



**KNAUF** CEILING  
Solutions

## **TIPS & TRICKS**

7 tips you should know for planning ceiling solutions in healthcare facilities

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# 7 *tips you should know for planning ceiling solutions in healthcare facilities*

Where many people come together in a comparatively small space, where intensive communication and care takes place around the clock, supported by devices, machines and a complex technical infrastructure, it can hardly be silent. Effective room acoustics meeting the applicable requirements are therefore indispensable in healthcare facilities.

Solutions cannot come off the shelf, but have to be individually planned and implemented. The following seven tips explain important details for this process and provide valuable advice.

# 1 Noise has a significant impact and a wide range of effects in healthcare facilities



Patients and personnel in healthcare facilities can be affected by noise-related stress and high noise levels. For employees, this means that mental activities and communication with each other are significantly hampered. At the same time, the healing process of patients can be negatively affected, which in turn leads to longer hospital stays and negative experiences.

When planning hospitals, hygiene and room acoustic requirements must both be met, in varying degrees, from the entrance area to intensive care units. Harmonising the requirements is a great challenge. Infection control, hygiene and washability are obvious standards in hospitals that can be achieved primarily through the use of smooth materials and reverberant surfaces. However, these generate reverberation effects that make the room appear loud and are therefore annoying for patients and staff.

Through careful design and forward planning of the rooms, acoustically sensitive areas can be separated from acoustically unproblematic areas, for example, by zoning. Special ceiling and wall elements that meet both hygienic and room acoustic requirements can be utilised.



# 2 Healthcare facilities require customised room acoustics

The German standard DIN 18041 „Acoustic quality in rooms – requirements, recommendations and instructions“ provides valuable guidance for room acoustics. DIN 18041 classifies rooms in healthcare facilities in room group B (audibility over a short distance) and depending on the type of room, the classification ranges from B2 to B5.

DIN 18041 also specifies the acoustic requirements for nearly all types of rooms in healthcare facilities, depending on the room use. The aim is to reduce the mean noise level and limit reverberation based on the

length of stay and level of comfort. The A/V ratio, where A is the absorption from the room surfaces („equivalent absorption area“) and V is the volume, is the measure used to define the room acoustic performance requirements.

In summary, the A/V ratio varies depending on the room group classification, with higher requirements for rooms where special comfort is desired (B5,  $A/V \geq 0.30$ ) compared to those with shorter stay times (B2,  $A/V \geq 0.15$ ).

## The following areas from healthcare facilities are classified in room groups B2 to B5:

### B2:

Rooms for short-term stay (including entrance halls, reception areas with waiting areas)

$A/V \geq 0.15$

### B4:

Workrooms (including reception and counter areas, laboratories, resident rooms in care facilities, single and multi-person offices)

$A/V \geq 0.25$

### B3:

Rooms for long-term stay (including patient rooms and treatment rooms)

$A/V \geq 0.20$

### B5:

Rooms with special requirements for noise reduction and room comfort (including canteens, industrial kitchens and exercise rooms)

