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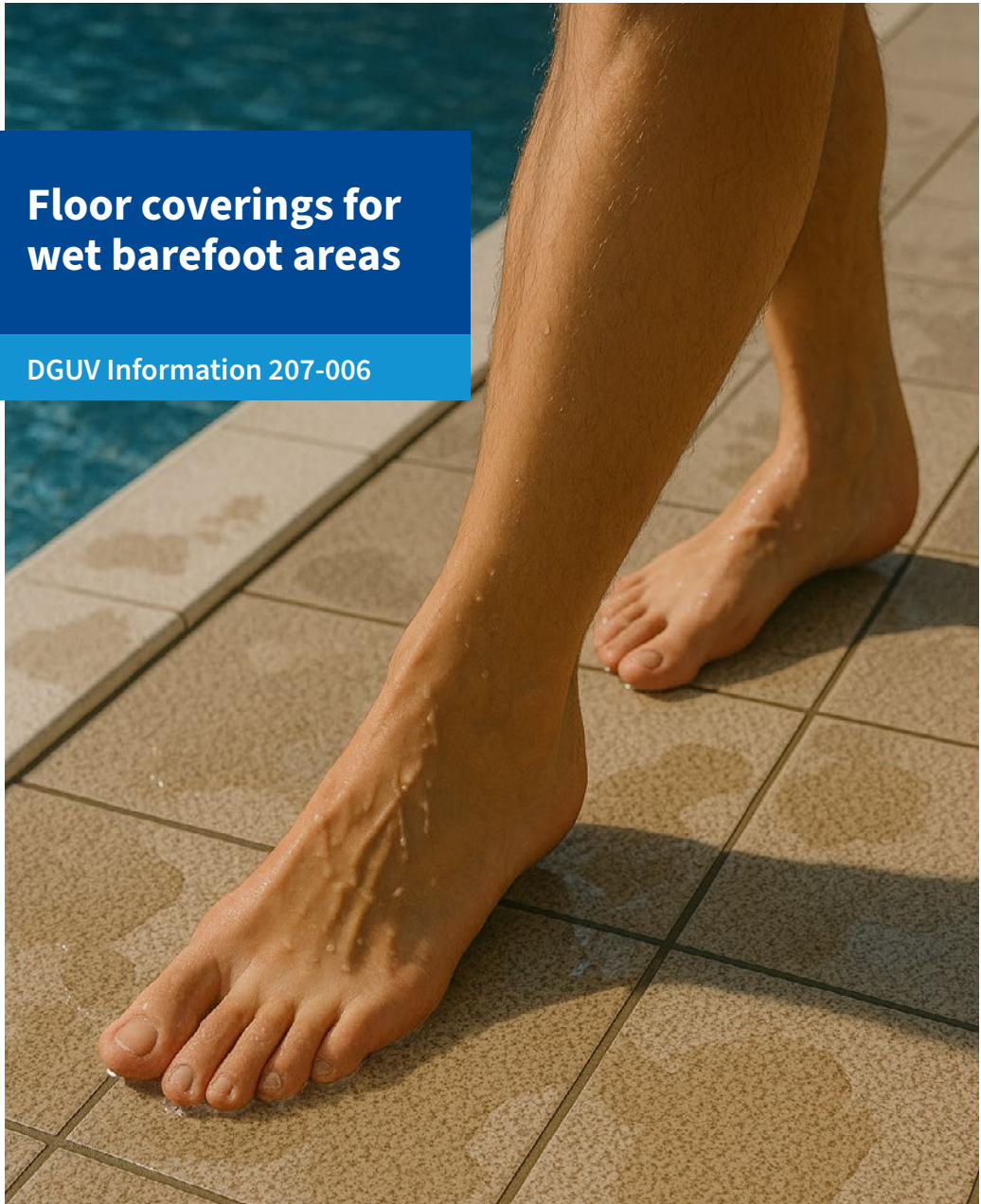

Floor coverings for wet barefoot areas

DGUV Information 207-006

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Floor coverings for wet barefoot areas

Changes from the last edition March 2021:

- The test method has changed: DIN EN 16165
- Addition to Section 3.1: Assignment of test results to the assessment groups (see Table 1)
- Table 2 has been revised
- Editorial changes

Contents

Preliminary remarks

DGUV Information leaflets provide guidance and recommendations to facilitate the practical implementation of regulations within specific areas or circumstances.

