

207-006

DGUV Information 207-006



Floor coverings for wet barefoot areas

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Preliminary remarks

DGUV Informationen provide guidance and recommendations to facilitate the practical application of regulations within a specific area or set of circumstances.

DGUV Informationen are primarily written for employers. Their aim is to provide guidance for the implementation of national occupational safety regulations or accident prevention regulations and demonstrate how accidents at work, occupational diseases and work-related health hazards may be prevented.

By following the recommendations made in the DGUV Informationen, particularly the examples given for solutions, employers may assume that they have taken appropriate measures for the prevention of work accidents, occupational diseases and work-related health hazards. However, if Technical Rules are available that have been prepared by designated committees for a more precise elaboration of national occupational safety regulations, these take precedence. If this leaflet contains regulatory items taken from national occupational safety regulations or from accident prevention regulations, these are included in the annex.

1 Scope of application

Slip accidents account for the largest fraction of accidents that occur, necessitating a careful selection of floor coverings as well as cleaning methods and agents.

The Technical Rule for Workplaces ASR A1.5/1,2 “Floors” regulates the installation and use of floors in workplaces.

This DGUV Information discusses additional requirements for the installation and use of floor coverings in wet barefoot areas.

It is characteristic of wet barefoot areas that floor coverings intended for these areas will become routinely wet and are walked on with bare feet. The scope of this DGUV Information also includes floor coverings used on ramps as well as the treads of staircases and ladders.

Wet barefoot areas can be found in swimming pool facilities and hospitals as well as in changing rooms and bathroom and shower facilities of sports centres and workplaces.

2 Terms and definitions

Assessment group is a measure of the required level of slip resistance for floor coverings in wet use areas, which is determined by type examinations carried out according to German standard DIN 51097. Group A requires the least slip resistance and C the most.

Coefficient of sliding friction, μ , is the dimensionless quotient calculated from the horizontal frictional force and the vertically acting force between the slider and the horizontal floor during movement at a constant speed.

- μ_{ZM} is the coefficient of sliding friction for materials in a new condition, calculated according to German standard DIN 51131 using an SBR slider and SLS solution (ZM stands for zero measurement).
- μ_{CM} is the coefficient of sliding friction for materials in operational condition, calculated according to German standard DIN 51131 using an SBR slider and SLS solution (CM stands for standardised control measurement).

Reference measurement is the determination of the μ_{ZM} carried out as specified in German standard DIN 51131 (with an SBR slider and SLS solution) for a floor covering in new condition prior to building site clean-up (installed and grouted). The reference measurement value serves as a reference for comparisons with the condition of the flooring at later points in time.

Control measurement is the determination of the μ_{CM} carried out as specified in German standard DIN 51131 (with an SBR slider and SLS solution) for the floor covering in operational condition.

SBR slider is a slider (styrene butadiene rubber **material**) standardised according to German standard DIN 51131.

SLS solution is a lubricant standardised according to German standard DIN 51131 used for making determinations in a wet condition. The lubricant consists of a 0.1% SLS solution (sodium lauryl sulfate) in deionized water.

Reserve sample is a sample of flooring retained from the batch installed (at least 2 m²) for later inspections.

3 Requirements for floor coverings in wet barefoot areas

3.1 Slip resistance

Only floor coverings manufactured specifically for this use are to be installed in wet floor areas with barefoot traffic. DGUV Information 207-006 provides guidance for choosing the appropriate floor covering. It is based on the German national standard test method DIN 51097 “Ramp test”. This is the only available method that is suitable for testing all types of flooring.

Specific types of floor areas have been assigned to assessment groups A, B or C depending on the level of slip risk; increasing slip resistance is required from A to C.

For each of the specific areas, the table below specifies the lower limit for the angle of inclination that must be achieved by the various types of flooring during testing according to standard DIN 51097 (see Section 5); the list does not include all types of wet barefoot areas.

Table 1 Classification of specific types of wet barefoot areas into assessment groups

Assessment group	Lower limit for the angle of inclination	Areas
A	12°	<ul style="list-style-type: none"> • Passage ways and sanitary facilities with barefoot traffic (normally in dry condition) • Individual and communal changing and locker rooms • Pool floors in non-swimmer areas with a water depth greater than 80 cm in the entire pool area • Sauna and relaxation areas (normally in dry condition)
B	18°	<ul style="list-style-type: none"> • Passage ways and sanitary facilities with barefoot traffic, if not assigned to A • Showers and shower areas • Steam baths • Areas surrounding disinfectant sprayers • Pool surrounds • Pool floors in non-swimmer areas with a water depth lower than 80 cm in some areas of the pool • Pool floors in the non-swimmer areas of wave pools • Movable pool floors • Paddling pools

