

# Choosing the Right Panel Material for Your Modular Cleanroom

FRANCESCO NIGRIS

Deciding whether your cleanroom should be modular instead of drywall is not the only decision a project team has to make when considering a cleanroom. In most cases, the choice of panels is not as clear cut as once was the norm. Different requirements and needs may lead to different material selection. This article will outline the pros and cons for the different solutions and the consequences from the technical and financial point of view that these choices will generate.



Once you've decided that you need a cleanroom, then what? For one, you have to decide what type of cleanroom you require. Many people within an organization will not have the knowledge necessary to make an informed decision regarding their cleanroom construction materials. An outside design and building firm is typically the answer. They can help you with your cleanroom design, lighting schemes, and HVAC layouts, and also spearhead your construction. In addition to design and building firms, many cleanroom vendors also offer these services as customers turn to vendors for advice and turnkey solutions.

Before you set out to approve a cleanroom vendor, it's important for you to understand some basics. With so many vendors available you'll want to know what makes one vendor stand out from another. Various cleanroom vendors supply a multitude of different wall panels, insulation, ceiling systems, and floors. But which one is right for you? I'll try to explain some of the different systems available to make you a more informed shopper as you outsource your cleanroom.

### MODULAR OR DRYWALL?

One of the first questions is modular or drywall? Modular offers the most flexibility. It will allow you to expand as your business expands. Drywall has its economical advantages but is quite permanent, and can be more expensive if all cost variables are factored in.

Let's see the details:

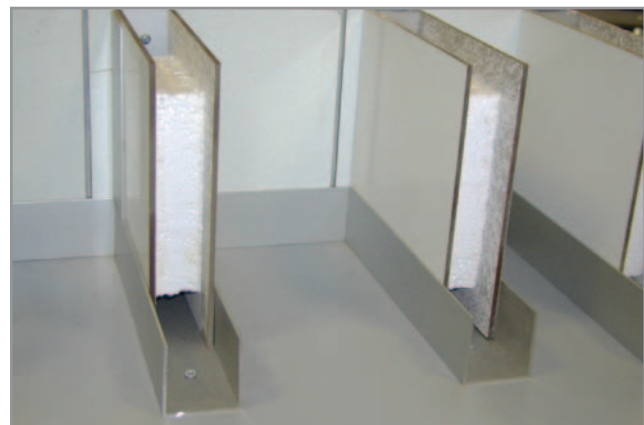
**Cost.** Undoubtedly, the solution using drywall coated with epoxy paint looks, at first glance, the most inexpensive option. In fact, while the level of initial investment could be lower compared with the cost of square feet of installed wall using a modular system, the picture may change looking at a wider scenario. The cost comparison should also take into account the need of project supervision during assembly (experienced and skilled site managers cost money!) and the need of training (and making sure that supplied procedures are respected and enforced) of contractors who usually are not familiar with the strict rules of a pharmaceutical, biotechnology, or any company that needs to maintain clean environments and area separation. Project management costs should also be compared: a modular cleanroom company should be able to supply at least the architectural turnkey, including flooring, ceilings, furniture, and accessories, using a dry wall contractor for your partition; your project manager will probably end up dealing with five or six different suppliers. Sometimes you will end up paying more for single accessories or services. Your con-

tractor will not get, most probably, the same level of discounts for cleanroom products that a well marketed modular cleanroom company would get. I would suggest the fact that most modular cleanroom vendors can supply product resistant to scratches or hits. What would be the cost of shutting down your cleanroom if a dry wall, epoxy-coated partition is hit, gypsum is potentially spreading into your clean environment, and you have to stop your production, fix the damage, and revalidate?

**Need of flexibility.** A modular system is intrinsically a flexible system. Different suppliers offer different levels of flexibility; but, in the end, you will be always be able to change you partition layout before, during, and after wall assembly. Depending on the modular cleanroom supplier of your choice, this might be more or less easy, but it will be feasible; it will be done in a clean way without the need to create dust, debris, and any type of scrap incompatible with production areas. Modular cleanroom modifications can be done with the proper precautions while production is in process; dry wall partition modification needs a greater and much more careful approach.

