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Contens

Stránka

1. Basic product categories 4
1.1 RAKO CERAMIC TILES FOR 2020 4
1.2 BUILDING CHEMISTRY FOR FIXING OF CERAMIC TILES – RAKO SYSTEM 4

2. Identification system and recommended applications of ceramic tiles by RAKO 5
2.1 TYPES OF CERAMIC TILES BY RAKO 5
2.2 IDENTIFICATION OF CERAMIC TILES IN THE CATALOGUE 7
2.3 IDENTIFICATION OF PRODUCTION BATCHES 8

3. Overview of tile properties **9**
3.1 WATER ABSORPTION 9
3.2 FROST RESISTANCE 10
3.3 SIZES AND GEOMETRIC PARAMETERS 10
3.4 SLIP RESISTANCE OF FLOORS 12
3.5 ABRASION RESISTANCE OF GLAZED FLOOR TILES - ABRASION RESISTANCE (PEI) 18
3.6 ABRASION RESISTANCE OF UNGLAZED FLOOR TILES – DEEP ABRASION RESISTANCE OF TAURUS TILES 19
3.7 STRENGTH 19
3.8 CHEMICAL PROPERTIES 21
3.9 HYGIENIC PROPERTIES OF TILES 22
3.10 THERMAL CHARACTERISTICS OF TILES 23
3.11 ELECTRICAL PROPERTIES OF TILES 23
3.12 OPTICAL CHARACTERISTICS OF TILING ELEMENTS – LRV 24

4. Shopping tips and considerations before fixing **26**

5. Tile processing **28**
5.1 PREPARATION OF THE BASE AND TILES BEFORE FIXING 28
5.2 TILE CUTTING AND DRILLING 28

6. Tile fixing methods **29**
6.1 Contact gluing of ceramic tiles 29
6.2 FROST RESISTANT TILING ON BALCONIES 31
6.3 UNDERFLOOR HEATING 33
6.4 STAIRS 36

7. Laying of tiles in a dry technique **37**
7.1 LAYING INTO LAWNS AND GRAVEL 37
7.2 LAYING ON TARGETS 38

8. Jointing of tiles, dilatation **41**
8.1 NON-FLEXIBLE JOINTS 41
8.2 FLEXIBLE EXPANSION JOINTS 42

9. Maintenance and cleaning of ceramic wall and floor tiles **44**

10. Certification of products, quality management system, and ecological evaluation **47**

11. Warranty conditions **50**

1. Basic product categories

1.1 RAKO CERAMIC TILES FOR 2019

The offer of RAKO ceramic wall and floor tiles is divided into two groups. The **RAKO HOME** household line of ceramic products is intended for final users, while the **RAKO OBJECT** system solution of ceramic products for buildings is intended for designers and architects.
RAKO HOME represents a wide assortment of ceramic wall and floor tiles, including decorative and functional accessories for complete solutions of bathrooms, floors and kitchens of home interiors, balconies, terraces, and outdoor swimming pools.
The broad range of RAKO OBJECT ceramic products introduces to architects, designers and experts an integrated system of complementary series, focusing on high technical requirements. The complete range of products can be found in the RAKO HOME | OBJECT catalogues, or at **www.rako.cz**.

1.2 BUILDING CHEMISTRY FOR FIXING OF CERAMIC TILES – RAKO SYSTEM

The complete offer of building chemistry products, which presents the optimal solution for laying of ceramic floor and wall tiles, from housing interiors to demanding applications for tiling of swimming pools, enclosed balconies, terraces or industrial floors.
The catalogue of products of building chemistry RAKO SYSTEM includes materials for preparation of the base (levelling compounds, penetration coatings), water-proofing stoppers, gluing and jointing materials (cement, epoxy, silicone and polyurethane), as well as fixtures for maintenance of tiled surfaces. We recommend consulting specific technologies with technical consultants of the project team. For contact and other information please visit **www.rakosystem.cz** and **www.rako.cz**.

2. Identification system and recommended applications of ceramic tiles by LASSELSBERGER, s.r.o.

2.1 TYPES OF CERAMIC TILES BY LASSELSBERGER, s.r.o.

Recommended use of offered types of ceramic tiles:

Fully vitrified unglazed floor tiles, catalogue codes: Txxxxxxx, Dxxxxxxx,
Fully vitrified unglazed frost-resistant ceramic tiles with very low water absorption less than or equal to 0.5%, made in compliance with EN 14411:2016 BIa UGL, Annex G. The products are intended mainly for floor tiling in exteriors and interiors exposed to climatic effects and subject to extreme mechanical stress, abrasion and pollution. For this reason, they are particularly suitable for floors in shopping centres, restaurants, administrative buildings, car showrooms, food processing and chemical plants, as well as outdoor horizontal surfaces of balconies, terraces, and passageways. They are characterised by high strength, frost and chemical resistance. The polished unglazed tiles are designed for exclusive interiors and façades. The vitrified unglazed tiles are offered in monochrome as well as multicolour variants with anti-slip relief, standard smooth or polished surface. The material mass (body) is fully coloured, thus creates the actual appearance of the ceramic surface. The tiles with declared anti-slip surface finish must be used for floors with the risk of slipping pursuant to the applicable regulations. The floor tiles in the sizes of 5 x 5, 30 x 60, 60 x 60 cm and polished floor tiles are rectified. In addition to guaranteeing accurate dimensions (calibre), they also have improved geometrical properties (straight edges, right-angled corners), allowing precise laying and format combinations. The TAURUS INDUSTRIAL or KAAMOS INDUSTRIAL series tiles are produced in 13 mm or 15 mm thickness for heavily stressed floors in industrial operations, such as markets, workshops, manufacturing halls and warehouses.

Fully vitrified glazed floor tiles, catalogue code: Dxxxxxxx,
Fully vitrified ceramic glazed frost resistant tiles with very low water absorption less than or equal to 0.5%, made in compliance with EN 14411:2016 Bla GL, Annex G. The products are of universal use as floor and wall tiles for interiors and exteriors, exposed to climatic effects, high mechanical stress and pollution. For this reason, they are very suitable for apartments and apartment buildings, also for the exterior in terraces and balconies. Ceramic tiles with the abrasion resistance PEI 5 and declared slip resistance are particularly suitable for public buildings (e.g. restaurants, shops, hotels, offices, governmental buildings, car showrooms). The vitrified glazed floor tiles are available in many colours, designs, and surface finishes (smooth, relief, anti-slip, lapped etc.). The material mass (body) is fully coloured in some products in order to match the colour of the mass with the upper glaze. This is a design and functional element, usable, for example, for the production of accessories by milling of anti-slip grooves, or by grinding of round step edges of step tiles or cove skirting. The mosaics and floor tiles in the sizes of 2,5 x 2,5, 5 x 5, 10 x 10, 15 x 15, 20 x 20, 30 x 60, 60 x 60, 20 x 80, 40 x 80, 80 x 80, 20 x 120, 30 x 120 a 60 x 120 cm are rectified and besides the accurate dimensions (calibre), they also have improved geometrical parameters
(linearity, rectangularity), allowing precise laying and format combinations. The KAAMOS, SALOON, QUARZIT, PIAZZETTA and REBEL series floor tiles are manufactured also in the reinforced thickness of 20 mm as a complete solution for dry laying system for terraces, balconies, final walking surfaces ingardens, roofs, pergolas, swimming pools, or public spaces.

Compact glazed floor tiles, catalogue code: Gxxxxxxx,
Glazed ceramic tiles with water absorption higher than 0.5% and less than or equal to 3.0%, made in compliance with EN 14411:2016 BIb GL, Annex H.
These tiles can be used for interior floors and walls including exterior façades which are exposed to the weather. An example of their application is their universal use on floors and walls of bathrooms, kitchens, passages, offices, exterior façades, saunas, showers, swimming pools in interiors, deep freeze rooms, food processing plants, etc.

The tiles are made in a wide range of colours with glossy and matt finish, decorated with various technique (printing, dusting, spraying), or with a glaze or relief for anti-slip purpose.

Wall tiles, catalogue code: Wxxxxxxx,
Ceramic glazed wall tiles with water absorption higher than 10%, made in compliance with EN 14411:2016 BIII GL, Annex L. They are designed for tiling of interior walls and not suitable for exposure to climatic effects, frost, permanent effects of water, acids and alkali, their vapours and abrasives. They are thus used for tiling walls of bathrooms, kitchens, laundries or other interiors.
In environments where porous wall tiles will be exposed to the direct action of water, in shower boxes etc., it is necessary to use a CG2WA type grouting material with reduced water absorption.
The tile surface is smooth or slightly embossed, with glossy, semi-matt or matt glaze, in single or multi-coloured designs, or decorated with various techniques (digital printing, Rotocolor). Depending on the used glaze type (transparent, semi-transparent), transient dark colouring of the tile cannot be excluded, as it is determined by its structure and caused by humidity infiltration in the tile. The colouring may further be supported with water permeability of the joints, insulation layers in the base (water is held between the insulation layer and the glaze), and high air humidity in bathrooms with insufficient ventilation. However, this transient colouring does not represent a defect of the product. Large-format wall tiles (30 x 60 and 30 x 90 cm) are manufactured also in a rectified design. In addition to guaranteeing accurate dimensions (calibre), they also have improved geometrical properties (straight edges, right-angled corners), allowing precise laying and format combination.

Non-ceramic accessory materials – glass of catalogue code Vxxxxxxx, natural stone of catalogue code: Sxxxxxxx,
Unique accessory materials complementing ceramic wall tiles. Properties of these materials and their characteristic differences in colour, structure and other properties are determined by the production technology or by their natural origin.

POOL vitrified drawn floor tiles and shapes, catalogue code: XPxxxxxx,
Highly vitrified glazed frost-resistant ceramic products with very low absorption less than or equal to 0.5%, made by a drawing technique in compliance with EN 14411:2016 Ala GL, Annex M. They are suitable for professional solutions of edges of public as well private indoor and outdoor swimming pools.

Use of RAKO wall and floor tiles according to water absorption parameters and hardness classes:

Types of ceramic wall and floor tiles and their use according to EN 14411: 2016	Water absorption	Hardness class according to the Mohs hardness scale	Frost resistance	Application in interiors	Application in exteriors
Fully vitrified glazed floor tiles	≤ 0,5%	7	YES	Walls, floors	Walls, floors
Fully vitrified unglazed floor tiles	≤ 0,5%	7	YES	Walls, floors	Walls, floors
Compact glazed tiles	> 0,5 - ≤ 3%	5	Only on façades (no tunnel)	Walls (no tunnel)	Walls (no tunnel)
Wall tiles	> 10%	3	NO	Walls	

2.2 IDENTIFICATION OF CERAMIC TILES IN THE CATALOGUE

The following data have been provided in a uniform format for ceramic tiles in the RAKO product catalogue:

1. **Type and specification of ceramic tile** – wall tiles, floor tiles, vitrified tiles
2. **Catalogue number** – eight-character number, e.g. **Txxyyzzz,**
   where **the first position** defines the product type, e.g.:

T, D	– vitrified unglazed ceramic tiles	water absorption ⩽ 0.5% gr. BIa
D	– vitrified glazed ceramic tiles	water absorption ⩽ 0.5% gr. BIa
G	– glazed ceramic tiles	water absorption ⩾ 0.5 ⩽ 3% gr. BIa
W	– glazed ceramic wall tiles	water absorption ⩾ 10% gr. BIII
X	– glazed ceramic tiles POOL	water absorption ⩽ 0.5% gr. AIa
V	– glass tiles	
S	– natural stone tiles	

3. **Icons of important properties** – symbols for frost resistance, abrasion resistance, etc.
4. **Size** – nominal size of the tile in cm
5. **Colour shade** – unintentional colour differences caused by different production batches (lots)
6. **Intentional variation of shades** – intentional colour differences between individual pieces of ceramic tiles (stone, wood, concrete, etc.)
7. **Variation of shades:**
   V1 – minimum differences, monochrome tiles
   V2 – small differences between individual pieces
   V3 – big differences imitating for example natural materials
   V4 – big and completely random differences

Before laying, individual V2-V4 tiles should be mixed tiles from several cardboards and laid randomly, and the resulting surface should be composed according to the pictorial material provided by RAKO, or web pages **www.rako.cz. It is important to combine individual patterns of floor tiles, including their turning by 90° or by 180° to avoid placing identical patterns next to one another in order to achieve a balanced appearance of the floor or wall.**

For example, the Random series (V4):



2.3 IDENTIFICATION OF PRODUCTION BATCHES

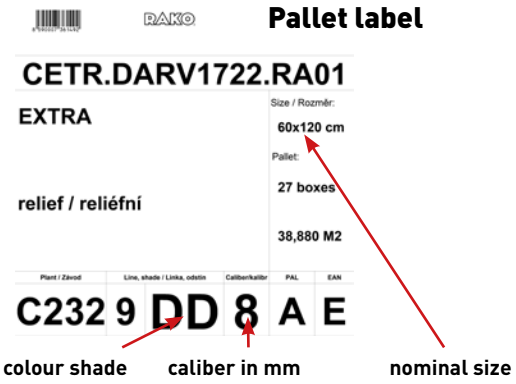
All ceramic tile products are made in batches which may differ from each other in colour shade and dimensions. The batches are identified in client documentation, on palettes, and in delivery notes. In addition to the catalogue number, name of the series and the type of surface or product, packages include identification of shade, declared dimensions, calibre, quality, and EAN code. Tiles from individual batches with different identification of the colour shade or declared size shall not be used on the same surface. The colour shade on the cardboard packaging is marked with a combination of two or three characters, and the size is indicated as a code number.

Identification of the colour shade, size, quality, and use of glaze on a cardboard packaging and on a pallet.

Fig. 1 **Carton**



Pallet label



Please check the markings on the packaging before laying to verify if the tiles you purchased for one area have the same batch, colour shade, size and quality.

3. Overview of tile properties

3.1 WATER ABSORPTION



Water absorption is the most important property when selecting the type of tiles for a particular environment. Water absorption is property of ceramic products, and applies to water and other liquid infiltration. Water absorption is defined as an increase of its weight in % after the saturation with water. The water absorption test is performed using the procedure specified in the standard EN ISO 10545-3. Vitrified ceramic tiles with low water absorption show the best resistance under extreme conditions, especially frost resistance.

Based on water absorption, ceramic tiles are classified into several categories:

Water absorption	Type	Standard	Use
E > 10 %	Wall tiles, catalogue numbers **W.....**	EN 14 411:2016 BIII GL, Annex L	Only for interior walls
0.5%< E ⩽ 3%	Glazed tiles, catalogue numbers **G.....**	EN 14 411:2016 BIb GL, př. H	Universal use for tiling of floors and walls in interiors and exterior facades, POOL suitable for exteriors
E ⩽ 0,5 %	Fully vitrified tiles, catalogue numbers **T.....** **D.....** **XP.....**	EN 14 411:2016 BIa GL a UGL,př. G EN 14 411:2016 AIa GL, př. M	Highly frost resistant tiling of floors and walls stressed by abrasion for exterior and interior applications, facades, balconies, terraces outdoor and indoor pools

Ceramic tiles with high water absorption, i.e. wall tiles supplied under the European standard EN 14411:2016 BIII GL, Annex L, are intended for interior walls and they are not suitable for outdoor tiling and frost resistant applications. **In environments where the porous tile is to be directly exposed to water, such as in shower boxes etc., the CG2 WA grouting with reduced water absorption must be used for joint filling, for example GF grouting – see chapter 8. Jointing of tiles, dilatation.** In areas with high air humidity, it is necessary to provide for good air circulation and good ventilation to prevent water from soaking into porous tiles and making them darker.

Ceramic glazed tiles with low water absorption from 0.5% to 3%, supplied under EN 14411:2016 BIb GL, Annex H can be used universally. Therefore, they are suitable for wall and floor tiling in interiors and for exterior frost resistant wall tiling. **All POOL products, including shaped ceramic tiles for pools, XP....., show water absorption less than 1%, are frost resistant and also applicable to outdoor pools.**

Fully vitrified frost resistant ceramic tiles with water absorption less than 0.5% (such as TAURUS GRANIT), supplied according to EN 14411:2016 BIa GL and UGL, Annex G, and are particularly suitable for horizontal and vertical exterior surfaces. They can be used universally and when selecting specific products for a particular application, additional criteria should be taken into account, e.g. slip resistance, abrasion resistance of glazed tiles, etc.

The product name and the respective standard are always provided on the cardboard packaging of the product.

3.2 FROST RESISTANCE

For exterior tiling, it is essential to use only frost resistant ceramic tiles, which can withstand the long-term exposure to frost, and climatic effects. Frost resistance is tested by a predefined number of frosting-defrosting cycles under conditions pursuant to the EN ISO 10545-12 standard. Low water absorption is the best prerequisite of absolute frost resistance. Porous tiles are not frost resistant and are exclusively applicable in interiors. Floors and walls in exteriors should be tiled with highly resistant unglazed or glazed vitrified tiles of the BIa group pursuant to EN 14411:2016.

Ceramic tiles by RAKO with water absorption less than or equal to 3% and fully vitrified tiles with water absorption less than 0.5% will remain intact even at temperatures below -30°C and more than 100 frosting-defrosting cycles, as required by EN ISO 10545-12.

Therefore, the mentioned compact tiles and vitrified tiles are suitable for applications in damp premises, or on surfaces exposed to climatic effects, including frost. **Fully vitrified ceramic tiles, such as TAURUS GRANIT (EN 14 411:2016 BIa), are the most suitable products for frost resistant surfaces of terraces and balconies.** Glazed tiles ColorTWO (EN 14 411:2016 BIb) are suitable for façades and wall tiling of cooling and freezing boxes.

