

TECHNICAL CATALOGUE

2018

Contents

	Page
1. Basic product categories	3
1.1 LASSELSBERGER, S.R.O. CERAMIC TILES FOR 2018	3
1.2 BUILDING CHEMISTRY FOR FIXING OF CERAMIC TILES – RAKO SYSTEM	3
2. Identification system and recommended applications of ceramic tiles by LASSELSBERGER, s.r.o.	4
2.1 TYPES OF CERAMIC TILES BY LASSELSBERGER, s.r.o.	4
2.2 IDENTIFICATION OF CERAMIC TILES IN THE CATALOGUE	5
2.3 IDENTIFICATION OF PRODUCTION BATCHES	6
3. Overview of tile properties	8
3.1 SIZES AND GEOMETRIC PARAMETERS	8
3.2 WATER ABSORPTION	9
3.3 FROST RESISTANCE	10
3.4 STRENGTH	11
3.5 ABRASION RESISTANCE OF GLAZED FLOOR TILES - ABRASION RESISTANCE (PEI)	13
3.6 ABRASION RESISTANCE OF UNGLAZED FLOOR TILES – DEEP ABRASION RESISTANCE OF TAURUS TILES	14
3.7 SLIP RESISTANCE OF FLOORS	14
4. Chemical properties	22
4.1 RESISTANCE AGAINST CHEMICALS PURSUANT TO THE EN ISO 10545-13 STANDARD	22
4.2 RESISTANCE TO STAINING PURSUANT TO EN ISO 10545-14	22
5. Hygienic properties of tiles	24
6. Thermal characteristics of tiles	24
7. Electrical properties of tiles	25
8. Optical characteristics of tiling elements – LRV	25
9. Technical parameters	27
10. Shopping tips and considerations before fixing	30
11. Tile processing	32
11.1 PREPARATION OF THE BASE AND TILES BEFORE FIXING	32
11.2 TILE CUTTING AND DRILLING	32
11.3 TILE FIXING AND IDENTIFICATION OF ADHESIVE MATERIALS	33
11.4 FROST RESISTANT TILING ON BALCONIES	35
11.5 UNDERFLOOR HEATING	37
11.6 STAIRS	40
12. Jointing of tiling elements, dilatation	41
12.1 NON-FLEXIBLE JOINTS	41
12.2 FLEXIBLE EXPANSION JOINTS	42
13. Maintenance of tiled surfaces	44
14. Certification of products, quality management system, and ecological evaluation	47
15. Warranty conditions	50

1. Basic product categories

1.1 LASSELSBERGER, S.R.O. CERAMIC TILES FOR 2018

The offer of LASSELSBERGER, s.r.o. 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 and RAKO OBJECT catalogues, while pool solutions are specified in the POOL catalogue, or at **www.rako.eu**

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 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.eu** and **www.rako.eu**.

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:

TAURUS fully vitrified unglazed floor tiles, Catalogue No.: Txxxxxxx

Fully vitrified unglazed frost-resistant ceramic tiles with very low water absorption less than or equal 0.5 %, made in compliance with EN 14411:2016 Bla 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 restaurants, administrative buildings, car showrooms, foodprocessing and chemical plants, as well as outdoor horizontal surfaces of balconies, terraces, and passageways. They are characterized by high strength, frost and chemical resistance. The polished unglazed tiles are designed for exclusive interiors and facades.

The vitrified unglazed TAURUS tiles are offered in monochrome as well as multicolour variants with anti-slip relief, standard smooth or polished surface. The material mass (body) can be coloured, thus replacing the aesthetic function of a glaze. In this way, we create the actual surface design. The tiles with declared anti-slip surface finish must be used for floors with the risk of slipping pursuant to the applicable regulations. Large tiles (30 x 60 and 60 x 60 cm) and polished tiles are rectified for accurate dimensions allowing for precise laying and format combinations. TAURUS INDUSTRIAL series tiles are thickened to 15 mm for heavily stressed floors in industrial operations (workshops, manufacturing halls and warehouses).

