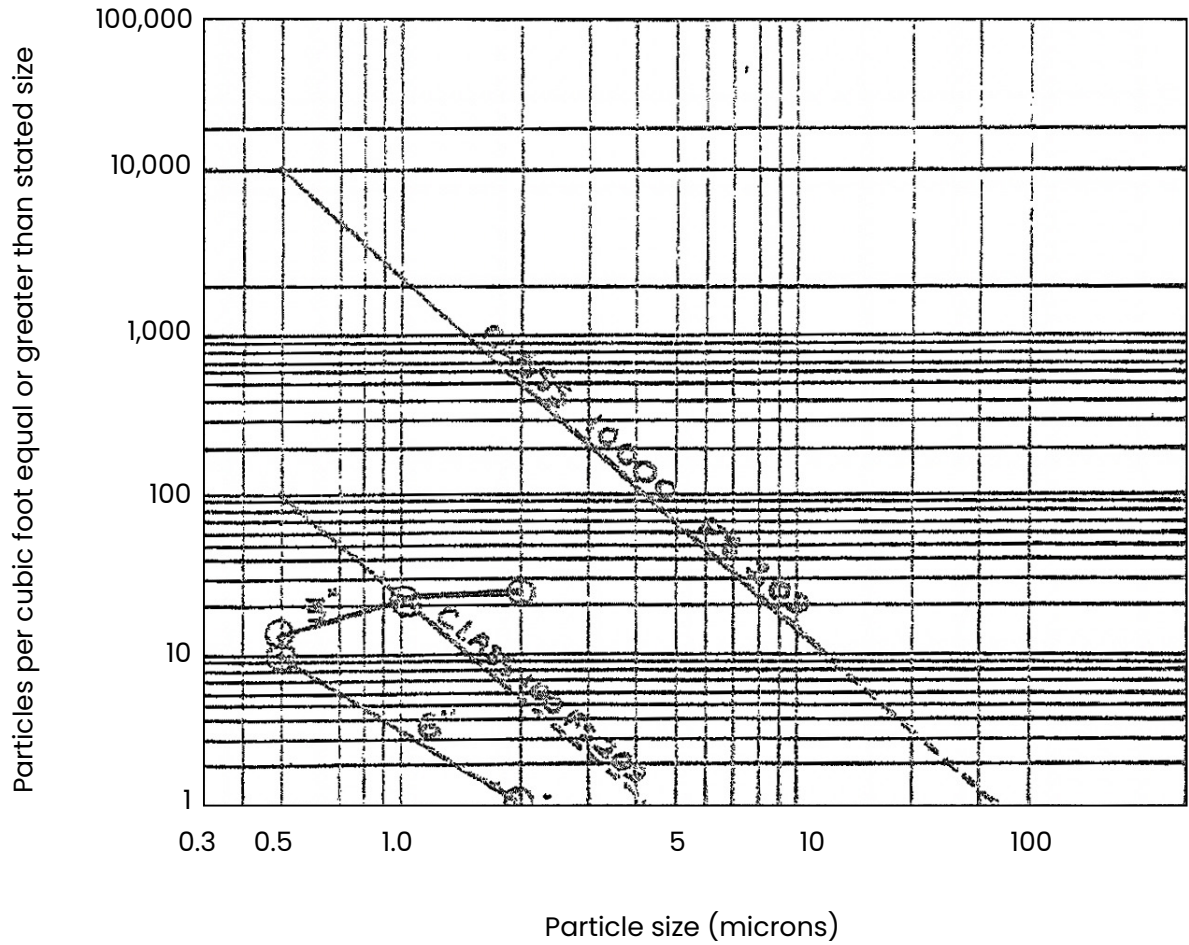
|             | Hoods Empty<br>Probe 6" From Front |    |    |    |    |    |
|-------------|------------------------------------|----|----|----|----|----|
|             | Test #                             |    |    |    |    |    |
|             | #1                                 | #2 | #3 | #4 | #5 | #6 |
| 4μ & over   |                                    |    |    |    |    |    |
| 3μ & over   |                                    |    |    |    |    |    |
| 2μ & over   |                                    |    |    |    |    |    |
| 1μ & over   |                                    |    |    |    |    |    |
| 0.5μ & over |                                    |    |    |    |    |    |



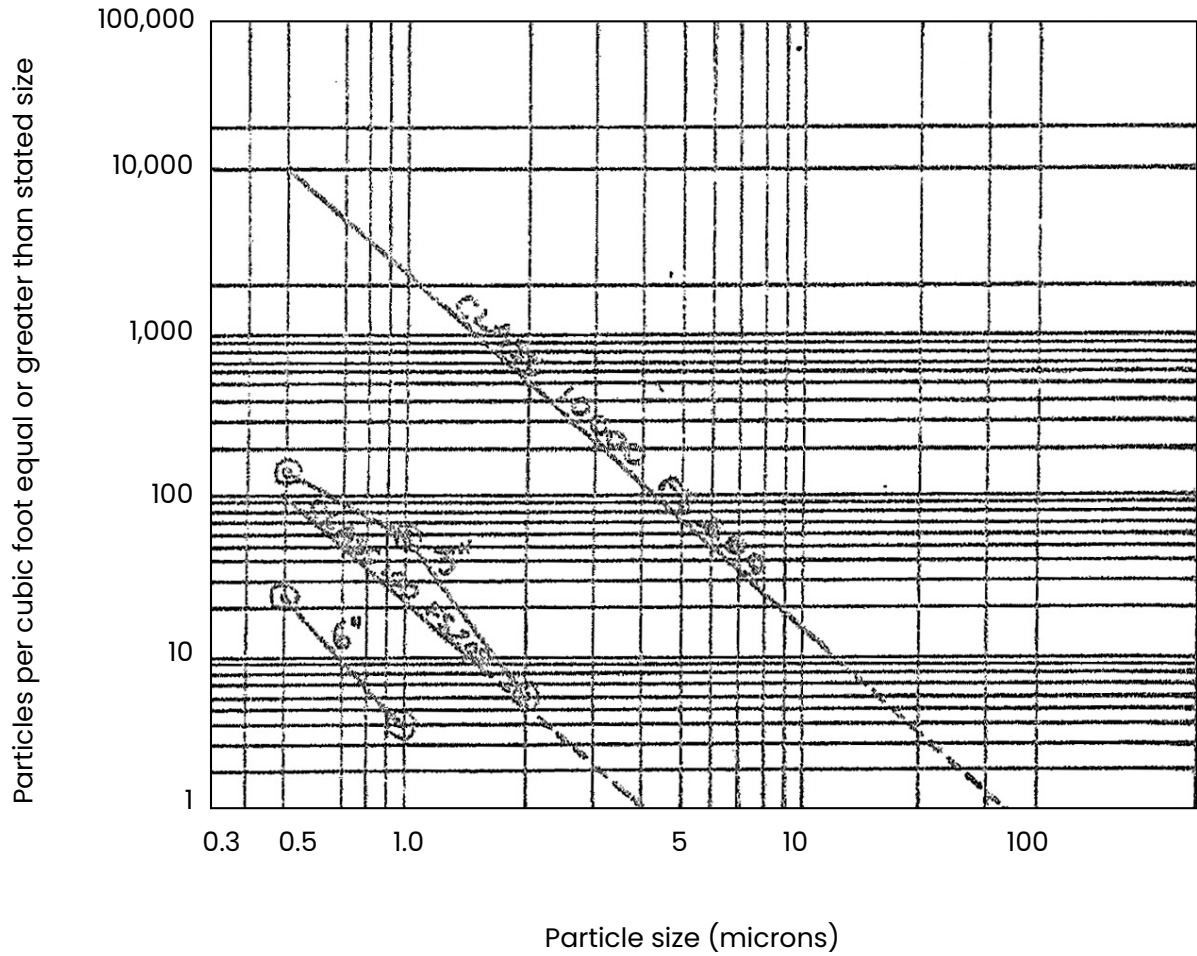
| Laminar Flow - Microscope Installed<br>At Rest |        |               |       |                      |               |       |       |       |
|------------------------------------------------|--------|---------------|-------|----------------------|---------------|-------|-------|-------|
