



# Sterile stainless steel serves cleanrooms

When studying viruses, making computer chips, or bottling medicines, particles 100 times smaller than a grain of sand can spell disaster. Ultra-sensitive procedures like these take place in cleanrooms, the most meticulously controlled spaces on earth. Type 316 stainless steel is widely used in this sector.

How can researchers study diseases and other dangerous substances without jeopardizing public health? Where are many medicines and most computer chips made? The answer is found in a cleanroom, an enclosed, strictly monitored area with a specified maximum number of particles per cubic meter. There are many kinds of cleanrooms that serve a variety of purposes and industries, though the majority are used to manufacture sensitive products like pacemakers. While some cleanroom spaces are just a few square meters in size, some span the entirety of factory floors. The interiors of these important spaces depend on stainless steel furniture. Some cleanrooms are even constructed with stainless steel wall panels. Why? Because stainless steel, especially the molybdenum-containing Type 316, resists repeated chemical cleanings without deterioration. The latest ISO standards require higher concentrations of chlorine and more hydrogen peroxide than previous additions, making them more aggressive, likely leading to wider use of Type 316 stainless steel in certain cleanroom settings.

➤ The inside of a cleanroom for medical device manufacturing features a variety of stainless steel furniture and equipment.



## A condemnation of contamination

All cleanrooms adhere to the International Standards Organization (ISO) 14644 standard, which stipulates the

level and size of particles allowed. Temperature and humidity are also strictly regulated. There are nine levels or “classes” of cleanroom. With each class, the number of particles allowed decreases by a factor of 10. The specific classification required depends on the sensitivity of the goings on within the cleanroom. Generally, class 5 is considered the cut off for extreme levels of cleanliness. Particles smaller than bacteria pose a risk to operations below that threshold. Biotechnology is one such industry that requires operation at class 5 or lower.

Even entering a cleanroom is a complicated affair. Workers generally put on gowns and other protective gear in a separate changing room. They must move meticulously and slowly, so as not to contaminate the outside of the gown with skin particles while dressing. After that they may pass through an air shower, depending on the application. This scrupulous protocol is because humans working inside a cleanroom are its single largest source of contamination. The average person sheds 10 grams of skin a day, in addition to hair and other particulate. Wearing a specialty gown helps, but it isn't enough. Behemoth HVAC systems cycle air and filter out particles that inevitably enter the environment. Of course, everything must be scrubbed clean at regular intervals. Damage to equipment or furniture from cleaning, even minor, can halt an entire operation.

Type 316 stainless steel contains 2% molybdenum, which provides additional corrosion protection for frequent exposure to cleaning chemicals like hydrogen peroxide. Without molybdenum's added pitting resistance,

➤ This perforated mobile step ladder is an example of furniture requiring rigorous cleaning because people repeatedly step on it.



➤ This stainless steel cleanroom features an integrated air shower and pass-through chamber to minimize the inflow of contaminants.

lower-alloyed grades of stainless steel can develop crevices and pits from repeated cleaning, which become excellent hiding spots for bacteria.

## Specifying the surface

Every surface in a cleanroom is an opportunity for a problem. Stainless steel is key because it's the only common construction material that can be polished to have an extremely smooth surface. A smooth finish reduces variance between microscopic peaks and valleys where corrosive cleaning chemicals can remain left behind. If not thoroughly removed after cleaning, residual amounts of chemicals can cause corrosion over time. Surface roughness also influences how an object interacts with its environment. Smoother finishes are less abrasive, reducing friction when in contact with other surfaces, such as gloved hands. Abrasion causes particles to release into the atmosphere and therefore poses a risk to hygiene.

Cleanrooms represent a growing market where Type 316 stainless steel's hygienic properties shine. Demand for cleanroom operations is likely to rise over the next decade, largely driven by rapid growth of the healthcare sector in India, China, Nigeria, and other countries with large populations and growing middle classes. Expanding regulatory framework worldwide also supports demand for more cleanrooms, more sophisticated equipment within them, and stricter cleaning regimens. Molybdenum-containing stainless steels are an ideal, low maintenance material to serve this critical and expanding sector. (Karlee Williston)