KENTAUR fully vitrified glazed floor tiles, Catalogue No.: Dxxxxxxx

are fully vitrified ceramic glazed frost resistant tiles with very low water absorption less than or equal to 0.5 %, manufactured to comply 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 KENTAUR tiles are available in many colours and designs and surface finishes (smooth, relief, anti-slip, lapped etc.). The material mass (body) is in some products coloured in order to match the colour of the mass with the glaze where anti-slip grooves are milled in the body or, for example, during grinding of the round step edges of the step tiles. Large size tiles (30 x 60, 60 x 60, 40 x 80, 80 x 80, 20 x 120 and 30 x 120 cm) are rectified for accurate dimensions allowing for precise laying and format combinations.

Compact glazed floor tiles, Catalogue No.: Gxxxxxxx

are 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 Blb 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, swimming pools in interiors, saunas, deep freeze rooms, food processing plants, etc. **These tiles are not intended for horizontal surfaces on balconies and terraces. Water absorption of the POOL tiles is under 1 %, they are frost resistant and suitable for showers and exterior pools.**

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 use. Tiles with the gold, platinum and mother-of-pearl surface can be used only for interior walls!

Wall tiles, catalogue number: Wxxxxxxx

are 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, underground water, acids and alkali, their vapours and abrasive detergents. They are thus used for tiling walls of bathrooms, kitchens, laundries or other interiors. **In an environment where the wall tile will be exposed to the direct action of water, in a shower enclosure etc., it is necessary to use a CG2WA type grouting material with reduced water absorption.** The tile surface is smooth or embossed, with glossy, semi-matt or matt glaze, namely transparent, semi-transparent, or non-transparent, plain- or multi-coloured, or decorated with various techniques (digital print, 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. 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, enabling precise laying with a minimum joint.

Non-ceramic accessory materials – glass of Catalogue No. Vxxxxxxx, natural stone of Catalogue No. 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 sintered drawn floor tiles and shapes, Catalogue No.: XPxxxxxx

Highly sintered glazed frost-resistant ceramic products with very low absorption less than or equal to 0.5%, made by a drawing technique in accordance with EN 14411:2016 Ala GL, Annex M, suitable for professional designs of edges of public as well private indoor and outdoor swimming pools.

2.2 IDENTIFICATION OF CERAMIC TILES IN THE CATALOGUE

The following data have been provided in a uniform format for ceramic tiles in the LASSELSBERGER, s.r.o. 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 – vitrified unglazed ceramic tiles TAURUS	water absorption ≤ 0.5 % gr. Bla
D – vitrified glazed ceramic tiles KENTAUR	water absorption ≤ 0.5 % gr. Bla
G – glazed ceramic tiles	water absorption $\geq 0.5 \leq 3$ % gr. Bla
W – glazed ceramic wall tiles	water absorption ≥ 10 % gr. BIII
X – glazed ceramic tiles POOL	water absorption ≤ 0.5 % gr. Ala
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. **Description of intentional variation of colours, structure of the surface and design of V1 to V4 decorations**

Before laying, individual pieces 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. 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.

Variation of shades, embossing, or colours within one product:

- 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

For example, the Random series (V4):



2.3 IDENTIFICATION OF PRODUCTION BATCHES

All ceramic tile products are made in batches which batches 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, packages include identification of shade, declared dimensions, quality and, as applicable, abrasion and slip resistance properties.

Tiles from batches with different identification of the colour shade or calibre – 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 (letters or numerals), see Fig. 1, 2, table with declared size W, mm.

Identification of a product batch in documentation – structure of a 10-character number:

Example:

Where:

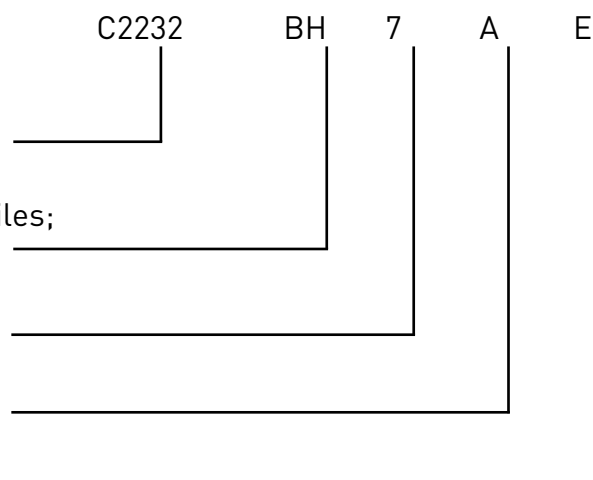
a) country, production plant, line, or supplier (5)