Assessment group	Lower limit for the angle of inclination	Areas
B	18°	<ul style="list-style-type: none"> • Ladders and stairs outside of the pool area, if not assigned to C • Upper surfaces of diving platforms, diving stands and springboards, if not assigned to C • Sauna and relaxation areas, if not assigned to A
C	24°	<ul style="list-style-type: none"> • Ladders and stairs leading into the water • Stairs ladders and stairs leading to springboards or diving platforms and water slides • Surfaces of diving platforms and springboards in areas used only by divers. (The non-slip surfaces of the diving platforms and springboards must extend around the front edge and cover all areas gripped by the hands and toes of the divers) • Starting platforms • Walk-through pools • Kneipp wading pools, wading pools • Sloping pool edges • Ramps on the pool surround inclined at an angle > 6%

Seating areas intended to accommodate foot traffic such as stands and platforms, which are located in the vicinity of a pool and may become wet from water carried over by users, are to be treated like floor areas.

If barefoot areas are also intended for use with footwear, the areas must additionally comply with the requirements specified in ASR A1.5/1,2.

The “**user friendliness**” of the floor coverings is not evaluated by the test method described in DIN 51 097 and is therefore to be assessed separately on a case-by-case basis.

3.2 Planning and installation

When installing new flooring, it is important to choose an appropriate floor covering as specified in Section 3.1. In addition, the following procedure is recommended for the inspection and maintenance of the anti-slip properties of the floor:

- Reserve samples at least 2 m² in size should be retained for later inspections.
- Zero measurements should be performed for each floor covering.
- The first control measurement should be performed for each floor covering following the building site clean-up and before the flooring is first put into service.
- If necessary, additional control measurements should be performed to ensure that changes in the anti-slip properties can be identified at a later point in time.

The installation of slip-resistant flooring is not sufficient by itself to prevent accidents. For this reason, the following additional requirements are to be observed:

- Structural measures should be implemented to ensure that water does not accumulate in traffic areas as far as this is possible. One possible solution would be to install a floor with a sufficient gradient and a sufficient number of floor drains (.....) for more detailed information see, for example, Code of Practice R 25.07 of the Deutsche Gesellschaft für das Badewesen e. V. (DGfDB) “Gradients in floor coverings of swimming pools”. The flooring of pool surrounds should have a gradient of at least 2% and that in shower areas 3%).
- According to Annex 1.5, Paragraph 2, of the Ordinance on Workplaces (Arbeitsstättenverordnung, ArbStättV), the floors in the rooms must not have any uneven areas, holes, tripping points or dangerous slopes. Floor coverings must be securely installed to prevent any movement, they must be load-bearing, safe to walk on and slip resistant.
- A tripping point is defined as an uneven area of floor with a difference in height of 4 mm and above.
- Covers for overflow and drainage channels must be flush with the floor.
- Variances in the height of grout joints are to be kept within acceptable levels (see Code of Practice “Height differences – Height differences in cladding and flooring made of ceramic, cast and dimension stone” of the German Construction Federation (Zentralverband Deutsches Baugewerbe)).

- No sharp edges; the edges of cut tiles are to be deburred or chamfered.
- The front edge of each stair is to be rounded (rounded nosings, for example shaped bricks). Additionally, the front edges of stairs leading into the water are to be clearly distinguishable by their colour.

To facilitate cleaning, level and profiled flooring may be installed along walls up to a distance of about 15 cm from the walls, in corners and under furnishings and components firmly anchored to the floor.

3.3 Cleaning and maintenance

Cleaning and maintenance have a decisive impact on slip resistance. However, a distinction is made between the final building site clean-up carried out at the end of the building phase and prior to the beginning of service and the routine cleaning work performed over the entire service life of the flooring.

The physical characteristics of the floor covering, in particular its anti-slip properties, must not be impaired by the cleaning agents or floor cleaning machines used. The cleaning instructions provided by the manufacturer of the product (with respect to floor coverings or cleaning agents) are to be observed.

3.3.1 Final building site clean-up

Following installation and finishing, the flooring must be cleaned to remove the debris and dirt that accumulated during building (for example, cement residues).

The anti-slip properties of the flooring must not be impaired during cleaning.

3.3.2 Routine cleaning

The items below are to be observed while performing routine cleaning during operations:

- A cleaning and maintenance plan suitable for the type of floor covering must be drawn up before the flooring is put into service.

- Appropriate cleaning products, disinfectants and care products that do not impair the anti-slip properties of the flooring must be used.
- The development of a film from cleaning products, disinfectants and care products must be prevented.
- Non-abrasive machines for cleaning large floor areas, preferably devices with scrubbing brushes, are to be used.
- The cleaning work must be performed as specified in the cleaning and maintenance plan and according to good professional practice. Cleaning, disinfecting and maintenance work are to be inspected regularly.

