Variables Impacting Cleanroom Construction

by Blake Hodess

WHITE PAPER

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About Blake Hodess

President of Hodess Construction Corporation, Blake G. Hodess offers over 40 years of construction experience. Blake is highly recognized in the industry for his expertise in cleanrooms and advanced technology construction. He has vast experience in all project responsibilities throughout the construction process, as well as cleanroom construction.

A published author, Blake has been featured in numerous trade journals and has guest lectured on the design-build of cleanroom projects.

Hodess Cleanroom Construction has consistently ranked among the ENR Top 600 Specialty Contractors. It is the company's initiative to create and build successful and high quality facilities for clients and the cleanroom industry. Blake believes that the continuous focus and dedication to their clients directly relates to the company's success.

VARIABLES IMPACTING CLEANROOM CONSTRUCTION

BY BLAKE HODESS

Once you've made the decision to build a cleanroom, what happens next? Examining variables that are required for your cleanroom is step one. However, you need to understand how these variables affect your manufacturing process. Every process is different. Your individual process needs must be examined thoroughly.

This article discusses why and how variables can impact cleanroom construction. The task is to perform an in-depth analysis of these variables as they relate to your manufacturing processes because they will drive your cleanroom design and construction decision-making.

HOW TO SELECT A CLEANROOM DEVELOPMENT TEAM

The first step is to form a cleanroom development team comprised of key internal staff and external consultants that can help analyze needs, as well as design and build the type of cleanroom you need.

Internal cleanroom development team members should include individuals who know your process best and know how the different variables impact your manufacturing procedures.

External cleanroom development team members are often designers, builders, manufacturers of cleanroom systems, and/or a combination of disciplines rolled into one entity.

To identify external cleanroom development team members that may be helpful to you, contact associates, client and friendly competitors in your industry. Ask them for referrals on designers, builders and manufacturers that have successfully provided cleanroom expertise in your industry or similar industries.

WHAT YOUR CLEANROOM TEAM SHOULD DO

The first task for the cleanroom development team is determining what variables and how each variable impacts your manufacturing process. Critical variables that should be examined include: cleanliness level, temperature, humidity, sound level, vibration control and static control. To help identify these variables, the amount of work and a potential layout of your process work flow need to be communicated to the development team.

A walk-through of existing facilities and a review of the actual process are critical and should be requested by the

cleanroom development team initially as an immediate need for understanding and ensuring that final requirements are met. Be leery of cleanroom entities that assume they know your process. Be cautious in applying standard or pre-manufactured, non-customized technologies. You can end up with more cleanroom that you require, an inappropriate cleanroom classification, or a cleanroom layout that is not complementary to your process. The cleanroom environment is another tool to help increase the manufacturing yield. It should be considered a tool and not an end in itself.

Full integration of the cleanroom as a tool is the primary objective for initial discussions and setting the goals required for the cleanroom development team. The team should use a list of the variables as well as a survey form to review the primary objectives and utilization of the room.

HOW VARIABLES IMPACT YOUR PROCESS AND THE TYPE OF CLEANROOM NEEDED

Cleanliness Level. Cleanrooms are classified by cleanliness level. ISO 14644 gives testing and certification procedures and requirements for designing and classifying a room. This involves reviewing the types of filtration to be supplied on both outside and recirculated air and should, in today's environment, also involve a review of chemical and airborne biological filtration requirements. Some areas of manufacturing will require extensive re-filtration of outside air and recirculated air and others will not. Classification of the room should be based on the potential for contaminate destruction of the end use product. An ISO 3 cleanroom at 0.12 microns may be applicable to a process such as submicron semiconductor manufacturing, but may be overkill for the plastic molding industry, film industry and others.

Temperature. A review of the effective temperature on the end use product is critical. The HVAC systems involved in cleanroom construction can run up to 60 percent or greater of the total construction cost. The temperature and humidity requirements can drive the operating and initial installation cost. If the project is a renovation or addition to an existing plant, a survey should be conducted regarding the ability to reuse features of the existing building to minimize temperature, humidity and HVAC requirements. Under new construction procedures, a review of the various types of systems available should be conducted to make sure that the owner is getting the optimum operating cost and initial first cost systems available to meet the temperature requirements as predicated by the process.

Humidity Control. There are two sides to the humidification requirement. Each may affect process and static control. Humidification can be accomplished by many means including steam, ultrasonic, electronic, clean steam, cold water vaporization and evaporation. The way humidification is generated for winter conditions and dry climate conditions needs to be considered relative to its potential contamination issues and energy use. Often the humidification procedure can be combined with the heating in one process, or it be may be coupled with the creation of purified water for a process such as deionized water. Humidification needs to be reviewed to ensure that the humidifiers are selected and installed properly, and that proper absorption temperatures and spaces are provided in the HVAC systems to ensure that future maintenance and fallout issues do not occur.