b) colour shade of the batch, 2 characters = glazed tiles;
5th position + 2 characters = unglazed tiles (2/3)

c) declared size in mm (1)

d) pallet type: A – complete, B – incomplete (1)

e) marked with EAN code – E, no code – N (1)



Identification of the catalogue number, shade, declared size (Tab. W, mm), quality and abrasion resistance symbols on a package – see examples of labelling.

Fig.1 Cardboard packaging for glazed tiles



colour shade caliber in mm quality abrasion resistance

Label for glazed wall and floor tiles

COBJ.WAAKB104.RA.1				
SYSTEM		Size / Rozměr: 25x33 cm		
matt / mat		Pallet: 54 boxes 81,000 M2		
Plant / Závod	Line, shade / Linka, odstín	Size/velikost	PAL	EAN
C223	4	LE	0	A E

colour shade caliber in mm nominal size

Fig.2 Cardboard packaging for unglazed tiles



colour shade caliber in mm quality

Label for unglazed floor tiles

CGRA.TAA35065.LB.1				
TAURUS GRANIT		Size / Rozměr: 30x30 cm		
standard / standardní		Pallet: 52 boxes 52,000 M2		
Plant / Závod	Line, shade / Linka, odstín	Size/velikost	PAL	EAN
C231	8	L8	9	A E

colour shade caliber in mm nominal size

Prior to starting to fix tiles it is necessary to verify the batch-related data specified on packaging. The combination of the tiles with different catalogue numbers on one surface must be discussed and ordered in writing with the supplier or dealer in advance.

3. Overview of tile properties

3.1 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. The declared size is specified on packaging and delivery notes in millimetres. Accurate values and tolerance for all types of LASSELSBERGER, s.r.o. products are provided in information annexes to the catalogues RAKO HOME and RAKO OBJECT.

Rectified Tiles

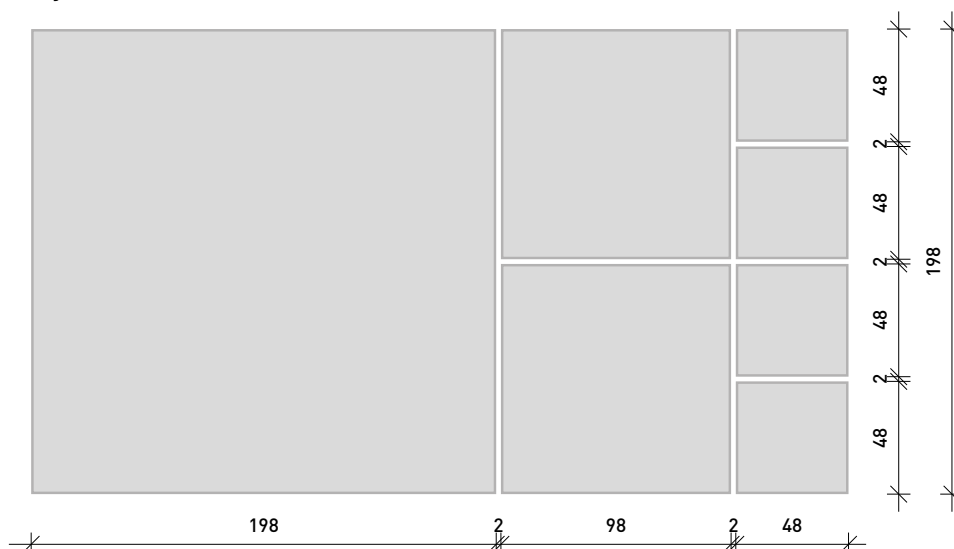
Low-absorption floor tiles of sizes 10 x 10, 20 x 20, 22.5 x 45, 22.5 x 22.5, 15 x 45, 45 x 45, 15 x 60, 30 x 60, 60 x 60, 40 x 80, 80 x 80, 20 x 120 and 30 x 120 cm and wall tiles of sizes 30 x 60 and 30 x 90 cm are mainly offered with rectified edges, which are ground with high precision and allow installation with a narrow joint from 2 mm. In the catalogue, **rectified (ground) tiles are always marked with the letter R icon**. 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 and 45 x 45 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 tiles into a single surface with continuous joints. **However, joint widths narrower than 2 mm reduce the capability to absorb the tension between the base and the tile itself. For example, the Austrian ÖNORM B 3407:2015 standard stipulates the minimum width of a non-elastic joint of 2 mm for interiors and 5 mm for exteriors. 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, décors

