

## Achieving Cleanroom Standards

Companies that produce sensitive products use cleanrooms to prevent contaminants present in outside air from destroying the product's functionality. This includes technology firms, which benefit from cleanrooms to safely limit the amount of particles in the air when manufacturing sensitive electronic equipment.

Though cleanroom environments are a critical part of quality assurance, they are surprisingly unregulated by the U.S. government. In fact, the only federal standard that regulated cleanrooms was canceled in 2001, although manufacturers still widely use the standard as a guideline today.

The International Organization for Standardization (ISO), of which the United States is a member, covers the classification of air purity in cleanrooms, and specifies the requirements for testing and monitoring cleanrooms to prove compliance. But from an employer's perspective, it is not ISO 14644-1 and ISO 14644-2 standards that should determine how to treat your cleanroom facility; rather, it makes the most business sense for you to treat your cleanroom with the utmost care to ensure that the facility stays up to specifications.

### Different Standards of "Clean"

Individual industries set their own standards for just how "clean" companies' cleanrooms must be. For example, integrated circuit manufacturers must operate in a cleanroom of no more than ISO Class 4, which does not allow any particles greater than 5 micro-meters in size, or one-thousandth of a millimeter. Check the ISO published standards to determine the proper ISO rating for your facilities.

Standards aside, a cleanroom is only useful if it is maintained properly. Many employers are unaware of the fact that a particle 200 times smaller than the width of a human hair can cause a major contamination disaster in the cleanroom. Contamination will not only cost your company because of expensive downtime while the problem is fixed, but it will also result in increased product costs. Many electronic products produced in a contaminated cleanroom will not function properly and can result in product recall.

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### Be Proactive to Avoid Contamination

Building a cleanroom properly is the first step to saving money in the long run because it is much easier to eliminate the possibility of contamination as the facility is being built. Removing contamination after the fact is not only extremely difficult, but also enormously costly in both time and money. It is important to warn your employees that contamination can come from many unexpected sources, including:

- Other elements of the building or facility that hold the cleanroom, including walls, floors, ceilings, paint, coatings and air conditioning debris.
- Equipment and supplies, such as particles from

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friction, vibrations, brooms, mops, items brought into the cleanroom and cleanroom debris.

- Microorganisms, like viruses, bacteria and fungus. The microelectronics industry is concerned with bacteria especially because of their high ion content.
- Most importantly, people are often the biggest source of contamination. This can come from skin flakes and oil, hair, saliva, cosmetics or perfume, and clothing debris like lint and fibers. However, it can also come simply from peoples' presence; a motionless person, standing or seated, generates 100,000 0.3 micron-sized particles each minute, and a person walking at a swift pace will generate 10,000,000 particles per minute.

Ensuring that the facility meets the accurate air quality standards starts with requiring employees to wear the proper equipment while inside the cleanroom. The level of caution taken will also depend on industry standards, because each ISO classification has its own minimum gowning requirements that range from a simple frock to a full-on suit, complete with face mask and boots. There are also varying levels of cleanliness that must be met before entering the cleanroom, such as walking through an air blast before entering the facility, which are set for each ISO classification.

## Precautions and Considerations

To lower your cleanroom's risk of contamination, take the following precautions:

- Very small voltage static electricity discharge can destroy silicon chips in microelectronics. Many surfaces in cleanrooms are poor conductors (i.e., plastics) and can develop and retain a high electrostatic charge. When cleaning these surfaces it may be necessary to leave a film of antistatic agent to conduct the charge away safely.
- Warn employees about the danger to the company in bringing personal items – such as wallets and

phones – out while in the cleanroom.

- Encourage employees to make as subtle and slow of movements as possible while in the cleanroom.
- Check periodically for leakages in the shell enclosing the cleanroom that separates the clean air from the rest of the building.
- Monitor the construction of the cleanroom closely.
- Regularly measure and test the cleanroom to ensure it is running properly.

Remember that following these guidelines could save your company hundreds of thousands of dollars in lost product and in downtime by lessening your risk for cleanroom contamination.