

Concepts

Products

Service



**For the highest performance and a good conscience.**  
NORTEC raised floor systems



**Lindner**

Building New Solutions

# Building new solutions.

Lindner undertakes major worldwide projects in all areas of interior finishes, insulation technology, industrial services and building facades. From pre-planning through to project completion Lindner is your partner of choice.

The Company's extensive manufacturing capability enables quality to be strictly maintained whilst allowing maximum flexibility to meet individual project requirements.

Environmental considerations are fundamental to all Lindner's business principles.

Through partnerships with clients Lindner turns concepts into reality.

## Choosing Lindner you have:

**Lindner Concepts:**  
Tailored solutions specifically geared to satisfy individual project requirements

**Lindner Products:**  
Quality materials and systems to the very highest industry standards

**Lindner Service:**  
Comprehensive project management services

# NORTEC raised floor systems

Top quality for your interiors.



## Your benefits at a glance

- First-class underfoot comfort
- Excellent load-bearing capacity
- Non-combustible
- Individual panels simple to remove and interchange
- Huge selection of floor coverings

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# For the highest performance and a good conscience.

## Lindner NORTEC

Lindner is one of the world's leading and largest manufacturers for raised and hollow floor systems. We achieve best dimensional accuracy and a technical maturity level which is unique in the market on the very state-of-the-art and environmental friendly equipment at production sites in Germany.

### System products made in Germany.

Lindner floor systems as well as NORTEC raised floors from calcium sulphate are developed in house as complete systems. Every component is adjusted to each other in order to guarantee a perfect result. In our factories, we do not only process the carrier panels – from recovered paper, recycled gypsum and reprocessed water – but also the complete substructure. Over 15,000 t of steel per year are formed and afterwards galvanized at our premises for their finishing with the production of raised and hollow floor pedestals.

### Eco-friendly.

Lindner's excellent quality is not left to chance, but is assured by a sophisticated quality management system, demonstrated by our certification to ISO 9001. Samples taken during production are tested against a full range of technical parameters such as stability, breaking load, dimensional accuracy, adhesive values, etc. (over 100 test criteria in all). Our test labs are equipped with ultra-modern test equipment, and constantly test edge trims, adhesives, zinc layer thickness etc.

Independent institutes test all systems to the accepted standards for noise, fire safety and mechanical resistance. Tests meeting European standards and certification for almost all European countries are part of our portfolio. We also have the respective evidences for international sales areas.

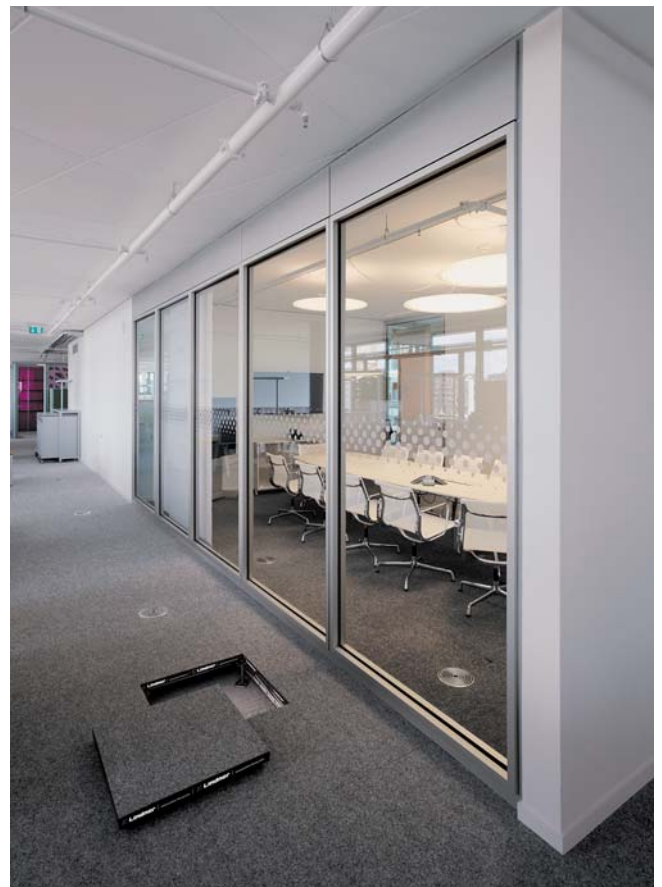


Our high-quality NORTEC raised floor panels are made from recovered paper, recycled gypsum and reprocessed water.

## A floor for any occasion

The NORTEC raised floor system offers impressive in-built properties and truly state-of-the-art technology. It is the ideal product for almost any field of application. NORTEC floor panels give superb underfoot comfort. They are manufactured from calcium sulphate (gypsum): a non-combustible material with superlative structural and physical properties. This product also offers outstanding levels of soundproofing. As a

manufacturer, we can determine the choice of raw materials used. The Institute of Building Biology in Rosenheim recommends NORTEC as a biologically-neutral building material. Our gypsum panels are virtually emission-free. NORTEC can be combined with many other systems, offering a great degree of flexibility. There is also a practically limitless choice of floor coverings.

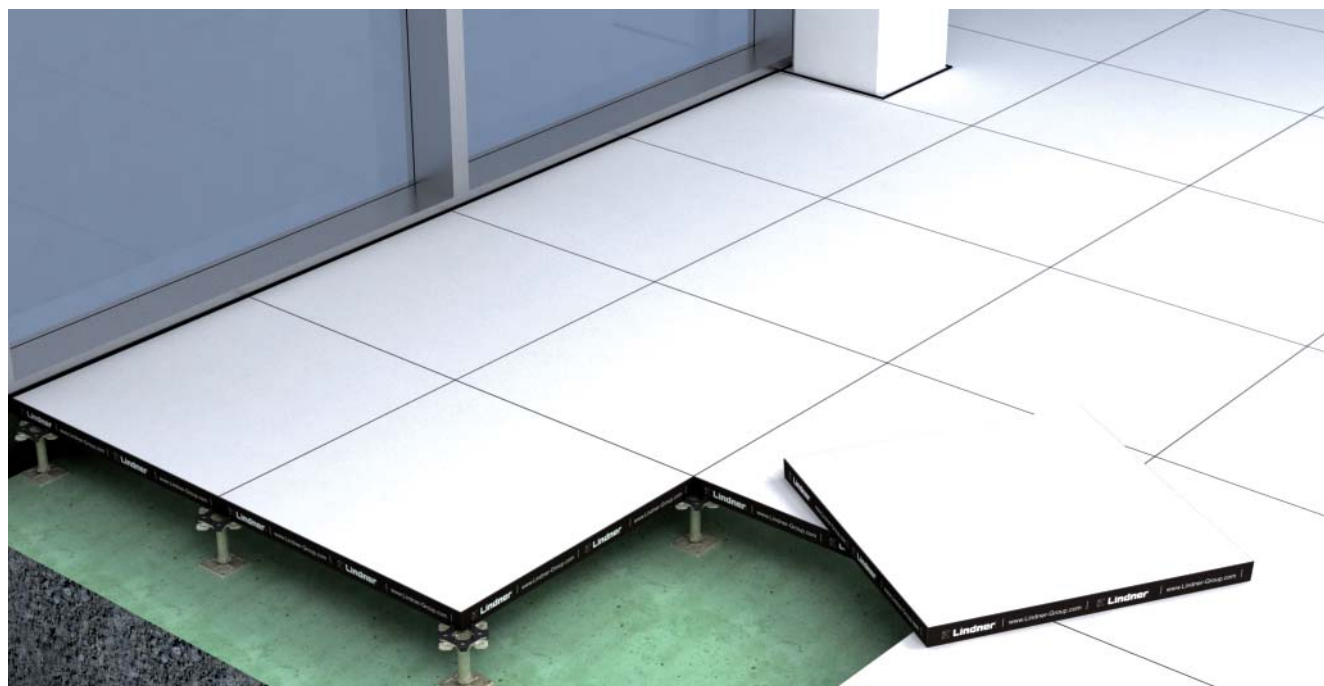


### Typical areas of use

- Foyer and reception areas
- IT control centres
- Training and research rooms
- Office and design areas
- Industrial and working rooms



# System data – NORTEC



Panel	Fibre-reinforced calcium sulphate panel, optionally with galvanised steel sheet at underside, optionally with edge trim to protect against impact and moisture	
Load-bearing capacity	2 kN - 11 kN	
Fire protection	A2, A1 (non-combustible)	
Reaction to fire performance of the panel	F 30, REI 30 and F 60, REI 60	
Fire resistance performance		
Resistance to earth	$\geq 10^6 \Omega$	
System weight	37 kg/m <sup>2</sup> - 71 kg/m <sup>2</sup>	
Standard finished floor heights	28 mm - 2,000 mm	
Panel thickness	16 mm - 44 mm	
Pedestal spacing	600 mm x 600 mm (other pedestal base spacings system-dependent)	
Sound protection		
Normalised flanking level difference $D_{n,f,w}$	48 dB - 56 dB	
Weighted sound reduction index $R_w$	62 dB	
Normalised flanking impact sound pressure level $L_{n,f,w}$	73 dB - 47 dB	
Reduction of impact sound pressure level $\Delta L_w$	11 dB - 36 dB	
Suitable floor coverings	Elastic coverings / textile coverings / HPL / WOODline / STONEline / loose-laid tiles / sheets	
Accessories	<ul style="list-style-type: none"> <li>- Expansion joints</li> <li>- Stringers</li> <li>- Electrical outlets</li> <li>- Air ventilation outlets</li> </ul>	<ul style="list-style-type: none"> <li>- Facings</li> <li>- Intermediate floors</li> <li>- Edge panels</li> <li>- Bridging profiles</li> </ul>

Please see the system data sheets for more detailed technical information on each system.

# System description – NORTEC

## Panel

NORTEC floor panels are made from calcium sulphate and are particularly impressive in terms of stability and versatility. Edges can be supplied with or without edge trim, and are tapered for easier installation or removal of the panels.

Support elements have been specially developed for use with raised flooring. The main components of these panels are gypsum and high-quality cellulose fibres.

Various panel thicknesses as well as special formats round off the NORTEC product line.

## Load-bearing capacity

We have developed a special manufacturing process to meet more demanding structural specifications without increasing the thickness. Steel sheet can also be applied to the under side to increase load bearing capacity.