These are offered for example in nominal sizes 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 mesh – 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. 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/en/download/certificates.html>.

3.2 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 14411:2016 BIII GL, annex L	only for interior walls
0.5% < E ≤ 3%	Glazed tiles, catalogue numbers G.....	EN 14411:2016 BIb GL, annex 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 14411:2016 BIa GL and UGL, annex G EN 14411:2016 AIa GL, annex 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 cabins etc., the CG2 WA grouting with reduced water absorption must be used for joint filling, for example GF grouting – see chapter 12. Jointing of tiling elements, 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 TAURUS and KENTAUR, with water absorption less than 0.5 %, supplied according to EN 14411:2016 BIa GL and UGL, annex G, are particularly suitable for horizontal and vertical exterior surfaces. They can be used universally. 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.

3.3 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. Exterior walls and pavements should be tiled with highly resistant unglazed or glazed vitrified tiles of the BIa group pursuant to EN 14411:2016 standard.

Ceramic tiles by LASSELSBERGER, s.r.o. 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 TAURUS and KENTAUR (EN 14411:2016 BIa) are the most suitable products for horizontal frost resistant surfaces of terraces and balconies.** Glazed tiles ColorTWO (EN 14411:2016 BIb) are suitable for facades 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, facades and edges. Nevertheless, it is also very important to observe the recommended system solutions and fixing procedures (see chapter 11. Instruction for Tile Processing – 11.4 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.



3.4 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 size and larger thickness are more resistant than thinner tiles of a larger size. The thickness of 8 to 10 mm is suitable for common applications in housing premises, sanitary facilities, administration buildings etc. The tiles of common thicknesses can be loaded with car tyres (e.g. in car showrooms). The tiles 15 mm are suitable for floors exposed to high mechanical loads e. g. in stores, halls, workshops. Floor tiles TAURUS INDUSTRIAL and glazed vitrified tiles ROCK INDUSTRIAL with the increased thickness of 15 mm, featuring high strength and breaking load at the moment of tile breaking - up to 5 500 N (÷ 550 kp), see data in Table 3, are recommended for floors loaded with solid rubber wheels of fork-lift trucks or polyamide wheels of handling carts. 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 tile fracture is (for example) up to 5 500 N (÷ 550 kg) with a size of 20 x 20 cm and with a thickness of 15 mm – 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/mm² (MPa) is required by the standard. The modulus of rupture of compact and vitrified tiles KENTAUR and TAURUS is at least 35 N/mm² (35 MPa), resp. 40 N/mm² (MPa), and it is significantly higher than required by the standards. The standards require at least 30, resp. 35 N/mm² (MPa); see the Technical parameters shown in the RAKO HOME and RAKO OBJECT catalogue.

