Dynamic Design: The Cleanroom

Maintaining Clean

STUDENT TEXT

Johnsson Space Center

Ultra Low Penetrating Air (ULPA) filters in the ceiling of the cleanroom are constantly filtering the air inside the cleanroom. High Efficiency Particle Air (HEPA) filters are found on the cleanroom suits to filter the air that people breathE in the cleanroom. See video clip 00-02a to hear Contamination Control Lead Scientist Eileen Stansbery discuss how these filters work. Once a cleanroom has been certified at a particular level of clean, it is up to the personnel that work in the cleanroom on a daily basis to constantly monitor the conditions and correct the problem if contamination occurs. There are two primary ways in which contamination is monitored in the Genesis cleanroom. The first is a witness plate. This is a wafer that is placed near the area where the assembly is done. This plate can be tested periodically to determine if the amount of contamination is above the specifications for that class of cleanroom. The second is an air particle counter that is used to count the number of particles in a sample of the air space.

Sampling is an important part of everyday life. Think about all the times you have heard of sampling. One example is when you get a small taste of ice cream in order to decide whether you want an entire ice cream cone of that particular flavor. Another example is when you go to a restaurant and see several menu items that interest you. One way to handle that is to order a sampler item, which contains smaller portions of several menu items. Finally, when groups take opinion polls, a sample is taken from which data is reported to the public.

A sample is a representative part of something that is larger. In the case of the cleanroom, the air that is in the entire cleanroom is the population of air particles. What a person breathes in while in the cleanroom might be considered a sample. Sampling is the method that one uses to obtain this part of the population. Sampling is an important aspect of any survey. “Systematic observations, such as random testing of manufacturing parts taken from an assembly line, can be used for purposes of quality control. The relationship between the characteristics of a sample and the population from which it is drawn lies behind the use of sampling for monitoring process control and quality in the workplace.” (NCTM, 2000) In other words, the number and quality of samples that are taken determine how generalizable the sample is to the population.

Let’s use an example of a prize to be given away in your class today to explain the three methods of collecting samples. The easiest method of taking a sample is called the **convenient** method. In our example the teacher would give the prize to the students who are closest to her desk. This would be the easiest because it would require very little effort on the teacher’s part. Yet many students in the class would say that this is not fair.

A **systematic** sampling technique is when the sample is taken at regular intervals. In our example the teacher might take out her grade book and read off every fifth person’s name to come forward to collect the prize. While this method will give a more representative sample of the students in the class, not everyone would have a shot at the prize. Again students would complain that this is not fair.

A third method of choosing a sample is called **random**. In this case, the students would write their names on a piece of paper and put them in a box or bag. The teacher would then pick ten names out of the hat for students to collect the prize. Not everyone would get selected, but each person would have a chance of being selected. A random sample is the best method for choosing a sample. The students who did not win, still might not think it is fair. “A sample is most likely to be representative when it has been randomly chosen from the population.” (NCTM, 2000)

The air particle counter is used to measure contamination of samples of air in the Genesis cleanroom. Two models of air particle counters are used. The APC Plus Airborne Particle Counter counts four size ranges of particles simultaneously, 0.3, 0.5, 1.0, and 5.0 microns. The APC Plus has three sampling modes and can display data in particles per cubic foot,

particles per liter, and total particles. The sample count and sample interval times can be programmed. The date, time, and particle counts for up to 200 locations are stored in memory.

The LASAIR® optical particle counters are specifically designed for contamination monitoring in cleanroom facilities. Minimum sizing thresholds are available at 0.1, 0.2, 0.3, and 0.5 microns. An aerosol manifold can be configured to work with the LASAIR® counter to allow for sampling of multiple locations within a cleanroom in an efficient manner. The LASAIR® particle counter is able to record critical contamination trends as well as short term bursts and will display this data in a time series histogram. Automatic sampling and storage of up to 99 data samples can be programmed into the system with printed reports available in full screen or compress print. Compare and contrast these two instruments.

As we have seen sampling is an important part of the Genesis mission and in your everyday life. In your journal write down what you have learned from this activity and text about sampling. Discuss considerations you would have if you were going to conduct a survey or complete an experiment where sampling was necessary.