|                                                | Test # | 3" From Front |       |                      | 6" From Front |       |       |       |
|                                                |        | #1            | #2    | #3                   | #4            | #5    | #6    |       |
| 4μ & over                                      | 1396   | 290           | 1600  | 2300                 | 700           | 686   | 980   | 78F   |
| 3μ & over                                      | 2698   | 690           | 2300  | 1700<br>2820<br>6000 | 1500          | 1860  | 1840  | 1730  |
| 2μ & over                                      | 4992   | 1070          | 4900  | 5000<br>9000         | 3600          | 4550  | 4540  | 4230  |
| 1μ & over                                      | 7953   | 5960          | 8800  | 9100<br>24900        | 11300         | 8930  | 8060  | 9430  |
| 0.5μ & over                                    | 22530  | 29700         | 21000 | 16900                | 25400         | 20970 | 13230 | 19820 |



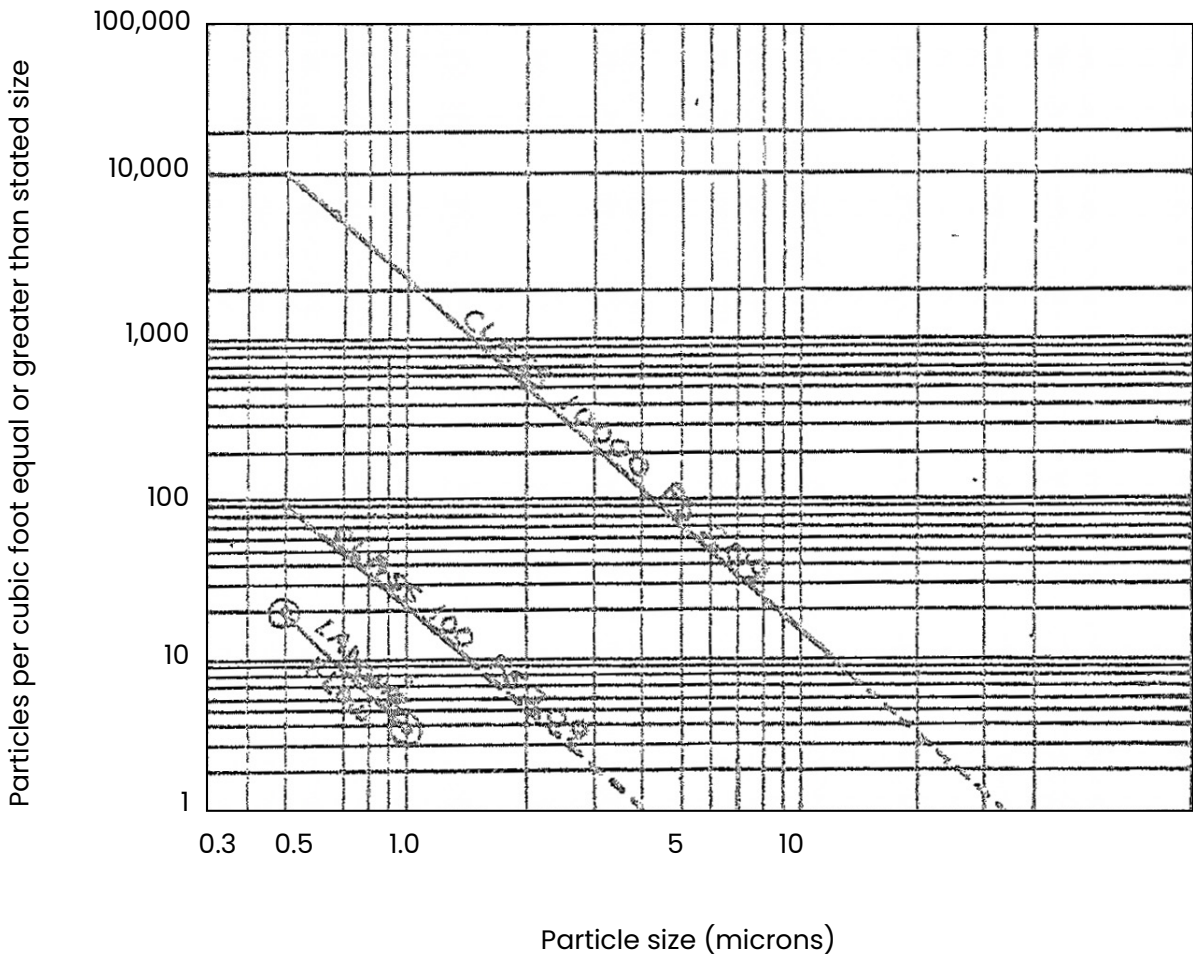