Calculation of modulus of rupture (N/mm², MPa) according to EN ISO 10545-4

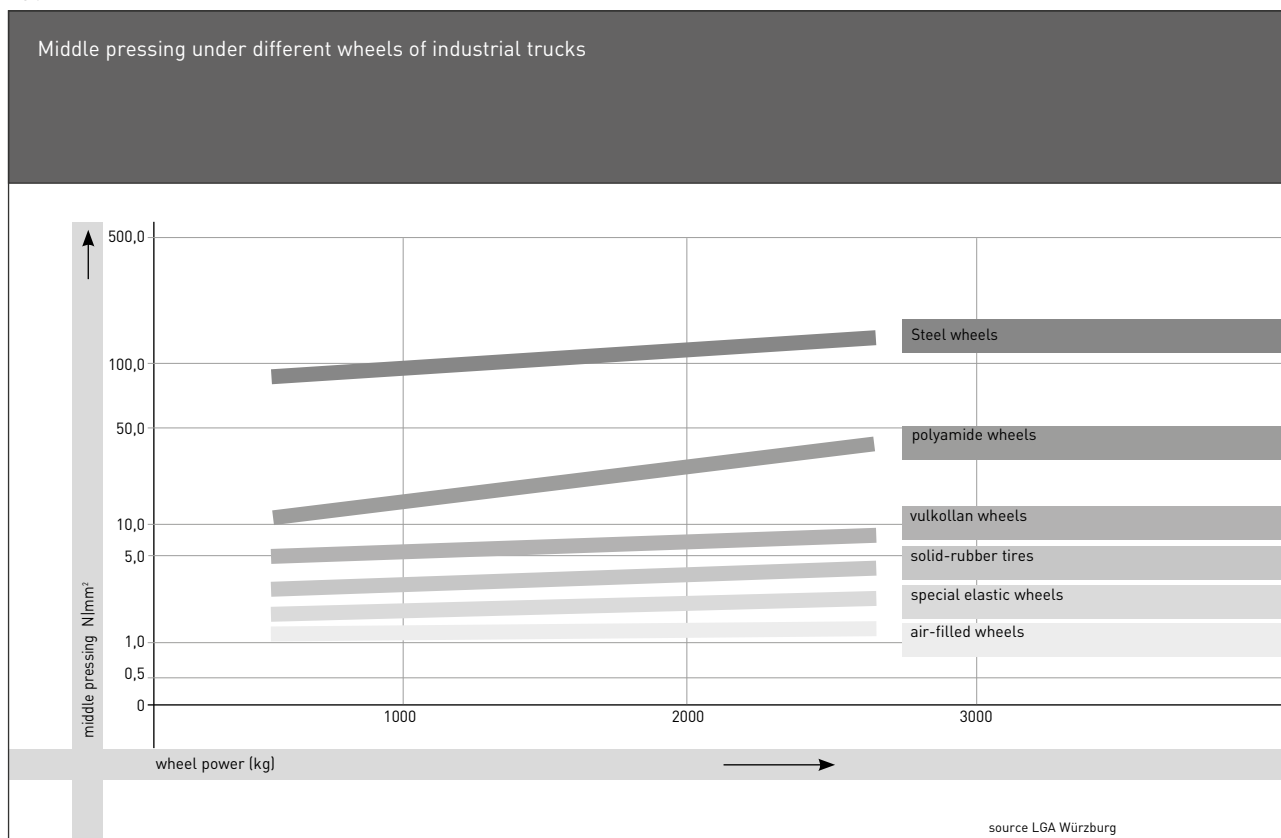
$$R = \frac{3 \times F \times L}{2 \times b \times h^2}$$

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/mm²

Tab. 1



Tab. 2

Work procedures for wall tiles with a high amount of traffic (recommending guideline according to German FDF 2005)			
Traffic load group	Possible application	Breaking load after breaking the tile (N)	Load (N/mm ²)
1	flats, bathrooms	unter / under / moins de 1500	-
2	shops, offices, exhibitions	1 500–3 000	up to 2
3	shops, industry, warehouses	3 000–5 000	2–6
4	industry (motion of trucks with volcano or polyamide)	5 000–8 000	6–20
5	industry (motion of trucks with polyamide or metal wheels)	more than 8000	more than 20

Tab. 3

	Dimensions cm	Thickness cm	Breaking load N	
Taurus	14,8 x 14,8	0,9	2 000	ⓕ Breaking load Ⓛ Bearing Span h
	19,8 x 19,8	0,9	1 900	
	19,8 x 19,8	1,5	5 500	
	29,8 x 29,8	0,9	1 700	
	29,8 x 29,8	1,5	5 000	
	59,8 x 59,8	1,0	3 000	
Rock Industrial	29,8 x 59,8	1,5	3 000	
Note: At these values the tile is broken by bending stress.				