## Fire protection

NORTEC offers outstanding safety: our careful choice of panel components ensures a fire resistance performance of up to 60 minutes (Fire resistance performance F60, REI 60). The carrier panel is non-combustible.

## Resistance to earth

Calcium sulphate panels can be produced with conductive properties. By using highly conductive components such as coverings, adhesives and edge trims, the electrostatic charge can be continually dispersed to earth. In such cases, it is important to choose a suitable floor covering.

## System weight

The weight of the system varies from 37 kg/m<sup>2</sup> to 71 kg/m<sup>2</sup>, depending on customer requests and load-bearing requirements.

## Installation height

For heights of 500 mm plus we recommend horizontal reinforcement with stringers.

## Pedestals

Pedestals are made from galvanised, yellow chromatised steel and are infinitely adjustable in height. They are equipped with a precision-engineered adjusting bolt.

## Sound dampening plates

Sound dampening gaskets are made of conductive / non-conductive plastics. They support optimum positioning of the floor panels and optimise sound as a result of their material properties.

## Gluing of pedestals

Pedestal base glued to subfloor.

Adhesives of different qualities depending on the environmental requirements.

## Height fixing

A sealant varnish made from low-emission materials is used for this purpose.

## Wall connection

A permanent, pre-stressed wall connection with sealing tape works as a sound decoupling whilst also absorbing horizontal movements.

## Structural subfloor

As a rule, all structural subfloors are sealed to ensure lasting pedestal adherence. We recommend a 2-component finish for air-conducting system floors.

## Suitable floor coverings

Elastic or textile floor coverings are highly suitable for our raised floor panels. Loose-laid tiles are also suitable. WOODline creates a particularly pleasing feel – while solid stone finishes from our STONEline range can also be used.



# Lindner substructures

## Pedestals

The substructure is an important component of every system floor. The pedestals create the cavity needed to accommodate the services. Lindner metal pedestals can be adjusted to almost any height, therefore compensating for any unevenness in the subfloor. From design to manufacture including the galvanisation – we produce our pedestal range entirely in-house.

We manufacture highly accurate pedestals for raised floors. Our many years of experience ensure high load-bearing capacity and excellent durability for all our products. Lindner systems can be combined with one another in many ways, and supplemented with different reinforcement profiles.



### Lindner pedestals from our own production

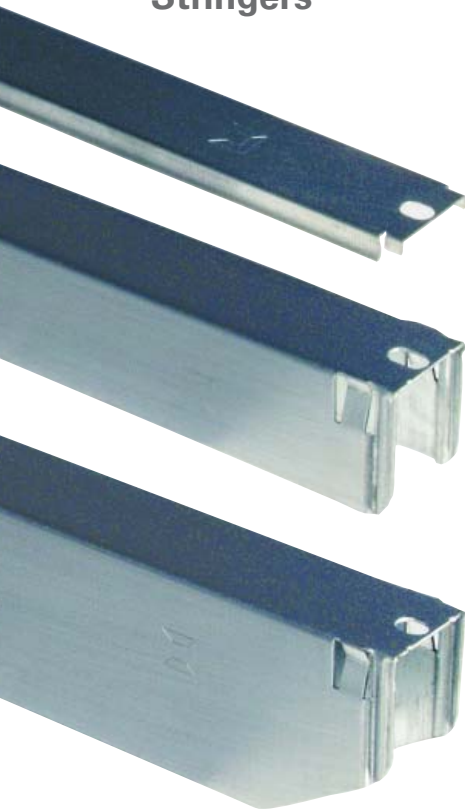
- Large adjustable range
- Corrosion resistant
- High load-bearing capacity
- Easy installation

# Reinforcement profiles

Even a standard Lindner floor system offers excellent load-bearing capacity. Should this prove insufficient, the system can be upgraded by reinforcement

profiles, adjusted to the specific purpose. Many options are available, from the lightest stringer which increases lateral rigidity through to a C-profile.

## Stringers



### Type RO (Height: 7.5 mm)

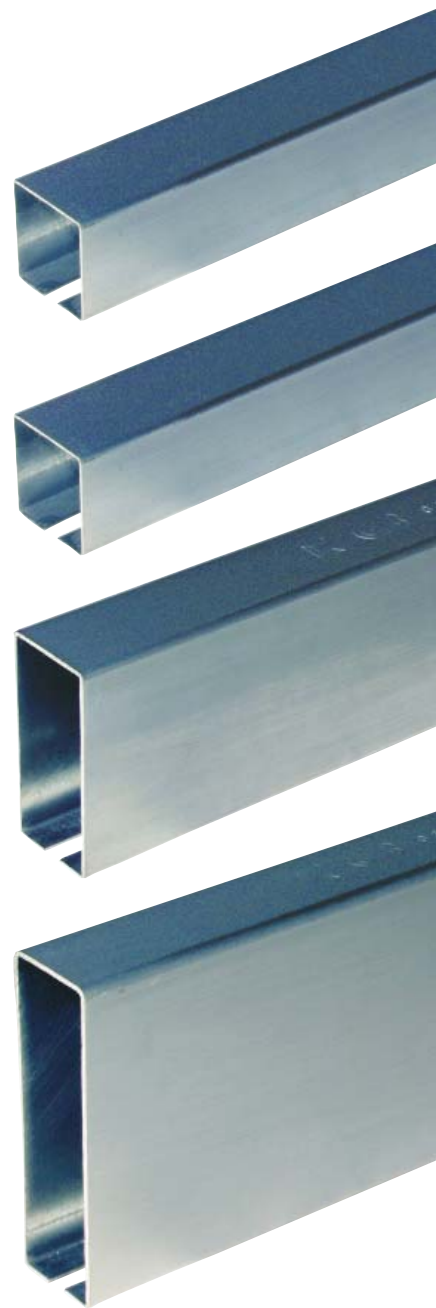
The type RO stringer is made from cold-rolled galvanised steel sheet with clip function. Clipping (screwing optional) ensures a firm hold on the pedestal head, thus preventing any noise, for example rattling. The sole purpose of the stringer is to reinforce the system horizontally.

### Type RL (Height: 35 mm)

### Type RM (Height: 54 mm)

Type RL (light) and type RM (medium) stringers are made from cold-rolled galvanised steel sheet. Springs are inserted laterally on the ends of the stringers which are then clipped into the pedestal from above by pressing downwards (screwing optional). RL and RM stringer are used for horizontal and vertical system reinforcement.

## C-profiles



Type CL (height: 41 mm)

Type CS (height: 41 mm)

Type CM (height: 84 mm)

Type CH (height: 126 mm)

Cold-rolled galvanised steel sheet, for use in switch room construction. Profiles are installed lengthwise in a continuous line underneath the floor using a hammerhead screw or a spring clip. A significant increase in load can be achieved depending on the dimension of the C-profile being used.

# NORTEC acoustic

The raised floor NORTEC acoustic impresses with its outstanding adjustment of the room acoustics. Perforations in the floor panels ensure the optimum usage of the air volume in the intermediate space as resonance absorber. This lowers the volume level as well as the reverberation time in rooms. Very good sound absorption values are achieved especially with

high and low frequencies. The low frequent effect can be additionally amplified by the use of insulation materials and acoustic fleece. The NORTEC acoustic equipped with an acoustic pan achieves a degree of absorption  $\alpha_w$  of 0.75 and thus creates a silent and relaxed atmosphere in atria, offices and a lot of other rooms.



## Product features

- Impressive degree of absorption  $\alpha_w$  of up to 0.75
- Various options by a selection of qualified coverings
- Different variants of the acoustic panels can be combined with each other and with other floor systems



Beratung  
Consulenza

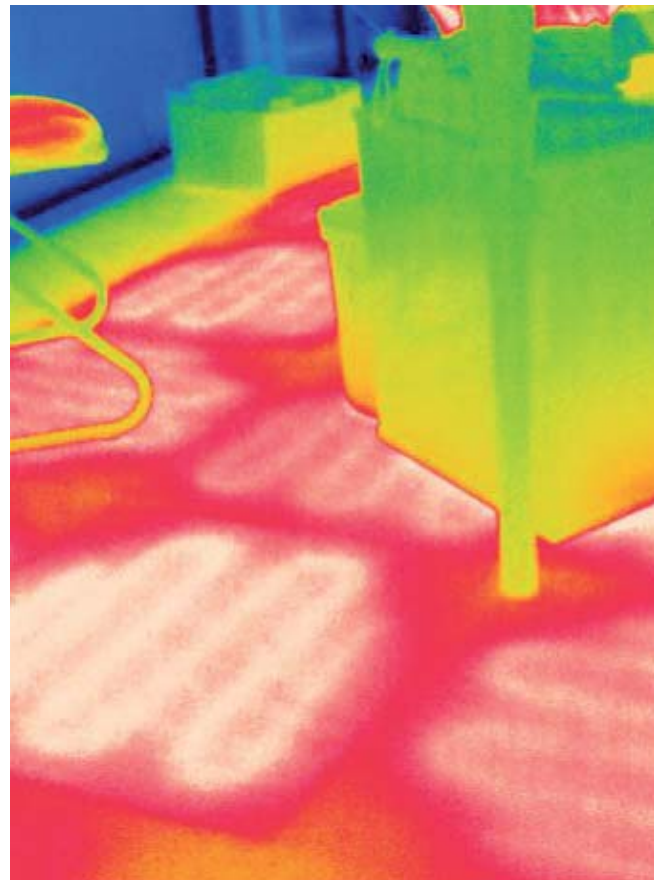
# NORTEC comfort

NORTEC comfort creates a pleasant environment for the occupier. Intelligent heating and cooling systems incorporated into the floor panels regulate the interior climate perfectly – both in summer and winter.

The system offers integrated, high-performance under floor heating with good heat reflection – also ideal as a retrofit.

This ensures a comfortable living and working environment. Architects can also enjoy more design freedom: radiators are unnecessary, extending the planners' scope when designing the interior layout for foyers and premium quality office space.

NORTEC comfort can also be installed at an impressively low floor height and is especially lightweight.