In the practical implementation of frost resistant tiling, a very important aspect is the quality of the base, adhesive and grouting materials, because the main objective is to prevent penetration of moisture under the tiled surface, especially on horizontal surfaces, façades and edges. Nevertheless, it is also very important to observe the recommended system solutions and fixing procedures (see chapter 6. Instruction for Tile Processing – 6.2 Frost-Resistant Tiling on Balconies).

Each product for which LASSELSBERGER, s.r.o. guarantees frost resistance is identified with the frost resistance symbol in the catalogue.

3.3 SIZES AND GEOMETRIC PARAMETERS

Nominal and declared size:
Ceramic tiles are identified according to EN 14411:2016 with **nominal sizes** in cm, for example: 10 x 10, 20 x 20 cm. Specific manufactured sizes – **declared dimensions (W)** of ceramic tiles are shown on packaging in mm. Methods to determine geometric parameters of ceramic tiles and allowed deviations from the declared sizes are described in the standard EN ISO 10545-2. Accurate values and tolerance for all types of RAKO products are provided in information annexes to the catalogues RAKO HOME | OBJECT..

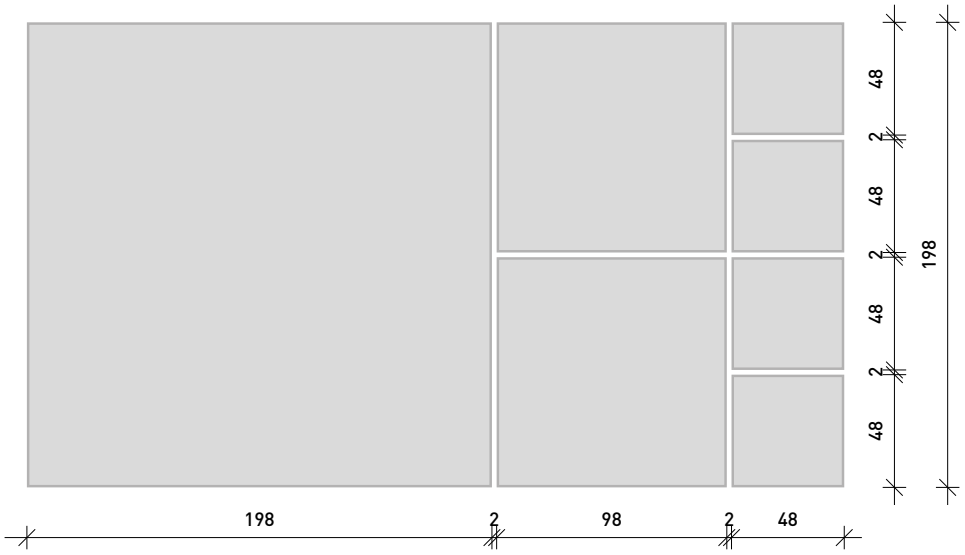
Rectified tiles
Low-absorption floor tiles with the sizes of 10 x 10, 20 x 20, 22.5 x 45, 22.5 x 22.5, 15 x 45, 45 x 45, 15 x 60, 30 x 60, 60 x 60, 40 x 80, 80 x 80, 20 x 120, 30 x 120 cm, 60 x 120 cm and wall tiles with the sizes of 30 x 60 and 30 x 90 cm are mainly offered with rectified edges, which are ground with high precision and allow installation with a narrow joint from 2 mm. In the catalogue, rectified (ground) tiles are always marked with the letter R. The ground edges of the rectified wall tiles and floor tiles are fragile and require careful and cautious handling. Careless movement and contact with any other material could cause the tile edge or corner to be chipped off.

Non-rectified tiles
Non-rectified tiles of the ColorTWO, POOL and TAURUS series included in the RAKO OBJECT catalogue are mostly made in module dimensions 8. In addition, there are non-rectified wall tiles with module dimension 8 in the RAKO HOME catalogue in the sizes of 20 x 40, 20 x 60, and 30 x 60 and non-rectified floor tiles in the sizes of 10 x 10, 20 x 20, 10 x 20, 30 x 30, 33 x 33, 45 x 45, and 30 x 60 cm.

For non-rectified tile elements including accessories, the decisive role is played by the declared dimensions of the product contained in the product batch, which are important when using several types of ceramic tile elements on one surface and for maintaining the same joint width. Owing to natural dimensional inaccuracies of the non-rectified products, we however do not recommend installing tiles with a joint narrower than 2 mm. Dimensional differences in the case of very narrow joints are discernible in accordance with the standard. For this reason, in the case of installation of non-rectified tile elements, we recommend a joint width of about 3-4 mm.

Module sizes

Module sizes, e.g. M 10 x 10, M 20 x 20 cm, are suitable for combinations of tiles of different formats on one surface while keeping running joints. For example size 8 (598 x 598, 298 x 598 mm) allows modular combinations of these sizes of polished, lapped and standard tiles, or rectified wall tiles into a single surface with continuousv joints. **However, joint widths narrower than 2 mm reduce the capability to absorb the tension between the base and the tile itself. As a rule, we do not recommend installation without joint spacing. This mode of installation completely eliminates the absorption of the tension between the base and the tile; moreover, the dirt that collects in the joints cannot be removed.** Ceramic products with module sizes consist of multiples of the basic sizes. The identification of the product size also includes the width of a uniform joint in order to achieve uniform joints on a surface made of different tile sizes.



Mosaics, decors

These are offered for example in the nominal sizes of 2.5 x 2.5, 5 x 5, 5 x 10 cm etc. The sizes of the individual types of mosaic, décors and accessories are derived from the basic tile sizes to which their dimensions are harmonised. Individual elements are glued on plastic or paper meshes – sets in the sizes of 30 x 30, 30 x 60 cm etc., accelerating and facilitating laying in glue class C2. If necessary, the mesh of the set may be cut into individual bands or listellos, or the size of the sets and joints may be corrected to suit adjacent elements and large tiles. Permitted deviations from the declared sizes are described in the Technical Construction Regulations – STO – see the website http://www.rako.cz/ke stazeni/certifikaty,
https://www.rako.cz/en/for-professionals/documents-forceramic-tiles/certificates..

3.4 SLIP RESISTANCE OF FLOORS



This is one of the most important features of the tile surface determining suitability for particular areas where safe movement of persons is to be assured. Requirements for slip resistance of floors are given by national standards, for example in the Czech Republic Decree No. 268/2009 Coll. and standards CSN 74 4505, CSN 73 4130 and CSN EN 13 451-1, with more details specified in the safety regulations ASR A 1.5/1, 2, which can be recommended for buildings across Europe (see Table 4).

Slip resistance of ceramic tiles is assessed by methods defined in the following standards:

- CEN/TS 16 165:2012 Determination of slip resistance of pedestrian surfaces – Methods of evaluation
- DIN 51 097 Determination of slip resistance in areas for barefoot walking
- DIN 51 130:2014-02 Determination of slip resistance for work areas and surfaces with increased risk of slip
- CSN 725191 Slip resistance specification
- ASR A1.5/1, 2 Safety regulation

Following the CSN 72 5191, ASR A1.5/1, 2 and DIN 51 130 standards, tiles are categorised as R9 to R13 according to the slip angle for buildings used by the public.

Higher demand for slip resistance is often connected with the requirement for the ability of the embossed tiles to hold a certain quantity of liquid splashed on the floor (this is most often required in fat processing operations etc.) According to the DIN 51 130:2014-02 standard this feature is expressed by the volume of the embossment indents in cm^3 in proportion to the tile area of 1 dm^2 – the displacement volume. This feature is expressed with the letter V and the relevant numerical data (for example V4). The following tables show a survey of the tested values of anti-slip features of RAKO HOME and RAKO OBJECT tiles.

Tab. 4

Overview of requirements for anti-slip floors					
Regulation	**Required value**	**Country**	**Field of application**	**LASSELSBERGER, s.r.o.**	
Decree 268/2009 Coll. CSN 74 4505 Floors	sliding friction coefficient dry and wet μ ⩾ 0,3	mandatory in CR	Floors of apartment and residential rooms	All floor tiles RAKO	μ ⩾ 0,3
Decree 268/2009 Coll. CSN 74 4505 Floors	sliding friction coefficient dry and wet μ ⩾ 0,5	mandatory in CR	Floors of buildings for public use	Floor tiles LB marked with icons see the Technical Catalogue www.rako.eu	μ ⩾ 0,5
Decree 268/2009 Coll. CSN 73 4130 Staircases and sliding ramps	sliding friction coefficient dry and wet μ ⩾ 0,5 + tg α	mandatory in CR	staircases and sloping ramps for people with limited mobility	Selected floor tiles see the Technical Catalogue or www.rako.eu	μ ⩾ 0,6
Decree 268/2009 Coll. CSN 72 5191 EN 13451-1 Swimming pools DIN 51 097	slip angle ⩾ 12°	mandatory in EU, CR	Changing rooms, corridors for barefoot walking...	Floor tiles marked with icon	A (12°)
	slip angle ⩾ 18°	mandatory in EU, CR	Public showers, pool decks, paddling pools, stairs...	Floor tiles marked with icon	B (18°)
	slip angle ⩾ 24°	mandatory in EU, CR	Starting blocks, water stairs, inclined pool sides, underwater stairs	Floor tiles marked with icon	C (24°)
Safety regulations ASR A1.5/1, 2 DIN 51 130:2014-02	slip angle from 6 to 10°	non mandatory in CR mandatory in EU except CR	canteens, offices, corridors of office buildings, schools and hospitals	Floor tiles marked with icons see the RAKO OBJECT Catalogue	R9
	slip angle from 10 to 19°		warehouses, small kitchens, sanitary facilities		R10
	slip angle from 19 to 27°		school kitchens up to 100 lunches per day, car washes, garages, laundries, entrances and outdoor stairs		R11
	slip angle from 27 to 35°		kitchens over 100 lunches per day, dairies, smokehouses, cold rooms		R12
	slip angle from 35°		fat refineries, tanneries, slaughterhouses, sausages and delicatessens		R13

Methods for evaluation of slip resistance of ceramic tiles are described in the European technical specifications CEN/TS 16 165 and in the Czech standard CSN 72 5191, which offer several methods to describe anti-slip properties of tiles:

a) Determination of friction coefficient of tile surface pursuant to MMR Decree 268/2009 Coll., and CSN 74 4505 standard – Floors, or;
b) Determination of the slip angle and slipping properties for wet surfaces for barefoot walking in agreement with standard DIN 51 097. Determination of the slip angle and of slipping properties for working premises and surfaces with increased slipping hazards in agreement with standard DIN 51 130:2014-02, or;
c) Determination of slip resistance using the pendulum deflection method. This method is mostly used in Anglo-Saxon countries as a method allowing for high accuracy of slip resistance property measurement directly on the construction site.

All methods of slip resistance assessment are equally valid and their use in practice depends on the type of the tested material and the measurement conditions.

ad a) Measuring of the friction coefficient means in practical terms measuring of the friction coefficient between the tested tiles and standard types of rubber materials. The friction coefficient is determined for dry and wet surfaces. This methodology pursuant to the CSN 74 4505 standard is mainly used in the Czech Republic and other countries of Central and Southern Europe. **The standard specifies that horizontal floors of apartments have a friction coefficient of no less than 0.3. For areas accessible to the public, the standard requires that the surfaces and tiles have a friction coefficient of no less than 0.5.** These applications require a choice of tiles with the defined anti-slip properties. The tiles are indicated in the catalogues with the anti-slip icons and their anti-slip values are shown in the tables below.

ad b) The most frequently used methods to measure slip resistance according to CEN/TS 16 165, CSN 72 5191, DIN 51 097 and DIN 51 130:2014-02 use the measurement of a slip angle on an inclined plane on which a test person is moving. The inclined plane with the tested tiles surface of prescribed size are inclined at the speed of 1° per second up to the angle of slip when the test person becomes unstable when trying to walk, and starts slipping. Subjectivity of the evaluation is eliminated through several repetitions of the determination; the test is performed by 2 independent persons with correction coefficients, ascertained using a set of calibration tiles.
A major advantage of the slip resistance determination applying this method is the possibility to evaluate significantly embossed tiles, as well as to systematically classify **the tiles into individual, accurately defined user groups based on the ascertained slip angle**, which are used mainly in Germany and Western Europe (ASR A1.5/1, 2 Technical rules for floors – see the following tables and the **RAKO OBJECT catalogue**).

Anti-slip characteristics of ceramic tiles RAKO OBJECT according to CEN/TS 16 165:2012 (ČSN 72 5191)

Program, Serie	koeficient tření		DIN 51 130		DIN 51 097
RAKO OBJECT 2020	μ za sucha	μ za mokra	R	V (cm^3/dm^2)	(A, B, C)
Block	⩾ 0,6	⩾ 0,5	R10		B
Block lappato	⩾ 0,6	⩾ 0,5	R9		–
Kaamos (DAA..., DAK...)	⩾ 0,6	⩾ 0,5	R10		A
Kaamos (DAK12..., DDM06...)	⩾ 0,6	⩾ 0,5	R10		B
Kaamos (Outdoor)	⩾ 0,7	⩾ 0,7	R11		B
Taurus					
Surface S/SF 5 x 5 cm	⩾ 0,7	⩾ 0,6	R10		B
Surface S 10 x 10 cm	⩾ 0,7	⩾ 0,6	R10		B
Surface S/SF 20 x 20 cm	⩾ 0,6	⩾ 0,5	R10		A
Povrch S/SF ⩾ 30 x 30 cm	⩾ 0,6	⩾ 0,5	R9		A
Surface SB	⩾ 0,7	⩾ 0,6	R10		A
Surface SR1	⩾ 0,7	⩾ 0,6	R11	V4	B
Relief SR2	⩾ 0,7	⩾ 0,6	R12	V4	B
Relief SR3	⩾ 0,7	⩾ 0,6	R12		B
Relief SR4	⩾ 0,7	⩾ 0,6	R12	V4	C
Relief SR7	⩾ 0,7	⩾ 0,6	R11		B
Relief SR20	⩾ 0,7	⩾ 0,6	R13	V8	C
Relief SRM	⩾ 0,6	⩾ 0,6	R11		B
Relief SRU	⩾ 0,7	⩾ 0,6	R10		B
Surface SL	⩾ 0,5	⩾ 0,3	-		–
Shaped pieces for blind persons *	⩾ 0,7	⩾ 0,6	R11		A
ColorTWO | POOL					
Surface smooth slip-resistant (GAK)	⩾ 0,6	⩾ 0,5	R10		B
Surface anti-slip relief (GAF...)	⩾ 0,6	⩾ 0,5	R10		B
Surface anti-slip relief (GRN...)	⩾ 0,6	⩾ 0,5	R10		B
Surface anti-slip relief (GRS...)	⩾ 0,6	⩾ 0,5	R10		B
Surface anti-slip relief (GRH...)	⩾ 0,7	⩾ 0,5	-		C
Step tile POOL XPC55005	⩾ 0,7	⩾ 0,6	-		C
Overflow profile POOL XPP56005	⩾ 0,7	⩾ 0,6	-		C
Outlet channel POOL XPx58023	⩾ 0,7	⩾ 0,6	-		C
Mosaic matt 5 x 5 cm	⩾ 0,5	⩾ 0,5	-		-
Mosaic matt 2,5 x 2,5 cm	⩾ 0,5	⩾ 0,5	-		-

„V4" – drainage space in relief surface (4 cm^3/dm^2)
„V8" – drainage space in relief surface (8 cm^3/dm^2)

*intended only for guiding and warning strips for the blind

For floors with high requirements for slip resistance, the ASR A1.5/1, 2 regulation recommends appropriate embossment, where, for example in food industry or industrial kitchens, the embossed surface of tiles must be able to accommodate a certain amount of fat or other substances into its cavities. Depending on the type and height of the embossment, a so-called discharge volume in cm3 per 1 dm2 is defined in accordance with DIN 51 130:2014-02, and designated by the V letter and the corresponding numerical value (for example: V4), see Table:

Min. discharge volume in cm^3/dm^2	Identifier
> 4	V4
> 6	V6
> 8	V8
> 10	V10

Anti-slip characteristics of ceramic tiles RAKO HOME according to CEN/TS 16 165:2012