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

By following the recommendations made in the DGUV Information leaflets, particularly the examples of possible 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 were developed by designated committees to more precisely define the requirements of national occupational safety regulations, these take precedence. All regulatory items that were adopted from national occupational safety regulations or from accident prevention regulations have been included in the annex.

1 Scope of applicability

Slipping is one of the leading causes of accidents. For this reason, care must be taken when choosing both the flooring materials and the cleaning methods and agents used to maintain them.

The installation and use of floors in workplaces is regulated by the Technical Rule for Workplaces ASR A1.5 “Fußböden” (Floors). One of its aims is to ensure that the surfaces of floors in areas that are usually wet and have barefoot traffic are safe to walk on.

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

The properties that distinguish wet barefoot areas are that the flooring materials installed in these areas are routinely wet and walked on with bare feet. The term floor coverings as used in this DGUV Information also includes mats, ramps as well as the treads of stairs and ladders.

Wet barefoot areas can be found in swimming pool facilities, in hospitals, in changing and locker rooms and in the bathrooms and shower rooms of sports centres and workplaces.

2 Terms and definitions

Assessment group is a measure of the level of slip resistance required for floor coverings in wet use areas, which is determined by type examinations carried out according to the German standard DIN EN 16165 Annex A. In terms of slip resistance, the lowest level is required for Group A, the highest for Group C.

Dynamic coefficient of friction, μ, is a dimensionless quantity that represents the ratio of the horizontal frictional force to the vertical force between the slider and the horizontal floor as the slider moves across the floor at a constant speed.

μ_{ZM} is the dynamic coefficient of friction for new, unused materials, calculated according to DIN EN 16165 Annex D using an SBR slider and SLS solution (ZM stands for zero measurement).

μ_{CM} is the dynamic coefficient of friction for materials in use, calculated according to DIN EN 16165 Annex D using an SBR slider and SLS solution (CM stands for standardised control measurement).

Reference measurement is the value obtained for the μ_{ZM} as specified in DIN EN 16165 Annex D (with an SBR slider and SLS solution) for new flooring prior to building site clean-up (installed and grouted). The value serves as a reference when assessing the condition of the flooring at later points in time.

Control measurement is the value obtained for the μ_{CM} as specified in DIN EN 16165 Annex D (with an SBR slider and SLS solution) for flooring during use.

SBR slider is a slider (styrene butadiene rubber material) standardised according to DIN EN 16165 Annex D.

SLS solution is a lubricant standardised according to DIN EN 16165 Annex D used for making determinations in wet conditions. The lubricant consists of a 0.1 % SLS solution (sodium lauryl sulphate) in deionized water.

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

Underfoot comfort describes the surface properties of flooring that is considered pleasant and painless when walked on with bare feet. The flooring does not represent a risk of injury.

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 areas with barefoot traffic. This DGUV Information offers guidance in choosing an appropriate flooring material. It is based on the test method specified in DIN EN 16165 Annex A “Barefoot ramp test”. This is the only method suitable for testing all types of flooring. In the following table, the test results are classified into assessment groups.

Table 1 Classification of test results $\alpha_{barefoot}$ into assessment groups

Test results $\alpha_{barefoot}$	Assessment group
> 12° to 18°	A
> 18° to 24°	B
> 24°	C

Specific types of floor areas have been assigned to the assessment groups A, B or C depending on the risk of slipping; the level of slip resistance required increases from A to C. The list of wet barefoot areas is not exhaustive.