| EdgeGARD® - Microscope Installed<br>At Rest |     |               |    |         |               |         |        |     |
|---------------------------------------------|-----|---------------|----|---------|---------------|---------|--------|-----|
| Test #                                      |     | 3" From Front |    |         | 6" From Front |         |        |     |
|                                             |     | #1            | #2 | #3      | #4            | #5      | #6     |     |
| 4μ & over                                   | 0/  | 0             | 0  | 0       | 0             | 0       | 0      | 0/  |
| 3μ & over                                   | 0/  | 0             | 0  | 0       | 0             | 0       | 0      | 0/  |
| 2μ & over                                   | 26/ | 4             | 38 | 8<br>52 | 2             | 0       | 0      | 1/  |
| 1μ & over                                   | 22/ | 50            | 16 | 0       | 0             | 0       | 0      | 0/  |
| 0.5μ & over                                 | 13/ | 6             | 24 | 10      | 18            | 4<br>16 | 4<br>6 | 10/ |



| Laminar Flow<br>Cabinet Empty |      |                     |    |     |                     |    |     |
|-------------------------------|------|---------------------|----|-----|---------------------|----|-----|
| Test #                        |      | Probe 3" From Front |    |     | Probe 6" From Front |    |     |
|                               |      | #1                  | #2 | #3  | #4                  | #5 | #6  |
| 4μ & over                     | 0/   | 0                   | 0  | 0   | 0                   | 0  | 0/  |
| 3μ & over                     | 0/   | 0                   | 0  | 0   | 0                   | 0  | 0/  |
| 2μ & over                     | 0.6  | 10                  | 0  | 10  | 0                   | 0  | 0/  |
| 1μ & over                     | 56.5 | 100                 | 50 | 20  | 2                   | 6  | 4/  |
| 0.5μ & over                   | 147  | 290                 | 30 | 100 | 12                  | 36 | 24/ |

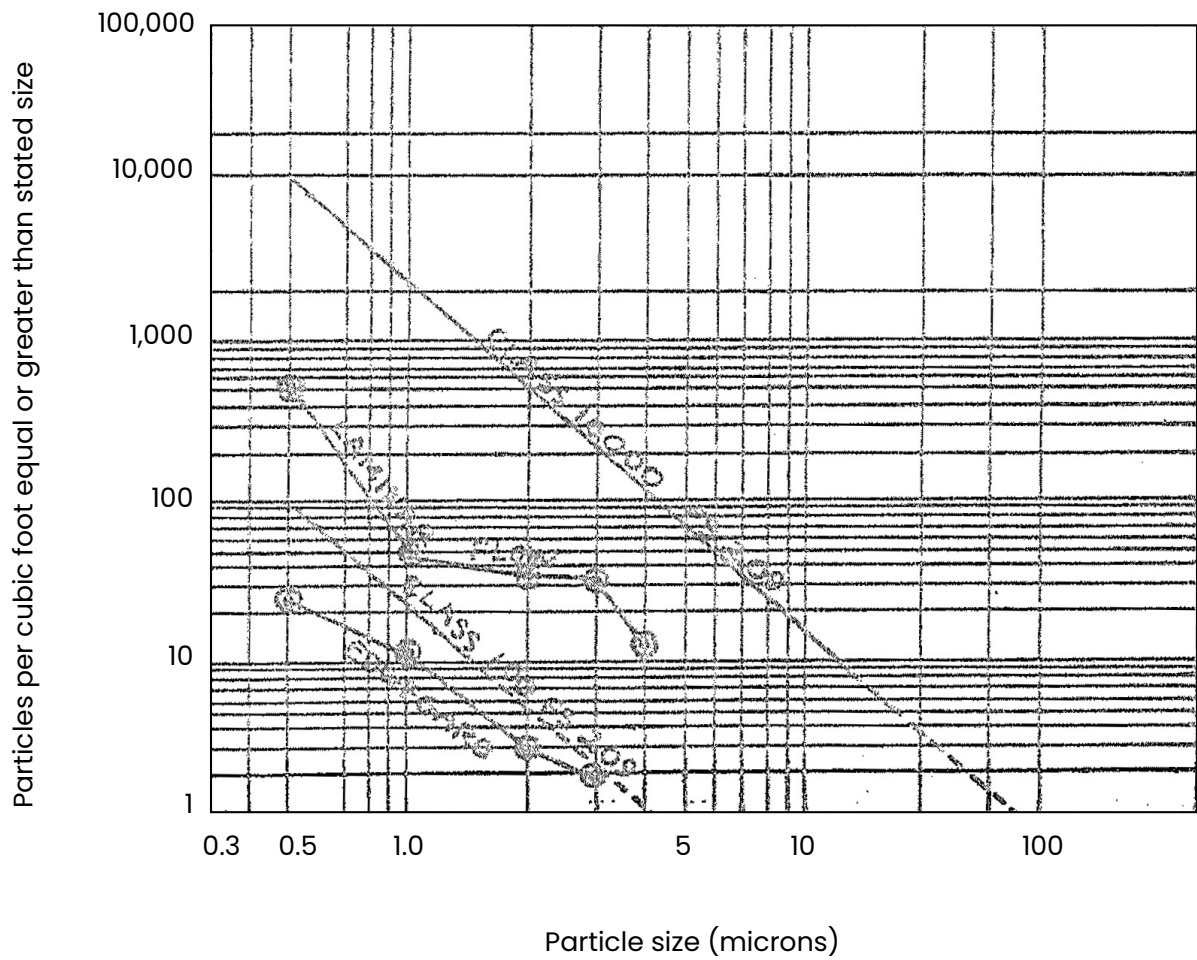


| Hoods Empty<br>Probe 6" From Front |    |    |    |    |    |    |