## Product features

- Heats up and cools down very quickly
- Almost any floor covering can be used
- Heat rating 85 - 95 W/m<sup>2</sup> and cool rating 25 - 40 W/m<sup>2</sup>
- Eco-friendly; low water temperature



# NORTEC power

NORTEC power shoulders the weight of heavy-duty situations. In certain circumstances floors need to withstand heavier loads, for example foyers, manufacturing plants, museums and libraries.

In such situations, NORTEC power offers unbeatable load-bearing strength. The floor system carries immense loads.



## Product features

- Special panel composition
- Strengthened pedestals
- Stringers are not required
- Safe for driving over with heavy motorised lifting apparatus

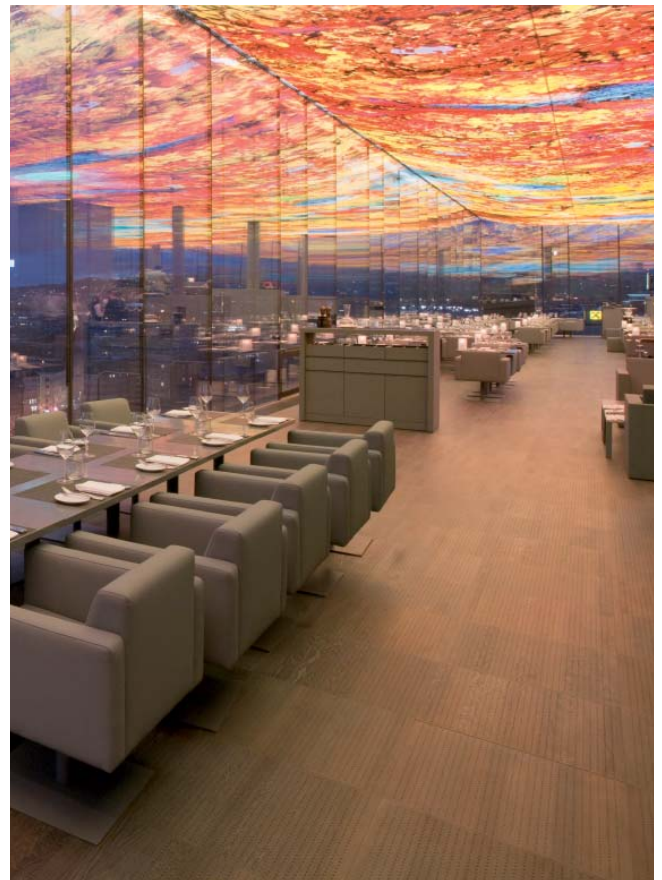




# NORTEC sonic

NORTEC sonic offers a sophisticated ventilation system. The raised floor makes a convenient supply with fresh air possible. The fresh air is controlled directly by the perforations in the floor and guided draught-free into the rooms to be supplied. Perforated floor panels ensure perfect air flow.

Besides a constantly fresh air, architects and clients can also heat and cool rooms with NORTEC sonic without limiting the scope for the implementation of your ideas by extensive installations. The perforations in the floor have a further advantage: They absorb sound and improve in this way the room acoustics.



## Product features

- Air flow of up to 1,500 m<sup>3</sup>/h at 20 Pa possible
- Variety of perforation designs
- Suitable for seepage ventilation coverings



# System accessories

## Electrical outlets

As all electrical installations are fed under the raised flooring, electrical connections can be placed exactly where you want them by the installation of electrical outlets.



## Bridging profiles

For structural reasons bridging is required where pedestals cannot be installed. In such cases we offer special bridging profiles which are easy to install and yet improve dynamic and static load-bearing capacities.



## Expansion joints

Expansion joint profiles are used to absorb horizontal deflections and vertical weighing down constructively and invisibly.



## Air ventilation outlets

Air ventilation outlets allow the room to be air-conditioned and ventilated without creating draughts. A number of different systems are available:

### - Open system

Ventilation comes directly from the cavity, which is designed as a pressure floor, through the corresponding air ventilation outlets into the room.

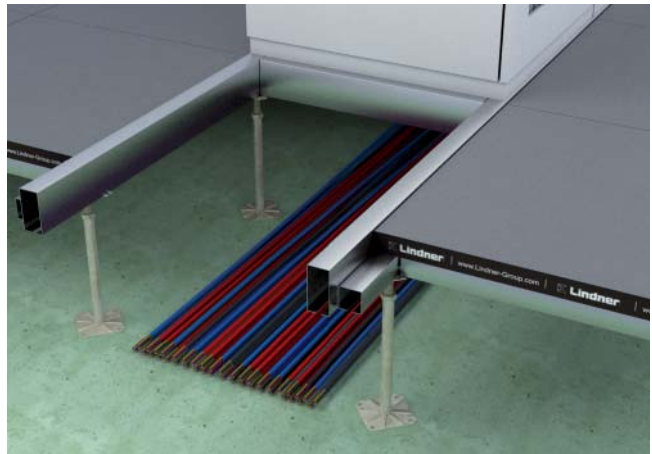
### - Closed system

In a closed system, the air is fed through pipes or through cavity barriers with fixed connections to the air ventilation outlets.



## C-profile frames

For technical service rooms, we always recommend the use of stable switch room frames, as these provide the required lateral and vertical load-bearing capabilities. The combination of two C profiles with variable heights (CL and CM) provides sufficient stability for switch gear or server racks. Raised floor panels are not installed under the cabinets, so that cables can be connected more easily to the electrical components. Cold air is supplied through the opening in the floor, regulating the operating temperature of the components.

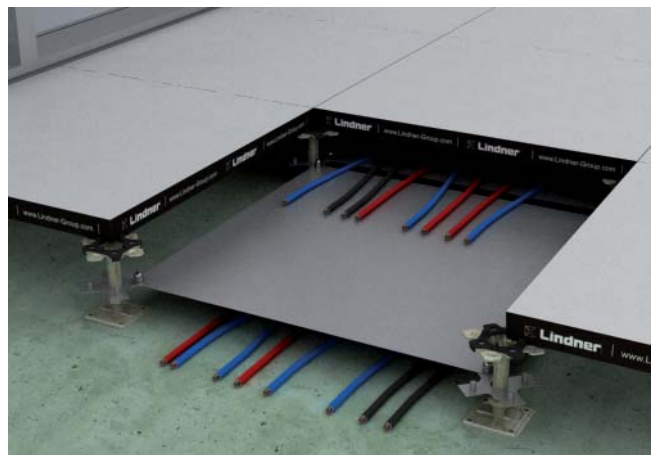


## Intermediate floor for cables

Where there is a lot of cabling, additional installation elements will be required. An intermediate floor should be installed to carry cables. It consists of a star-shaped carrier plate with welded threaded bolts into which a steel sheet cassette is hooked and screwed tight. Intermediate floors also enhance the horizontal stability of the system.

You can choose from two options:

- intermediate floors which can be walked on
- intermediate floors which cannot be walked on



# System accessories

## Facings

Staircases, platforms, etc. need to be finished with a front cladding (facing). Where features such as free-standing borders are required, the top edges of the facing will be protected with a stair edging profile. Angles screwed to the subfloor and bracings installed in the upper area of the facing ensure a stable structure.



## Cavity barriers

Three different types of cavity barriers can be installed to meet different requirements.

- Ventilation barriers  
made from coated chipboard panels
- Fire protection barriers  
made from solid gypsum wall blocks (min. 80 mm)
- Soundproofing barriers  
made from porous concrete (min. 100 mm)



# Naturally sustainable

A responsible approach to humans and nature is a matter of course for us as a manufacturer of long lasting floor systems in premium quality for more than 25 years. We are continuously optimising our wide range of floor systems with the objective to further reduce their impact on the environment over their entire life cycle. Every production step in our manufacturing base in Dettelbach is subject to a thorough control of the ambitious energy, material and quality requirements – from the raw material to the ready-to-use system – thanks to its unique production intensity of the NORTEC raised floors. This ensures that our clients do not only get a sophisticated product but that they can also rely on the ecological suitability by for example the use of components with low emissions. As a direct result of these effective measures the harmlessness to the health has been verified with test chamber measurements.

The results and the constant findings of a life cycle assessment of the base in Dettelbach are part of the environmental declaration according to ISO 14021 which is available for the procedure of furnishing proof of the environmental performance of Lindner NORTEC.



Lindner is a founding member of the German Sustainable Building Council (DGNB) and member of the US Green Building Council. We are actively involved in building up awareness for the principles of sustainable construction and the development of relevant standards.

## Sustainable construction with Lindner system floors:

- Extremely durable products with best functional characteristics and high economic efficiency
- End-to-end procedure of furnishing proof of the ecological material characteristics by environmental product declarations
- Consultancy service with all current building certifications, as for example according to DGNB, LEED, BREEAM

## Simply healthier: NORTEC system floors – naturally recycled.

- Exclusively healthy and environmentally compatible materials
- Solvent- and VOC-free (tested according to EU regulations / ASTM standard)
- Almost emission-free and building biologically neutral
- Calcium sulphate panel made from more than 99 % recycled material
- Environmentally friendly raw material extraction from secondary products of different manufacturing methods (FGD gypsum)
- CO2 neutral systems (panel and pedestal) available; carbon footprint verifiable thanks to a comprehensive life cycle assessment of the manufacturing bases in Dettelbach and Arnstorf

# Load-bearing capacity

The permissible loading capacity is calculated and tested with the involvement of official bodies. The final results are substantiated by certificates of conformity to the application guideline for the standard DIN EN 12825.

The following key criteria are used:

- a) Load value
- b) Supporting surface of the load indenter
- c) Positioning of the load on the test sample
- d) Safety factor

The critical load for raised floors is the point load. Floor systems are assigned a load and deflection class on the basis of their static load-bearing properties and the related deflection levels. As a rule strip loads and distributed loads are not taken into account, as they are not applicable.

## Point loads



To determine the point load, a static load (such as a table leg) is simulated. On the basis of the permissible point load thus established, the system is generally assigned an appropriate load and deflection class. In accordance with standard practice, the load is applied with a 25 mm x 25 mm indenter.



## Distributed loads

Like the point load, the distributed load is a static load. In contrast to the point load, the area of the indenter is 1 m<sup>2</sup>. The term distribution load is commonly used in structural engineering. It is used to determine the strength of reinforced concrete floors. For raised floors, the specification or assessment of a distributed load is inappropriate.