Programm, Serie	Reibungskoeffizient		DIN 51 130	DIN 51 097
RAKO HOME 2020	μ bei Trockenheit	μ bei Nässe	R	(A, B, C)
Alba (DAR...)	⩾ 0,6	⩾ 0,5	R10	A
Alba (DDM06...)	⩾ 0,6	⩾ 0,5	R10	B
Alba (DDPSE...)	⩾ 0,6	⩾ 0,5	R9	-
Alba lappato (DAP...)	⩾ 0,6	⩾ 0,5	R9	-
Base (DAK...)	⩾ 0,5	⩾ 0,3	R9	A
Base (DAR...)	⩾ 0,6	⩾ 0,5	R10	B
Base (DDM06...)	⩾ 0,6	⩾ 0,5	R10	B
Betonico	⩾ 0,6	⩾ 0,5	R10	B
Blend	⩾ 0,5	⩾ 0,5	R9	A
Blend (DDM...)	⩾ 0,5	⩾ 0,5	R10	A
Cemento (DAK...)	⩾ 0,6	⩾ 0,5	R9	A
Cemento (DAR..., DDM06...)	⩾ 0,6	⩾ 0,5	R10	B
Cemento (DDPSE...)	⩾ 0,6	⩾ 0,5	R10	A
Cemento (DAG...)	⩾ 0,7	⩾ 0,6	R11	C
Concept	⩾ 0,6	⩾ 0,5	R9	-
Extra	⩾ 0,6	⩾ 0,5	R10	B
Faro	⩾ 0,6	⩾ 0,5	R9	A
Faro (DDM06...)	⩾ 0,6	⩾ 0,5	R10	B
Form (DAA..., DAR...), dekor (DDP3B...)	⩾ 0,6	⩾ 0,5	R9	A
Form (DDM05..., DDR05...)	⩾ 0,6	⩾ 0,5	R10	A
Garda	⩾ 0,6	⩾ 0,5	R9	A
Geo	⩾ 0,7	⩾ 0,5	R10	A
Limestone (DAK...)	⩾ 0,5	⩾ 0,5	R9	A
Limestone (DAR..., DDM06...)	⩾ 0,6	⩾ 0,5	R10	A
Piazzetta	⩾ 0,6	⩾ 0,5	R10	B
Piazzetta (Outdoor)	⩾ 0,7	⩾ 0,7	R11	B
Pietra	⩾ 0,6	⩾ 0,5	R10	A
Pietra (DDPSE...)	⩾ 0,7	⩾ 0,6	R10	B
Quarzit (DAA..., DAK...)	⩾ 0,5	⩾ 0,5	R9	A
Quarzit (DAR..., DDM06...)	⩾ 0,6	⩾ 0,5	R10	B
Quarzit Outdoor	⩾ 0,7	⩾ 0,7	R11	B
Rebel (DAK...)	⩾ 0,6	⩾ 0,5	R9	A
Rebel (DDM06..., DAK12...)	⩾ 0,6	⩾ 0,5	R10	B
Rebel (Outdoor)	⩾ 0,7	⩾ 0,7	R11	B
Rock (DAA..., DAK..., DDVSE...)	⩾ 0,6	⩾ 0,5	R10	A
Rock (DAK12..., DAK1D..., DDM06..., DDP34...)	⩾ 0,7	⩾ 0,6	R10	B
Rock lappato (DAP...)	⩾ 0,6	⩾ 0,5	R9	-
Saloon (DAK...)	⩾ 0,6	⩾ 0,5	R9	A
Saloon (DDM06...)	⩾ 0,6	⩾ 0,5	R10	B
Saloon Outdoor	⩾ 0,7	⩾ 0,7	R11	B
Trend	⩾ 0,6	⩾ 0,5	R9	A
Trend (DAK12..., DDM06..., DDM0U...)	⩾ 0,6	⩾ 0,5	R10	B
Trend (DDPSE...)	⩾ 0,6	⩾ 0,5	R10	A
Unistone (DAA..., DAK...)	⩾ 0,6	⩾ 0,5	R9	A
Via	⩾ 0,6	⩾ 0,5	R9	A
Via (DDM05...)	⩾ 0,6	⩾ 0,5	R10	B

The overview of anti-slip properties is also specified at: www.rako.eu – download – Declaration of Performance.
Anti-slip of stair and balcony shaped pieces corresponds to the anti-slip of basic tiles in the given series.

German safety regulation ASR A1.5 can serve as suitable guidelines for more detailed selection of slip resistance parameters for specific conditions for workplace floors and floors in premises intended for work with the danger of slipping. However, within the territory of the Czech Republic, only national regulations and standards are valid;

0	**General work rooms and areas*)**	
0.1	Entrance areas, indoors**)	R9
0.2	Entrance areas, outdoors	R11 or R10 V4
0.3	Stairs, indoors***)	R9
0.4	Outdoor stairs	R11 or R10 V4
0.5	Sloping indoor ramps, e.g. for wheelchairs	one degree higher then surroundings
0.6	Sanitary premises	
0.6.1	Toilets	R9
0.6.2	Washrooms and change rooms	R10
0.7	Relaxation rooms and canteens	R9
0.8	First aid rooms	R9
1	**Manufacture of margarine, edible fats and oils**	
1.1	Melting of fat	R13 V6
1.2	Cooking oil refinery	R13 V4
1.3	Margarine production and packaging	R12
1.4	Cooking fat production and packing, oil bottling	R12
2	**Milk processing, cheese production**	
2.1	Fresh milk processing and butter production	R12
2.2	Cheese production, storage and packaging	R11
2.3	Icecream manufacturing	R12
3	**Chocolate and confectionery production**	
3.1	Sugar processing	R12
3.2	Cocoa production	R12
3.3	Production of raw mixtures	R11
3.4	Fabrication of chocolate bars and shells and filled chocolates	R11
4	**Production of bread, cakes and pastries** (bakeries, cake shops, production of long-life bakery products)	
4.1	Dough preparation	R11
4.2	Rooms in which predominantly fats or liquid mixtures are processed	R12
4.3	Washing-up rooms	R12 V4
5	**Slaughtering, meat processing**	
5.1	Slaughter-house	R13 V10
5.2	Tripe processing room	R13 V10
5.3	Meat sectioning	R13 V8
5.4	Sausage kitchen	R13 V8
5.5	Boiled sausage unit	R13 V8
5.6	Raw sausage unit	R13 V6
5.7	Sausage drying room	R12
5.8	Gut store	R12
5.9	Salting and curing rooms, smoking establishments	R12
5.10	Poultry processing	R12 V6
5.11	Cold cuts and packaging unit	R12
5.12	Workshop with sales area	R12 V8 ****)
6	**Fish processing, production of delicatessen**	
6.1	Fish processing	R13 V10
6.2	Production of delicatessen	R13 V6
6.3	Manufacture of mayonnaise	R13 V4
7	**Processing of vegetables**	
7.1	Production of sauerkraut	R13 V6
7.2	Vegetable tinning	R13 V6
7.3	Sterilizing rooms	R11
7.4	Rooms in which vegetables are prepared for processing	R12 V4
8	**Wet areas in food and beverage production** (if not specifically mentioned)	
8.1	Storage cellars	R10
8.2	Beverage bottling, fruit juice production	R11
9	**Catering establishments**	
9.1	Kitchens in the catering trade (restaurant kitchens, hotel kitchens)	R12
9.2	Kitchens for catering purposes at special-purpose homes, schools, kindergartens, and sanatoria	R11
9.3	Kitchens catering for hospitals, clinics	R12
9.4	Large kitchens catering for industrial and university canteens, and contract catering	R12 V4
9.5	Food preparation kitchens (fast food kitchens, snack bars)	R12
9.6	Kitchens for heating up frozen meals	R10
9.7	Coffee and tea kitchens, hotel garni kitchens and ward kitchens	R10
9.8	Washing-up rooms	
9.8.1	Washing-up rooms for 9.1, 9.4, 9.5	R12 V4
9.8.2	Washing-up rooms for 9.2	R11
9.8.3	Washing-up rooms for 9.3	R12
9.9	Dining rooms, guest rooms, canteens including serving counters	R9
10	**Cold stores, deep freeze stores**	
10.1	for unpacked goods	R12
10.2	for packed goods	R11
11	**Sales outlets, shops**	
11.1	Reception of goods, meat	
11.1.1	For unpacked goods	R11
11.1.2	For packed goods	R10
11.2	Reception of goods, fish	R11
11.3	Serving counters for meat and sausage	
11.3.1	For unpacked goods	R11
11.3.2	For packed goods	R10
11.4	Service point for bread, bakery products, unpackaged goods	R10
11.5	Serving counters for dairy products and delicatessen, unpacked goods	R10
11.6	Serving counters for fish	
11.6.1	For unpacked goods	R12
11.6.2	For packed goods	R11
11.7	Serving counters, except for nos. 11.3 to 11.6	R9
11.8	Meat preparation rooms	
11.8.1	For meat preparation, except for no. 5	R12 V8
11.8.2	For meat processing, except for no. 5	R11
11.9	Florists shops	R11
11.10	Points of sales with ovens	
11.10.1	For the production of bread, cakes and pastries	R11
11.10.2	For the warming up of prefabricated bread, cakes and pastries	R10
11.11	Sales areas with stationary chip pans or grills	R12 V4
11.12	Shops, customer rooms	R9
11.13	Preparation areas for food for self-service shops	R10
11.14	Cash register areas, packing areas	R9
11.15	Outdoor sales areas	R11 or R10 V4
12	**Health service rooms**	
12.1	Disinfection rooms (wet)	R11
12.2	Pre-cleaning areas of sterilization	R10
12.3	Faeces disposal rooms, discharge rooms, unclean nursing work rooms	R10
12.4	Pathological facilities	R10
12.5	Rooms for medical baths, hydrotherapy, fango preparation	R11
12.6	Washrooms of operating theatres, plastering rooms	R10
12.7	Sanitary rooms, ward bathrooms	R10
12.8	Rooms for medical diagnosis and therapy, massage rooms	R9
12.9	Operating theatres	R9
12.10	Wards with hospital rooms and corridors	R9
12.11	Medical practices, day clinics	R9
12.12	Pharmacies	R9
12.13	Laboratories	R9
12.14	Hairdressing salons	R9
13	**Laundry**	
13.1	Rooms with continuous-flow washing machines or with spin-drier	R9
13.2	Rooms with washing machines at which the clothes are taken out dripping wet	R11
13.3	Ironing rooms	R9
14	**Fodder concentrate production**	
14.1	Dried fodder production	R11
14.2	Fodder concentrate production using fat and water	R11 V4

see Table 4, Page 15. For public floors, Decree 268/2009 Coll. and standard CSN 74 4505 for floors prescribe the friction coefficient of min. 0.5. For floors which are not protected from rain (e.g. on terraces, balconies and loggias), the anti-slip criterion must be met even when the surface is wet.

15	**Leather production, textiles**	
15.1	Wet areas in tanneries	R13
15.2	Rooms with fleshing machines	R13 V10
15.3	Areas where leather scraps accumulate	R13 V10
15.4	Rooms for making leather impermeable by means of grease	R12
15.5	Dye mills for textiles	R11
16	**Paint shops**	
16.1	Wet grinding workshops	R12 V10
16.2	Powder paint shops	R11
16.3.	Spray paint shops	R10
17	**Ceramics industry**	
17.1	Wet grinding mills (processing of ceramic raw materials)	R11
17.2	Mixers; handling of materials like tar, pitch, graphite and synthetic resins	R11 V6
17.3	Presses (shaping); handling of materials like tar, pitch, graphite and synthetic resins	R11 V6
17.4	Moulding areas	R12
17.5	Glazing areas	R12
18	**Glass and stone processing**	
18.1	Stone cutting, stone grinding	R11
18.2	Glass shaping of hollow glass ware, container ware, glass for building purposes	R11
18.3	Grinding areas for hollow glass ware, flat glass	R11
18.4	Insulating glass manufacture; handling of drying agents	R11 V6
18.5	Packaging, shipping of flat glass; handling of anti-adhesive agents	R11 V6
18.6	Etching and acid polishing facilities for glass	R11
19	**Cast concrete factories**	
19.1	Concrete washing areas	R11
20	**Storage areas**	
20.1	Storage areas for oils and fats	R12 V6
20.2	Areas for packed food	R10
20.3	Outdoor storage areas	R11 or R10 V4
21	**Chemical and thermal treatment of iron and metal**	
21.1	Pickling plants	R12
21.2	Hardening shops	R12
21.3	Laboratory rooms	R11
22	**Metal processing, metal workshops**	
22.1	Galvanizing shops	R12
22.2	Grey cast iron processing	R11 V4
22.3	Mechanical processing areas (turnery, milling shop), punching room, pressroom, drawing shop (pipes, wires) and areas exposed to increased stress by oil and lubricants	R11 V4
22.4	Parts cleaning areas, exhaust steam areas	R12
23	**Vehicle repair workshops**	
23.1	Repair and servicing bays	R11
23.2	Working and inspection pits	R12 V4
23.3	Car washing halls, washing areas	R11 V4
24	**Aircraft repair workshops**	
24.1	Aircraft hangars	R11
24.2	Repair hangars	R12
24.3	Washing halls	R11 V4
25	**Sewage treatment plants**	
25.1	Pump rooms	R12
25.2	Rooms for sludge draining facilities	R12
25.3	Rooms for screening equipment	R12
25.4	Stands of workplaces, scaffolds and maintenance platforms	R12
26	**Fire brigade buildings**	
26.1	Vehicle parking places	R12
26.2	Rooms for hose maintenance equipment	R12
27	**Inhalation and air passage treatment facilities**	
27.1	Preparation room	R10
27.2	Conditioning room	R10
27.3	Exercise room	R11
27.4	Sluice	R10
27.5	Target premises	R11
27.6	Warming room	R11
27.7	Dispatch room	R9
28	**Schools and kindergartens**	
28.1	Entrances, corridors, break halls	R9
28.2	Classrooms	R9
28.3	Staircases	R9
28.4	Toilets, washrooms	R10
28.5	Teaching kitchens in schools (see also 9)	R10
28.6	Kitchens in kindergartens (see also 9)	R10
28.7	Wood processing workshops	R10
28.8	Technical sections of workshops	R10
28.9	School courtyards	R11 or R10 V4
29	**Financial institutions**	
29.1	Counter areas	R9
30	**Plant traffic routes in outdoor areas**	
30.1	Footpaths	R11 or R10 V4
30.2	Loading platforms	
30.2.1	Covered	R11 or R10 V4
30.2.2	Not covered	R12 or R11 V4
30.3	Sloping ramps (e.g. for wheel-chairs, loading platforms)	R12 or R11 V4
30.4	Tank-up areas	
30.4.1	Tank-up areas, covered	R11
30.4.2	Tank-up areas, not covered	R12
31	**Parking facilities**	
31.1	Car parks and u/g garages not affected by weather *****)	R10
31.2	Car parks and u/g garages affected by weather	R11 or R10 V4
31.3	Outdoor parking lots	R11 or R10 V4

*) For floors in wet areas walked on barefoot, see the GUV information "Floor coverings in wet barefoot areas" (ASR A1.5/1,2).

**) Entrance areas according to number 0.1 are all areas with direct access from outside and in which moisture from outside can be brought.

***) Stairs according to number 0.3 are those possibly not exposed to moisture brought in from outside.

****) If the same floor covering was laid in all areas, the displacement space can be lowered down to V4 after a risk analysis (taking into consideration the cleaning method, the working processes and the quantity of slippery substances on the floor).

*****) The pedestrian areas which are not subject to a risk of slipping because of weather influences such as driving rain or moisture brought in.

3.5 ABRASION RESISTANCE OF GLAZED FLOOR TILES - ABRASION RESISTANCE (PEI)

PEI

Resistance to surface wear – abrasion resistance – is the ability of glazed ceramic products to resist certain abrasives under given conditions. The abrasion resistance of glazed floor tiles is determined according to EN ISO 10545-7 with aluminiumoxid-grains, balls of steel and water in an eccentric circling system in the PEI-wet-test. The tested tiles are then classified according to the speed during which the profile remains undamaged into categories PEI 1 to PEI 5.

- **Resistance class PEI 1**

Glazed ceramic tiles to be walked on with soft-soled shoes with low walking traffic frequency without presence of abrasive impurities. Application areas include bedrooms, residential apartments except for antechambers, and terraces, where there is a risk of introduction of outdoor impurities.

- **Resistance class PEI 2**

Glazed ceramic tiles burdened with normal footwear with low walking traffic and negligible abrasive impurity presence. Application areas include bathrooms, residential apartments except for entrance and similar areas with higher walking traffic where there is a risk of introduction of outdoor impurities.

- **Resistance class PEI 3**

Glazed ceramic tiles burdened with normal footwear with medium walking traffic and negligible abrasive impurity presence. Application areas include whole residential apartments, family houses and hotel bathrooms.

- **Resistance class PEI 4**

Glazed ceramic tiles more intensely stressed by higher walking traffic with normal footwear and increased stress and impurity presence. Application areas include exhibition and commercial spaces and offices.

- **Resistance class PEI 5**

Glazed ceramic tiles stressed by high walking traffic with high wear stress and impurity volume. Application areas include shops, restaurants, counters, garages, bus and train stations and airport terminals.

Tile floors with higher abrasion resistance can also be used in areas requiring lower abrasion resistance (such as tile class 5 can be used in places requiring minimum abrasion resistance class 3 – residential apartments, family houses).

For surfaces with busy foot traffic it is recommended to consult practical application of tiles with the manufacturer in advance. Based on practical experience, cleaning mats are recommended in entrance areas for shops and restaurants also where floor tiles of the highest abrasion resistance class are applied; this will significantly extend the service life of tiles and reduce the total amounts of dirt and dust carried into the shop or restaurant.

Information about abrasion resistance of individual variants of glazed tiles by RAKO is specified in the promotional materials with the abrasion resistance symbol and number of the achieved abrasion level, such as for example **PEI 4**, see **www.rako.eu** and the individual product descriptions.

3.6 ABRASION RESISTANCE OF UNGLAZED FLOOR TILES – DEEP ABRASION RESISTANCE



The abrasion resistance of unglazed tiles in operation is best characterized by **deep abrasion resistance**. Resistance of unglazed tiles to deep abrasion (abrasion resistance) is the ability of unglazed ceramic tiles to resist certain abrasives under given conditions. Test principle is to determine the amount of material of the body on the tile face abraded away by grinding action of a test tool under specified conditions - according to the standard EN ISO 10545-6. Pursuant to the standard, the abraded volume must not exceed 175 mm3. Fully vitrified tiles resist deep abrasion very well, their abrasion is only ca. 135 mm3, which have practically no limitation in terms of surface wear.
The high deep abrasion resistance of fully vitrified RAKO tiles makes it possible to use them for floors with extremely busy foot traffic (industry, warehouses, public transport stations, underpasses, passageways, supermarkets).