**Timing.** Drywall can be supplied in a shorter time frame. A modular cleanroom company might have the need to manufacture custom-made accessories, while the contractor selected for dry wall can be on site "the next day". Then, timing reliability and project milestones control might be better with a modular wall system ISO 9001 company than with a small "next door" contractor. In this case, history and experience will play a great role.

**Project management resources.** As mentioned above, going with drywall will mean the need for more involvement of project management; if these resources are not available internally, then outsourcing them might ➤



Sterifoam insulation

lead to communication or cost control issues. A modular wall system company should supply project management as a part of its core business.

*Project environment.* Creating partition and ceilings within an existing production area might lead to a problem with ongoing production incompatible with material used for erecting dry walls.

*Durability.* Modular cleanroom suppliers have a large variety of materials that differ in terms of durability. Some offer materials that give a much higher reliability in terms of robustness in comparison with dry walls. Dry walls might be faster to install, but in certain situations, the walls will get worn faster.

*Financing.* Modular cleanrooms can be considered, from a financial standpoint, as equipment. They can be leased or expensed in your financial statement as any other piece of equipment.

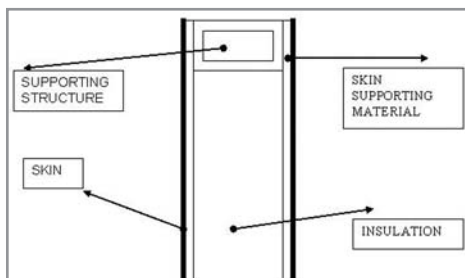
**What to decide?**

Say for instance, you have decided to go with a modular system. Now you have to deal with the wide selection of materials available with different suppliers or within the assortment of a single supplier.

Let's take an overview of the main materials available. Here is a sketch showing the main components of a modular panel. Next is a chart with a selection of ten of the most common panels available in the marketplace.

**SKINS**

Wall panel skins are the surfaces of the wall panels that are exposed. What type of modular panel skins should your cleanroom be constructed of? To answer



Panel schematic

SKIN	SKIN SUPPORTING STRUCTURE	INSULATION	SUPPORTING/ENCLOSING STRUCTURE
UPVC	Carbon Steel	Aluminum Honey Comb	None
UPVC	Carbon Steel	Rockwool	Aluminum/Carbon Steel
UPVC	Carbon Steel	Sterifoam (Polystyrene)	None
UPVC	Carbon Steel	Polyurethane	None
HPL 4mm	None	Aluminum Honey Comb	Aluminum/None
HPL 4mm	None	Rockwool	Aluminum
HPL 4mm	None	Sterifoam (Polystyrene)	Aluminum/None
HPL 4mm	None	Polyurethane	Aluminum/None
EPOXY POWDER COATING	Carbon Steel	Aluminum Honey Comb	None
EPOXY POWDER COATING	Carbon Steel	Rockwool	Aluminum/Carbon Steel
EPOXY POWDER COATING	Carbon Steel	Sterifoam (Polystyrene)	Aluminum Carbon Steel/None
EPOXY POWDER COATING	Carbon Steel	Polyurethane	Aluminum Carbon Steel/None
EPOXY POWDER COATING	Aluminum	Aluminum Honey Comb	None
EPOXY POWDER COATING	Aluminum	Rockwool	Aluminum/Carbon Steel
EPOXY POWDER COATING	Aluminum	Sterifoam (Polystyrene)	Aluminum Carbon Steel/None
EPOXY POWDER COATING	Aluminum	Polyurethane (Polystyrene)	Aluminum Carbon Steel/None
STAINLESS STEEL	None	None	None
STAINLESS STEEL	Carbon Steel	All the Above	Aluminum Carbon Steel/None
STAINLESS STEEL	HPL 3mm	All the Above	Aluminum Carbon Steel/None
ALL THE ABOVE	All Above	None	Aluminum Carbon Steel

\*\*Walls built with lexan or soft PVC are not considered here as either a non-long term solution or for specific use.