|------------------------------------|----|----|----|----|----|----|
| Test #                             | #1 | #2 | #3 | #4 | #5 | #6 |
| 4μ & over                          |    |    |    |    |    |    |
| 3μ & over                          |    |    |    |    |    |    |
| 2μ & over                          |    |    |    |    |    |    |
| 1μ & over                          |    |    |    |    |    |    |
| 0.5μ & over                        |    |    |    |    |    |    |

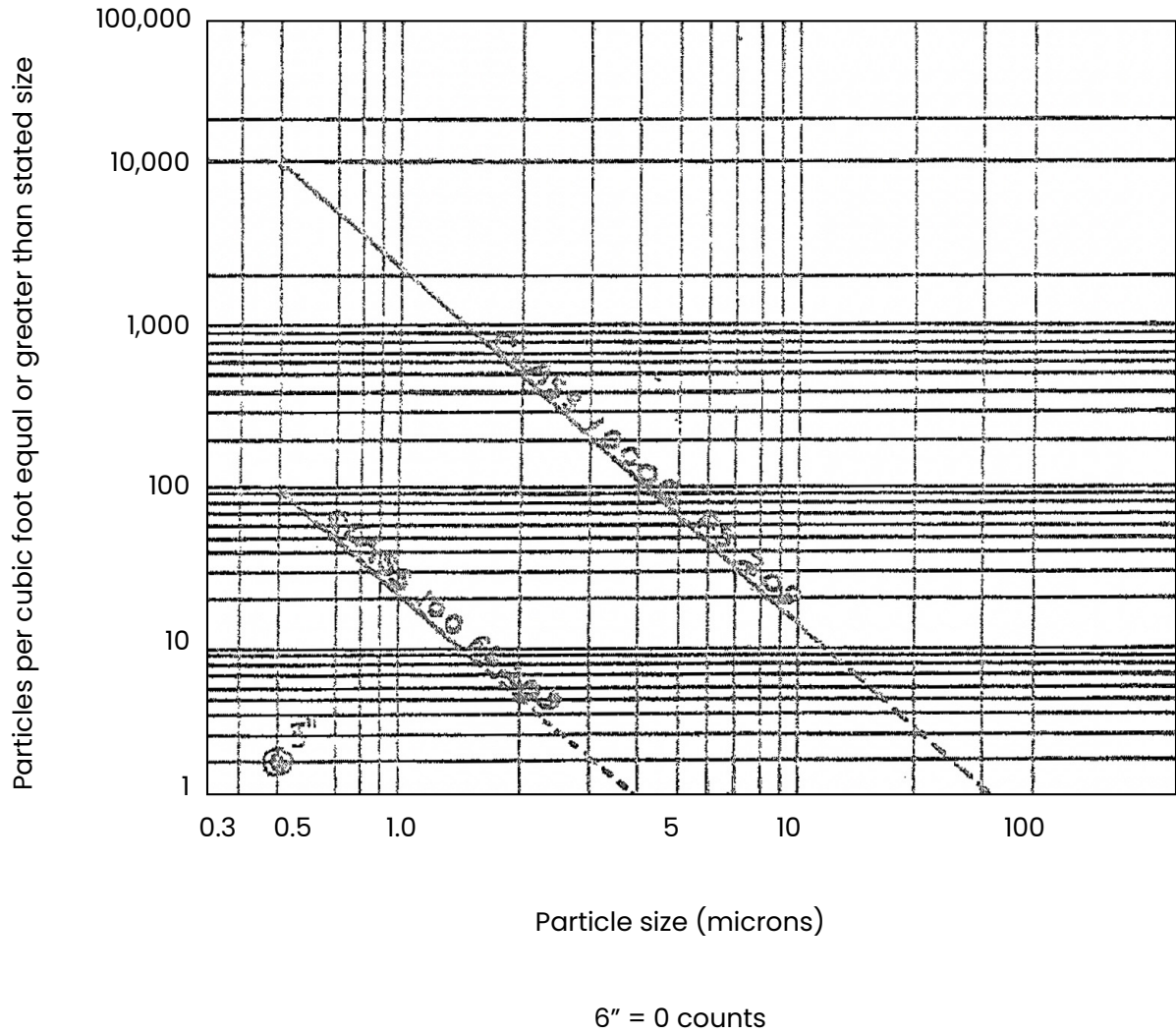


EdgeGARD® hood count - 0

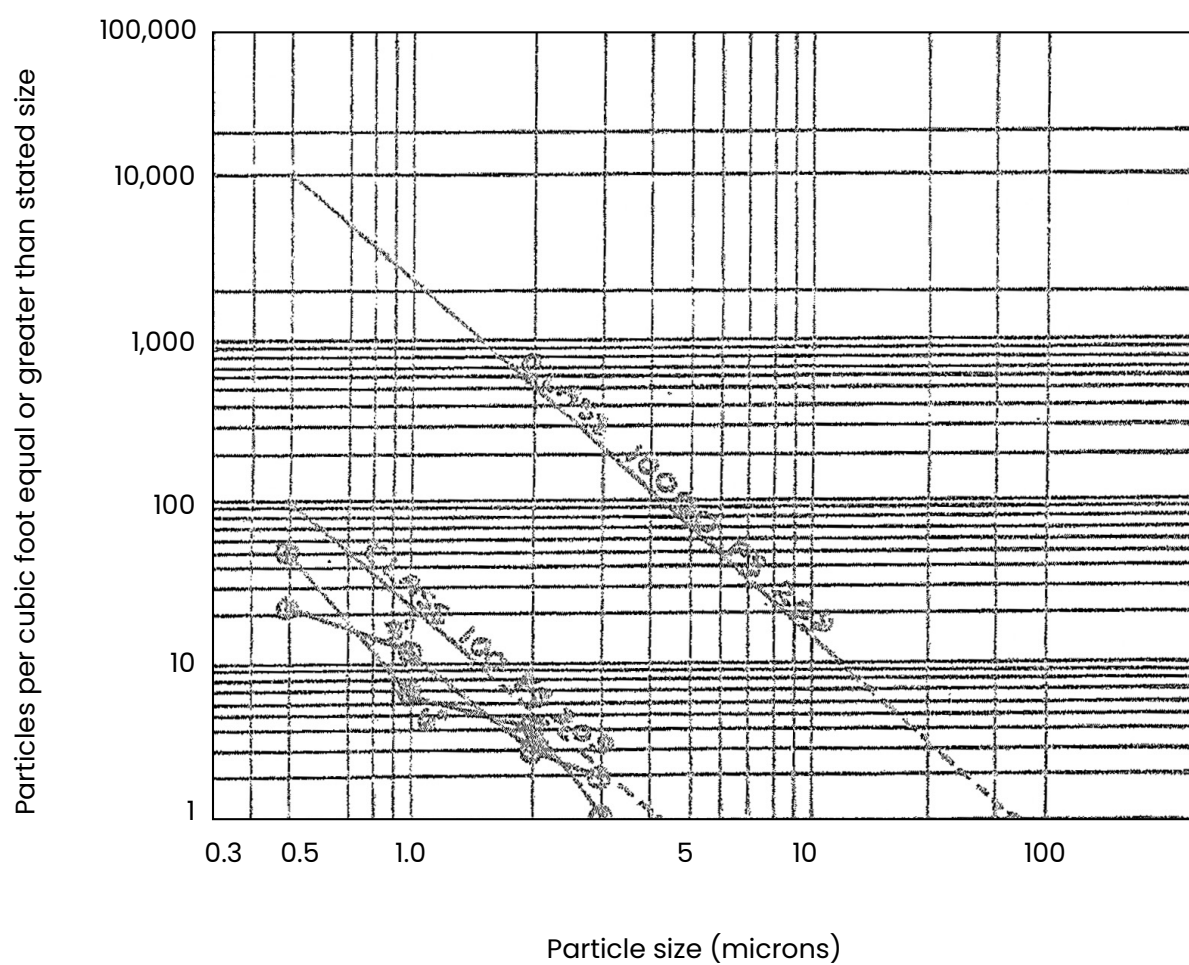
| Operator Working<br>Microscope 6" From Front |    |    |    |    |    |    |
|----------------------------------------------|----|----|----|----|----|----|
| Test #                                       | #1 | #2 | #3 | #4 | #5 | #6 |
| 4μ & over                                    |    |    |    |    |    |    |
| 3μ & over                                    |    |    |    |    |    |    |
| 2μ & over                                    |    |    |    |    |    |    |
| 1μ & over                                    |    |    |    |    |    |    |
