

# Cleaning the Cleanroom

BY RALPH KRAFT

Maintaining the integrity of the cleanroom begins in the design and planning stages.

Within the conceptual stages and even in the design stages of building a cleanroom, a major support team is often neglected. This is not done on purpose; but from past experience, it is too often assumed that maintenance and other support functions will appear as needed, perform their tasks in the usual manner with little or no impact on the process and production schedules, and then disappear again. Not so.

Cleanroom maintenance begins at the design and planning stages of the cleanroom – if at all possible. Admittedly, this is an enviable position for those building a cleanroom. The design team should consist of the designer, the cleanroom manager and the maintenance department.

## MAINTENANCE-FRIENDLY DESIGN

The maintenance department's function within this design/build team is to head off any design or operational considerations that would have a negative impact on the serviceability of any equipment dedicated to the cleanroom or the cleanroom itself. For instance, maintenance should ask:

- How accessible for serviceability is the equipment within the confines of the cleanroom?
- Are facilities made available within the confines of the cleanroom space for proper cleanroom cleaning equipment? What about dedicated tools that will stay within the cleanroom space?
- Is all monitoring equipment placed in a conspicuous place so that facilities department personnel can take and log periodic readings?
- Is all the monitoring equipment serviceable from outside the cleanroom? For example, if there are a lot of manometric gages mounted with only the face showing, how does maintenance department personnel calibrate the gage, if required?
- Are the service chases unobstructed for better servicing of equipment or will this be another storage area for contaminant-generating materials?
- If fan-powered HEPA filter modules are to be utilized, it is advisable to discuss how to change the pre-filters without violating the ceiling integrity along with relocating the speed controllers in a more accessible location.

- If the cleanroom will have a raised-floor application with utilities within this cavity, make sure that the shut-off valves and electrical disconnects are accessible for any emergency situations as well as good maintenance protocol. In some cases, it is better to have remote controls for valves that are in remote or extremely difficult to reach places. Be sure that all hazardous material lines have visible lock-out methods with a log for all to sign who are part of this lock-out procedure.

Most sub-floor cavities within a raised-floor application are not designed to accommodate cleaning activities, however, this must be taken into consideration in the design stages along with all piping, electrical and other services that will be located within this cavity as well as ports for the in-house vacuum system.

- Are all air handling units serviceable without violating the integrity of the cleanroom? Where will the shut off valves be located for all piping? Once the cleanroom is in an operational mode, there should be a routine monitoring and logging program instituted on a regular frequency. The reasoning behind this program is that no cleanroom, or for that matter any facility, goes out of spec all of a sudden – except, possibly, because of a broken drive belt or busted water line which no one can predict.

## DAILY MONITORING AND LOGGING

It is imperative that the monitoring of the cleanroom's integrity – as far as the seating of doors, panel seals, construction joints, pipe chases, air lines and pass-throughs and any other penetrations in the walls, ceiling and floors – be checked and logged periodically in order to maintain the cleanroom as it was intended originally.

Daily monitoring should focus on the pressure differentials of:

- HEPA filters (using a few, in strategic locations as typical)
- Pre-filters (this can be accomplished on a 30-day cycle as well)
- Differentials between rooms:
  - Class 1 cleanroom to Class 10 cleanroom
  - Class 10 cleanroom to Class 100 cleanroom
  - Class 100 cleanroom to Class 1,000 cleanroom

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**WEEKLY MONITORING AND LOGGING**

As part of a weekly monitoring and logging program, check the condition of all point-of-use filters on all air guns. Check the condition of any monitoring instrumentation such as wet bulb/dry bulb chart recorders. For safety reasons, there should be an audible as well as a visible alarm on the following items, which should be monitored and logged on a weekly basis.

- Emergency exits
- Emergency lighting
- Exhaust fume hoods

*The maintenance department's function within the design/build team is to head off any design or operational considerations that would have a negative impact on equipment serviceability.*

- Overhead emergency shower
- Emergency eyewash stations
- Biological safety cabinets

Because of the chemicals within any utility water system, the overhead shower and the eyewash stations should be tested and logged on a bi-weekly basis to insure proper operation.

Having established an "on-going living record" of the cleanroom's mechani-

cal and architectural integrity, considerations now have to be addressed on the daily maintenance of the room itself.