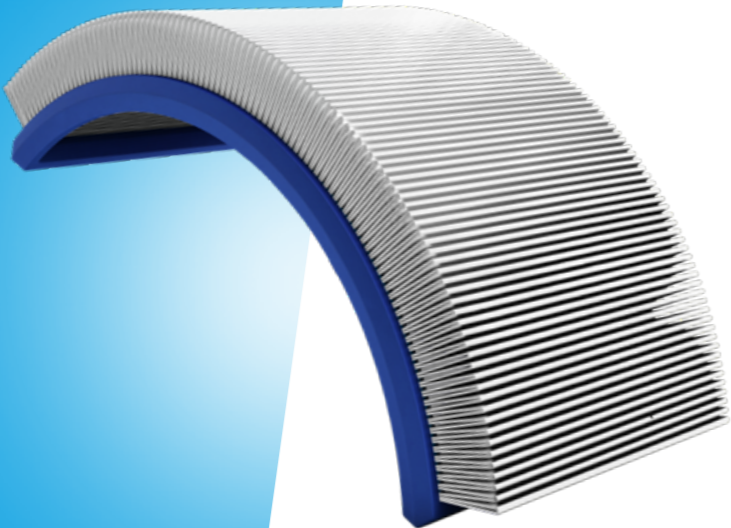
$A/V \geq 0.30$

# 3 Ceiling systems in clean rooms must comply with hygiene standards and regulations

A clean room is a room in which the concentration of airborne particles is kept as low as necessary. Clean rooms are indispensable in medical research, treatment and the sterile production of pharmaceuticals. They allow various parameters such as the number of particles, number of germs, temperature, humidity and pressure to be precisely monitored and set.

This ensures that the existing and incoming air is extremely pure and meets all the required cleanliness criteria. This helps protect patients and ensure the quality of medical products.

In these rooms, materials for acoustic ceilings or their surfaces must be compatible with the standards and regulations for hygiene and classified according to the precise areas of application.



The air purity classification according to ISO 14644-1 is the best-known standard in the field of clean room technology. It specifies the maximum number of particles in the ambient air and divides the clean rooms into classes from ISO 1 to ISO 9, with class 1 making the highest demands on purity.

Laminar air flow is characteristic of the classification in air purity classes 1 to 5. Here, no turbulence forms, and the flow pattern is uniform. With a turbulent flow (air cleanliness classes 6 to 9), eddies are created and the flow pattern behaves unevenly.

	1	2	3	4	5
laminar flow					
turbulent flow	6	7	8	9	

**ISO 14644-1 defines the following particle numbers per m<sup>3</sup> for the clean room classes:**

ISO Class number (N)	Maximum allowable concentrations (particles/m <sup>3</sup> ) for particles equal to and greater than the considered sizes, shown below <sup>a</sup>					
	0.1 μm	0.2 μm	0.3 μm	0.5 μm	1 μm	5 μm
1	10 <sup>b</sup>	<sup>d</sup>	<sup>d</sup>	<sup>d</sup>	<sup>d</sup>	<sup>e</sup>
2	100	24 <sup>b</sup>	10 <sup>b</sup>	<sup>d</sup>	<sup>d</sup>	<sup>e</sup>
3	1 000	237	102	35 <sup>b</sup>	<sup>d</sup>	<sup>e</sup>
4	10 000	2 370	1 020	352	83 <sup>b</sup>	<sup>e</sup>
5	100 000	23 700	10 200	3 520	832	<sup>d, e, f</sup>
6	1 000 000	237 000	102 000	35 200	8 320	293
7	<sup>c</sup>	<sup>c</sup>	<sup>c</sup>	352 000	83 200	2 930
8	<sup>c</sup>	<sup>c</sup>	<sup>c</sup>	3 520 000	832 000	29 300
9 <sup>g</sup>	<sup>c</sup>	<sup>c</sup>	<sup>c</sup>	35 200 000	8 320 000	293 000

<sup>a</sup> All concentrations in the table are cumulative, e.g. for ISO Class 5, the 10 200 particles shown at 0.3 μm include all particles equal to and greater than this size.  
<sup>b</sup> These concentrations will lead to large air sample volumes for classification. Sequential sampling procedure may be applied; see Annex D: Cleanrooms and associated controlled environments – Part 1: Classification of air cleanliness by particle concentration (ISO 14644-1:2015).  
<sup>c</sup> Concentration limits are not applicable in this region of the table due to very high particle concentration.  
<sup>d</sup> Sampling and statistical limitations for particles in low concentrations make classification inappropriate.  
<sup>e</sup> Sample collection limitations for both particles in low concentrations and sizes greater than 1 μm make classification at this particle size inappropriate, due to potential particle losses in the sampling system.  
<sup>f</sup> In order to specify this particle size in association with ISO Class 5, the macroparticle descriptor M may be adapted and used in conjunction with at least one other particle size. (See C.7.: Cleanrooms and associated controlled environments – Part 1: Classification of air cleanliness by particle concentration (ISO 14644-1:2015))  
<sup>g</sup> This class is only applicable for the in-operation state.