3.7 STRENGTH

This property expresses the tile ability to resist without destruction a mechanical load from, for instance, motion of fork-lift trucks. The tiles of smaller sizes and larger thickness are more resistant than thinner tiles of larger sizes. The thickness of 8 to 10 mm is suitable for common applications in housing premises, sanitary facilities, administration buildings etc. The tiles of common thickness can be loaded with car tyres (e.g. in car showrooms). The tiles with the thickness of ≥15 mm are suitable for floors exposed to high mechanical loads e. g. in stores, halls, workshops. Floor tiles TAURUS INDUSTRIAL or KAAMOS INDUSTRIAL with the increased thickness of 15 mm are recommended for floors loaded with solid rubber wheels of fork-lift trucks, or polyamide wheels of handling carts. The tiles feature with high strength and breaking load at the moment of tile breaking - up to 5 500 N (÷ 550 kp), see data in Table 3. Special industrial non-ceramic tiles are required for floors loaded with steel wheels with no rubber cover - see Table 1 and 2.

For installations on targets, the information about the breaking load of ceramic tiles is determining. When measuring the breaking load, the tile is fixed to the base in a similar way as for the installation on targets. The test is carried out by gradual loading in the middle of an individual tile, which is placed on cylindrical edges on sides. Loading from above is carried out in a similar cylindrical edge. The breaking load at the moment of floor tile fracture is up to 11 000 N (÷ 1100 kg) for tiles with a size of 60 x 60 cm and with a thickness of 20 mm (such as KAAMOS OUTDOOR) – see Table 3. The strengths achieved by RAKO ceramic tiles significantly exceed the strengths required by the standards for modulus of rupture. The actual strength of the tiles is at least 20 MPa, whilst the minimum of 15 N/mm^2 (MPa) is required by the standard. The modulus of rupture of compact and vitrified tiles is at least 35 N/mm^2 (35 MPa), resp. 40 N/mm^2 (MPa), and it is significantly higher than required by the standards. The standards require at least 30, resp. 35 N/mm^2 (MPa), see the Technical parameters shown in the RAKO HOME OBJECT catalogue.

Calculation of modulus of rupture (N/mm^2, MPa) according to EN ISO 10545-4

$$R = \frac{3 \times F \times L}{2 \times b \times h^2}$$

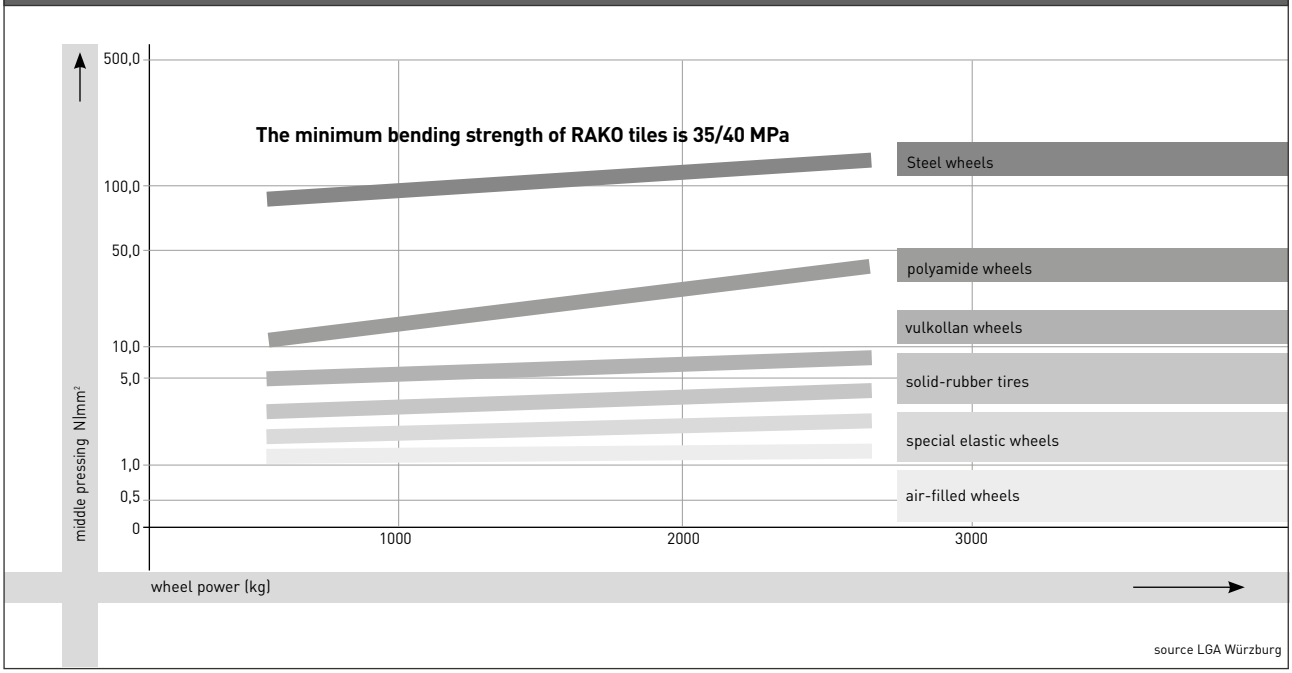
Breaking strength (N) according to EN ISO 10545-4

$$S = \frac{F \times L}{b}$$

F = breaking load in N, **L** = distance between edges in mm, **b** = width in mm, **h** = thickness in mm, **R** = modulus of rupture N/mm^2

Tab. 1

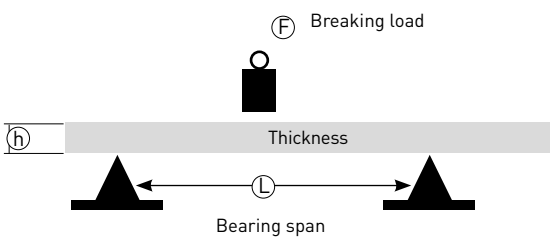
Middle pressing under different wheels of industrial trucks



Tab. 2

Work procedures for wall tiles with a high amount of traffic			
Traffic load group	**Possible application**	**Breaking load after breaking the tile (N)**	**Load (N/mm²)**
1	Flats, bathrooms	under 1 500	–
2	Shops, offices, exhibitions	1 500–3 000	do 2
3	Shops, industry, warehouses	3 000–5 000	2–6
4	Industry (motion of trucks with volcano or polyamide wheels)	5 000–8 000	6–20
5	Industry (motion of trucks with polyamide or metal wheels)	more than 8 000	more than 20

Tab. 3

	Formát v cm	Tloušťka v cm	Lomová síla N (kg)	
				
Taurus	20 x 20	0,9	1 900 (÷190)	
	20 x 20	1,3	4 200 (÷420)	
	20 x 20	1,5	5 500 (÷550)	
	30 x 30	0,9	1 700 (÷170)	
	30 x 30	1,3	4 000 (÷400)	
	30 x 30	1,5	5 000 (÷500)	
Taurus | Block | Kaamos	60 x 60	1,0	3 000 (÷300)	
	30 x 60	1,0	1 500 (÷150)	
Kaamos Industrial	30 x 60	1,5	3 000 (÷300)	
RAKO Outdoor	60 x 60	2	11 000 (÷1 100)	
Quarzit Outdoor	60 x 60	3	30 000 (÷3 000)	

3.8 CHEMICAL PROPERTIES

RESISTANCE AGAINST CHEMICALS PURSUANT TO THE EN ISO 10545-13 STANDARD

Resistance against chemicals is assessed pursuant to the EN ISO 10545-13 standard. Ceramic tiles are exposed to test solutions, and, on the basis of the visually observed effect after a certain time period, they are classified as follows. Wall tiles by RAKO resist home chemicals and water treatment chemicals used in pools pursuant to EN ISO 10545-13. While selected wall tiles with increased resistance against chemicals included in class A and marked with the icon resist acids and lyes pursuant to EN ISO 10545-13, the other wall tiles by RAKO are classified as min. B.

Aqueous test solutions

- household chemicals: ammonium chloride solution 100g/l;
- salts for water treatment in swimming pools: sodium hypochlorite solution 20 g/l

Classes according to EN 14 411:2016:

- A/B/C*

Acids and lyes

- Low concentrations (L)
  a) Hydrochloric acid solution 3 %
  b) Citric acid solution 100 g/l
  c) Potassium hydroxide solution 30 g/l
- High concentrations (H)
  a) Hydrochloric acid solution 18 %
  b) Lactic acid solution 5 %
  c) Potassium hydroxide solution 100 g/l

Classes according to EN 14411:2016:

- A/B/C*

*Class A shows the highest resistance to chemicals, which decreases more and more towards C.

RESISTANCE TO STAINING PURSUANT TO EN ISO 10545-14

The face side of wall tiles is exposed to test solutions of stain-generating substances for a certain period of time after which the face side of the tiles is cleaned in the specified manner and changes are assessed visually. On the basis of the results the tiles are classified in five classes.

Stain-generating substances used for the test

- Green substance in oil, red substance in oil, iodine solution in alcohol 13 g/l, olive oil

Cleaning

- Cleaning detergents: hot water (+55 °C), weak detergents (pH 6.5–7.5), strong detergents (pH 9–10)
- Dissolving detergents: hydrochloric acid solution 3%, potassium hydroxide solution 200 g/l, acetone
- Unsuitable chemical substances: ceramic tiles are not hydrofluoric acid resistant

Classes: 5/4/3/2/1*

* Class 5 means maximum stain resistance, decreasing towards the lowest resistance class 1

Selected types of RAKO products, such as TAURUS, KENTAUR and POOL floor tiles, show very good resistance against chemicals, see the attached table, and in combination with putties and joint fillers with chemical resistance are applicable as wall and floor tiling in chemical processing plants, battery maintenance plants, dairies, soda water production plants, breweries etc. For these purposes, traditional fixing on cement and cement grouting is unsuitable and chemical resistant materials must be used, e.g. epoxy penetration, epoxy damp proofing material, epoxy adhesive, and epoxy grouting materials.

Whiteware wall tiles with water absorption over 10% are not suitable for industrial applications requiring resistance against chemicals. They are resistant against common household chemicals and actions of neutral cleaning agents (without grinding effects with a pH value from 6.5 to 7.5). For specific wall tiling (laboratories, car repair shops, accumulator rooms, etc.), ColorTWO tiles with a very good chemical resistance can be used. Decorative tiles decorated with gold, platinum, pearly and metallic colours are not recommended for chemical stressed areas and the procedure of their maintenance is specified in chapter 14. Cleaning and maintenance of ceramic wall and floor tiles.

Resistance of RAKO ceramic wall tiles against chemicals

Products by class – EN 14411:2016	Examples of RAKO products	Resistance against home chemicals		Resistance against acids and lyes in low concentrations		Resistance against acids and lyes in high concentrations		Resistance to staining	
		ISO 10545-13	LB	ISO 10545-13	LB	ISO 10545-13	LB	ISO 10545-14	LB
BIII GL	ColorONE, RAKO HOME wall tiles	at least B	at least A	Manufacturer declaration	at least B	Manufacturer declaration	at least B	3	3
BIb GL	ColorTWO, pressed POOL tiles	at least B	at least A	Manufacturer declaration	at least B	Manufacturer declaration	at least B	3	3
BIa GL/UGL	Kentaur, Taurus	at least B	at least A	Manufacturer declaration	at least A	Manufacturer declaration	B/A	at least 3 for GL, not required for UGL	3
AIa	drawn POOL tiles	at least B	at least A	Manufacturer declaration	at least B	not required	at least B	3	3

3.9 HYGIENIC PROPERTIES OF TILES

RAKO products are regularly tested for **radiation-hygienic safety** as per the Decree by the State Office for Nuclear Safety 422/2016 Coll., as amended by Act 263/2016 Coll. RAKO products meet the requirements mentioned above, and they are safe.

Ceramic products RAKO are regularly tested for release of lead (Pb) and cadmium (Cd) from glazes according to EN ISO 10545-15. The performed analyses prove the ceramic tiles by RAKO, are harmless for human health, see the statement of properties on **https://www.rako.cz/en/for-professionals/documents-for-ceramic-tiles/declaration-of-performance.**
Selected TAURUS, ColorTWO and POOL products have attests of sanitary harmlessness in contact with food and drinking water on
https://www.rako.cz/en/for-professionals/documents-for-ceramic-tiles/certificates, prepared by an independent sanitary laboratory..

Ceramic wall and floor tiles including shaped pieces, rounded mouldings with corrugation ColorTWO or TAURUS and TAURUS GRANIT base moulding for food processing areas with radius R 44 of the rounding are easy to maintain, thus allowing for compliance with the strict hygienic requirements for food processing plants and healthcare facilities. They are suitable for all types of applications requiring surfaces free of pathogenic germs, moulds, dust, and other pollutants.

Suitable application of ceramic tiles on floors and walls can also improve the home microclimate, e.g. reduce occurrence of dust, pollen and mites.

3.10 THERMAL CHARACTERISTICS OF TILES

Thanks to their convenient thermal properties (conductivity and heat accumulation), all types of RAKO tiles are ideal floor coverings on underfloor heating. Comparison of thermal conductivity (coefficient of heat conductivity) of floor coverings and ability to accumulate and emit heat (thermal emission) of various floor coverings:

Material	Coefficient of heat conductivity λ (W/m·K)	Thermal emission b (λ·ρ·c)
Ceramics	1,0	1,8
Cement screed/concrete	1,3	2,6
Anhydrite	1,8	3,8
PVC, vinyl	0,2	0,3
OSB boards	0,1	0,3

ρ – volume weight (kg/m^3)
c – specific thermal capacity (J/kg·K)

The thermal expansion coefficient of wall and floor tiles is very low. At a distance of 6 m, and at a temperature difference of 50°C, the ceramic material is expanded by 2.4 mm. However concrete, for example, changes its length to about twice this value. Therefore, dilatation joints are performed, which are able to absorb such stresses in the base. Comparison of coefficients of linear thermal expansion for different materials:

Material	Coefficient of linear thermal expansion α (10-6·K-1)
Ceramics	4—8
Cement screed/concrete	10—12
Steel	12—13
Aluminium	22—28

3.11 ELECTRICAL PROPERTIES OF TILES

Antistatic flooring is required for floors of operating theatres, laboratories, production of medical and pharmaceutical products, explosive substances, and microelectronics. Ceramic tiles belong among electrical insulators, therefore, electric charge is discharged using conductive joints between small or mosaic tiles. Detailed information is available on www.rako.cz.

3.12 OPTICAL CHARACTERISTICS OF TILES – LRV

The capacity of ceramic tiles to reflect or absorb light is a consideration for certain applications. The evaluation parameter is represented by light reflections of the individual colours between black Y = 0 and white Y = 100. Requirements for buildings are laid down for example by the Austrian standard ÖNORM B 1600: 2012 for improved orientation in public access buildings with the help of the prescribed contrast of light and dark surfaces based on the Light Refractance Value (LRV) of the individual surfaces. Not required in the Czech Republic.

LRV values are only informative and can change in relation to the hue of individual batches.
LRV values for selected tiles are measured using a spectrophotometer according to CIE 1931:

RAKO HOME		
Serie	LRV glazed floor tile	
Extra	DARxx720	55
Extra	DARxx721	26
Extra	DARxx722	58
Extra	DARxx723	41
Extra	DARxx724	20
Extra	DARxx725	9
Geo	DARxx314	6
Pietra	DAKxx628	55
Pietra	DAKxx630	60
Rock	DAKxx632	46
Rock	DAPxx632	47
Rock	DAKxx633	42
Rock	DAKxx637	10
Trend	DAKxx652	53
Trend	DAKxx653	38
Trend	DAKxx655	16
Unistone	DAKxx609	61
Unistone	DAKxx613	8

RAKO OBJECT	LRV matt unglazed surface ColorONE, ColorTWO, POOL (matt)		LRV glossy glazed surface ColorONE, ColorTWO, POOL	
RAL 0304060	WAAxx373 GAAxx459	15	WAAxx363 GAAxx359	17
RAL 0506080	WAAxx460 GAAxx460	34	WAAxx450	29
RAL 0607050	WAAxx282 GAAxx150 GAAxx750	48	WAAxx272	48
RAL 0858070	WAAxx222 GAAxx142 GAAxx742	57	WAAxx201	60
RAL 0908040	WAAxx221 GAAxx124	61	WAAxx200	64
RAL 0958070	WAAxx464 GAAxx464	60	WAAxx454	58
RAL 1208050	WAAxx465 GAAxx465	54	WAAxx455	56
RAL 1306050	WAAxx466 GAAxx466	31	WAAxx456	29
RAL 1907025	WAAxx467 GAAxx467 GAAxx767	40	WAAxx457	39
RAL 2408015	WAAxx540 GAAxx003 GAAxx703	59	WAAxx550	61
RAL 2606025	WAAxx541 GAAxx127	28	WAAxx551	29
RAL 2902035	WAAxx545 GAAxx005, GAAxx555 GAAxx755	6	WAAxx555	6
RAL 0001500	WAAxx732 GAAxx048	5	WAAxx779 GAAxx548	5
RAL 0004000	WAAxx765 GAAxx248	10	WAAxx755	10
RAL 0805005	WAAxx111 GAAxx111	18	WAAxx011	21
RAL 0607005	WAAxx110, WAAxx210 GAAxx110	49	WAAxx010	49
RAL 0008500	WAAxx112 GAAxx112	70	WAAxx012	68
WHITE	WAAxx104 GAAxx023 GAAxx723	86 79	WAAxx000 GAAxx052	90
RAL 0709010	WAAxx107 GAAxx107	78	WAAxx007	78
RAL 0508010	WAAxx108 GAAxx108	57	WAAxx008	63
RAL 0607020	WAAxx311 GAAxx311	39	WAAxx301	37
RAL 0607010	WAAxx312 GAAxx312	33	WAAxx302	32
RAL 0805010	WAAxx313 GAAxx313	18	WAAxx303	19
RAL 0502010	WAAxx681 GAAxx671	6	WAAxx671	7

LRV glazed floor tile Taurus COLOR		LRV glazed floor tile Taurus GRANIT		LRV glazed floor tile BLOCK KAAMOS	
TAAxx019	8	TAAxx069	11	DAxxx780	37
TAAxx007	16	TAAxx065	18	DAxxx781	27
TAAxx006	26	TAAxx076	31	DAxxx782	18
TAAxx003	–	TAAxx078	–	DAxxx783	11
TAAxx011	65	TAAxx060	–	DAxxx784	39
TAAxx010	51	TAAxx062	51		
TAAxx025	–	TAAxx061	40	DAxxx585	48
		TAAxx073	39	DAxxx586	43
		TAAxx068	–	DAxxx587	28
		TAAxx074	33	DAxxx588	14
		TAAxx082	17	DAxxx589	25
		TAAxx080	27		
		TAAxx075	31		

4. Shopping tips and considerations before fixing

- When selecting ceramic tiles consider, apart from aesthetic aspects, the conditions of their use. Discuss options available and select the suitable type of tiles.