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 LASSELSBERGER, s.r.o. 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 OF TAURUS TILES



The abrasion resistance of **unglazed tiles** in operation is best characterized by **deep abrasion resistance**.

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 standard EN ISO 10545-6. Pursuant to the standard, the abraded volume must not exceed 175 mm³. Fully vitrified **TAURUS** 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 **TAURUS** tiles makes it possible to use them for floors with extremely busy foot traffic, e.g. in supermarkets, public transport stations, underpasses, passageways, garages, and the like.

3.7 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 floor standard CSN 74 4505, with more details specified in the safety regulations ASR A1.5/1, 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 cm³ in proportion to the tile area of 1 dm² – 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 $\mu \geq 0,3$	CR	Floors of apartment and residential rooms	All floor tiles LASSELSBERGER, s.r.o.	$\mu \geq 0.3$
Decree 268/2009 Coll. CSN 74 4505 Floors	sliding friction coefficient $\mu \geq 0,5$	CR	Floors of buildings for public use	Floor tiles marked with icons see the RAKO HOME and RAKO OBJECT catalogues or www.rako.eu 	$\mu \geq 0.5$
Decree 398/2009 Coll. CSN 73 4130 Staircases and sloping ramps	For staircases: sliding friction coefficient on a walking staircase surface $\mu \geq 0.5$, on a front edge of parallel treads up to the distance of 4 cm from the edge $\mu \geq 0.6$ For ramps: sliding friction coefficient $\mu \geq 0.5 + \tan \alpha$	CR	staircases and sloping ramps for people with limited mobility	Selected floor tiles see the RAKO HOME and RAKO OBJECT catalogues or www.rako.eu 	$\mu \geq 0.6$
EN 13451-1 Swimming pools ASR 1.5/1, 2 Safety regulations (Germany) DIN 51 097	slip angle $> 12^\circ$	EU, CR	Changing rooms, corridors for barefoot walking...	Floor tiles marked with icon 	A (12°)
	slip angle $> 18^\circ$	EU, CR	Public showers, pool decks, paddling pools, stairs...	Floor tiles marked with icon 	B (18°)
	slip angle $> 24^\circ$	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 35°	Germany, EU recommended for CR	Floors of buildings for public use	Floor tiles marked with icons see the RAKO HOME and RAKO OBJECT catalogues 	R9-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:

- Determination of friction coefficient of tile surface pursuant to MMR Decree 268/2009 Coll., and CSN 74 4505 standard – Floors, or
- 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
- 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 two 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**).



For work floors, the regulations **ASR A1.5/1, 2 – Technical rules for floors**, DIN 51 130:2014-02 and CSN 72 5191 recommend anti-slip tiles for the following fields of application:

Slip angle	Identification	Use
6–10°	R9	Interior and resting areas, canteens, offices, official building corridors, school corridors, hospital corridors...
10–19°	R10	Warehouses, small kitchens, sanitary premises...
19–27°	R11	School kitchens, washing lines, laundries, entrance areas, outdoor stairs...
27–35°	R12	Large kitchens, working pits, dairies...
over 35°	R13	Fat refineries, leather works, and slaughter houses...

Requirements for slip resistance of floors are given in national regulations and standards, see Table 2. Floors should be smooth, with a prescribed degree of anti-slip surface, and they should be maintained on a regular basis. The friction coefficient of min. 0.5 is prescribed for public floors by Decree 268/2009 Coll. and standard CSN 74 4505 for floors. In cases where the floor surface may be wet (e.g. entrance areas, uncovered parts – terraces, balconies, stairs, pool decks, showers, bathrooms, etc.), the slip resistance criteria must be met also for wet surfaces. For more accurate selection of anti-slip parameters for public building floors it is recommended to use the Technical Rules ASR A1.5/1, 2 for floors in workplaces with the risk of slipping, also listed in the RAKO OBJECT catalogue.