**CLEANROOM SUPPLIES AND EQUIPMENT**

**Cleaning Detergents:**

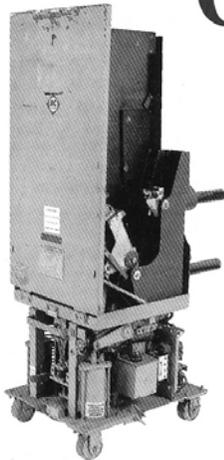
All cleaning detergents should be free of sodium, ammonia, chlorides, potassium metals or any hazardous chemicals. In addition, they should be biodegradable and anti-static. It is best to purchase these cleaning

solvents in a concentrated form in order to control the mixture strength for specific applications.

**Wipes:**

The one basic item to remember in the selection of wipes is the higher the polyester content, the lower the linting of the wipe. At the same time, the higher the polyester content, the lower the absorb-

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ency rate. Remember to match your wiper to your application.

Therefore, it is imperative to establish a method to select wipes. As an end user of wipes, my company has put together the following items to compare the various wipe products on an equal basis:

- Absorption capacity (water)
- Absorbency rate (water)
- Basic weight (oz. to sq. yd.)
- How the manufacturer packages and rates the wipes
- Shedding characteristics – how many particles at 0.5 micrometers per cubic foot
- The sodium content in parts per million (ppm) extracted in de-ionized water
- The chlorine content in parts per million (ppm) extracted in de-ionized water
- Price – wipes per package, packages per case, cost per case, discounts on

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quantity, freight allowance, delivery, payment terms

#### Mops and Sponges:

No cotton string mops should be utilized within the cleanroom envelope because of their contaminant-generating capabilities. The mop handle should not be a regular wood dowel; rather, it should be made of stainless steel or fiberglass. The

mop head should be made of a chamois-type material that has a low linting characteristic.

All sponges should be made of urethane or polyester materials and processed within the cleanroom. All buckets and wringers should be made of stainless steel or high impact plastic. No galvanized buckets are permitted within the cleanroom.

#### Cleaning Frequency:

All operators should clean their immediate work area at least once a shift, leaving the remaining areas to the trained cleanroom custodian with the realization there will be some overlap of the cleaning process on certain items.

There are various classes of cleanrooms, from Class 1 through Class 100,000. We will be addressing a Class 100 (non-FDA) cleanroom as a typical application since this classification level

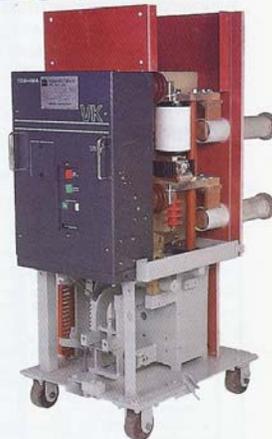
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is fast becoming more commonplace.

*Recommended frequencies of cleanroom cleaning:*

- Work surfaces – damp mop at end of each shift
- Walls/windows – damp mop down at end of each shift
- Lights – vacuum bi-weekly
- Ceiling – vacuum bi-weekly
- Floor – damp mop with detergent solution and vacuum dry at the end of each shift. *Note:* The use of wax for floor preservation is controversial; the better appearance and floor pres-

ervation advantages of waxing must be weighed against the extrainment of abraded wax particles into the clean process air stream. Portable vacuum systems will have a post motor HEPA filtration of 99.99 percent at 0.5 micrometers or larger. Any acrylic materials such as light lenses and egg-crate ceiling tile should be cleaned only with de-ionized water, because acrylic materials will yellow and become brittle with the use of an alcohol-based cleaning agent.

All cleaning motions should be accomplished in a one direction, with a

overlapping stroke of the previous wiping stroke. This includes vacuuming, wiping and mopping disciplines.

The sequence of cleaning cleanrooms is the same as painting your way out of a room. Starting at the farthest wall from the gowning area, clean the ceiling first, then the back wall followed by the two side walls, finishing with the wall closest to the gowning area. The floor is accomplished in the same manner as the ceiling, by starting at the farthest wall and working towards the gowning area.

Cleaning the gowning area is a repeat sequence of the cleanroom, starting at the wall closest to the cleanroom and working towards the plant ambient.

Purchasing of cleanroom custodial supplies begins with knowing what will be compatible with your specific manufacturing process. There are numerous, knowledgeable firms which specialize in providing cleanroom supplies. All you have to do is qualify them.

*Ralph Kraft is vice president of RKII Cleanroom Services, located in Rochester, New York. His firm has been providing certification, cleaning and troubleshooting of cleanrooms since 1977. He is co-author of "Cleansweep" a training manual for cleanroom users, and he served as technical advisor for "Mr. Professor," a computer-based training program on proper cleaning procedures for cleanrooms.*

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