Flush interface with windows

this question, you need to assess the purpose of the cleanroom along with how you plan on cleaning your cleanroom. Are you going to use a wet or dry agent or both? Do you intend to sterilize or sanitize? Answering these questions will give you a cleanroom matched to you and not a cleanroom a vendor sold you off the shelf. Let's look more closely at some of the options available.

#### *uPVC: unplasticized polyvinyl chloride*

##### Advantages:

- Very good resistance to all major cleaning agents
- Chemically welded joints and seams
- Available in different colors
- Average resistance to scratches
- Class A fire certification

##### Negatives:

- Need of skin supporting structure in case of scratches you lose the integrity of your wall
- Once seams are welded, you lose modularity and flexibility

#### *HPL 4 mm: high-pressure laminate impregnated with phenolic resins (also known as "phenolics")*

##### Advantages:

- Very good resistance to all major cleaning agents
- Available in different colors
- High resistance to scratches
- Class A fire certification
- Easy to work for flush installation of accessories and for modification during erection
- Solid, 4-mm panel; no need of supporting skin structure; in case of scratch or wall chipping, no low class material exposed to the environment

##### Negatives:

- Cost might be higher for application where easy to clean flush surfaces are not mandatory
- New to the industry in the North American marketplace

#### *Epoxy powder coating: based on a epoxy resin with a hardener, such as DICY (dicyandiamide) or special phenolic hardeners*

##### Advantages:

- Very good resistance to all major cleaning agents
- Available in different colors
- Class A fire certification
- Depending on the skin, supporting structure may have competitive costs

##### Negatives:

- Low resistance to scratches
- Need of skin supporting structure, in case of scratches integrity of the wall is lost

#### *Stainless steel: AISI 304 or AISI 316 are normally used in the industry*

##### Advantages:

- Excellent resistance to all major cleaning agents
- Class A fire certification
- May or may not need skin supporting structure
- In case of scratching or wall chipping, no low class material exposed to the environment

##### Negatives:

- Low resistance to scratches and hand marks very visible. (Only aesthetic problems)
- Not easy to work to allow flush applications of coverings and accessories
- Higher cost

### SKIN SUPPORTING STRUCTURE

Generally using a system that needs supporting skin structure presents the following pros and cons:

##### Advantages:

- It allows the use lower class material not exposed to the clean areas, thus reducing costs

##### Negatives:

- In case of scratches or wall chipping low class material exposed to the environment



Flush interface with coverings and HPL panel



Epoxy powder-coated walls

*Carbon Steel: in most cases galvanized carbon steel is used*

Advantages:

- Low cost
- It allows for Class A fire certification
- Good mechanical stability

Negatives:

- In case of scratches lower class material exposed to the clean area
- In case of scratches contact with water and cleaning agents may lead to rust and corrosion
- Difficult to handle for modifications on site
- Difficult to handle for flush built accessories and covings

*HPL 3 mm: high-pressure laminate impregnated with phenolic resins; generally used as supporting structure for Stainless steel or PVC coating*

Advantages:

- Consistency with the use of HPL 4 mm for integration with door and coving profiles used in other areas
- Good mechanical stability

Negatives:

- High cost

## INSULATION

Some modular wall manufacturers' products include panels without insulation.