For practical purposes, the indenter of 1 m<sup>2</sup> spans the raised floor grid (60 cm x 60 cm) and thus the individual panel. The panel and pedestal acts here merely as an intermediate layer, transferring the load to the concrete subfloor.

## Dynamic loads



**To determine the permissible dynamic load (such as a forklift), the following must be taken into account:**

- Weight of the vehicle without load
- Total weight of the vehicle with load
- Max. wheel load
- Contact surface of the tyres or rollers
- Wheelbase
- Max. drive or tow speed
- Number, diameter, width and material of tyres or rollers
- Max. acceleration and deceleration during lifting
- Safety factor

A corresponding safety coefficient will be determined for the ascertained static load (permissible total weight of the vehicle) using the aforementioned factors and multiplied by the max. permissible static load. When selecting a floor covering, one must be sure that the floor covering and adhesive are suitable for these special requirements.

# Load-bearing capacity

## Static values acc. to DIN EN 12825

The European raised floor standard EN 12825 describes a system test process for panels and pedestals (resp. substructure) to identify the maximum load and relevant classifications. The load is transferred onto the system using a test indenter

of 25 mm x 25 mm (625 mm<sup>2</sup>). The load points shown are to be checked. The failure criteria shown below for classification of the system is the breaking load and the deflection (vertical displacement) with nominal load and load class.

## Load classes

Class <sup>1)</sup>	Breaking load <sup>2)</sup>	Nominal load <sup>3)</sup>	Element class <sup>4)</sup>	Applications and usage scenarios
1	≥ 4,000 N	2,000 N	1	Offices without public access and without heavy equipment
2	≥ 6,000 N	3,000 N	2	Office areas with public access
3	≥ 8,000 N	4,000 N	3	Rooms with increased static loads
4	≥ 9,000 N	4,500 N	-	Areas with fixed seating, design offices
5	≥ 10,000 N	5,000 N	5	Exhibition areas, workshops with light use, storage rooms, libraries
6	≥ 12,000 N	6,000 N	6 <sup>5)</sup>	As with load category 5,000 N, but with increased load requirements, industrial and workshop floors, vault rooms
-	≥ 14,000 N	≥ 7,000 N		Heavy duty floors, production areas, such as clean rooms

1) Classification of the load acc. to DIN EN 12825

2) To determine the breaking load, the load is applied to the weakest point of the panel (see illustration) using a 25 x 25 mm test indenter and is increased until the panel fails.

3) The nominal load or load class is determined from the breaking load divided by the safety factor  $\nu = 2$

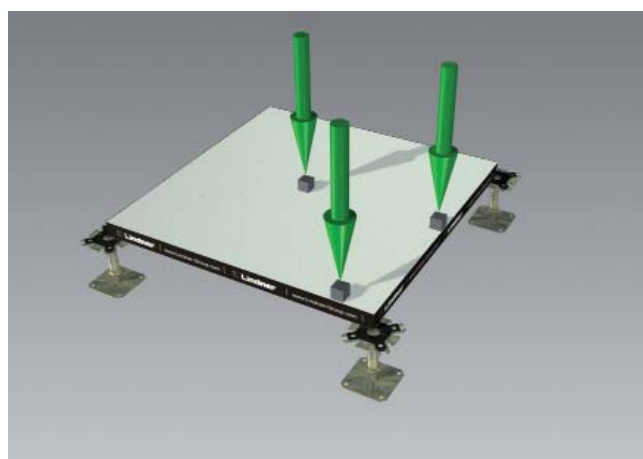
4) Load classification in accordance with the application guideline for raised floors

5) Higher breaking/nominal loads are required in individual cases for raised floors with high load-bearing requirements, see NORTEC power systems

## Deflection classes

For a load at the level of the nominal load (this is the breaking load divided by the safety factor), the vertical deflection measured must not exceed the values given in the table below.

Class	Maximum deflection
A	2.5 mm
B	3.0 mm
C	4.0 mm



## Static values acc. to International Standard

International Standards describe the testing of components for the classification by load classes. Raised floor panels and pedestals are tested and classified individually. The maximum load is applied to the panel using a 25 mm x 25 mm (625 mm<sup>2</sup>) test

indenter. The load points shown are to be tested. The raised floor panel is supported on solid cylinders. The failure criterion is the breaking load and a maximum panel deflection of 2 mm (l/300).

## Load classes

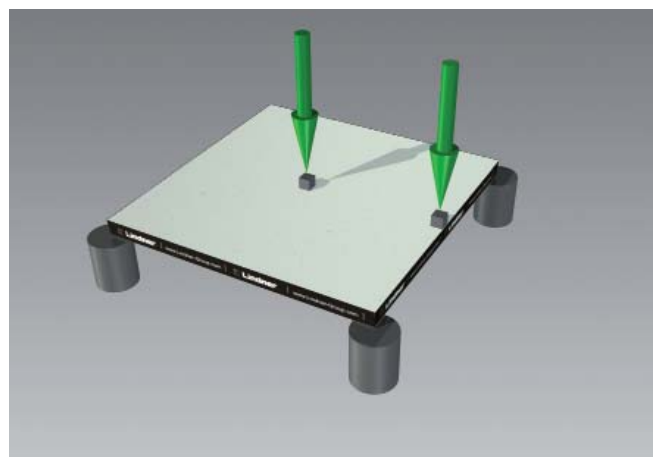
Class <sup>1)</sup>	Breaking load <sup>2)</sup>	Nominal load <sup>3)</sup>	Deflection <sup>4)</sup>	Applications and usage scenarios
1	≥ 6,000 N	3,000 N	max. 2 mm	Offices with a high proportion of communication equipment, telephone exchanges, engineering offices, auditoriums, training and treatment rooms
2	≥ 8,000 N	4,000 N	max. 2 mm	Computer rooms with more demanding requirements, print rooms, industrial floors with light traffic, storage rooms, workshops with light use and libraries
3	≥ 10,000 N	5,000 N	max. 2 mm	Computer rooms with more demanding requirements, print rooms, industrial floors with light traffic, storage rooms, workshops with light use and libraries
4	≥ 10,000 N	> 5,000 N	max. 2 mm	Floors with forklift traffic, industrial and workshop floors, vault rooms

1) Classification of load

2) To determine the breaking load, the load is applied to the weakest point of the panel (see illustration) using a 25 x 25 mm test indenter and is increased until the panel fails.

3) The nominal load is determined from the breaking load divided by the safety factor  $v = \min. 2$

4) Where the panel is loaded with the nominal load, the maximum permissible deflection is l/300.



# Fire protection

More than 500 fire victims and countless casualties in Germany each year speak for themselves: The safety of the occupants of a building in the case of a fire has to have highest priority!

At the same time buildings all over the world are always getting bigger and more complex in their use. In view of these developments, it is vital that the constructional fire protection is considered with each project right from the beginning and lies within the hands of competent planners, manufacturers and installers.

In the case of emergency the development of a fire can be prevented or at least safe escape routes respectively a good accessibility for rescue forces can be secured by a carefully adjusted building concept. The effective limitation of the possible damage for the building owner is thereby a welcome side effect.

System floors offer the possibility to place building services and installations in the floor cavity. Requirements to the fire safety are imposed for rooms in need for protection as these installations are bringing calorific potential into the cavity of the system floor.

The following protection objectives are defined in Germany which can of course be viewed as relevant requirements for the improvement of the safety level of buildings worldwide:

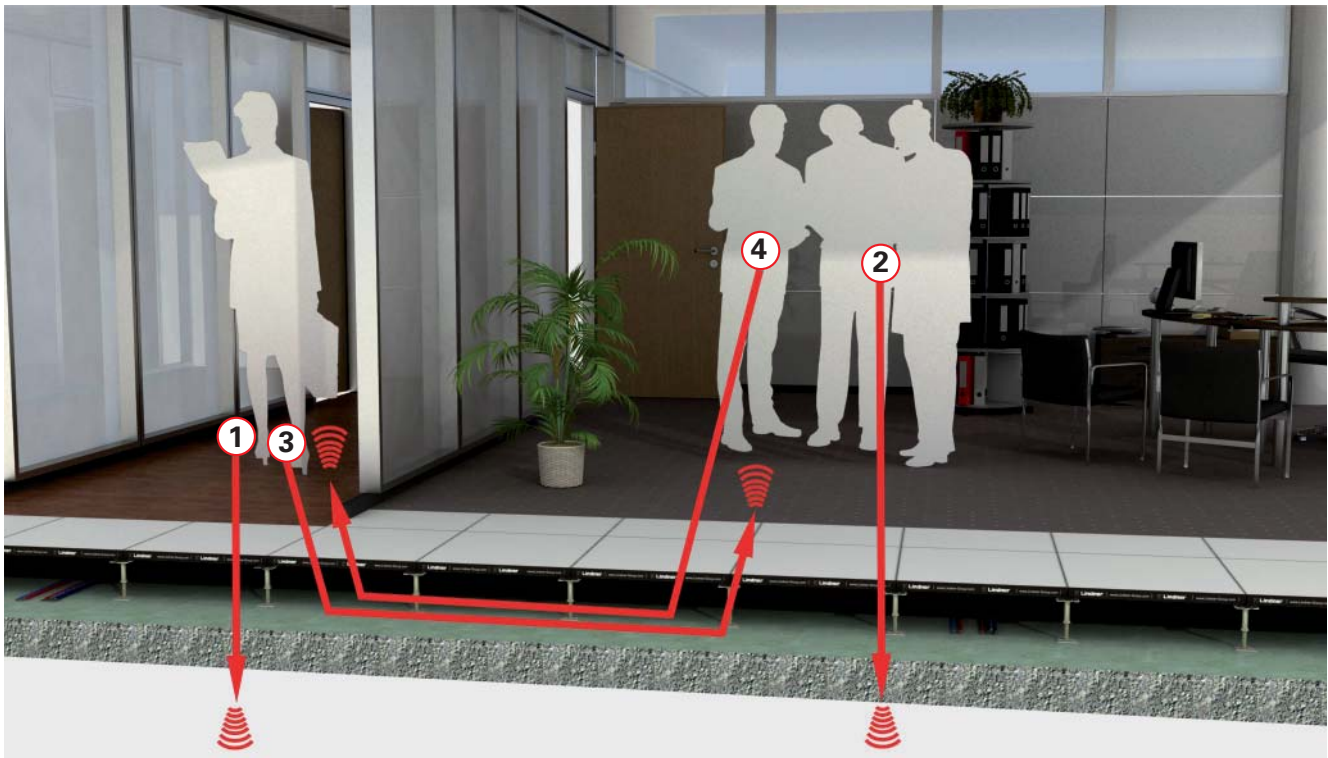
- Prophylaxis against the development of fire and smoke
- Prevention of the spreading of fire and smoke
- Guarantee of sufficient rescuing and firefighting operations.