Source: Cleanrooms and associated controlled environments – Part 1: Classification of air cleanliness by particle concentration (ISO 14644-1:2015)

It should be noted that clean rooms of classes 1 to 5 according to ISO 14644-1 have a high presence of filters and the use of closed ceiling elements is sometimes not possible. Clean rooms with horizontal displacement flow are an exception.

# 4 The NFS norm is the most stringent standard in Europe regarding airborne contamination

Acoustic ceilings and wall absorbers should meet the criteria of the French (internationally applicable) standard NF S 90-351:2013. This standard defines the safety requirements for the design, construction, operation, maintenance, and usage methods of systems for air purification and air control in healthcare facilities.

**The standard divides the various areas of application into four risk zones.**

Zone 1	low risk: offices, entrance areas, corridors
Zone 2	average risk: examination + patient rooms, sanitary + kitchen areas
Zone 3	high risk: examination rooms, laboratories, intensive care units
Zone 4	very high risk: operating theatres, clean rooms

The four zones are each assigned to clean room classes, decontamination classes and microbiological cleanliness classes. Knauf Ceiling Solutions has a wide range of ceiling systems that have been tested and approved for the highest demands according to NF S 90-351:2013

Risk zone	Clean room class	Decontamination class	Microbiological cleanliness class
Zone 1 (Low risk)	no requirements	no requirements	no requirements
Zone 2 (Average risk)	ISO 8 < 3 500 000 particle >0,5 µm/m³ air	CP <sub>(0.5)</sub> 20	M 100
Zone 3 (High risk)	ISO 7 < 350 000 particle >0,5 µm/m³ air	CP <sub>(0.5)</sub> 10	M 10
Zone 4 (Very high risk)	ISO 5 < 3500 particle >0,5 µm/m³ air	CP <sub>(0.5)</sub> 5	M 1



# 5 A microbiological classification is recommended

The details for this area are also specified in the French standard NF S 90-351:2013. The microbiological cleanliness certifies that the ceiling does not contribute to the development of bacteria and is classified by an index from 1 to 100.

As part of the test, the surface is contaminated with certain microorganisms over a period of 3 to 7 days (depending on the bacterial strain used) and the reduction in germs on the surface and in the room air is assessed. This results in the classification into microbiological cleanliness classes. M1 represents the best possible class. Further classes are M10 and M100. The lower the index, the more resistant the ceiling is to the proliferation of bacteria.

The use of mineral and metal ceiling tiles can prevent the growth of various pathogens. Healthcare and hygiene products from Knauf Ceiling Solutions have been tested against the following pathogens / microorganisms\*:

- Escherichia coli
- Staphylococcus aureus
- Bacillus cereus
- Streptococcus pneumoniae
- Acinobacter baumannii
- Candida albicans
- Aspergillus brasiliensis
- Aspergillus niger
- Klebsiella pneumoniae

\* Tested according to the following standards:  
EN ISO 846: 1997, ASTM G21-15, ISO 22196: 2011, JIS Z 2801, NF S 90-351:2013





# 6

## Cleaning, disinfection and humidity resistance of the surfaces are relevant

The surfaces of the ceiling elements in healthcare facilities must be cleaned or disinfected regularly, taking hygiene aspects into account, depending on the area of application. The visible surface of the tiles must be able to withstand these processes without restricting their specific properties. In principal, it is recommended to consult a hygiene expert when choosing the material for the ceilings in healthcare facilities.

## CLEANING

It is important to use only the right cleaning method with the appropriate cleaning agents for each face coating of the ceiling tiles. The following types of cleaning are possible:



### 1. Dry cleaning

A normal vacuum cleaner should be used as the standard cleaning method for dust, loose dirt and / or deposits, provided it has a soft brush.