Advantages:

- Avoid use of product that may lead to fumes in case of fire
- Cost
- Easier use of wall interior for utilities or electrical wiring

Negatives:

- Risk of condensate build up within walls
- No noise or heat insulation

*Aluminum honeycomb: cell size, grade of aluminum, depth of the material, and thickness of the cell wall are all variable that can vary based on different application and requirements*

Advantages:

- High fire resistance
- Very well accepted by FM
- Low weight/high strength
- Mechanical stability

Negatives:

- Higher cost
- Low thermal and noise insulation

*Styrofoam is a trademarked name for a specific form of insulation manufactured by The Dow Chemical Company; "styrofoam" is not synonymous with "polystyrene," polystyrene is a vinyl polymer*

Advantages:

- Very good insulation performances (noise and heat)
- No problem if exposed to installer during cutting for modifications on site
- Very good mechanical stability
- Competitive price

Negatives:

- Fire resistance not as good as other insulating material



Flush interface with covings and HPL panels



Flush interface with HPL and interlock indicator light.

- FM requires stricter anti fire measures if polystyrene is used.
- Due to fire resistance codes, it requires enclosing structure

*Rockwool: a mass of fine intertwined fibers with a typical diameter of 6 to 10 micrometers; mineral wool may contain a binder and an oil to reduce dusting and making it water repellent (hydrophobic)*

Advantages:

- Good insulation performances (noise and heat)
- Good fire resistance performance; well accepted by FM

Negatives:

- Poor mechanical stability performance; it normally requires enclosing and supporting structure
- Light precaution must be taken if operators are exposed to rock wool fibers

*Polyurethane: a polymer consisting of a chain of organic units joined by urethane, used for this purpose as rigid foam*

Advantages:

- Good insulation performances (noise and heat)
- No problem if exposed to installer during cutting for modifications on site
- Very good Mechanical stability
- Competitive price

Negatives:

- Fire resistance not as good as other insulating
- FM may require stricter anti fire measures if polyurethane is used
- Due to fire resistance codes, it requires enclosing structure

## ENCLOSING SUPPORTING STRUCTURES

The selection of one or another of the above materials may lead to the need of using supporting or enclosing

material. "Soft" or easy to disaggregate material, such as rockwool, may require an enclosing structure to provide the panel with the necessary mechanical stability or to prevent the gravity falling effect of the disaggregation over time. Clean area SOP requirements may require the enclosure of any insulating material within the panel. The choice of the material used for the supporting/enclosing structure may be dictated by the consistency with the material used for skin support. It will not make sense to use a higher quality material, such as aluminum, if the supporting skin is galvanized steel.

## CONCLUSION

All the material listed above has been used and approved within the pharma-biotech-semiconductor industries worldwide. There are no general standards that prevent the use of any the above materials. The choice then will be dictated by the need and the requirements of every single project.

Price might be a leading factor in choosing; but then, as for the drywall/modular comparison, sometimes little upfront savings may lead to either higher expenses later or poor aesthetic results after a few months of operation.

The HPL system has a great advantage of not needing a supporting structure, thus avoiding the risk of exposing the cleanroom to easy to degrade materials. HPL is easy to be worked and cut on site, and allows for modification during the erection/installation process. HPL can be milled and or grooved in order to allow for the flush mounting of most accessories and covings. The easy to clean installations and final results are, according to my opinion, a great plus in an environment where cleanliness is the primary goal.

With regards to insulation material, if noise and thermal insulation is a requirement, then rockwool might be the best choice. If cleanliness of all components and fire reaction performance is the goal, the aluminum honey comb might be considered the best choice. The final choice can then be driven by the overall quality of the supplier providing one or more of the above-listed panel types. Price, unique technical solutions, existence of QA procedures, supporting service during the DQ process, overall flexibility, delivery terms, installation support and quality, and reliability are then the usual factors to be evaluated when selecting a supplier.



**Francesco Nigris** is the Vice President of Nicomac Srl, Italy; manufacturer of modular systems, and President of Nicomac, Inc., since 1991, distributor of the NICOMAC Srl products in USA, Canada, and Puerto Rico; 80 Oak Street, Norwood, NJ 07648. He can be reached at ph. 201 768 9501, ext. 12; francesco.nigris@nicomac.it; www.nicomac.com.