- When buying wall and floor tiling, check the precise product dimensions in mm (declared size). Rectified wall and floor tiles have identical dimensions within the permissible tolerance, but non-rectified products differ depending on the production batch. Non-rectified floor tiling with nominal dimensions of 33 × 33 cm can be manufactured e.g. in a declared dimension of 331 × 331 mm or also 333 × 333 mm. In this case, the information on the carton is marked with an end number in mm, i.e. 1 or 3 (dimension code) – see Chapter 3.3 – Marking of production batches. Knowing the dimension code and the precise dimension in mm is important not only for designing placement with the same joint but also for buying missing goods afterwards if necessary.

- Information on the tint of the product, which we state on the carton as a 2-digit (glazed ware) or 3-digit code (unglazed ware) is of the same importance when you buy wall and floor tiles - see Chapter 3.3 - Marking of production batches. The tint varies depending on the production batch. Preserving the same tint is important for maintaining the same colour of installed tiling but also for buying missing goods afterwards if necessary.

- RAKO wall tiles **(catalogue number W.....)** are suitable only for interior wall tiling.

- Compact RAKO tiles **(catalogue number G.....)** are frost resistant and suitable for interior applications for walls, showers of pools and public buildings, interior floors and exterior façade cladding.

- Vitrified ceramic tiles **(catalogue numbers T..... , D.....)** are highly frost resistant and are designed particularly for horizontal, frost-resistant tiling, e.g. on balconies and terraces. Selected types have the ultimate surface abrasion resistance. Unglazed products (such as TAURUS GRANIT) with a declared slip resistance are therefore suitable for floors with busy foot traffic, e.g. for supermarkets, public transport stations, administrative buildings, etc.

- Drawn ceramic tiles **XP.....** with water absorption below 0.5 % are frost-resistant and recommended for outdoor and indoor pools.

- Carefully measure the required surface to be tiled, and always buy an additional 10 – 15 % of the tiling material than theoretically calculated (waste at walls, particularly for oblique laying, unexpected adjustments and repairs, etc.).

- When buying tiles, always discuss the expected foot traffic in the building, and select tiles featuring suitable abrasion resistance.

- For applications involving slipping hazards (e.g. floors used by public, building entrances, wet floors in public showers, pool surroundings, wet and greasy floors in large kitchens) always select suitable anti-slip floor tiles.

- Fixing of tiles should be performed by a professional company. If you fix the tiles by yourself, carefully study the instruction manuals provided by the manufacturers of ceramic tiles, cements, adhesives, and cutting instruments. For laying of wall and floor tiles in bathrooms,

pools, balconies and terraces, we recommend system solutions using the procedures of base penetration, levelling, adhesive, damp-proofing, jointing and cleaning materials, e.g. the RAKO SYSTEM (www.rakosystem.eu).

- Before laying the tiles, we suggest you select from several cartons and arrange them as illustrated in the inspiration photo documentation in RAKO catalogues, or on the www.rako.eu web site. Never mix production batches with different shades or sizes on one tiled surface.

- When laying ceramic tiles do not forget about circumferential and structural dilation joints around the load-bearing and dilation parts of the building structure, or in the case of large surfaces also partial dilations with the span of 3 m, especially in the case of heated or outdoor floors, facades or terraces. When fixing tiles on large surfaces, make sure that expansion joints are made around supporting and expansion parts of construction, particularly on outdoor floors, facades and terraces.

- When installing ceramics, remember to make perimeter and structural expansion joints in the dilatation parts of constructions. In the case of larger interior surfaces, it is necessary to divide the surfaces into dilatation sections and to make surface expansion joints with a maximum span of 6 m. As regards heated floors, outdoor terraces and areas, you should shorten the length of a dilatation section to 3 m with a maximum ratio of the sides of 1 : 2.

- It is highly recommended that the original cartons are retained for a reasonable time to assist batch identification etc for extra requirements or problems.

5. Tile processing

Tile design and fixing should be performed by a professional company. If you plan to fix the tiles yourself, make sure you are well informed about the recommended use of particular tiles, their fixing and grouting, as well as about the importance of individual properties of ceramic tiles and cutting methods. For tile fixing, it is necessary to adhere to the approved rules according to valid standards, in particular, CSN 73 3451 and CSN 74 4505, and to use a RAKO SYSTEM solution and recommended building chemistry (www.rakosystem.cz).

5.1 PREPARATION OF THE BASE AND TILES BEFORE FIXING

Before commencing the laying of tile, it is necessary to prepare a stable and level base pursuant to CSN 74 4505, which must be of sufficient strength and must be free of dust residues, greasy spots and excess water. It is necessary for the base of industrial floor paving to conform to CSN EN 206-1 and strength class C20/C25, which guarantees a minimum compressive strength of 20 N/mm2 (MPa). In the case of bases that are unstable and flexible such as chipboard, it is necessary to prevent slumping and to provide them with special separating layers before laying tiles. Insulating coatings and primers are applied on bases if necessary. **Before fixing, spread the ceramic tiles from several boxes on at least 2 m^2 of the surface and check the general appearance and, in particular, setup of patterns combined from various types of products, various base colours and accessories, decorative strips –listellos etc. according to the tile laying plan. It is recommended to have the designed layout approved by the owner, investor, or user of the building.**

5.2 TILE CUTTING AND DRILLING

RAKO brand wall tiles can be cut with readily available classic lever-operated cutters. Dense and sintered floor tiles have great surface hardness (5-7 on the Mohs hardness scale). Therefore, we recommend using diamond wheels intended for sintered ceramic tiles to cut these materials. Cutting accuracy is ensured here by the stability and compactness of cutting tools, and by secure clamping of the material being cut. Stable stand saws are recommended. The most modern cutting tools are fixed straight on the floor tile proper by means of suction clamping elements – see Fig. 3, 4, 5, and 6. When cutting floor tiles with a thickness of 2 cm, stands saws or cutters with guide bars are used – see Fig 7.
When drilling and cutting holes in a vitrified body, use diamond hole saw bits intended for this purpose (sometimes identified as GRES PORCELANATO or PORCELAIN). The RAKO vitrified body is more than two times harder than a traditional tile body. According to the Mohs hardness scale, the tiles achieve a measured value of 3, compact tiles a value of 5. and vitrified tiles a value of 7. Proceed according to the manufacturer's instructions during work (speed, cooling, etc.). However, a bit can be damaged by striking the base construction material (e.g. brick, concrete or stone), i.e. the cutting edge can be dulled or melted, or the diamond can become exposed to the point where it breaks off. When drilling into base materials, it is therefore best to use a classic bit with a steel tip, with the drill set to the hammer function.



Fig. 3 - Hole saw bits for vitrified floor tiling



Fig. 4, 5 – A stand saw for wet cutting of wall and floor tiling; a diamond wheel for vitrified floor tiling



Fig. 6 – A tile corner cutter for vitrified floor tiling



Fig. 7 – A cutter with a guide bar and clamping suction

6. Tile fixing methods

Recommended procedures are available for tiling of walls and floors.

1. **Contact gluing of ceramic tiles**
2. **Laying of ceramic tiles in a dry technique without the use of adhesives**

6.1 CONTACT GLUING OF CERAMIC TILES

Gluing of tiles with a thin layer of an adhesive is a progressive modern procedure for high-quality flat stable bases made of concrete, anhydrite, brown coat, plasterboard or from precision blocks; first a thin layer of glue is applied as a base and spread onto a flat base that has been treated with a suitable primer and, afterwards, an even layer of the adhesive is formed using a suitable toothed spatula. While for wall tiling a thinner layer of adhesive is sufficient, for floor tiling a thicker layer must be used. The tooth size of the stretching ridge depends on the size and flatness of the surface. Individual tiles are placed onto the surface treated in this way. Various spacing aids (e.g. small crosses and wedges) are employed to ensure regular joints. Tiles soiled by the adhesive should be cleaned in time. Uneven bases must always be levelled and adjusted by means of special screeds or levelling compounds. Unstable bases (OSB boards, Cetris boards) must always be provided with a contact bridge (RAKO SYSTEM P203) before further use of the system solution.

As regards laying large ceramic tiles outdoors and indoors, you should apply the adhesive of at least class C2/S1 to both the base and reverse of the tile (the adhesive must be smoothened with

the maximum thickness of the final layer 3 mm) to ensure maximum adherence to the base and rule out the possibility of the tile breaking off in the event of differing expansion of the base and tiling. Double-side gluing (buttering-floating) also reduces the risk of the formation of air cavities, which are undesirable because of a decrease in adherence. Moreover, water condenses and freezes and, subsequently, the tiling breaks off outdoors. To ensure the flat placement of large floor tiles, which require a skilled professional tiler, levelling wedges can make the work easier – see Fig. 8.
The stretcher bond layout is recommended for laying rectangular floor tiles. Standards permit manufactured rectangular floor tiles to be slightly curved. These permitted deviations can be mitigated precisely by the stretcher bond layout, with the tiles not laid in the centre of the adjacent tile but moved slightly by one-third, see Fig. 10 and 11. While handling large-format tiles, special suction clamping elements are used (see Fig. 9).

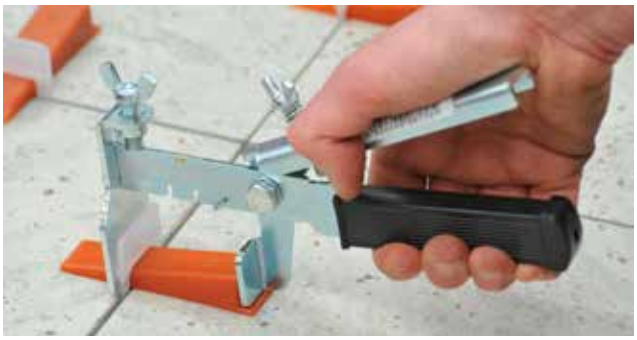


Fig. 8 – Levelling wedges



Fig. 9 – Suction clamping elements for large formats

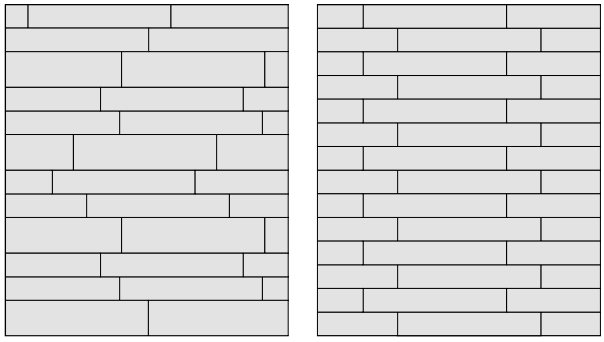


Fig. 10 – Recommended stretcher bond layout

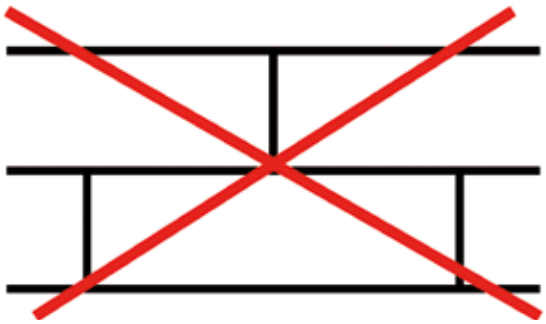


Fig. 11 – Stretcher bond layout not recommended

Classification and identification of adhesives according to EN 12 004
According to the material type, adhesives for ceramic tiles are divided as follows:
C – cement, D – dispersion, R – reactive of hardened resins.

Each type is available in two categories:
1 – for common, standard use in interiors, with the minimum adhesion of 0.5 MPa,
2 – for more demanding applications, e.g. non-absorbent bases and in exteriors with the minimum adhesion of 1.0 MPa.

Additional properties of adhesives are identified as follows:
F – quick-setting, T – with reduced slip, E – with extended open time.
Deformability (flexibility) of adhesives according to EN 12 002
S1 – deformable, deflection from 2.5 to 5 mm = flexible adhesive,
S2 – highly deformable, deflection over 5 mm = super flexible adhesive.

Examples of identification and recommended use of cement adhesives

C1 – a standard cement adhesive for common use, gluing of ceramic tiles on stable bases in interiors (for example: RAKO SYSTEM AD501),

C1 T – a standard cement adhesive with reduced slip (for example: RAKO SYSTEM AD505),

C1 FT – a quick-setting cement adhesive with reduced slip (for example: RAKO SYSTEM AD580),

C2 TE S1 – a flexible cement adhesive with reduced slip, prolonged opening time and enhanced deformability for both interiors and exteriors (for example: RAKO SYSTEM AD530).

6.2 FROST RESISTANT TILING ON BALCONIES

You should pay close attention to the laying of frost-resistant tiling due to the fact that the quality of the base and actual tile laying work has a substantial impact on the lifetime of the final tiling. The recommended procedure for fixing of ceramic tiles on balconies is shown in Fig. 12, 13, 14, and 15. The base must be made of a frost resistant mature material, without additional deformations, with a clean, smooth surface, free of dirt, dust or grease. The horizontal surfaces must have a slope of at least 2%. The banister structure must be anchored outside the ceramic surface.

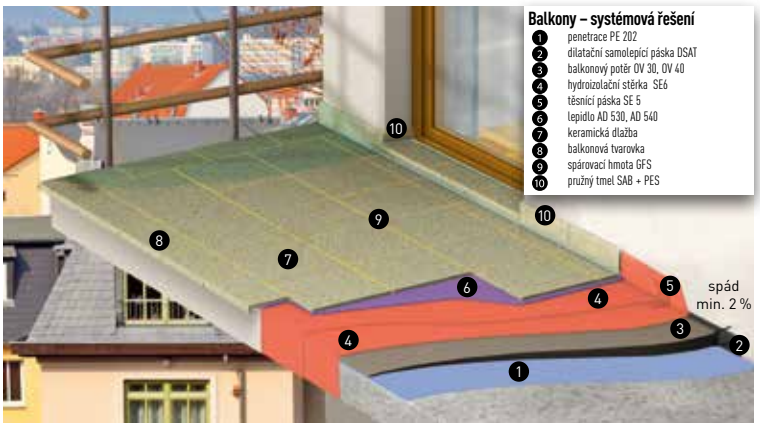


Fig. 12 – Balcony structure



Fig. 13 – Buttering-floating fixing method

A damp-proofing layer is applied in two coats to a primed sloped base by means of a damp-proofing screed (RAKO SYSTEM SE6). The damp-proofing layer must be watertight around discharge fixtures, and applied at least 15 cm upwards on the adjoining vertical surfaces and walls, using a flexible sealing tape (RAKO SYSTEM SE6). On the damp-proofing layer, apply vitrified ceramic tiles **RAKO HOME a RAKO OBJECT with balcony shaped pieces**, into a flexible frost resistant adhesive, type C2TE S1 (RAKO SYSTEM AD530). Gluing is carried out by the combined application of the adhesive compound to both the base and the floor tile (buttering-floating) with the removal of bubbles and cavities in the sealant, see Fig. 13, which prevents water from accumulating beneath the tiling.

The layer must respect and implement the prescribed dilation joints in **the surface** in maximum spacing of 3 m. For the reason of thermal expansion of the ceramic tile it is recommended to avoid darker shades of exterior floor tiles which may tear from the substrate or crack in the joints under the effect of sunshine. The temperature of the ambient environment and of the base during the placement of tiling and its hardening must not drop below +5°C. After hardening, joints should be filled with frost resistant flexible grouting materials (RAKO SYSTEM GFSS, CG2WA), expansion joints filled with polyurethane materials (RAKO SYSTEM SAB). Reliable results and long term service life of tiled surfaces on balconies can be ensured by using the recommended RAKO SYSTEM solutions, https://www.rako.cz/en/for-professionals/system-solutions-rako-system/balcon.