Table 2 Classification of specific types of wet barefoot areas into assessment groups

Assessment group	Areas
A	• Walkways and sanitary facilities with barefoot traffic (mainly dry) • 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 (mainly dry)
B	• Walkways 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 non-swimmer areas of wave pools • Movable floors • Paddling pools • Ladders and stairs outside of the pool area, if not assigned to C • Covers for overflow channels consisting of frame elements and grating • Sauna and relaxation areas, if not assigned to A
C	• Ladders and stairs leading into the water • Stairs leading to springboards or diving platforms and water slides • Surfaces of diving platforms and springboards • Starting platforms • Walk-through pools • Kneipp wading pools, wading pools • Sloped pool coping and pool surrounds intended for foot traffic • Covers for overflow channels not assigned to B (e.g. signage) • Ramps on the pool surround with a slope > 6 %

Seating areas also intended to be walked on, 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 subject to the same requirements as floor areas.

If barefoot areas are also intended for use with footwear, the areas must additionally comply with the requirements for slip resistance specified in ASR A1.5 (R Group).

3.2 Planning and installation

When installing new flooring, appropriate flooring materials as specified in Section 3.1 must be chosen. Furthermore, the following procedure is recommended for the inspection and maintenance of the anti-slip properties of the floor:

- Reserve samples at least 2 m^2 in size should be retained for later inspections.
- Zero measurements should be taken for each flooring material.
- The first control measurement should be taken 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 taken to ensure that changes in the anti-slip properties can be identified at a later point in time.

Accidents cannot be prevented simply by installing slip-resistant flooring. Therefore, the following requirements are to be observed as well:

- Structural measures should be taken to ensure that water does not accumulate in traffic areas as far as this is possible. One solution would be to install flooring with a sufficient gradient of at least 2 % for the pool surround and a gradient of at least 3 % in shower areas and to ensure that there are a sufficient number of floor drains.
- Covers for overflow and drainage channels must be flush with the floor.
- According to Annex 1.5, Paragraph 2, of the Ordinance on Workplaces (Arbeitsstättenverordnung, ArbStättV), the flooring installed in rooms

must be level without any holes, tripping points or dangerous slopes. Flooring materials must be installed securely to prevent any movement of the flooring, they must be load-bearing, safe to walk on and slip resistant.

- Please note: tripping points on otherwise level surfaces are defined as areas with a height difference of more than 4 mm
- Height differences in grout joints are to be kept within acceptable levels (see Code of Practice “Height differences in cladding and flooring made of ceramic, cast and dimension stone” of the German Construction Federation (Zentralverband Deutsches Baugewerbe).
- The flooring should feel comfortable under foot. Sharp edges are not permissible and, if necessary, are to be deburred or chamfered.
- The front edge of each step is to be rounded (with rounded nosings, e.g. shaped bricks or edge protectors). Additionally, the front edges of steps leading into the water are to be clearly distinguishable by their colour.

To facilitate cleaning, level and unprofiled flooring may be installed along walls up to 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 are crucial factors for slip resistance. A distinction is made between the one-time, final building site clean-up carried out prior to the beginning of service and the routine cleaning work performed during operations.

The physical characteristics of the flooring materials, in particular their anti-slip properties, must not be impaired by the cleaning agents or machines used. The cleaning instructions provided by the manufacturer of the product (with respect to flooring materials and 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 (e.g. cement residues).

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

3.3.2 Routine cleaning

The following must be observed when performing routine cleaning during operations:

- A cleaning and maintenance plan suitable for the type of flooring material must be drawn up before the flooring is put into service.
- The cleaning and maintenance plan must be reviewed and, if necessary, modified.
- Appropriate cleaning products, disinfectants and maintenance 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 maintenance products must be prevented.
- Non-abrasive machines for cleaning large floor areas, preferably devices with scrubbing brushes, must be used.

