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General assessment of the possible uses of metal ceiling systems in medical facilities*

Content

Introduction

On behalf of the Association of Industrial Metal Ceiling Manufacturers TAIM e.V., the German consulting centre for hospital epidemiology and infection control (BZH GmbH) is carrying out a professional assessment of the use of metal ceilings in rooms of medical facilities.
The basis for this is provided by the documents and information provided to us on the systems and the individual components from the TAIM manual for metal ceiling systems.

Basic requirements for metal ceiling systems

Metal ceilings shall basically meet the requirements of the harmonized product standard “EN 13964 Suspended ceilings - Requirements and test methods”.

Under “Hygiene, health and environment - Toxic gases and dangerous substances”, the only requirements made relate to release of asbestos, formaldehyde release and / or formaldehyde content and dangerous substances.
Furthermore, there the susceptibility to the growth of harmful microorganisms is described in two levels: "not susceptible" and "susceptible", but without information on specific testing and evaluation procedures.
Specific requirements regarding medical facilities are not defined herein. In addition to EN 13964, the THM - Technical Manual for Metal Ceiling Systems by TAIM e.V. applies. This refers, among other things, to the lack of hygiene specifications in EN 13964 and recommends that these shall be defined by the building consultants.

Characteristic features of metal ceiling systems

The ceiling membrane (visible from the room side) is fixed to the substructure using various options such as hanging, laying or clamping. Some of the membranes can be swung down and additionally moved in this state. This results in different joint characteristics. By selecting a suitable joint characteristic (closed joint, e.g. by using a neoprene gasket, overlapping of the supports on the back of the ceiling membrane or by using a sealant), the entry of dust deposits from the ceiling cavity into the room below can be avoided.
As a rule, the ceiling membranes are revisable.

Legal and technical requirements in medical facilities

Since the expected stresses on a suspended ceiling are lower compared to e.g. partition walls, floors or furniture, the following requirements shall be considered.

- Mechanical requirements
  e.g. wear resistance, scrub resistance, etc.
- Chemical / physical requirements
  e.g. acid-/ alkali resistance
- Hygienic requirements
  e.g. resistance to disinfectants, resistance to the growth of harmful microorganisms.

The requirements mentioned vary depending on the type of building (hospital, doctor's practice, nursing home, laboratories, clean rooms, etc.), the respective area of use (operating theatre, hospital room, corridor, etc.) as well as the components and surface materials used.
Comprehensive fulfilment of the technical specifications for the materials used should be a prerequisite for the use of the materials in the medical field and forms the basis for correct use, maintenance, cleaning and disinfectability.
Likewise, legal requirements of the respective country, e.g. in Germany at the federal or state level, as well as the current recommendations for the structural design of various medical units in the current recommendations of the responsible bodies or expert committees, are comparable in Germany to the Commission for Hospital Hygiene and Infection Prevention Robert Koch Institute (KRINKO) have to be considered.
Due to the regular changes, also in the area of hygiene recommendations, it is advisable and sometimes even required to involve a hospital hygienist in the construction planning and to have the planning evaluated.

Suitable materials and surfaces in the hospital sector

Basically, all surfaces used in hospitals shall be suitable for the areas and intended use, routinely cleaned and, if necessary, wipe with disinfectant. Wipe disinfection shall always be carried out immediately if a surface has been contaminated with infectious and or potentially infectious material.
Such infectious materials are, for example, secretions and excreta from the human body.
The risk of contamination for ceiling elements on the traffic routes in the clinic, i.e. in the hospital corridor and in most other rooms, apart from functional rooms such as special diagnostic and treatment rooms like operating theatres and cardiac catheterization laboratories, as well as some other areas, is usually to be classified as low, but the possibility of disinfecting the surface material shall also be given here.
Since suitable ceiling elements are also installed in clean rooms, tests carried out by the manufacturers of the coatings on material compatibility when using disinfectants are available, in which selected preparations with areas of application in medical facilities are