| 0.5μ & over                                  |    |    |    |    |    |    |



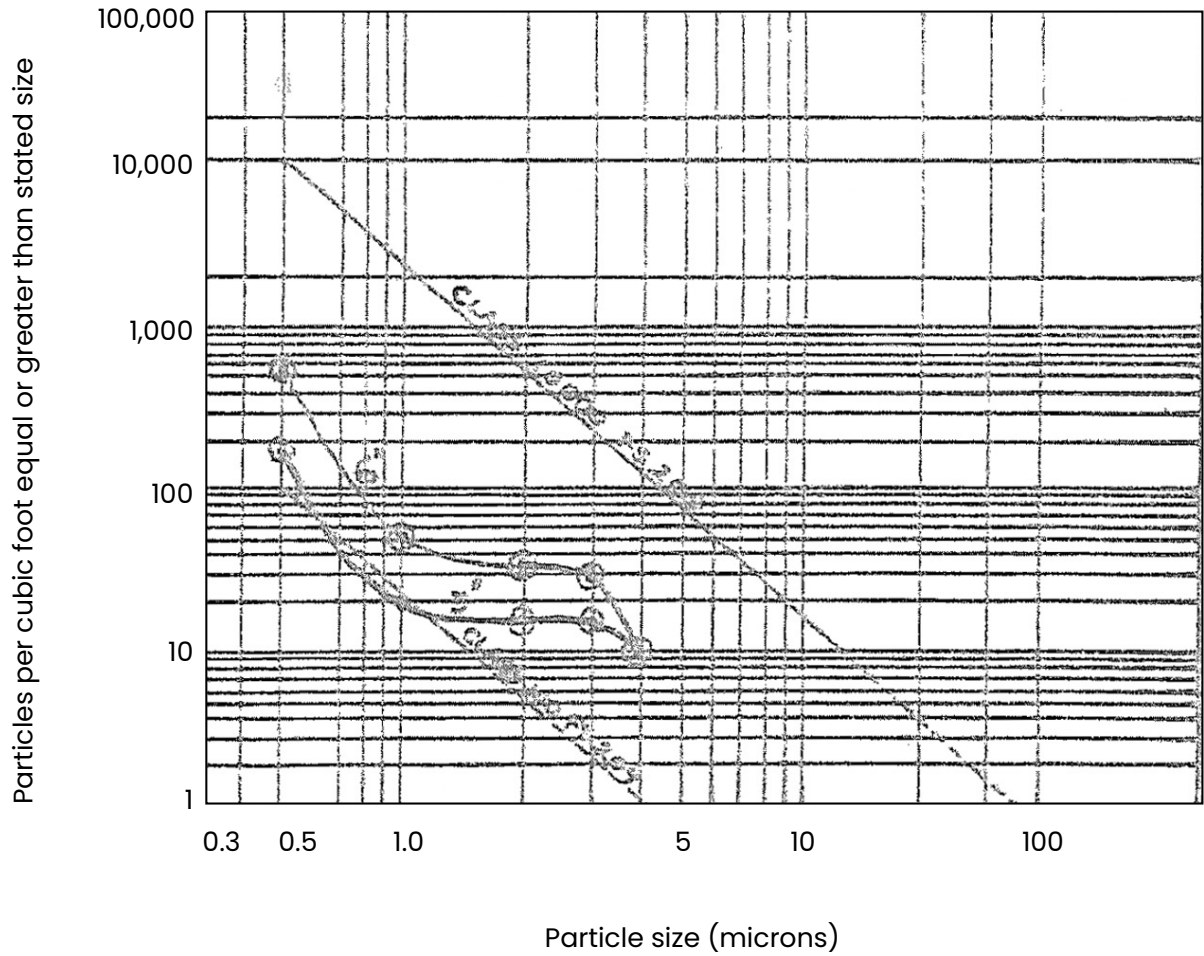
| EdgeGARD® Empty |        |                     |    |    |                     |    |    |
|-----------------|--------|---------------------|----|----|---------------------|----|----|
|                 | Test # | Probe 3" From Front |    |    | Probe 6" From Front |    |    |
|                 |        | #1                  | #2 | #3 | #4                  | #5 | #6 |
| 4µ & over       | 0      |                     |    |    | 0                   |    |    |
| 3µ & over       | 0      |                     |    |    | 0                   |    |    |
| 2µ & over       | 0      |                     |    |    | 0                   |    |    |
| 1µ & over       | 0      |                     |    |    | 0                   |    |    |
| 0.5µ & over     | 2      |                     |    |    | 0                   |    |    |



|             | EdgeGARD® Operator Working<br>Microscope Installed |               |    |    |               |    |    |     |