Besides the reaction to fire performance A1 "non-combustible", system floors in escape routes with a cavity of more than 200 mm, respectively in other rooms with more than 500 mm, have therefore to prove also a fire resistance performance in a fire test according to DIN 4102-2. Thereby they have to resist temperatures of up to 850 °C for at least 30 minutes in order to guarantee the escape from the building in the case of an emergency.



Lindner NORTEC is suited for the use in these areas due to its reaction to fire performance A1 according to EN 13501-1. The system has the respective F 30-AB / REI 30 classifications according to DIN 4102-4 respectively EN 13501-2.

# Sound protection



## 1 Reduction of impact sound pressure level $\Delta L_w$ tested to DIN EN ISO 140-8

Laboratory test measurement is carried out vertically, i.e. from floor to floor with a standard ceiling, allowing comparison between different systems. Higher values are favourable.

## 2 Weighted sound reduction index $R_w$ tested to DIN EN ISO 140-3

Laboratory test measurement is carried out vertically, i.e. from floor to floor, with a standard ceiling, allowing comparison between different systems. Higher values are favourable.

## 3 Normalised flanking impact sound pressure level $L_{n,f,w}$ tested to DIN EN ISO 10848-2

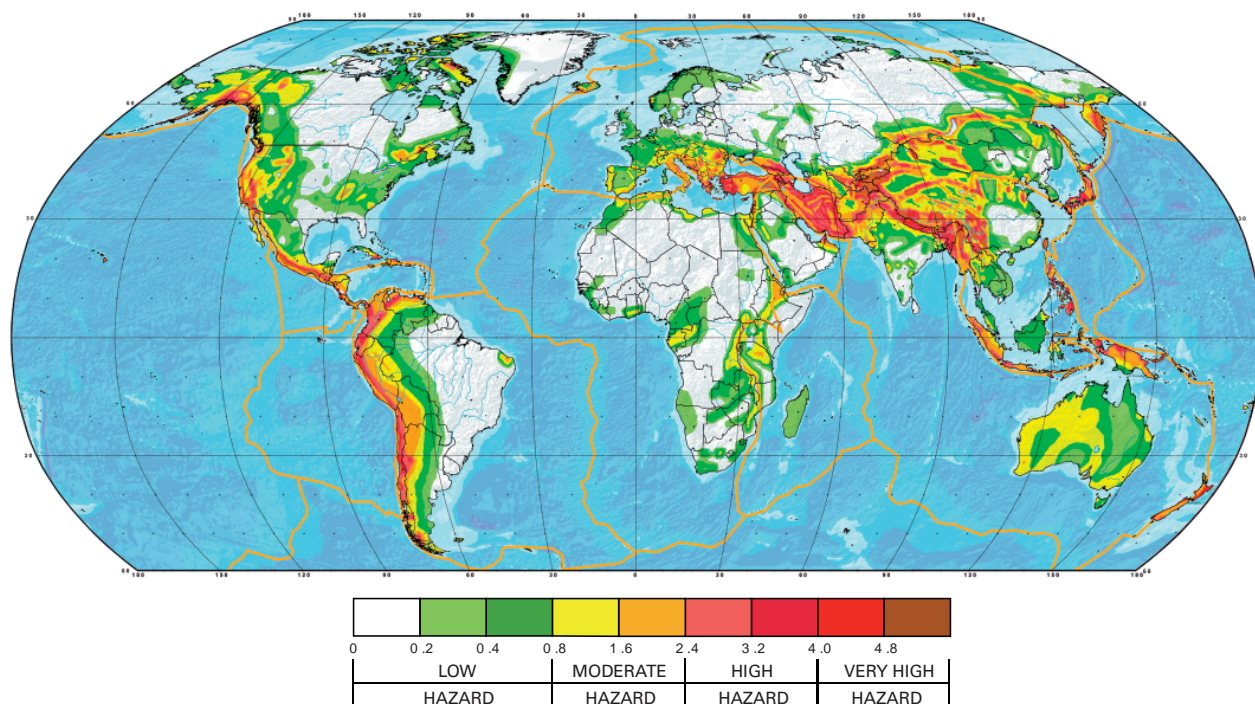
Laboratory test measurement is carried out horizontally in combination with a highly sound-proofing partition which is suspended from the ceiling and touches the surface of the raised floor. Lower values are favourable.

## 4 Normalised flanking level difference $D_{n,f,w}$ tested to DIN EN ISO 10848-2

Laboratory test measurement is carried out horizontally in combination with a highly sound-proofing partition which is suspended from the ceiling and touches the surface of the raised floor. Higher values are favourable.

Consider the correction degree according to VDI 3762 to calculate the values on the construction site. Combinations of raised and hollow floors are to be assessed individually. The corrective allowance should be specified by the planner.

# Seismic safety



Seismic hazard map – zones worldwide

Giardini, D., Grünthal, G., Shedlock, K. M. and Zhang, P.: The GSHAP Global Seismic Hazard Map. In: Lee, W., Kanamori, H., Jennings, P. and Kisslinger, C. (eds.): International Handbook of Earthquake & Engineering Seismology, International Geophysics Series 81 B, Academic Press, Amsterdam, 1233-1239, 2003.

Earthquakes are in most cases the result of seismic activities due to continental drifts in the Earth's crust. There is no certainty in the particularly active areas if and when an earthquake happens and as far as humans are concerned by the oscillations. This permanently dangerous situation makes especially in the construction sector new measures necessary in order to further fulfill global safety requirements. Lindner system floors are approved for these disaster areas.

The severity of a quake is classified in magnitude scales – of which the most famous surely is the Richter scale. The geographic division of the concerned zones is made by earthquake zones or hazard maps. These show that, although the highest occurrences are in Asia and on the American continent, some zones in Europe respectively Germany are also seismically very active. Consequently there are regulations in the construction standard Eurocode 8: DIN EN 1998-1:2010-12 for the seismic safe design in construction. The requirements of the Eurocode 8 for seismic safety are also valid for buildings which are classified in building class 1 and need to be maintained as part of the basic supply in the case of emergency, like for example hospitals, fire houses and power plants, also if those are not located directly in the concerned zones.

The risk of damage to humans and buildings by earthquakes can be reduced significantly by specific prevention measures like allowing the structural compensation of frequencies and additionally fixing other building parts. In interiors, this is made by fall protections, expansion joints and horizontal reinforcements.

Thereby the following objectives have priority:

- Protection of humans from the collapse of the building respectively from objects falling down
- Limitation of damages of buildings respectively guarantee of the function of certain sections
- Maintenance of the basic supply
- Restriction of eventual secondary damages, for example from the bursting of fire

The suitability of Lindner system floors for the categories A – F according to IBC (International Building Code) – from low seismic design requirements in the case of light frequencies to very high requirements with acute danger of life for humans in the building – was verified in collaboration with the Institute of Earthquake Engineering and Engineering Seismology in Skopje.

# Joint permeability

Where open air ducting is installed under the raised floor, the impermeability of the system needs to be guaranteed.

The following specific values were confirmed by the "Institut für Systembodentechnik" with test report 04/535BS:

## Influencing factors

$V_L$  = volume of airflow per unit of length

$a$  = joint permeability coefficient

$\Delta_p$  = test pressure difference

To optimise the air leakage coefficient of a raised floor system, we recommend the use of loose-laid tiles.

## Test results

- Wall connection with sealing tape;

Test of wall connection  $a_w$

→ Joint permeability coefficient

$a_w = 0.27 \text{ m}^3/(\text{h} \times \text{m})$

- Wall connection with sealing tape and incorporated stringers;

Test of wall connection  $a_w$

Joint length 6.0 m

→ Joint permeability coefficient

$a_w = 0.27 \text{ m}^3/(\text{h} \times \text{m})$

- Wall connection with airtight sealant; test of joints between the raised floor panels  $a_D$

Joint length 4.2 m

→ Joint permeability coefficient

$a_D = 0.04 \text{ m}^3/(\text{h} \times \text{m})$



# Static electricity

## Preliminary remarks

Static electricity as a natural phenomenon is familiar to the public, for example when getting an electric shock from door handles after walking across carpets.

These electrical discharges are generally of no danger to the people themselves. People may however be startled and, as a result, make a mistake.

In addition to this, however, there are consequences of static electricity that must be prevented. These range from the destruction of electronic components to the explosion of complete factories.

## Brief description

### Static electricity builds up = electrical charge

Static electricity always occurs from the movement of fixed insulators or liquid substances, strictly speaking from their separation. An extreme example is when dusty air passes a wall.

The resulting voltage depends on the air humidity. Dry air will cause higher charges to develop than humid air.

Electronic components are extremely sensitive to such events. Discharges of just 30 V can destroy them and/or trigger switching errors.

This results in unpredictable risks and thus incalculable costs. A fact which defuses the problem is to ensure that generally all electronic elements are shielded.

### Static electricity and conductivity

At best the occurrence of static electricity can be reduced by choosing appropriate materials but it cannot be prevented entirely. However, ensuring that all electric charges are discharged immediately and smoothly, prevents any danger to people or objects. If static electricity is continually discharged when it occurs, the charge cannot become large enough to cause an electrical discharge (electric shock).

### Static and dynamic electricity

Dynamic electricity is the electric power that is supplied by a power station, via electricity lines and is available as a voltage. Static electricity, in contrast, is not supplied by a voltage source, but rather is a one-off event, which is not immediately available again after discharge and has to be built up again.

## Test procedure for electrostatic properties

### Resistance measurements; measurement parameter $\Omega$ (ohm)

Most tests are carried out in a prescribed test climate, which, however, is not uniform for the different standards.

#### Contact resistance

( $R_1$  - Procedure A - DIN EN 1081)

Electrical resistance is measured on a sample between the tripod electrode placed on the surface of the floor covering and an electrode placed directly on the opposite underside.