mentioned. The list of suitable disinfectant products approved for the named medical area shall be given to the user. In case of doubt, the manufacturers still recommend additionally checking the suitability of the selected preparation.
The procedure listed for ceiling elements is to be observed analogously for corresponding structures or installations in the ceiling. These shall also be easy to clean and wipe with disinfectant, if necessary. The selection of flush installation variants of e.g. luminaires can make cleaning the surface easier.
In Germany, medical institutions usually choose disinfectants from the disinfectant list of the VAH (Disinfectant Commission in the Association for Applied Hygiene e.V.). All preparations listed there have been tested for their effectiveness against the corresponding spectrum of germs in accordance with the specifications of the guidelines issued by the Disinfectant Commission. Corresponding specifications for testing disinfectants are also made in the respective European standards. The DIN EN 14885 standard provides an overview of this.
The test methods to be used to prove the effectiveness of a disinfectant are comparable according to the requirements of VAH guidelines and European standards. For approval as a surface disinfectant, a bactericidal and yeasticidal (C. albicans) effect must be achieved (Disinfectant Commission in the Association for Applied Hygiene (VAH) e.V.).
For use as routine surface disinfection in the medical environment, it is recommended to select a product with additional virucidal or at least limited virucidal effectiveness.
Sporicidal effective products are used when there is contamination with bacterial spores, e.g. in patients with Clostridioides (formerly Clostridium) difficile-associated diarrhoea.
Alcoholic disinfectants are characterized by their rapid effectiveness and a broad spectrum of activity and, if possible due to the nature of the surface, can preferably be used for surface disinfection on surfaces up to a maximum of $2m^2$. (Risk assessment of hazardous substances component: rapid disinfection of small areas up to two square meters. Professional association for health and welfare 10/2019). The lack of sporicidal effect of alcoholic disinfectants does not appear to be a problem for disinfection in the case of contamination in the ceiling area.

In the event of contamination with potential spore contamination, disinfection with appropriate peroxide compounds, also included in the information on usable products, would be suitable from a hygienic point of view.
Materials installed in hospital areas should not separate any or only a few particles in

order to keep dust pollution as low as possible. Optically clean surfaces are generally to be regarded as less microbiologically contaminated, since microorganisms bind to dust particles. Generally immobile on dry surfaces, microorganisms bound to particles can be transported over long distances. The ceiling membrane can have no perforations or perforations of varying degrees - usually with acoustic fleece applied to the rear; this also influences the effectiveness as a sound-absorbing element.
In the hospital sector, the recommendation is to prioritize execution without perforation, especially in functional areas. However, ceiling membranes without perforations or ceiling membranes with only very few small perforations should also be selected in the other areas in order to counteract the adhesion of dust as much as possible and to ensure good cleaning or wiping disinfection. In addition to the situation or cleaning and wiping disinfection adapted to requirements, the regular cleaning of the ceiling membranes shall be carried out routinely according to the manufacturer's cleaning instructions in order to prevent dust deposits in perforations and on the surface.
A particularly sensitive area in a hospital is the operating area and there especially the operating room. Special ventilation technology with HEPA filters at the end ensures a largely particle-free air supply. On the one hand, this means that dust deposits are reduced. On the other hand, conversely, the built-in ceilings themselves shall not introduce any additional pollution into the room air. In addition, there is a risk in the operating room that, in the worst case, body fluids may splash into the ceiling area. This means that the variant without perforations (no acoustic panels) should generally be selected in the operating room in order to ensure a smooth, closed surface.

Accessibility

The built-in ceiling membranes should always be able to be accessed in order to allow easy and quick access to the ceiling cavity at every required location.
If ceiling membranes are moved in order to carry out revision work in the cavity behind or if ceiling membranes have to be replaced, care must be taken to ensure that no patients in the surrounding area can be affected by the release of particles. If it is to be expected that dust could possibly be released from the cavity, appropriate dust protection measures must be implemented and then specific, situation-related cleaning measures must be carried out.
Since the ceiling membranes once installed are shown as very tight according to the

manufacturer's instructions, dust entry from the cavity behind them into the space below is not to be expected in the installed state and additional sealing is therefore referred to as unnecessary.
It is preferable to use special tools to prevent the risk of uncontrolled opening. The installation of ceiling membranes that open slightly to pressure is not ideal from a hygienic point of view and carries the risk of uncontrolled opening with possible dust entry into the rooms below.
According to the information provided by the manufacturer on the material properties and the method of installation of the ceiling system, the hygienic requirements that are required for installation of ceiling membranes in all areas of a medical facility for patient care appear to be met, in particular preventing dust from trickling down, for example, on lines and the guarantee the required cleaning or disinfectability.

Conclusion

Metal ceiling systems are generally well suited for use in medical facilities due to their product properties if they are appropriately designed. The closed version can therefore be used in all areas of patient care if proper installation is ensured. The properties of the ceiling elements such as: smooth, abrasion-resistant, wipe disinfectable, and insensitive to the effects of moisture as well as tightness and accessibility are important for use in the medical field. Thorough planning, taking into account the applicable legal and technical requirements on the part of the building consultant and hospital hygiene, is always elementary. Proper execution must be ensured.

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Dr Eva Fritz Dr Ernst Tabori

*This document is a translation of the German version. TAIM e.V. is responsible for the correctness of the translation. The accuracy of the original German document was confirmed on 26.07.2021 by the signatures of Dr. rer. nat. Dipl.-Biol. Eva Fritz and Dr. med. Ernst Tabori.