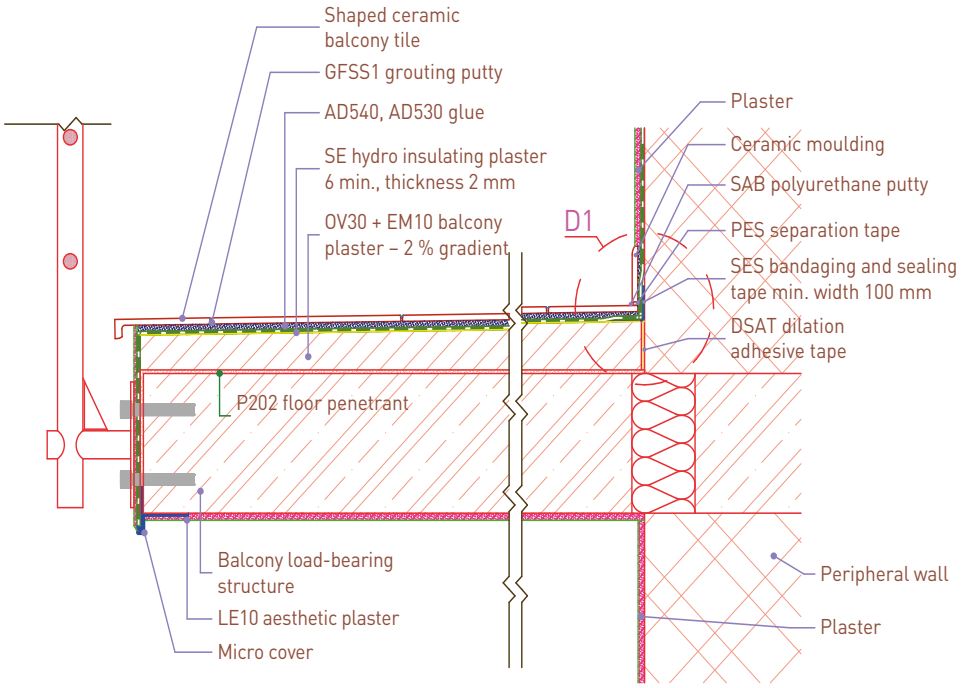


Fig. 14 – A section of a balcony

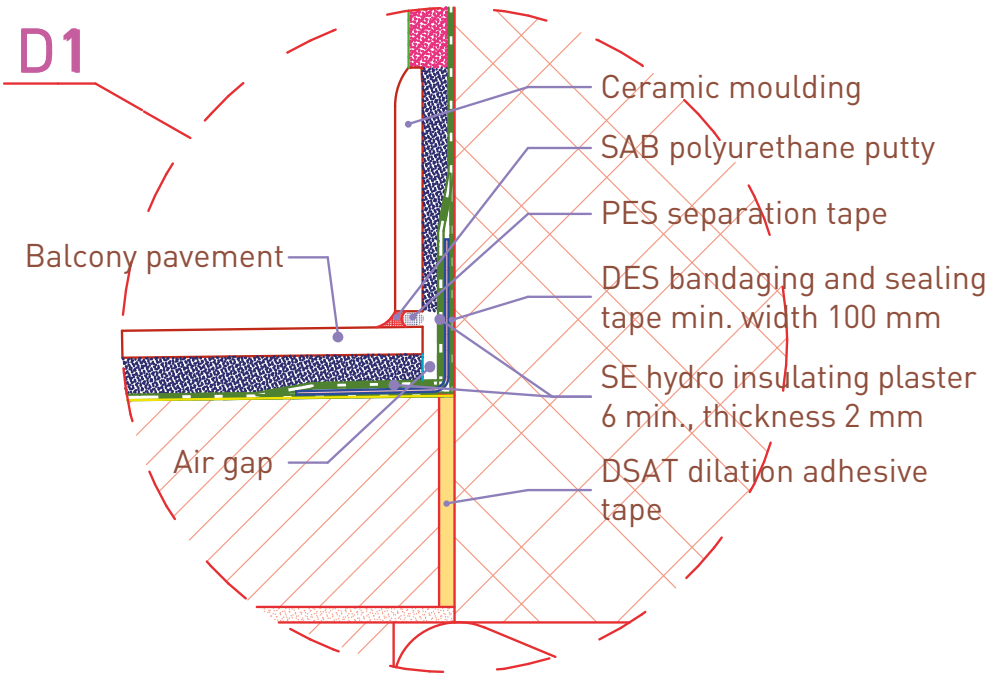


Fig. 15 – Detail of a balcony corner

6.3 UNDERFLOOR HEATING

Underfloor heating has a number of advantages. It enables ideal distribution of temperature in the heated room. For heating with a stove or common central heating, the difference between air temperatures at the floor and at the ceiling is up to 8°C, while for underfloor heating, the air temperatures throughout the space are constant and heat comfort is achieved even by lower temperature in the heated room. This method reduces thermal losses due to heat passage through building structures, infiltration and ventilation. **Ceramic tiles have convenient thermal conductivity and are able to accumulate and emit heat - see Chapter 3.10. Thermal characteristics of tiles, Page 21.**

Additional energy savings can be achieved through floor heating operation. As the system uses heating water of lower temperatures than other heating systems, it is possible to use low-temperature heat sources and condensation gas-fuelled boilers so that the condensation heat of exhaust gases can be used and the efficiency of the thermal sources may increase by up to 6%.



Fig. 16 – Example of water-based underfloor heating

Underfloor heating systems have substantial heating persistence due to the concrete slab weight, therefore, the temperature is controlled by programmable controllers.

For health reasons, the surface temperature of floors should not continually exceed 29°C. **The recommended tiles for underfloor heating include compact and vitrified RAKO tiles, as well as rectified large-format tiles.**

Electric floor heating
Floor heating cables and mats can be conveniently used for accumulation and direct heating of thin floors in the interiors or for defrosting systems. The heating cables or mats are inserted either in the levelling layer of the substrate or directly in the adhesive. Fig. 17 shows the procedure for insertion in the adhesive, during which the manufacturers' instructions must be respected. To avoid heat loss into the floor, mats with a built-in thermal barrier can be used – see. Fig. 18. For thin floor heating, vitrified RAKO HOME tiles and flexible adhesive and grouting materials C2TE S1 and CG2WA of the RAKO SYSTEM are suitable.

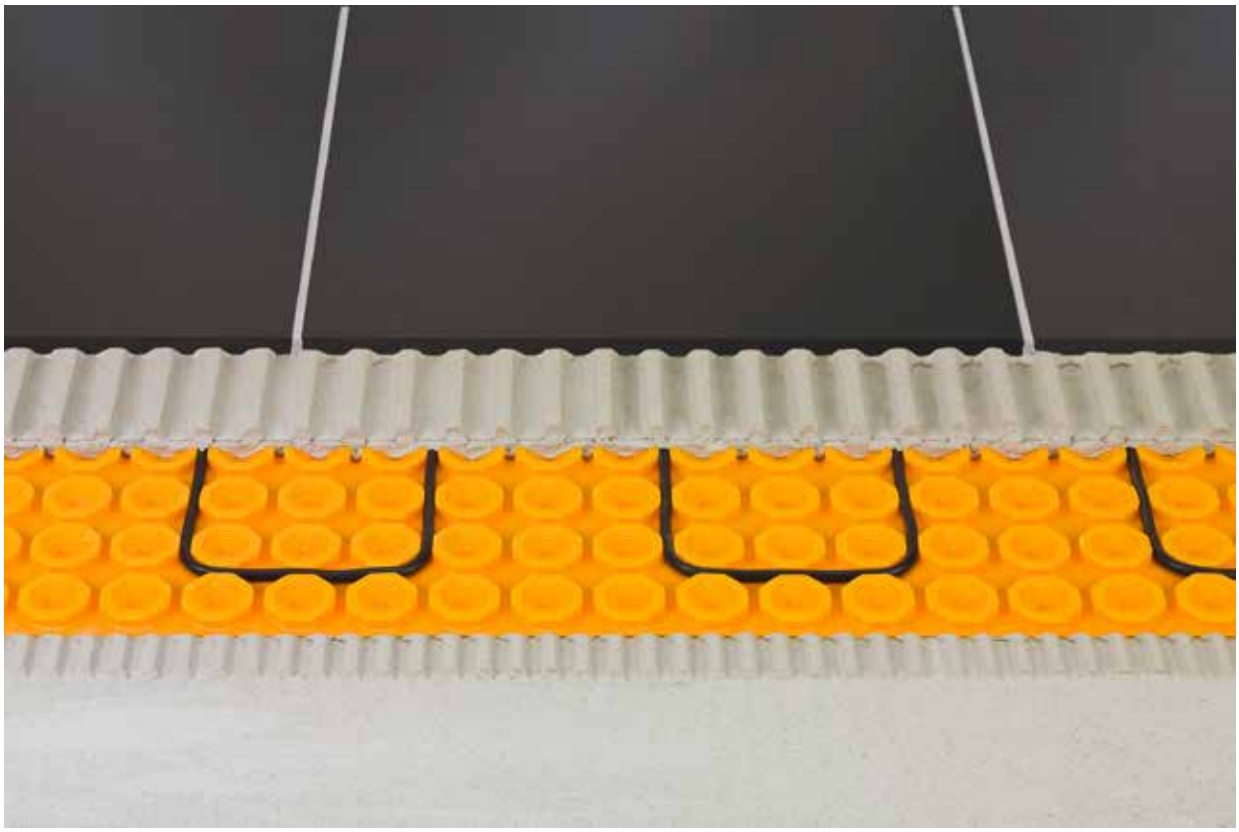


Fig. 17 – System of floor heating cables placed in special mats (Fig. Schlüter-Systems KG.)

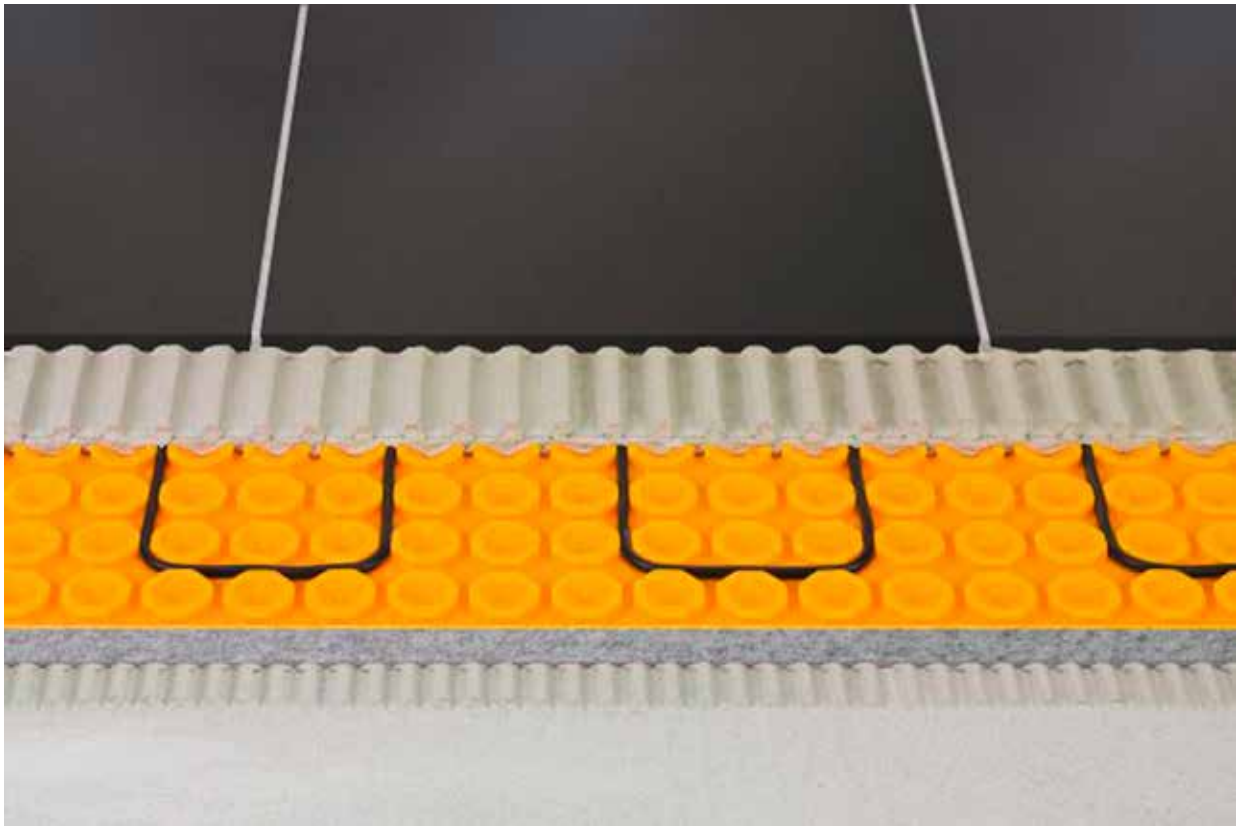


Fig. 18 – System of floor heating cables placed in special mats wit built-up thermal barriers (Fig. Schlüter-Systems KG.)

Water-based underfloor heating

Underfloor heating should be performed by a reputable construction company, while following the instructions for use provided by underfloor heating suppliers. Compliance with the assembly procedures described in the supplier's instructions for use and with the system design of the water-based underfloor heating (see Fig. 19 and 20) must be documented in the construction log. When using ceramic tiles as the flooring, the floor heating output is about 80 W/m2 (pipe spacing 150 mm, interior temperature 20°C, and input temperature 40°C). For carpet flooring, the output will drop by 25%. In addition, the change of the mean temperature of heating water by 5°C will result in an increase or decrease of the output. Temperature of floor heating water should not permanently exceed 50°C. Floor heating output always depends on the pre-set parameters such as heat loss of the room, pipe spacing, flooring material, floor structure, heat insulation, interior temperature, heating input temperature etc.

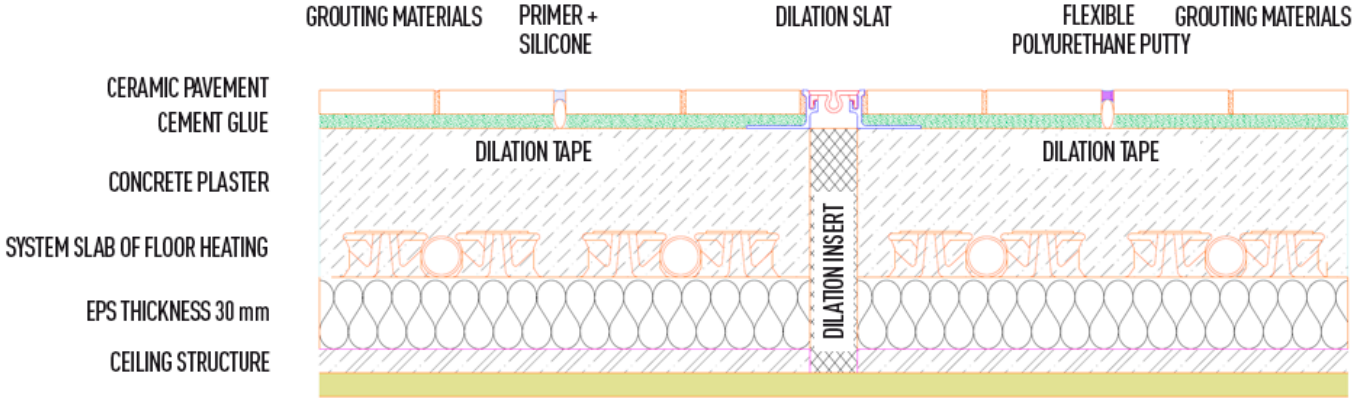
Even though the thermal expansion coefficient of wall and floor tiles is very low, it is necessary to perform expansion joints in accordance with the requirements of relevant standards (for example: CSN 74 4505). Surfaces that are subjected to thermal stress, e.g. terraces, balconies, façades and underfloor heating, must be divided by expansion joints, see Chapter 8. Jointing of tiles, dilatation. Maximum spacing of dilation fields in heat stressed surfaces is 3 m. The heating piping must comply with all applicable safety regulations.

Concrete or anhydrite layer thickness covering the floor heating pipes should be at least 45 mm. A plasticizer may be added into the concrete filler to ensure better contact with plastic pipes. The heating board must be separated from the external walls with expansion joints, as well as the adjoining heating circuits. For interiors with a low structure height, thin-layer hot-water underfloor heating is recommended with a low layer of screed of up to 20 mm – Fig. 21. A pressure test must be completed before concreting, and the pipes must be kept pressurized until the board is fully hardened (21 days for a cement slab). Also, the first heating must be gradual, the temperature in the system may grow by only 5°C in 24 hours. After the operating temperature is achieved, its reduction must also be gradual, or else the pipes may separate from the concrete and thus reduce the heat transfer and the power output.

Tiles may be fixed on the surface only after completion of all, using the flexible thin-layer adhesive RAKO SYSTEM AD530, class C2TE S1, which ensures excellent heat transfer to the base slab, with less than 4.5% of water in concrete and less than 0.3% of water in anhydrite (as measured by the carbide method). Tiles smeared with the adhesive must be promptly cleaned and covered with a protective foil to prevent fast release of water from the hardening adhesive and potential pollution. After the time specified by the manufacturer of the adhesive, the tiles should be jointed with a flexible grouting material (RAKO SYSTEM GFDRY) and immediately cleaned with a sponge and clean water.