#### Resistance to earth

( $R_2$  - Procedure B - DIN EN 1081)

Electrical resistance is measured on an installed floor covering between a tripod electrode pressed onto the top of the floor and the earth potential.

#### Surface resistance

( $R_3$  - Procedure C - DIN EN 1081)

Electrical resistance is measured on an installed floor covering between two tripod electrodes spaced 100 mm apart from one another.

#### Earth continuity

( $R_{ST}$  DIN 57100 / VDE 0100 T-10)

Resistance is measured between the surface of the installed floor covering and the earth potential.



### Measurements of charge; measurement parameter kV (kilovolts)

Walking test (DIN 54345, T2)

The charging voltage is measured by a test person shuffling across an installed floor covering wearing specific footwear.

Technical test (DIN 54345, T3)

The above mentioned walking test is simulated with a machine. This test can only be performed in a laboratory.

Terms

Antistatic

Elastic floor coverings are also antistatic if they are conductive.

Floor coverings are antistatic when they generally do not allow any disturbing electrostatic charges to develop; the charge needs to be less than or equal to 2.0 kV during the walking test.

Conductive

Floor coverings are conductive when their resistance to earth  $R_2$  – Procedure B is less than or equal to  $10^9 \Omega$ . However, lower resistances are also required in many cases.

Insulation

A floor is insulating according to DIN 57100 / VDE 0100T410, Sec. 6.3.3 (against contact voltage from the mains) if the earth continuity  $R_{ST}$  is not less than the following values:

$50 \text{ k}\Omega = 5 \times 10^4 \Omega$  for installations with nominal voltages under 500 V

$100 \text{ k}\Omega = 1 \times 10^5 \Omega$  for installations with higher nominal voltages

Note

As a result of different test conditions, the earth continuity can only be calculated approximately from the contact resistance ( $R_1$  – Procedure A – DIN EN 1081). However, from experience it is known that conductive floor coverings with less than  $10^6 \Omega$  do not meet the VDE requirements. Earth continuity for all types of floor coverings reduces where there is moisture in the flooring system.

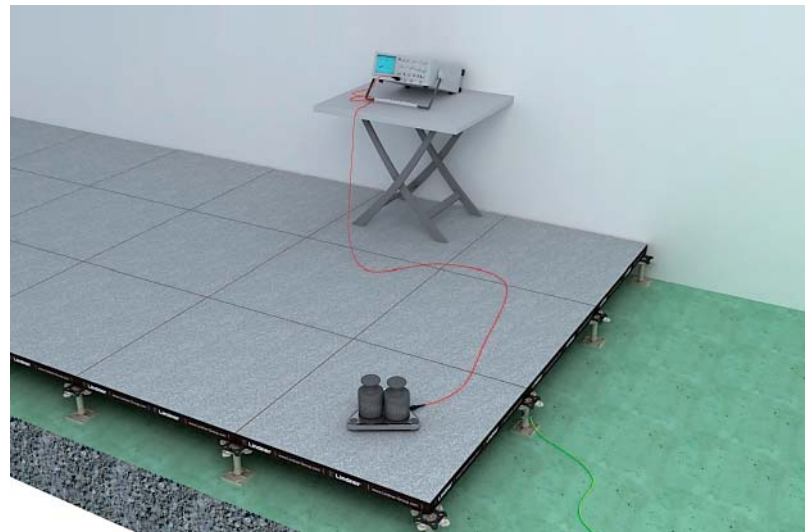
## Resistance to earth

Resistance to earth  $R_2$  –  
Procedure B – DIN EN 1081

Measurement of resistance to earth  $R_2$  of the installed floor covering. The electrical resistance of an installed floor covering is measured between the earth potential and an electrode placed on the surface of the covering. The tripod electrode is placed on the dry floor covering (48 hours after installation) and connected to the ohmmeter, just as is the earth connection. Load the tripod with at least 300 N before switching on the power.

Note

For values of  $10^{10} \Omega$ , static electricity can dissipate in about 1 second. Achieving less than  $10^9 \Omega$ , a floor covering is sufficiently conductive to prevent a potential fire hazard from flammable dusts or gases created from electrostatic loading resulting from walking on the covering. With less than  $10^6 \Omega$ , a covering is also suited for rooms for storage and production of explosives. The relevant requirements of the trade associations (e.g. ZH



1-200), electronics manufacturers and users have to be observed in each case.

Tripod electrode:	Aluminium panel with rubber feet
Weight:	Equal to or greater than 300 N
Test voltage:	$R \leq 10^6 \Omega$ mit 100 V; $R > 10^6 \Omega$ mit 500 V
Execution:	At least three measurements

# Charge measurements

Charge measurements with the walking test,

DIN 54345 / Part 2

- Measurements of the tendency to electrostatic charge during the walking test

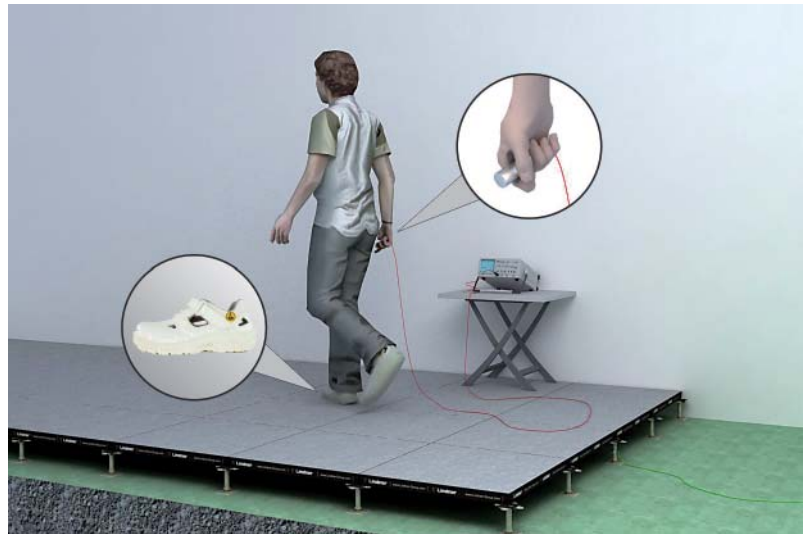
Duration of the walking test:

The charging voltage is measured when the person stands on the floor covering with both feet.

Floor coverings are considered to be antistatic if the charge voltage does not rise above 2,000 V (definition acc. to data sheet EDV 1, Issue 7/84 from the TFI Aachen for carpet flooring).

1 minute (shuffling gait) at 23 °C and at 25 % relative air humidity.

A special rubber provided by the National Materials Testing Institute (BAM) is used for the sole material of the shoes. This material is slightly conductive and supplies a resistance of around  $10^9 \Omega$  between the person and a conductive floor.



# Earth continuity

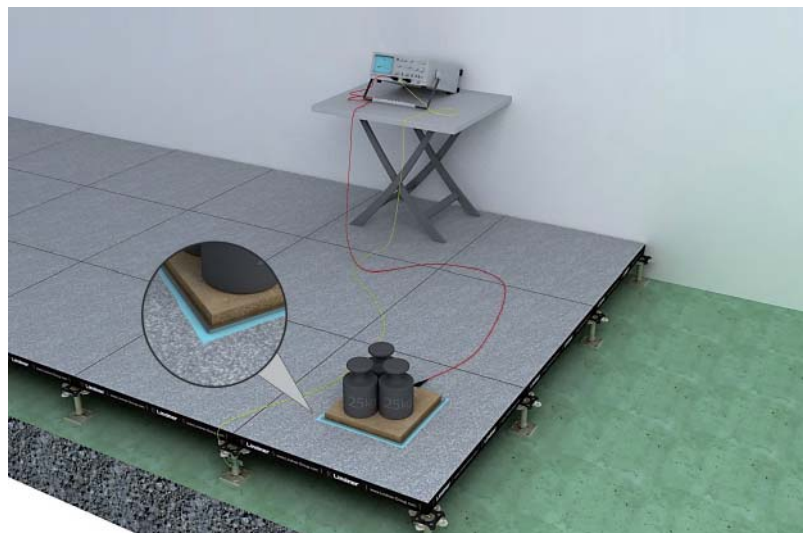
Earth continuity  $R_{ST}$ , DIN VDE 0100

- Measurement of the earth continuity between the surface of the installed floor covering and the earth potential

In workplaces handling components sensitive to static electricity and which regularly work with open voltage, e.g. in the test field, an electrically conductive floor covering must also be insulating acc. to DIN VDE 0100. The earth continuity measurement  $R_{ST}$  is used to assess the electrical insulating ability.

Note

VDE 0100 / Part 410 specifies a lower limit for the earth continuity  $R_{ST}$  as applicable to the workplaces mentioned above. In workplaces where the nominal voltage does not exceed 500 volts of alternating current, the earth continuity must be at least  $5 \times 10^4 \Omega$ .



If nominal voltages are between 500 and 1,000 volts of alternating current, the earth continuity must be at least  $1 \times 10^5 \Omega$ .

Electrode surface: 625 cm<sup>2</sup>.

# Examples of use

On the preceding pages we have clarified the meaning of the word electrostatic and the different measurements. What else must be taken into account where a raised floor is installed and what requirements are sensible?

The electrical resistance of individual areas are totalled which means in practice:

The resistance to earth  $R_2$  can never be lower than the highest resistance of the individual element in the sequence: floor covering – adhesive – raised floor panels – gaskets – pedestals.

## **The flooring systems must fulfil the following requirements:**

1. Office rooms with terminals, sale and exhibition rooms etc.  
  
In these areas, an antistatic floor covering which is equal to or less than 2 kV tested to DIN 54345.
2. Rooms with electronic equipment, such as data centres, computer operation rooms, office rooms with special equipment: earth resistance  $R_2$  less than or equal to  $10^9 \Omega$  or charging voltage U maximum 2 kV.
3. Unprotected electronic assemblies or components with operator protection requirements, e.g. test fields in the electronic production area: Earth resistance  $R_2$  less than  $1 \times 10^8 \Omega$ , earth continuity acc. to VDE 0100,  $R_{ST}$  operator  $5 \times 10^4 \Omega$  or  $R_{st}$  greater  $1 \times 10^5 \Omega$  (depending on nominal voltage).
4. Unprotected electronic assemblies or components, e.g. fabrication or laboratory rooms for the production, repair and testing of electronic equipment, assemblies or components: Earth resistance  $R_2$  less than  $1 \times 10^8 \Omega$ .
5. Explosive atmospheres in general, e.g. laboratories with risk of explosion, gas pressure regulating facilities, accumulator rooms: Earth resistance  $R_2$  less than  $10^8 \Omega$ .
6. In newly built rooms used for medical purposes,  $R_2$  less than  $10^7 \Omega$ , after four years  $R_2$  less than  $10^8 \Omega$ , HF surgery  $R_2$  greater  $5 \times 10^4 \Omega$ .