Dehumidification is typically a result of the air conditioning process used in cleanrooms. Sometimes additioal dehumidification may be required above and beyond what the operating temperature will derive during hot and humid times of the year. The design condition and requirement for operational conditions must be discussed early in the project.

Dehumidification can involve evenmore stringent and expensive applications of HVAC equipment if relative humidity needs to be driven below 38 percent for normal operations. At this stage desiccant dehumidification needs to be reviewed as applicable to the process. Desiccant adds to both capital and operating costs but may increase yield and may be necessary depending on your particular process.

Sound Level. Sound level can affect both performance in the fab, worker comfort, and vibration through airborne sound waves. The review of the sound requirements must be done at an early stage. Effects of process exhaust and process equipment sound levels should be reviewed thoroughly. There is no sense spending a lot of money to achieve a low sound level, if the background level of process exhaust and process equipment operations will be in excess of this. The key is to balance the sound level provided by the clean room system. The sound level should not exceed and not add to the sound level provided by the process and/or process exhaust systems.

Vibration Control. Vibration control can be a critical issue for some manufacturing operations and a non-issue for others. In the semiconductor industry, vibration control can be critical to the photolithography operations. In other manufacturing situations, such as biotechnology, pharmaceutical, plastics, circuit boards and others, this does not appear to be the case. Although vibration should be minimized in accordance with standard good HVAC practices, excessive funding is not necessary to dampen or remove vibration in many facilities. When vibration does need to be considered, the cleanroom development team should suggest the use of an outside consultant.

Static Dissipation. Many processes require eliminating static due to its disruption of the manufacturing procedure. In some particular industries, such as the semiconductor industry, static dissipation and static buildup are extremely important issues. Cleanrooms tend to build up static if not properly treated. Treatment can occur through the selection of building materials and through the humidification process.

Discussing how to deal with static is critical at the beginning of your cleanroom project to not only ensure that products selected for construction do not increase static, but also to consider the selection of products that can dissipate static.

Return on Investment. The discussion of return on investment is a critical one at the beginning of a project. Many projects are designed to increase yield, but some projects are also designed to increase sales. If your objective is to generate additional income and sales then the cleanroom may need to be highlighted and accentuated with the use of viewing windows and visual aids such as computerized pressure readings, particle monitoring systems, and temperature and humidity tracking systems. These features can help you verify for your clients the current and continuous operations in your facility, demonstrating that your quality control is as stringent as your clients' needs require.

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The selection of construction materials is critical as well. To ensure that the room is constructed of the most competitively priced, non-shedding, non-out gassing materials is crucial. A cleanroom manufacturer that can only supply its own pre-manufactured products may not be providing the most cost-effective construction, nor providing the most applicable products. The ability to purchase and include any of the current technologies available in cleanroom components for walls, floors, ceilings, filtration, HVAC, piping and other systems is critical. Do not allow yourself to be locked into one specific type of material or product at an early stage unless this product is absolutely the only thing available on the market for your process.

An important point to keep in mind regarding return on investment is that the lower the initial first cost and operating cost, the faster a project can go on-line and the higher the yield that the cleanroom can deliver. Higher yield translates to a greater return on investment, a competitive cleanroom tool, and a final product that is competitive.

Cover All the Bases. Specific needs must be examined during the cleanroom conceptual design and review stage. The cleanroom design and construction team that you build a relationship with needs to have program-specific reviews of the actual construction details and requirements of the room. Ceiling height for process equipment, crane accessibility, ultraviolet protection, chemical resistance of materials, clean-ability of the details of construction, requirements for certification for outside agencies such as the FDA, particulate monitoring systems, temperature and humidity control ranges, interface with existing building energy systems, and many other critical items need to be discussed.

The cleanroom design/building team needs to examine and work with you to root through the core issues, to understand the process and to ensure that the systems approach and materials installation approach truly responds to the process. At the end of the process, you should feel that the team selected to design and build your cleanroom performed proper variable analysis and delivered the best cleanroom for your money, the usage and productivity. If these goals are not met, then a successful cleanroom project will not occur. Make sure the team you select has knowledge of your process and how variables impact your manufacturing process. If you choose a team with this knowledge you can assure that you have selected the right design and construction team for your cleanroom project.

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About Hodess Cleanroom Construction

Hodess Cleanroom Construction (HCC), a division of Hodess Construction Corporation,specializes in cleanroom design, management, construction, and advanced cleanroom technology. Founded in 1971, Hodess Construction Corp. began as a general contracting firm, out of which Hodess Cleanroom Construction was born. It has since become an industryleader, providing a single-source solution for all cleanroom needs.