- The cleaning work must be performed as specified in the cleaning and maintenance plan and according to good professional practice. The cleaning, disinfecting and maintenance work is to be inspected regularly.

More information can be found in the guidelines DGfdB R 94.04 “Reinigung, Desinfektion und Hygiene in Bädern” (Cleaning, disinfecting and hygiene for swimming pools) published by the DGfdB (German Association for the Recreational and Medicinal Bath Industry) and on the RK list (ceramic tiling and cladding) and RE list (stainless steel) available on the online database.

3.4 Additional requirements

In certain cases, additional criteria may have to be considered when choosing a type of flooring material. Wet barefoot areas in medical bathing facilities (e.g. medical balneology and hydrotherapy departments in hospitals and spa facilities) are one such case. These facilities must additionally consider the factors below in order to accommodate patients with physical impairments:

- Use of crutches when walking
- Use of mobility aids, wheelchairs or portable patient lifts
- Triggering of reflexes in patients with certain disorders (e.g. patients with spastic paralysis)

4 Tested flooring materials

The board of trustees “Slip-resistant flooring – NB list” regularly publishes lists that classify tested flooring materials for wet barefoot areas into the established assessment groups. Manufacturers must submit a request for the testing and inclusion of a flooring material in the list.

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

Kuratorium “Rutschhemmende Bodenbeläge – Liste NB”
c/o Institut für Wand- und Bodenbeläge der Säurefliesner-Vereinigung e. V.
Postfach 12 54
D-30928 Burgwedel

When using the NB list, it must be taken into consideration that the test results are applicable only for the tested sample.

The manufacturer is responsible for guaranteeing that the product has consistent quality.

The flooring materials are tested by accredited institutions such as the following:

- Institut für Wand- und Bodenbeläge der Säurefliesner-Vereinigung e. V., Burgwedel (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 methods

The anti-slip properties of floor coverings for wet barefoot areas are tested according to the German standard DIN EN 16165 “Bestimmung der Rutschhemmung von Fußböden – Ermittlungsverfahren” (Determination of slip resistance of pedestrian surfaces – Methods of evaluation) Anhang A “Prüfung durch barfüßiges Begehen einer schiefen Ebene” (Annex A “Barefoot 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 DIN EN 16165 Annex A

The test method simulates the loads and traffic that flooring in wet areas is subjected to and incorporates the most important parameters for evaluating the slip-resistant properties of flooring intended for barefoot traffic under nearly realistic conditions.

In the ramp test, two operators take turns walking forwards and backwards with an upright posture over a floor sample. The sample is installed on an inclinable plane and the angle of inclination is gradually increased until safe walking on the surface is no longer possible and the operators slip.

The mean angle of slip obtained is used to evaluate the degree of slip resistance. Verification and correction procedures are incorporated to account for subjective influences.

6 Monitoring slip resistance over the service life

In order to be able to identify changes in the slip resistance of installed floors, data for comparison should be collected for the anti-slip properties of the flooring materials.

The basic principles are described and guidance is provided in DGUV Information 208-041 “Bewertung der Rutschgefahr unter Betriebsbedingungen” (Evaluation of the risk of slipping under workplace conditions).

6.1 Circumstances requiring control measurements

Circumstances in which control measurements must be taken include the following:

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

6.2 Test method

The test method described in DIN EN 16165 „Bestimmung der Rutschhemmung von Fußböden-Ermittlungsverfahren“, Anhang D „Tribometer-Prüfung” (“Determination of slip resistance of pedestrian surfaces – Methods of evaluation”, Annex D “Tribometer test”) is applied to take measurements under in-use conditions.

6.3 Short description of the test method used to determine the anti-slip properties of floor coverings according to DIN EN 16165 Annex D

Sliders are mounted on the base of an instrument used to measure friction (tribometer, e.g. GMG 200) as specified in DIN EN 16165 Annex D. The instrument is pulled over the flooring parallel to the surface at a constant speed. The force required to move the slider over the length of the measured track is determined. To calculate the dynamic coefficient of friction, this force is divided by the vertically exerted force.