|-------------|----------------------------------------------------|---------------|----|----|---------------|----|----|-----|
|             | Test #                                             | 3" From Front |    |    | 6" From Front |    |    |     |
|             |                                                    | #1            | #2 | #3 | #4            | #5 | #6 |     |
| 4μ & over   | 0/                                                 | 0             | 0  | 0  | 0             | 0  | 0  | 0/  |
| 3μ & over   | 1/                                                 | 0             | 2  | 0  | 4             | 0  | 2  | 2/  |
| 2μ & over   | 5/                                                 | 4             | 12 | 0  | 8             | 2  | 0  | 3/  |
| 1μ & over   | 7/                                                 | 4             | 12 | 6  | 16            | 14 | 8  | 13/ |
| 0.5μ & over | 44/                                                | 18            | 58 | 56 | 30            | 26 | 14 | 23/ |



| Laminar Flow Operator Working<br>Microscope Installed |     |               |    |    |               |    |    |     |
|-------------------------------------------------------|-----|---------------|----|----|---------------|----|----|-----|
| Test #                                                |     | 3" From Front |    |    | 6" From Front |    |    |     |
|                                                       |     | #1            | #2 | #3 | #4            | #5 | #6 |     |
| 4μ & over                                             | 10  |               |    |    |               |    |    | 12  |
| 3μ & over                                             | 16  |               |    |    |               |    |    | 32  |
| 2μ & over                                             | 16  |               |    |    |               |    |    | 36  |
| 1μ & over                                             | 20  |               |    |    |               |    |    | 48  |
| 0.5μ & over                                           | 190 |               |    |    |               |    |    | 544 |



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