More information can be found in the lists/guidelines published by the DGfDB:

- DGfDB Working document A 41 (RK list) “List of tested cleaning agents for ceramic tiling and cladding in swimming pools”
- DGfDB Working document A42 (RE list) “List of tested cleaning agents for pool basins and stainless steel components in swimming pools”
- DGfDB Guideline R 94.04 “Cleaning, disinfecting and hygiene for swimming pools”

3.4 Additional requirements

In certain cases, it may be necessary to consider additional criteria when choosing the type of floor covering. Wet barefoot areas in medical bathing facilities are one such case (for example, departments for medical balneology and hydrotherapy in hospitals and spa facilities). In these facilities, the factors below must additionally be taken into consideration in order to accommodate patients with physical disabilities:

- Walking with crutches
- Using mobility aids, wheelchairs or portable patient lifts to traverse floors
- Triggering of reflexes in patients with certain disorders (for example, patients with spastic paralysis)

4 Tested floor coverings

The board of trustees “Slip-resistant floor coverings – NB list” regularly publishes lists assigning tested floor coverings for wet barefoot areas to the established assessment groups. Manufacturers must apply for the inclusion of their tested floor coverings in the list.

Applications for inclusion in the list are to be submitted to:

Kuratorium “Rutschhemmende Bodenbeläge – Liste NB”
c/o Säurefließner-Vereinigung e. V.
Postfach 12 54
D-30928 Burgwedel

Please note that when using the NB list, the test results are applicable only to the tested sample.

It is the responsibility of the manufacturer to guarantee product consistency.

The floor coverings are tested by accredited institutions such as the following:

- Institut für Wand- und Bodenbeläge Säurefließner-Vereinigung e. V., Großburgwedel (Institute for Wall and Floor Coverings), Germany
- IFA Institut für Arbeitsschutz der DGUV, Sankt Augustin (IFA Institute for Occupational Health and Safety of the German Social Accident Insurance), Germany.

5 Testing of floor coverings in wet barefoot areas

5.1 Test method

The anti-slip properties of floor coverings for wet barefoot areas are tested according to the German standard DIN 51 097 “Testing of floor coverings – Determination of the anti-slip properties – Wet-loaded barefoot areas – Walking method – Ramp test”.

5.2 Short description of the test method used to determine the anti-slip properties of floor coverings for wet barefoot areas according to German standard DIN 51097

The testing procedure considers the types of load acting upon floor coverings in wet use areas. It evaluates the most important parameters for the assessment of the anti-slip properties of floor coverings intended for barefoot use as close to the actual conditions of use as possible.

During this procedure, two operators, with an upright posture, take turns walking forwards and backwards over the test floor surface. The sample is installed on an inclinable plane and the angle of inclination is gradually increased until the limit of safe walking on the surface is reached and the operators slip.

The mean acceptance angle obtained is used to express the degree of slip resistance. Subjective influences are limited by means of a calibration procedure.

6 Monitoring slip resistance under operational conditions

In order to be able to identify changes in the anti-slip properties of installed floors, comparative data that are characteristic of the anti-slip properties of floor coverings should be determined.

6.1 Circumstances requiring control measurements

Control measurements must be performed under the following circumstances:

- If the floor system is perceived as being “slippery” when walked on
- Analysis of the cause in the event of accidents/near misses
- Before/after testing
 - for surfaces prepared on-site
 - for subsequently applied coatings on floors following a finishing treatment
 - following the optimisation of cleaning procedures
- Analysis of the target and actual conditions to determine differences between the flooring in its original condition and the flooring in operational conditions. Reserve samples should be retained for this.
- Changes in use
- Monitoring of the effectiveness of the measures taken.

6.2 Test method

An example of a suitable method for testing is the determination method described in Chapter 5 of the DGUV Information 208-041 “Evaluation of the risk of slipping under operational conditions” with reference to German standard DIN 51131 “Testing of floor coverings – Determination of anti-slip property – Method for measurement of the sliding friction coefficient”.

6.3 Short description of the test method used to determine the anti-slip properties of floor coverings according to German standard DIN 51131

A measuring device for determining sliding friction as specified in German standard DIN 51131, such as the GMG 200, has sliders mounted on its base and is pulled at a constant speed parallel to the surface of the floor covering. The force required to move the slider over the length of the measured track is determined. To calculate the coefficient of sliding friction, this force is divided by the vertically active force.

6.4 Applications


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1. Planning stage
 2. Manufacturing of the floor covering (delivery and installation)
 3. Reference measurement for the installed and grouted floor covering prior to building site clean-up
 4. Building site clean-up
 5. First control measurement after building site clean-up
 6. Beginning of the service life of the floor covering – final handover to the pool operator (pool owner)
 7. Later control measurements to identify changes to the surface of the flooring as well as check the effectiveness of the cleaning and maintenance plan (monitoring of effectiveness)

Fig. 1 Individual steps for monitoring and preventive control of changes to the surface of floor coverings

6.4.1 Newly installed floor coverings

Reference measurements should be performed for newly installed floor coverings prior to the building site clean-up. The first control measurement should be performed after the building site clean-up in order to identify possible changes to the surface (see Fig. 1).