7. Explosive substances, e.g. where explosives are produced and stored, munitions or pyrotechnical items: Earth resistance  $R_2$  less than  $10^6 \Omega$ .

## **Summary:**

For most raised floor applications, a covering not exceeding the 2kV charge limit is usually sufficient. There is no requirement for earth resistance for the whole structure. Requirements for earth resistance as per the above list is usually only necessary in subareas e.g. central computer rooms.

Seen as a whole, the subject of static electricity is difficult to understand because of the many tests and requirements, a situation arising from excessive earth resistance requirements which were specified in the past.

Low conductivity of less than  $10^8 \Omega$  can only be achieved by raised floor manufacturers when using highly conductive coverings, panel materials and adhesives. With regard to construction costs, unnecessary excessive requirements should, therefore, be avoided. It should be mentioned here that corresponding user clothing (conductive footwear) is absolutely crucial. A technically perfect electrostatic floor construction is useless against non-conductive footwear. Damages due to electrostatic discharge in this instance are inevitable.

## **Source**

Safety Guideline for Raised floors, AGI Worksheet, manufacturer's recommendations, Carpet Research Institute.

# Floor coverings

## Standard coverings

Different floor coverings individualise your NORTEC raised floor. In general, all standard floor coverings are available. In addition to standard floor coverings, Lindner offers floor panels with finished surfaces. Every floor system gets a covering as a finish. Factory-bonded coverings with tested and emission-

free adhesives ensure the best quality and an extended life for your product.

You can choose from a range of coverings including rubber, PVC, HPL or carpet.

In addition, Lindner offers, besides the standard coverings, the series WOODline and STONEline.



### Possible floor coverings

- Elastic coverings
- Textile coverings
- HPL
- WOODline
- STONEline
- Steel sheet and aluminium foil
- Loose-laid tiles

## WOODline

The floor has always been an essential part of a highly specified room. Whether in a conference room or in the modern office, parquet floors make you feel good. Lindner parquet floors are manufactured from solid wood to the highest quality standards and are particularly durable and comfortable to walk on. The combination of a range of woods, designs and finishes means that all ideas are possible.

The edge trim is fitted to the top edge of the parquet, so that no moisture can penetrate into the parquet itself. The colour of the edge trim is supplied in the same colour as the parquet, making the joint between the panels and the edge trim itself barely visible.



Photo: © Walter Luttenberger

As with all natural products, wood differs in colour and structure. Print colours cannot reproduce the colour of the parquet exactly, therefore small differences might occur.

The wooden surfaces are offered oiled or varnished.

# Floor coverings

## Types of wood

Oak, steamed oak, bamboo, steamed bamboo, steamed beech, light beech, olive ash, ash, maple etc. – these wood types are only a small selection from our range. Other types of wood are available on request.

All selected suppliers for Lindner WOODline floor coverings guarantee highest quality and have a certification according to the high ecological requirements of the FSC / PEFC.



Oak



Smoked oak



Bamboo



Steamed bamboo



Steamed beech



Light beech



Olive ash



Ash



Maple



Cherry



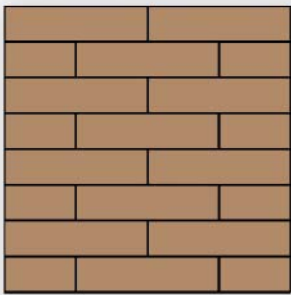
Walnut



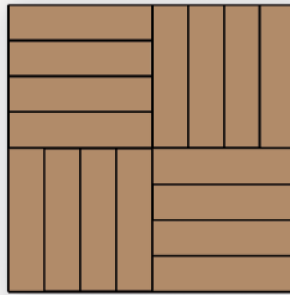
Teak

## Types of designs

3-strip



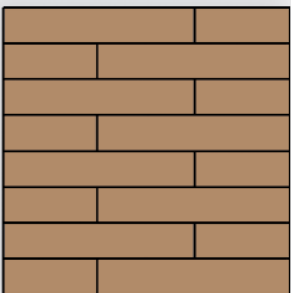
Cube, fourfold



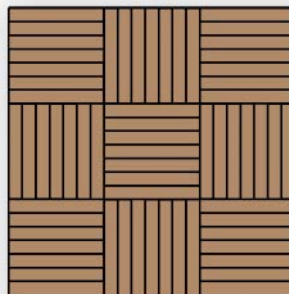
Large baton



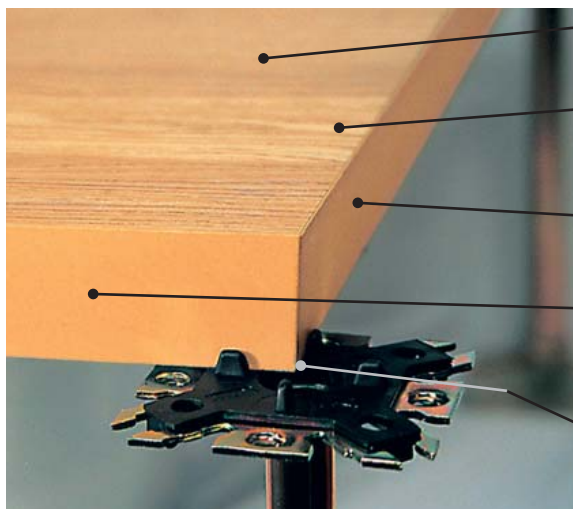
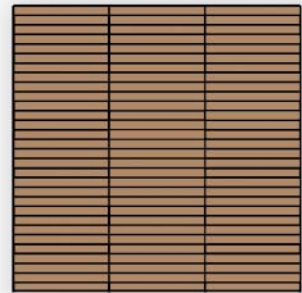
2-strip



Mosaic



Industrial parquet



Surface  
Varnish, oil

Covering  
High-quality wood panels in different designs  
and woods

Carrier panel  
Raised floor panel from calcium sulphate

Edge trim  
Colour adjusted to the type of wood. To protect the  
edge of the panel, the edge trim reaches to the top  
edge of the parquet

Barrier  
Impermeable foil as humidity barrier or steel sheet to  
increase load

### Advantages of varnished finishes:

- Extremely hard surface
- Highly wear resistant
- Low maintenance
- Resistant against bacteria and microorganisms
- Adjustable gloss level

### Advantages of oiled finishes:

- Low maintenance
- Damage through use is easy to resolve
- Ecologically friendly
- Maintains natural surface structure

# Floor coverings

## STONEline

STONEline offers a range of natural and artificial stone and ceramic tiles, factory bonded to our calcium sulphate panels.

Countless types of stones from a wide range of countries are available, as well as a great variety of colours.

New manufacturing techniques mean that the combined “sandwich” of stone and calcium sulphate panel can be processed as a single unit. This innovative production technology allows us to provide you with all-in-one solutions.

During manufacture of NORTEC panels with stone, the joints are made to fit 100 % accurately.

A colour-coordinated edge trim is fitted up to the top of the panel, thus preventing the edges of the stone from chipping off with opening and closing of the raised floor.





## Types of stone

A variety of stone surfaces is available to suit the design, use and load-bearing requirements of every interior: hard-wearing granite for extreme, long-term usage; highly valued, high-quality marble for high-class interiors, a wealth of artificial stones and ceramic coverings offering a range of surface options to suit modern design requirements.

### Ceramic and artificial stone: versatile and exquisite

A comprehensive, carefully-graded product range enables us to satisfy a wide variety of requirements in terms of function and aesthetics. Countless combinations of colours, sizes and patterns make it possible to fulfil almost any individual design.



Micron 60GL



Micron 60DG



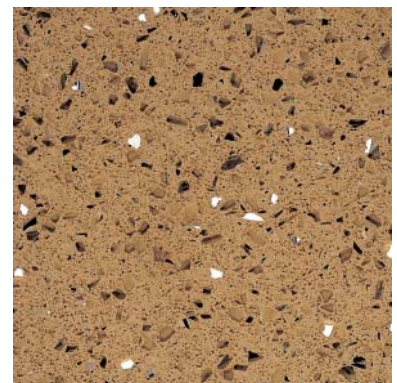
Micron 60N



35-50-05



10-10-05

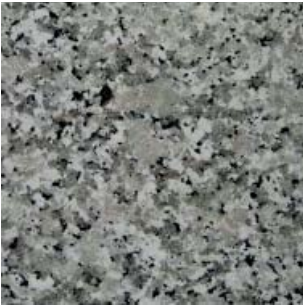


33-10-09

# Floor coverings

## Natural stone for the highest standards

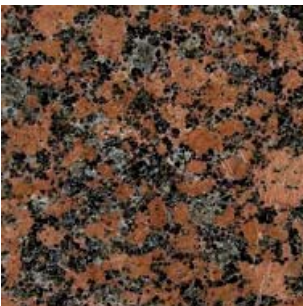
By using a variety of different stones, one can create individual highlights and give each interior its own particular style. The following types of stones are a small selection from our range.



Bianco Sardo Perla



Negro Marquina



Carmen Red



Assoluto Zimbabwe



Onice Cappucino



Impala



Silver Cloud Imperial



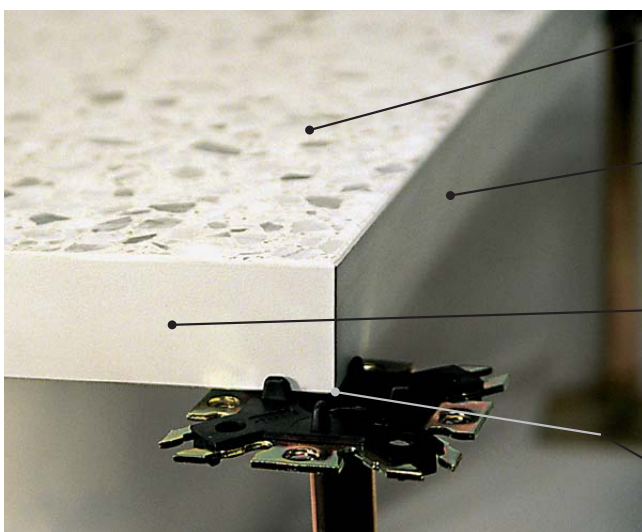
Imperial White

As with all natural products, stone varies slightly in colour and structure. Printer inks cannot match the colour tones of stone perfectly: minor differences in colour are therefore possible.