Fig. 19 and 20 – Picture and cross-section of water-based underfloor heating



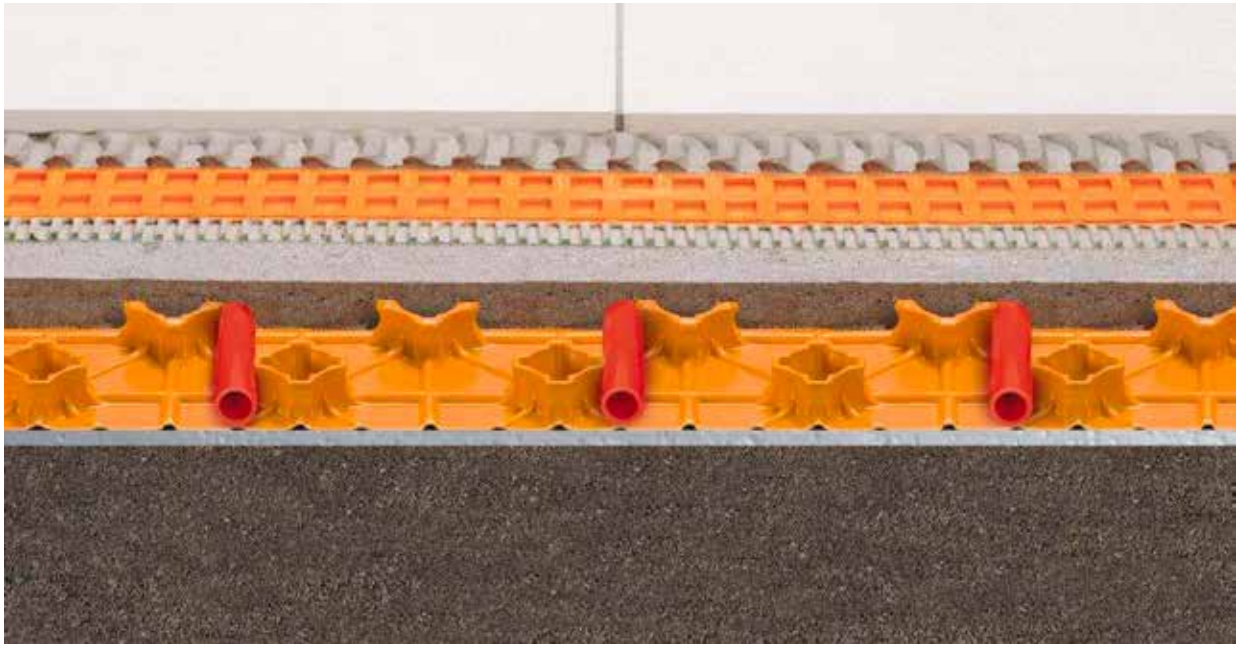


Fig. 21 – System of heating cables placed in special mats. Implementation of the electric floor heating (Fig. Schlüter-Systems KG).

6.4 STAIRS

To tile stairs in interiors or exteriors, we recommend using step tiles with the sizes of 30 x 30, 33 x 33, 30 x 60 cm, and custom made 30 x 60, 53 x 60, and 30 x 120 cm shaped step tiles.
For outdoors in front of tenement houses, offices and schools, it is necessary to use TAURUS GRANIT step tiles with the sizes of 30 x 30 cm and SR7, SRM relief surface, or RAKO HOME step tiles with the sufficient slip resistance pursuant to CSN 73 4130 – Stairways and sliding ramps. The required minimum sliding friction coefficient for interior staircases is 0.5 dry, and 0.5 wet for outdoor staircases. The 4 cm edge of the walking step on the outer corner of the stairway should be 0.6. In the case of outdoor premises, this value is required under wet conditions. Higher values are achieved by cutting slots at the edge of the step tile.
Fixing of tiles on stairs requires precision work. By carefully measuring, it is necessary to ensure the same height of all stairs in connection to surrounding floors, and other requirements of CSN 73 4130. In the exterior, it is necessary to prevent the penetration of water into the stair structure, using waterproofing coating (RAKO SYSTEM SE6), to the walking edge, to use good quality adhesive and grouting materials (RAKO SYSTEM AD530, GFDRY) and flexible polyurethane material (RAKO SYSTEM SAB) for internal edges of stairs.

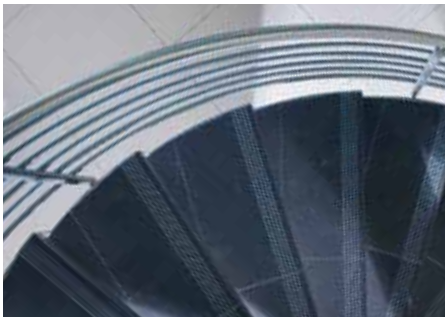




Fig. 20 – Step tiles

7. Laying of tiles in a dry technique

Vitrified rectified RAKO OUTDOOR floor tiles 60 x 60 cm with a thickness of 2 and 3 cm are frost resistant, therefore they can withstand external loads without major limitations. These tiles are suitable for the construction and renovation of modern terraces, balconies, immediate surroundings of swimming pools, pergolas, roofs, or walking floor surfaces embedded in grass areas. For their thickness and weight, the tiles can be laid in various fields, such as lawns, gravels, or placed on targets without the use of glue. Thanks to digital printing technology, the quality and design of these tiles are indistinguishable from natural materials, they faithfully imitate. Specifically, we can offer a unique design of stone, wood and cement in the QUARZIT, KAAMOS, SALOON, PIAZZETTA and REBEL series.

7.1 LAYING INTO LAWNS AND GRAVEL

Laying into lawns with a space of 4-5 cm between the tiles, allowing grass growth between the tiles. The long durability of this solution is affected by the perfect stability of the sub-base from a compacted layer of gravel under the tiles.

Installation – laying into lawns or gravel
First of all, prepare the subsoil underneath the tiles. It is essential to remove a 20 cm depth of soil from the area where tiles will be layed into gravel. Next, compacted subsoil at the bottom of a pit with a 2,5 % slope at 1 m distance is required and all the layers should have same depth. Geotextile fabric should be installed at the bottom to separate soil from the other layers and to eliminate any growing of roots. A layer of 15 - 20 cm of shattered stones of fraction 8 – 16 mm should be filled and compacted by a vibrating plate. Then, a second layer of finer fraction 4 – 8 mm with a thickness of 4 cm should be distributed homogeniously. In between these layers the kerbs (curbs) are usualy installed. During the tiling process a rubber pounder should be used to create a plane surface. A special cross spacer, adjusted to the width of joints (3 – 5 mm), must be used to allow water to penetrate into the soil and at the same time to remove the humidity by evaporation. Fill in the joints with sand or special grouting material. For driveway and parking station areas QUARZIT OUTDOOR porcelain ceramic tiles with a minimum of 3 cm thickness is required. Before laying the tiles, concrete kerbs must be installed around the edges of the tiling area to ensure the whole system is able to resist dynamic loads.





Fig. 22, 23 and 24 - Laying into gravel

7.2 LAYING ON TARGETS

The laying of tiles on targets is a modern, dry method of laying, based on a system of supports, or so-called "targets". Vitrified, frost-resistant RAKO OUTDOOR floor tiles, which are used for the laying on targets, must withstand the dynamic load caused by walking, which is ensured by tile increased thickness of 2 cm. Due to the thickness and weight of these tiles, they do not move on the supports, and tiles are stable. Laying on targets is not recommended as a solution for vehicles driving. The larger the size of the tile, the lower capability to withstand its fracture. When preparing targets under the tiles, the recommendations of ceramic floor tile manufacturers must be followed. The laying of tiles on targets allows to copy inclination of roofs, or simply align sloping terraces. In addition, this solution offers trouble-free access to distribution lines, water drainage, or waterproofing during operation. For outdoor applications, we recommend using the tiles with R 11/B anti-slip surfaces.

Targets and beams
The market offers a number of rubber or polypropylene targets at heights ranging from 0.5 to 100 cm, which are resistant to high temperatures and frost. They are height adjustable, or with a fixed height. Loading capacity of supports ranges from 650 kg to 1200 kg. Part of the solution for some screw-type targets is a key allowing to adjust the target height from the outside, without tile handling. On the target heads, there are washers with spacers to define joints between individual tiles in the range of 2–4.5 mm In the case of a flexible base under the targets, the structure stiffness can be increased by using beams, placed on the targets, or placing one extra target into the centre of the tile.

Installation – laying on targets with adjustable supports
Place the supports on the prepared base according to the RAKO OUTDOOR tile format so that the targets support the corners of the tiles. Adjust the number of expansion spacers on the target heads as needed – see Fig. 25 and 26.



Fig. 25



Fig. 26

Adjust the height of the targets by their turning. For horizontal laying, adjust the slope of the base using slope correctors – see Fig. 27 and 28. The supports equipped with telescopic heads are levelled automatically up to 10%.

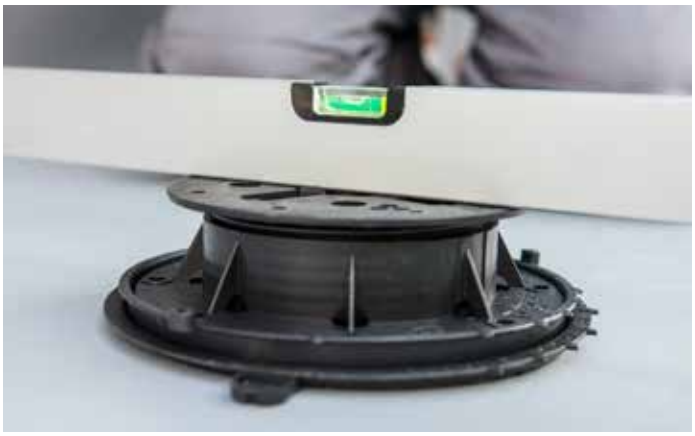


Fig. 27



Fig. 28

If there is not a solid edge around the tiles (skirting, wall, etc.), you have to use skirting clips in order to form the front part, and anchor the ceramic tiles on these clips (Fig. 29). At fixed edges, end stops are used to define the edge of laying (Fig. 30).



Fig. 29



Fig. 30

To increase the stiffness of target structure, and spread better the deflection of the base, use beams that should be placed into the spacers in the target's head (Fig. 31). The stiffness of the structure can also be increased by placing one extra target into the centre of the tile (Fig. 32).



Fig. 31



Fig. 32

Installation – laying on targets with a fixed height

Place the supports on the prepared base according to the RAKO OUTDOOR tile sizes of 60 x 60 cm so that the targets support the corners of the tiles. Rubber supports are recommended for installations where horizontal placement on targets is not required. Cut off the excess part of the supports near the walls or in the corners. The height of the targets can be changed by screwing or adjusting, and the height of the targets is identical on the whole area (Fig. 33 and 34).



Fig. 33



Fig. 34

Edges of the installation can be finished with metal profiles or fillets (Fig. 35). The stiffness of the structure can also be increased by placing one extra target into the centre of the tile (Fig. 36).



Fig. 35



Fig. 36

8. Jointing of tiles, dilatation

8.1 NON-FLEXIBLE JOINTS

Grouting can be performed once the adhesive has hardened sufficiently. Classic grouting with cement has been replaced with modern grouts of various colours. When using these it is necessary to observe the manufacturers' instructions and the correct amount of mixing water. The width of joints depends on the size, thickness, and type of tiles. Recommended optimum widths for inflexible joints pursuant to ÖNORM B 3407:2015 range from 2 to 5 mm; see Table 5 – Inflexible and flexible joints. Rectified floor tiles marked with an icon R have very small dimensional deviations and allow laying with a joint width of as little as 2 mm. Joints narrower than 2 mm are not recommended. Laying of ceramic wall and floor tiles without joints is unacceptable. Microscopic gaps in the case of laying with no joints cause water and dirt to get between floor tiles without the possibility of removing them. Conversely, a grouted joint absorbs expansion between floor tiles, thereby reducing the risk of the floor tile breaking off from the base. It is necessary for the grout to completely fill the joints in their entire depth without gaps and cavities. To prevent water entering through a joint into the base or side of porous tiles, grout with reduced water absorption (class of marking of joint sealants – W) should be used. Before applying the joint filler, it is recommended to test the jointing machine on a tile sample as its colour pigment may leave permanent traces on the ceramics.

Selection of grouts
Grouts are selected mainly based on the purpose which the joint is to serve. The manufacturer recommends using grouts from the RAKO SYSTEM line.
With grouts of intensive colouring you should test in advance the action of such compounds on sample tiles. Compounds for filling joints can be divided into groups by their chemical composition.
Inflexible:
Cement-based grouts (e.g. GFDRY, GFBIO, GFSS1)
Epoxy compounds (e.g. GEASY)
Flexible:
Silicone compounds (e.g. ASI, NSI)
Polyurethane compounds (e.g. SAB)

Cement grouts
CG2WA type RAKO SYSTEM cement grouts contain a mineral filler, white cement, polymers and additives improving the processing and utility properties of the type of compound concerned.

GFDRY – a flexible, highly hydrophobic moisture-proof grout with a Dry-effect function for all types of wall and floor tiling, 2-20 mm joints.

GFBIO – a flexible, highly hydrophobic, quick-hardening moisture-proof grout with a Dry- effect function and effective against fungi and algae, for all types of wall and floor tiling, 2-20 mm joints.

GFSS1 – a highly hydrophobised, moisture-proof, quick-hardening, super-flexible grout with fibres, suitable mainly for floor tiles on problematic bases, both in indoor and outdoor applications. Specially tested and certified for a balcony system, 2–20 mm joints.

The above types of cement grouts are not resistant to chemical stress.

The manufacturer recommends RAKO SYSTEM GFBIO and GFDRY flexible grouts for kitchen counter tops, bathrooms, company kitchens and floor tiling subjected to mechanical and thermal stress, including underfloor heating. **In an environment where a porous wall tile will be exposed to the direct action of water, in a shower box, etc., we recommend using a CG2 WA type GFBIO grout pursuant to EN 13 888 with reduced water absorption below 2 g of water in 30 min. pursuant to the test method of EN 12 808-5.**
The joints of floor-heating tiling do not differ from surfaces without heating; they have standard widths determined by the size, thickness and type of the floor tiles, e.g. rectified floor tiles with a 2 mm joint. However, it is necessary to complement them with expansion joints spaced at least 3 m apart against surfaces without underfloor heating, where the spacing of expansion joints is at least 6 m.

Epoxy grouts
These materials have been developed for special fields of application. They feature very good resistance to chemicals and mechanical stress and very good washability. Epoxy compounds (**RAKOSYSTEM GEASY**) meet the required demands on high chemical and mechanical resistance and are thus suitable for chemical and food-processing plants, e.g. breweries, slaughter houses, soda works, dairies, canning factories and for grouting swimming pools, wellness facilities, reservoirs, laboratory tables **and shower boxes subjected to greater water load, or for grouting wall tiles with transparent glaze**. The above-mentioned joint sealants are certified for contact with drinking water, which is why they are used without problems, and are favoured in drinking-water treatment plants.

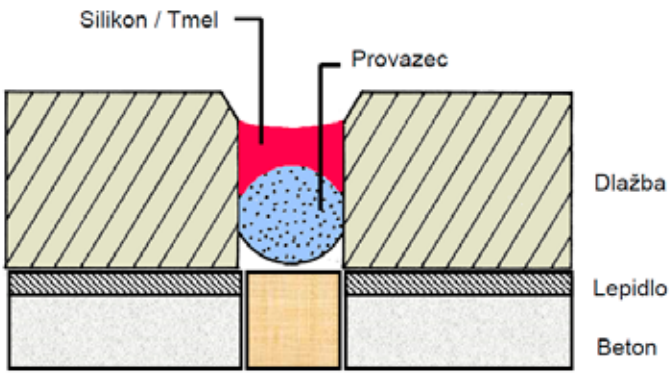
Grouting of glass accessories
Use conventional grouts, but for gluing and jointing glass elements it is necessary to use a white class C2 adhesive (RAKO SYSTEM AD550).

8.2 FLEXIBLE EXPANSION JOINTS

Expansion joints should be carried out in accordance with CSN 73 3451 and CSN 74 4505. It is always necessary to install perimeter expansion joints for wall and floor tiling. This means in the corners in wall/wall and wall/floor joints. Larger interior areas with a maximum size of 6 x 6 m should be divided by an intermediate expansion joint; outdoors and in the case of floors exposed to thermal stress (e.g. radiant heating, terraces, balconies and façades), intermediate joints with a maximum spacing of 3 m should be installed. When using larger formats outdoors (from 60 x 60 cm), we recommend that you shorten the dilatation section and, when selecting floor tiles, we recommend that you prefer light tints. When using dark products, large formats, and narrower joints, the smaller dilatation section is recommended.
To ensure a perfectly functioning flexible joint, insert a dilatation separation cord into cleaned joints (RAKO SYSTEM PES), Fig. 21, which reduces the risk of the flexible sealant adhering on three sides in the joint – see Fig. 22. Failure to insert a separation cord into an expansion joint tends to cause cracks and fissures in expansion joints – see Fig. 23. Silicone compounds (RAKO SYSTEM ASI) are used for filling expansion joints indoors, and polyurethane elastic compounds (RAKO SYSTEM SAB) are used exclusively outdoors. It is necessary to translate structural expansion joints in the base pursuant to CSN 73 3451 into expansion joints in the floor and wall tiling at least in the same width as the width of the joint in the base structure.
Expansion joints can also be made by means of special expansion joint strips, applied in wider, especially construction joints - see Fig. 24.