Additional control measurements are carried out at regular intervals to analyse the anti-slip properties over the service life (monitoring).

Further measures are to be considered if the determined values deviate by more than 10 %.

6.4.2 Evaluation of floor coverings already in use

If reference measurement values are not available, the following procedure is recommended:

- Comparative data should be collected for the floor in use and a reserve sample
- Comparative data should be collected for high traffic areas and low traffic areas of the floor in use

The comparative data must be collected under the same testing conditions.

6.4.3 Testing pre- and post-treatment

If any of the following measures are to be taken, comparative data for the flooring should be collected before the beginning and after completion of the measures to determine their effectiveness:

- Monitoring and optimising cleaning procedures
- Chemical treatment of the floor covering such as acid treatments
- Mechanical treatment of the floor covering such as sanding, blasting, etc.
- Application of a coating/seal

The data are to be collected at the same sites and under the same testing conditions.

7 Measures to improve the slip resistance of installed floor coverings

If slipping accidents occur with greater frequency and this increase is attributed to lower slip resistance of the flooring, suitable measures are to be taken (for example, technical, organisational or personnel).

- Optimisation of the cleaning and maintenance plan, for example:
 - Choosing appropriate cleaning agents and devices for the floor covering to improve its anti-slip properties
 - Analysing and, if needed, shortening cleaning intervals
 - Training the cleaning staff

If these changes do not have the desired effect, additional measures are to be taken, such as:

- Mechanical or chemical treatment of floor coverings
- Coatings
- Replacement of the floor covering

8 References

1. Verordnung über Arbeitsstätten (Arbeitsstättenverordnung-ArbStättV), 08.2004 (Workplaces Ordinance)
2. Arbeitsstättenregel „Fußböden“, ASR A1.5/1,2, 02.2013 (Technical Rules for Workplaces ASR A1.5/1,2 “Floors”)
3. DGUV Regel 107-001 „Betrieb von Bädern“ (Operation of swimming pools), 08.2018
4. DGUV Information 208-041 „Bewertung der Rutschgefahr unter Betriebsbedingungen“ (Evaluation of the risk of slipping under operating conditions), 01.2011
5. DIN 51097:2016-04 „Prüfung von Bodenbelägen, Bestimmung der rutschhemmenden Eigenschaft, Nassbelastete Barfußbereiche, Begehungsverfahren – Schiefe Ebene“ (German standard DIN 51097 “Testing of floor coverings – Determination of the anti-slip properties – Wet-loaded barefoot areas – Walking method – Ramp test”)
6. DIN EN 13451-1:2016-12 „Schwimmbadgeräte Teil 1-Allgemeine sicherheitstechnische Anforderungen und Prüfverfahren (German standard DIN EN 13451-1– Part 1 “Swimming pool equipment – General safety requirements and test methods”
7. DIN 51131:2014-02 “Prüfung von Bodenbelägen – Bestimmung der rutschhemmenden Eigenschaft – Verfahren zur Messung des Gleitreibungskoeffizienten” (German standard DIN 51131 “Testing of floor coverings – Determination of the anti-slip property – Method for measurement of the sliding friction coefficient”)
8. Richtlinie DGfDB-R 94.04 „Reinigung, Desinfektion und Hygiene in Bädern“, 12.2013 (Cleaning, disinfecting and hygiene for swimming pools)
9. Richtlinie DGfDB R 25.07 „Gefälleausbildung in Bodenbelägen von Schwimmbädern“, 08.2015 (Gradients in floor coverings of swimming pools)

10. Arbeitsunterlage DGfdB-A 41 (Liste RK) „Liste geprüfter Reinigungsmittel für keramische Beläge in Schwimmbädern“, DGfdB, 2018 (List of tested cleaning agents for ceramic tiling and cladding in swimming pools)
11. Arbeitsunterlage DGfdB-A 42 (Liste RE) „Liste geprüfter Reinigungsmittel für Beckenkörper und -bauteile aus Edelstahl in Schwimmbädern“, DGfdB, 2018 (List of tested cleaning agents for pool basins and stainless steel components in swimming pools)
12. Merkblatt „Höhendifferenzen – Höhendifferenzen in Keramischen-, Betonwerkstein- und Naturwerksteinbekleidungen und Belägen –“ Zentralverband Deutsches Baugewerbe, 11.2012 (Code of Practice “Height differences – Height differences in cladding and flooring made of ceramic, cast and dimension stone)

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