Other stone coverings are available on request.



Photo: © Wanzl GmbH & Co. Holding KG



- Covering  
High quality stone, in a wide variety of types
- Carrier panel  
Raised floor panels from calcium sulphate with various material thicknesses.
- Edge trim  
Colour adjusted to the stone finish. To protect the edges of the stone, the edge trim is fitted to the top edge of the covering
- Barrier  
Steel sheet to increase load

## Surface finishing

- Polished surfaces will bring out the full natural stone structure and colour
- Finely-burnished surfaces are classified to the slip resistance level R9
- With layered stones (e.g. Juparanà Colombo), the cutting of untreated blocks, either "with the grain" or "against the grain", and the choice of a suitable surface finish can create a variety of different appearances

## Advantages of STONeline

- Stability, low maintenance and durability
- Resistant to heat and damp
- Natural stone from selected international stone reserves
- Highly precise application and formatting

# Standards and regulations

## Association of System Floors (Bundesverband Systemböden e.V.)

The coming together of European countries and the creation of standards and laws to regulate this free market has resulted in medium-sized companies forming syndicates, so that they can increase their influence with public institutes and standardisation opposite their European counterparts.

This resulted in the Association of System Floors, founded on 1st January 1995 to represent the interests of medium-sized companies, such as the "Fachgemeinschaft Doppelboden" (Trade Community Raised Floors) or the "Fachverband Hohlrumböden" (Trade Association of Hollow Floors).

In addition to this synergy between associations, the Association of System Floors will also continue to support the European standardisation for raised floors in the CEN. This standardisation is intended to establish top-quality technical offers for raised floor products.

Please refer to the website of the "Bundesverband Systemböden e.V." ([www.systemboden.de](http://www.systemboden.de)) for up-to-date information, particularly BVS data sheets on system floor specifications, the overview on standard certified system floors and the German system floor ABP (General Constructional Supervisory Test Certificate) central register.

Lindner AG is a member of the Association of System Floors.

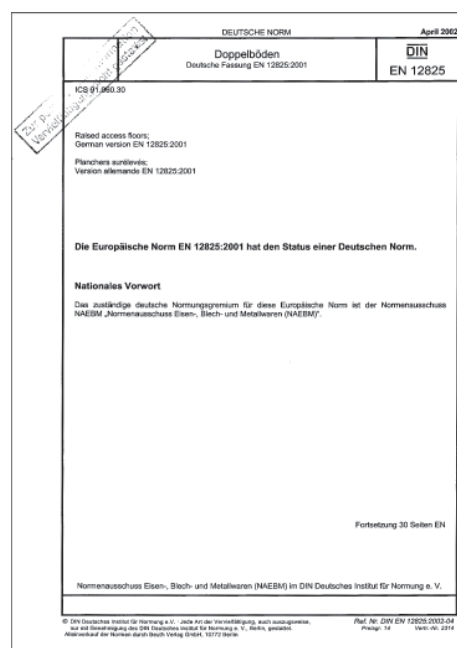
## DIN EN 12825 Raised flooring

System floors, particularly raised floors, are used in every modern administrative and office building and as such are an everyday product for planners and architects.

System floors also fulfil many safety tasks. The planner has to deal with many building regulations, technical requirements and products.

The DIN EN 12825 standard has introduced standardised European testing procedures and load classes for system floors based on the Construction Product Directive. The corresponding application guidelines are based on European standards, whilst taking into account the German Building Regulations Act and the generally recognised regulations on the technology in nationally applicable requirements and regulations. At the same time, they also regulate procedures for certifying standards compliance.

The full set of DIN standards can be requested from Beuth Verlag GmbH, Burggrafenstraße 6, 10787 Berlin, Tel. (030) 26 01 – 22 60, [www2.beuth.de](http://www2.beuth.de).



# Standards and regulations

## Application guideline for DIN EN 12825 Raised Floors

In the application guideline for use, as part of the DIN EN 12825, essential requirements and features are specified regarding the suitability of a raised floor for use and traffic, setting a safety standard for the construction process.

System floors are being developed continually in both a technical and scientific sense. As a result, the application guideline needs to be adjusted regularly to the latest technology.

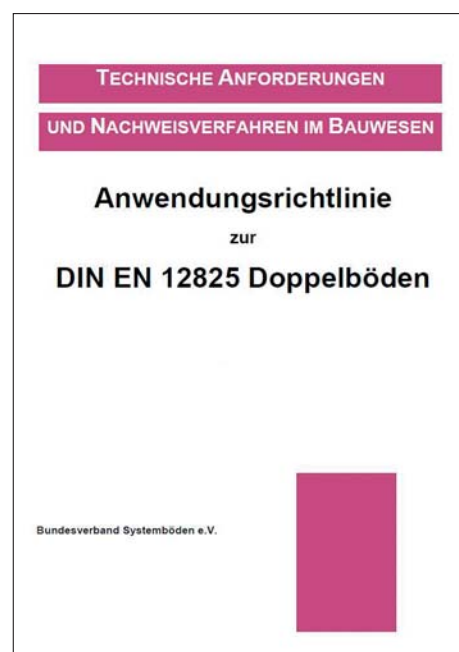
Only system floors that are produced in compliance with the standards, and which comply with the requirements of the application guideline in terms of construction, stability, materials, workmanship and life of product conformity are awarded the certificate for raised and hollow floors.

Monitoring of the safety standards is carried out by continual in-house monitoring and by regular external testing by neutral testing institutes and bodies in accordance with the application guideline.

Monitoring of safety standards guarantees adherence to the criteria required for suitability for use and traffic and so represents a reliable marker when choosing a floor system.

Installation of a certified raised floor is a guarantee for the users and owners that it complies with the latest technology in terms of safety, liability and industrial workplace regulations.

The guidelines for use are continuously added to and developed, to keep up to date with technical progress. The current version can be requested from the Association for System Floors.



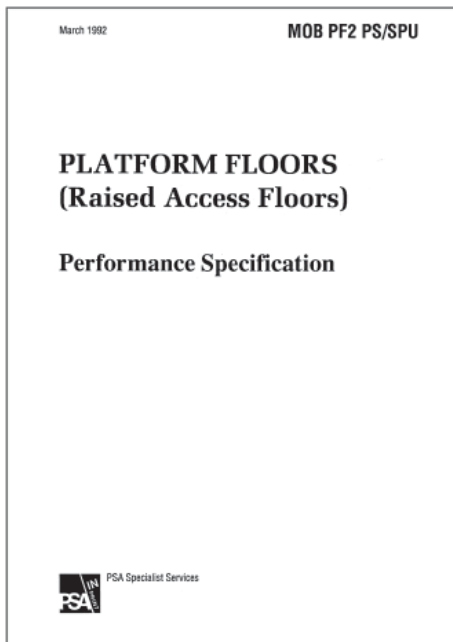
# Standards and regulations

## Property Services Agency (PSA)

The Method of Building (MOB) standard for raised floors was introduced in 1982 by the Property Services Agency (PSA) and is the old standard for raised floors in the United Kingdom and is now being increasingly replaced by the EN 12825 standard.

## Ceilings & Interior Systems Construction Association (CISCA)

CISCA is an American standardisation institute for the interior industry. Its publications include test standards for the raised floor industry. The test standards were developed based on comments received from American and other international manufacturers.

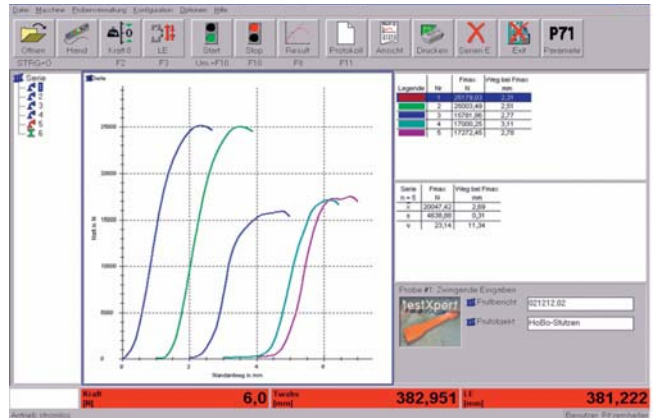


The requirements for floor systems produced by CISCA and the MOB/PSA standard are overspecified for a normal application; this leads to oversized floor systems. The much newer EN is more applicable to loads that actually occur during usage, which leads to more cost-effective floor systems which are also easier to install and to use. The London-based STANHOPE PLC architects office has published a statement on this issue, which you can request from us.

## Workshop testing

As with all other rules and regulations, suitable test criteria for workshops (workshop test certificates) are specified for practical application, ensuring the smooth function of raised floors with a special requirement profile.

The type and validity of the tests were put together by the LGA (State Trade Agency) in Nuremberg.



## We can do it all for you.

### Lindner Concepts:

- Airports and Railways
- Clean Rooms and Operating Theatres
- Cruise Liner and Ship Fit-out
- General Contracting
- Hotels and Resorts
- Insulation and Industrial Service
- Interior Fit-out and Furnishings
- Special-Purpose Constructions and Stadiums
- Studios and Concert Halls
- System Buildings

### Lindner Products:

- Ceiling Systems
- Doors
- Dry Lining Systems
- Facades
- Floor Systems
- Heating and Cooling Technologies
- Lights and Lighting Systems
- Partition Systems
- Roofing Systems
- Steel & Glass

### Lindner Service:

- Clearance of Harmful Substances
- Construction Management and Project Development
- Deconstruction and Interior Demolition
- General Planning
- Global Product Supplies
- Green Building
- Industrial Scaffolding
- Installation and Building Services
- Research and Development

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