6.4 Applicability

1. Planning stage
2. Manufacturing of the flooring (delivery and installation)
3. Reference measurements for the installed and grouted flooring 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 flooring – handover to the pool operator (pool owner)
7. Later control measurements to identify changes to the surface of the flooring and to check the effectiveness of the cleaning and maintenance plan (monitoring of effectiveness)

Fig. 1 Individual steps for inspecting floor coverings and monitoring changes on the surface for purposes of prevention

6.4.1 Newly installed flooring

A reference measurement should be taken from the newly installed flooring prior to the building site clean-up. The first control measurements should be

performed after the building site clean-up in order to detect changes on the surface that may have occurred (see Fig. 1).

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

If the determined values deviate by more than 10 %, additional measures have to be taken.

6.4.2 Evaluation of floor coverings already in use

The following procedure is recommended if reference values are not available:

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

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

6.4.3 Testing pre- and post-treatment

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

- Monitoring and optimisation of cleaning procedures
- Chemical treatment of the flooring, e.g. acid treatments
- Mechanical treatment of the flooring such as sanding, blasting, etc.
- Application of a coating/seal

The measurements are to be taken at the same site and under the same test conditions.

7 Measures to improve the slip resistance of installed floor coverings

If the flooring no longer appears to be safe to walk on, a more extensive risk assessment is to be performed and suitable measures taken (e.g. technical, organisational or personnel-related).

- Optimisation of the cleaning and maintenance plan, for example:
  - Choosing cleaning agents and equipment that are appropriate for the specific circumstances, e.g. the type of soiling and flooring materials
  - Evaluating and, if needed, adjusting cleaning intervals
  - Training cleaning staff
- Deep cleaning

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

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

8 References

1. Verordnung über Arbeitsstätten (ArbStättV), 03.2024 (Ordinance on Workplaces)
2. Arbeitsstättenregel “Fußböden”, ASR A1.5, 03.2022 (Technical Rules for Workplaces “Floors”) ASR A1.5
3. DGUV Regel 107-001 “Betrieb von Bädern” (DGUV Rule 107-001 “Operation of swimming pools”)
4. DGUV Information 208-041 “Bewertung der Rutschgefahr unter Betriebsbedingungen”, 09.2019 (DGUV Information 208-041 “Evaluation of the risk of slipping under workplace conditions”)
5. DIN EN 16165 „Bestimmung der Rutschhemmung von Fußböden – Ermittlungsverfahren“, 02.2023 (DIN EN 16165 “Determination of slip resistance of pedestrian surfaces – Methods of evaluation”)
6. DIN EN 13451-1 Teil 1 “Schwimmbadgeräte – Allgemeine sicherheitstechnische Anforderungen und Prüfverfahren”, 02.2021 (DIN EN 13451-1 – Part 1 “Swimming pool equipment – General safety requirements and test methods”)
7. Richtlinie DGfdB R 94.04 “Reinigung, Desinfektion und Hygiene in Bädern”, 12.2013 (DGfdB Guideline R 94.04 “Cleaning, disinfecting and hygiene for swimming pools”)
8. Richtlinie DGfdB R 25.07 „Gefälleausbildung in Bodenbelägen von Schwimmbädern“, 06.2024 (DGfdB Guideline R 25.07 “Gradients for floor coverings of swimming pools”)
9. Database of cleaning agents published by DGfdB (RK list, RE list)
10. Merkblatt „Höhendifferenzen in Keramischen-, Betonwerkstein- und Naturwerksteinbekleidungen und Belägen“ Zentralverband des Deutschen Baugewerbes, 08.2019 (Code of Practice “Height differences in cladding and flooring made of ceramic, cast and dimension stone”, German Construction Federation)

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