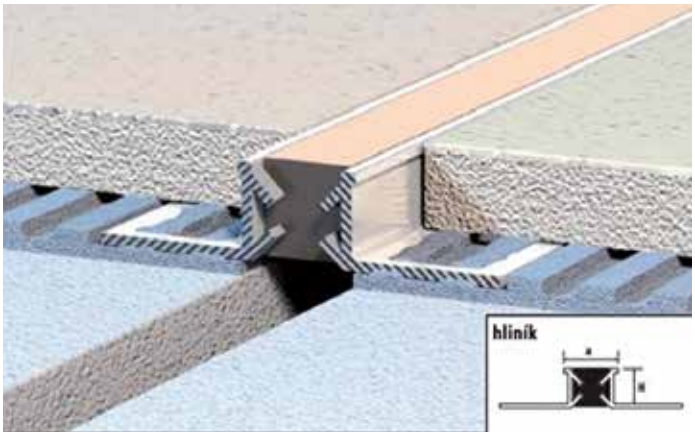
Obr. 21 – Separation cord



Obr. 22 – Section of a structural joint with the separation cord



Obr. 23 – A cracked expansion joint without the use of a separation cord



Obr. 24 – Flexible expansion joint strip

9. Maintenance and cleaning of ceramic wall and floor tiles

Regular and correct cleaning is an integral part of wall and floor tile care. Cleaning technique and products must be selected correctly depending on the soiling character, type of surface, and cleaning method. The following types of cleaning of ceramic materials must be distinguished:

Post-building-works cleaning – cleaning after the building works completion,
Regular cleaning – routine periodic cleaning,
Heavy duty cleaning – carried out 1–2 times a year.

Depending on the size and type of the surface to be cleaned, the cleaning can be done either by hand using a brush, cloth, pad or mop or, for cleaning large surfaces, suitable rotating cleaning machines or vacuum cleaners or high-pressure cleaning machines can be used. High-pressure cleaning machines with a spraying injector are suitable for severely soiled and anti-slip surfaces. Irrespective of the cleaning technique selected, it is necessary to make sure that the released dirt dissolved during the cleaning process is removed and not allowed to dry again. The most gentle and reliable way of removing it is by using a high-performance water vacuum cleaner. After cleaning the surface should remain dry.

Post-building-works cleaning – cleaning after building works completion
After tiles have been laid, the tiled surface must be cleaned of sediment and material left from building works and cement grouting. Detergents containing acids (pH < 6), so called cement residue removals, are best for this purpose. We recommend **RAKO SYSTEM CL802**. For this type of cleaning the detergent must be appropriately diluted to prevent dark and highly pigmented grouting materials from being disturbed and bleached. For wall tiles in group BIII, 50–100 ml of the **RAKO SYSTEM CL802** product can be diluted in 10 l of water. For compact and vitrified tiles in group BIb and BIa, 100–200 ml of the **RAKO SYSTEM CL802** product can be diluted in 10 l of water. First, the surface must always be thoroughly soaked with water and neutralised with water again after cleaning. Stains of paint, varnish, silicon or epoxy must be removed using special cleaning products.

Regular cleaning – routine periodic cleaning
Routine maintenance and cleaning of all types of tiles is performed by sweeping, vacuum cleaning or wiping the surface with a wet cloth or mop, using a suitable neutral detergent (pH 6.0 to 8.0); here we recommend **RAKO SYSTEM CL803**, for all types of wall and floor tiles at areas with a low amount of traffic (flats, family houses, offices) and with a high amount of traffic (shops, halls, hallways, apartment buildings...), we recommend **RAKO SYSTEM CL801**.

Heavy duty cleaning – thorough cleaning, carried out 1–2 times a year
It is used to remove heavily soiled surfaces created during the use of compact tiles and vitrified tiles in group BIb and BIa, which could not be removed by regular cleaning. Alkaline detergents (pH > 8) are most frequently used for removing greasy residues deposited on floor tiles are; we recommend **RAKO SYSTEM CL810**. For removing lime sediments caused by water hardness acidic detergents (pH < 6), we recommend **RAKO SYSTEM CL801**. In combination of these agents, we can remove also heavily soiled tiles. To clean heavily soiled surfaces, containing fatty deposits on wall tiles in group BIII, alkaline cleaners (pH> 8) are used; we recommend using the **RAKO SYSTEM CL810** and dilution recommended by the manufacturer. To remove lime scale deposits from hard water on wall tiles in group BIII, alkaline cleaners (pH< 6), such as the **RAKO SYSTEM CL810**, are recommended. Before the use of acidic detergent, moisten the tile surface, and, after application of diluted **RAKO SYSTEM CL801** (40–100 ml in 10 l of water), rinse the tile surface several times with clean water.

Do not use cleaning agents containing hydrofluoric acid for maintenance of wall and floor tiles, because ceramic tiles are massively distorted and permanently damaged after short-term exposure!
Never use non-recommended detergents which cause a film to develop on the tile surface which may reduce anti-slip properties of ceramic floor tiles, damage the glazing or optically change the surface, create smudges and impair cleaning ability. Always closely follow instructions of the detergent manufacturer in respect of application and dosing, since incorrect application can disturb and damage the ceramic surface and sealing materials.

Special cleaning procedures:

- **Decorative products with golden, platinum and mother-of-pearl surface finish**, must be cleaned with **RAKO SYSTEM CL803** detergent. Never use detergents and tools containing abrasive particles or corrosive chemicals for cleaning these products.
- **Metallic surface finishes**, e.g. the Defile (brown) series have a thin surface layer containing metal, and these require extra care when being cleaned. To reduce residues of the grouting material and dirt stains, we recommend to first wet the grouting with water and then degrease the tiles with a diluted **RAKO SYSTEM CL810** detergent (40–100 ml in 10l of water), then neutralise them with water and clean them with a **RAKO SYSTEM CL801** solution (40–100 ml in 10 l of water), and again rinse with clean water. The combination of the two detergents can then be alternated to achieve a perfect result. We do not recommend applying impregnation coating on metallic surfaces or using untested detergents.
- **Anti-slip floors must be cleaned regularly using recommended detergents** depending on the character of their soiling. Any dirt, sand, greasy deposits or remnants of snow and ice significantly reduce the anti-slip properties of the floor tile surface. For greasy patches we recommend **RAKO SYSTEM CL810** alkali detergent in the above specified concentration. The floor must be thoroughly rinsed with plenty of clean water before and after the use of acidic and alkali detergents. For cleaning larger areas we recommended using cleaning machines, either with a gentle mechanical cleaning mechanism or with pressure water. For removing water from the surface of anti-slip floor tiles, e.g. on walkways around swimming pools or floors in large kitchens, we recommend special tools (e.g. a window cleaning blades). Applying the **RAKO SYSTEM CL809** impregnation products makes the maintenance of both smooth and anti-slip floor tiles easier.
- **Floor tiles treated with the RAKO SYSTEM CL809 impregnation product** are easier to maintain and require less detergent (lower concentration). It is always necessary to use it on polished, vitrified, unglazed tiles TAURUS immediately after laying and cleaning, because polishing technology reduces the resistance to staining. **Polished unglazed flooring with open pores on the surface is more susceptible to the absorption of dirt and impurities. The very thin layer of RAKO SYSTEM CL809 impregnation product does not change changes the surface colour nor the floor tiles' anti-slip properties, and significantly reduces the amount of dirt accumulated on the tiles surface.** The product is applied in two very thin coats on carefully cleaned and dry tiles. For regular maintenance of treated floor tiles a solution of the **RAKO SYSTEM CL803** detergent with water – see above, will be sufficient.

A complete list of detergents can be found in **www.rakosystem.eu**, for information and advisory services contact our information e-mail: **info@rako.cz**, telephone: +420 800 303 333.

Cleaning procedures

When cleaning standard ceramic surface please follow these procedures.

Type of cleaning	Process	Cleaning agents and dilution
Post-construction cleaning - cleaning of loose dirt	Sweeping or vacuuming	
Post-construction cleaning – cleaning of cement residues, mineral, calcium and magnesium deposits, cement bloom, paint rock, rust	1. Ceramic tiles and joints should be completely wet (use sufficient quantity of clean water) 2. Apply the cleaning solution, leave for 10 to 15 min. then clean with microfiber mop, pad or nylon brush or sponge 3. Remove dissolved dirt 4. Mop the tiles up twice with sufficient quantity of water	Acid detergent, such as **RAKO SYSTEM CL802**, dosage: For wall tiles in group BIII, 50–100 ml for 10 l of water; for floor tiles in group BIb and BIa, 100-200 ml for 10 l of water
Removal of fats, oils, waxes, cosmetics and abrasions of from shoes	1. Apply the cleaning solution, let act leave for 10 to 15 min and clean with microfiber mop, pad or nylon brush or sponge 2. Remove dissolved dirt 3. Wash the tiles thoroughly with water afterwards	Alkaline cleaning agent eg **RAKO SYSTEM CL810**, Dilution: 40-100 ml per 10 liters of water
Regular cleaning - removal of normal soiling, such as dust, slightly sticky dirt, dirt from the street	Apply the cleaning solution, and clean with mop, pad, nylon brush or cloth	Neutral detergent eg **RAKO SYSTEM CL803**, **RAKO SYSTEM CL801** is recommended for areas with a high amount of traffic Dilution: 20-100 ml per 10 liters of water Bathrooms, WC - **RAKO SYSTEM CL804** (direct spraying)
General cleaning - acidic environment (mineral impurities: residues of cement, lime, calcium soaps, rust, scale, urines)	1. First, soak the tiles (joints)! 2. Apply the cleaning solution (concentrated solution may be used on stains) and clean using a mop with microfibers, a pad, or a cleaning machine 3. Remove the dissolved dirt by suction 4. Wash the tiles again thoroughly with water	**RAKO SYSTEM CL801**, dosage: 40-100 ml for 10 l of water **RAKO SYSTEM CL804** - by direct spraying
General cleaning - alkaline environment (contaminated with grease or oil)	1. Apply the cleaning solution and clean using a mop with microfibers, a pad, or a cleaning machine 2. Remove the dissolved dirt by suction 3. Wash the tiles again thoroughly with water	**RAKO SYSTEM CL810**, dosage: 40-100 ml for 10 l of water

10. Certification of products, quality management system, and ecological evaluation

LASSELSBERGER, s.r.o. constantly monitors the quality of its products. A quality management system for products and services has been developed in accordance with the international standard ISO 9001:2016. This management system has been regularly reviewed by the accredited company, which has also issued the certificate of its compliance according to CSN EN ISO 9001:2016.

RAKO products have been regularly reviewed by the independent accredited testing laboratory **Technicky and zkusebni ustav stavebni Praha** (Technical and Building Institute Prague) to verify conformity of tiles properties on the basis of the regulation of the European Parliament and EU Council No. 305/2011.

In addition, products and minerals are regularly reviewed by an independent testing laboratory for radiation-hygienic safety in agreement with the Decree issued by the State Office for Nuclear Safety No. 422/2016 Coll. within the definitions of Act No. 263/2016 Coll., which has insures the measurement of natural radionuclide in final products.

Based on the above-mentioned supporting documents, the following declarations have been issued to meet the needs of customers and distributors, in agreement with the European directives.

A/ DECLARATION OF PERFORMANCE AND DECLARATION OF CONFORMITY

1/ Verification of stability of ceramic tiles properties according to the regulation of the European Parliament and EU Council No. 305/2011, dated 9th March 2011, Evaluation system 4:

Declaration of performance: T13 01 – vitrified unglazed floor tiles BIa
T17 01 – vitrified unglazed BIa mosaic, maximum size of 7x7 cm

Declaration of performance: D13 01 – vitrified glazed floor tiles BIa
D17 01 – vitrified glazed BIa mosaic, maximum size of 7x7 cm
D18 01 - vitrified, large-format glazed floor tiles BIa

Declaration of performance: G13 01 – compact glazed floor tiles BIb
G17 01 – compact glazed BIb mosaic, maximum size of 7x7 cm
Declaration of performance: W13 01 – glazed wall tiles BIII

2/ The stableness of the properties of ceramic and glass mosaics and that of ceramic shaped tiles has been tested in accordance with the provisions of Act No. 22/1997 Coll. on technical requirements on products in conjunction with Government Decree No. 163/2002, in the wording of Government Decree No. 312/2005 Coll.

Declaration of conformity P 01 – Mosaics for wall and floor tiles (government decree No. 163/2002 in the wording of GD No. 312/2005 Coll.)
Declaration of conformity P 02 – Shaped ceramic bricks, step tiles, etc. (government decree No. 163/2002 in the wording of GD No. 312/2005 Coll.)
Declaration of conformity P 03 – Natural stone products
Declaration of conformity P 04 – Ceramic relief listellos and ceramic accessories (government decree No. 163/2002 in the wording of GD No. 312/2005 Coll.)

Manufacturer´s declarations are available in various languages at www.rako.eu..
(http://www.rako.cz/ke-stazeni/prohlaseni.html;
or http://www.rako.cz/en/download/declarations.html,
http://www.rako.cz/de/download/erklarungen.html).

B/ CERTIFICATES IN THE CZECH REPUBLIC

The certificates and STO (building technical attests) issued by the accredited testing laboratory No. 204 TZUS Plzen confirm compliance of the found properties of RAKO ceramic tiles with the requirements of **EN 14411:2016** and related regulations for the following products:

Ceramic tiles, dry pressed with water absorption over 10% declared according to CSN EN 14 411, Group BIII, Annex K

Ceramic tiles, dry pressed with water absorption 0.5% to 3% declared according to CSN EN 14 411, Group BIb, Annex H

Ceramic tiles, dry pressed with water absorption to 0.5% declared according to CSN EN 14 411, Group BIa, Annex G

Building technical attest STO No. 030 - 049913 – mosaic (governmental order No. 163/2002 Coll., as amended by the governmental order No. 312/2005 Coll.)

Building technical attest STO No. 030 - 049916 - ceramic special pieces (governmental order No. 163/2002 Coll., as amended by the governmental order No. 312/2005 Coll.)

Building technical attest STO No. 030–054498 – ceramic relief listellos and ceramic accessories for interior wall tiling (in harmony with Act No. 22/1997 Coll., pursuant to government regulation No. 163/2002 Coll., in the wording of government regulation No. 312/2005 Coll., government regulation No. 215/2016 Coll.)

Building technical attest STO No. 030–049079 – ceramic tiling or the blind and weak-sighted (according to Act No. 22/1997 Coll., pursuant to government regulation No. 163/2002 Coll., in the wording of government regulation No. 312/2005 Coll.)

C/ FOREIGN CERTIFICATES OF PRODUCTS

Compliance of properties of LASSELSBERGER, s.r.o. products with applicable standards on the respective territories has been also confirmed by certificates for the following countries:

FRANCE
RUSSIA
UKRAINE

D/ QUALITY MANAGEMENT SYSTEM CERTIFICATE

A CQS certificate of a quality management system under CSN EN ISO 9001:2016 for the process, design, development, manufacture and sale of ceramic lining and trading in an additional product line, including customer service at LASSELSBERGER, s.r.o., was issued on 30. 6. 2019 by the certification authority – the Czech Association for Quality Certification (CQS) in Prague.



E/ ENVIRONMENTAL PRODUCT DECLARATION (EPD)

Declaration on production of environmentally friendly products, complying with the applicable national and international standards ISO 14 025 and EN 15 804, and utilising the environmentally friendly management system. Technical and environmental information on products is provided in the catalogues RAKO HOME | OBJECT.

F/ ENERGY MANAGEMENT SYSTEM CERTIFICATE

An energy management system certificate under CSN EN ISO 50001, the objective of which is to optimise the use of energy in the production process and in non-production areas, to constantly reduce energy demand, and increase energy efficiency. The certificate was issued on 30 June 2016.

G/ LEED and BREEAM – LASSELSBERGER s.r.o. prepared for its customer materials where the possibility to meet the LEED and BREEAM criteria for the complete assessment of buildings is specified for ceramic tiles.

At the internet address
http://www.rako.cz/ke-stazeni/certifikaty.html and http://www.rako.cz/ke-stazeni/ekologie_epd.html our customers can find all the necessary documents for ceramic tiles, copies of the declarations of performance and conformity of products with the requirements for building products.

A confirmation of conformity with the requirements for these products is provided in each delivery note.

Information lines:
Tel.: **+420 800 303 333**
E-mail: **info@rako.cz**

11. Warranty conditions

The manufacturer LASSELSBERGER, s.r.o. Plzen provides for all its ceramic tiles a

2-year warranty

for the properties determined by EN 14411:2016.

The warranty shall apply only whilst observing the manufacturer's recommendations, proper storage and handling, as well as proper execution of construction and fixing work. It does not apply to defects caused by improper handling, improper cleaning and natural hazards (earthquakes, floods, fire, etc.).

Provided a customer receives products whose properties fail to meet the agreed quality then he/she is entitled to claim these products. In doing so, a specific procedure must be met. All claims must be made immediately in writing, and submitted to the immediate supplier – dealer. For visible defects (sizes, flatness, glaze defects, shades, type confusion), the claim must be made for the goods sent in original packaging and **before starting the fixing work**.

Dear Customer,

We are always available to answer questions and make recommendations concerning LASSELSBERGER, s.r.o. ceramic tiles and their specific applications.

LASSELSBERGER, s.r.o.
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This catalogue is not subject to change procedures and may be modified without notice. The updated version replaces earlier one in the full scope. This edition has been valid since 10/2019.

 wall tile

 floor tile

 frost resistance

 non-frost resistance

 a tile with increased chemical resistance

PEI surface wear resistance

 deep wear resistance

 slip resistance – footware

 slip resistance – barefoot

 price group per unit of measurement



nominal size of a tile (cm)



declared size of a tile (mm)



norm

 pcs/carton



pcs/m²



m²/carton

 carton/pallet



m²/pallet



kg/carton



kg/m²



gross pallet

 rectified

 mosaic

 digital printing technology

 glazed porcelain floor tile, EN 14411:2016
BIa, E≤0,5 %

News news 2020

intentional or possible colour variances, surface structures and design or diversity of colours:

 minimal deviations

 small deviations

 great deviations

 great and fully accidental deviations


1883-2020
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