### 2. Damp cleaning

The surfaces can be cleaned with a damp cloth for more intensive cleaning. This must always be done with a squeezed out, soft cloth or sponge. After cleaning, the surface must be dried with a soft cloth.



### 3. Wet cleaning

Wet cleaning must be carried out with lukewarm water (up to 40 ° C) using a sponge and in combination with a mild cleaning agent (pH value between 7 and 9). Make sure that the edges and the back of the tiles do not come into contact with moisture. After cleaning, the surfaces must be dried.



### 4. Steam pressure cleaning

The apparatus used should be a cleaner that generates steam under pressure (8 bar and 175°C).



### 5. High pressure cleaning

Pressure cleaning must only be carried out for ceilings with an exposed, pressure-resistant construction under the following technical requirements:

- Water temperature: max. 40 °
- Working pressure: max. 80 bar, the delivery rate may be max. 500 L / h
- Spray angle (nozzle): at least 30 °
- Minimum distance: 1.0 m (nozzle - surface)



### 6. Scrub cleaning

Scrubable with water containing mild soap or diluted detergent.



With cleaning methods 2 to 5, it is essential to prevent moisture from penetrating into the substructure. Before cleaning the ceiling surface, it is worth carrying out a test on a non-visible tile or on a test piece to assess the effect and to rule out any interactions with the coating. Abrasives are generally not suitable.

## DISINFECTANT RESISTANCE

In certain areas of application, hygiene regulations require the face side of the ceiling tiles to be disinfected. Therefore, when selecting the material, ensure that the surfaces are resistant to disinfectants.

## CORROSION RESISTANCE

In room environments with high humidity, ceiling systems must meet additional technical requirements. To ensure their long-term stability and durability, it is essential to use a suspension system with high corrosion resistance. Products made of galvanized steel with an additional protective coating have proven ideal for this

purpose. This extends the lifespan of the grid and maintains its aesthetic appearance. The internationally recognised standard EN 13964:2014 „Suspended ceilings – Requirements and test methods“ specifies the following exposure classes:

Class	Conditions	Application examples
<b>A</b>	Building components generally exposed to varying relative humidity up to 70 % and varying temperature up to 25° C, but without corrosive pollutants.	Offices, shops, schools, hotels, sports halls, storage areas
<b>B</b>	Building components exposed to varying relative humidity up to 90 % and varying temperature up to 30° C, but without corrosive pollutants.	
<b>C</b>	Building components exposed to varying relative humidity up to 95 % and varying temperature up to 30° C, and with the possibility of condensation, but without corrosive pollutants.	Showers, food production (e.g. dairies, breweries), laundries
<b>D</b>	More severe than the above.	Swimming pools, chemical plants





## 7 Professional support from hygiene advisors is useful

Qualified hygiene experts should be involved in the planning and implementation of room acoustic measures in healthcare facilities. The specialists may have acquired the necessary know-how through in-house training measures, or they may be hired by the healthcare facilities as external service providers. As specialists, they know the respective requirements and applicable regulations for hygiene and infection prevention and later also check their implementation during ongoing operations.

With early collaboration and ongoing intensive exchange between those responsible for planning, the hygiene specialists and the room acoustic experts, a professional ceiling solution can be achieved that meets the requirements of the highest hygiene standards and appropriate room acoustics.

***Build on us.***

**Knauf Ceiling Solutions GmbH & Co. KG**

Elsenthal 15,  
94481 Grafenau, Germany  
Phone: +49 8552 422-0  
[www.knaufceilingsolutions.com](http://www.knaufceilingsolutions.com)  
E-Mail: [info.kcs@knauf.com](mailto:info.kcs@knauf.com)

Registered court: Passau district court,  
Registration No.: HRA 7069  
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(Umsatzsteuergesetz): DE131249009  
Managing Director: Karl Wenig

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