For floors for barefoot walking, according to CEN/TS 16 165:2012, EN 13451-1, DIN 51 097, GUV 26.18 and CSN 72 5191, the anti-slip classes are defined pursuant to the application area as follows:

Slip angle	Identification	Use
> 12°	A	Mainly dry corridors for barefoot walking, changing rooms, bottoms of pools from 80 to 135 cm, dry saunas...
> 18°	B	Public showers, pool decks, paddling pools, stairs, bottoms of pools up to 80 cm, bottoms of pools with gradients up to 8° and depths below 135 cm, steam saunas...
> 24°	C	Underwater stairs, inclined pool decks, starting blocks, pool bottoms with gradient above 8° and depths below 135 cm, walking areas of toboggans...

The catalogue with the POOL programme offers anti-slip products from groups A > 12°, B > 18° and C > 24° for barefoot walking for public showers and pool surroundings, where the requirements according to EN 13451-1 must also be followed, and based on our experience, we recommend that you always consult it with our project team experts.

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 cm³/dm²	Identifier
> 4	V4
> 6	V6
> 8	V8
> 10	V10

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

Program Series	Friction coefficient		DIN 51 130:2014-02		DIN 51 097
OBJECT 2018 TAURUS	μ dry	μ wet	R	$\frac{V}{cm^3/m^2}$	[A, B, C]
Surface S 5 x 5 cm	≥0,7	≥0,6	R10	—	B
Surface S 10 x 10 cm	≥0,7	≥0,6	R10	—	B
Surface S 15 x 15 cm	≥0,7	≥0,6	R10	—	A
Surface S 20 x 20 cm	≥0,6	≥0,5	R10	—	A
Surface S ≥ 30 x 30 cm	≥0,6	≥0,5	R9	—	A
Surface S ≥ 30 x 30 cm Porfyr	≥0,6	≥0,6	R10	—	A
Oberfläche SB	≥0,7	≥0,6	R10	—	A
Relief 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
Step tile Taurus Granit, Porfyr	≥0,6	≥0,6	R10	—	A
Step tile Taurus Color	≥0,6	≥0,6	R 9	—	A
Step tile Taurus with relief SR7	≥0,7	≥0,6	R11	—	B
Taurus surface SL	≥0,5	≥0,3	—	—	—
Shaped pieces for blind persons*	≥0,7	≥0,6	R11	—	A
ColorTWO und POOL					
Surface anti-slip embossed (GRS...)	≥0,6	≥0,5	R10	—	B
Surface anti-slip embossed (GRN...)	≥0,6	≥0,5	R10	—	B
Surface anti-slip embossed (GAF...)	≥0,6	≥0,5	R10	—	B
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
Surface matt (GAA...)	≥0,5	≥0,3	—	—	—
Mosaic matt 5 x 5 cm	≥0,5	≥0,5	—	—	—
Mosaic matt 2,5 x 2,5 cm	≥0,5	≥0,5	—	—	—
Surface anti-slip C (GRH...)	≥0,7	≥0,5	—	—	C

"V4" - drainage space in relief surface [4 cm³/dm²]

*intended only for guiding and warning strips for the blind

Anti-slip character of floor tiles more demanding on cleaning

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

Program Series	Friction coefficient		DIN 51 130:2014-02	DIN 51 097
Fußböden 2018	μ dry	μ wet	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
Board (DAK...)	≥0,6	≥0,5	R9	A
Board (DDM06..., DDPSE...)	≥0,6	≥0,5	R10	A
Cemento (DAK...)	≥0,6	≥0,5	R9	-
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
Clay	≥0,6	≥0,5	R9	-
Clay (DDM06...)	≥0,6	≥0,5	R10	A
Como (DAR3B..., DDP3B...)	≥0,6	≥0,5	R9	A
Como (DDM05...)	≥0,6	≥0,5	R10	A
Concept	≥0,6	≥0,5	R9	-
Defile (DAA...)	≥0,6	≥0,5	R9	-
Defile (DDM06...)	≥0,7	≥0,6	R10	B
Era	≥0,6	≥0,5	R9	A
Era (DDM05...)	≥0,7	≥0,6	R10	B
Extra	≥0,6	≥0,5	R9	A
Extra (DAR12..., DDM06...)	≥0,6	≥0,5	R10	B
Faro	≥0,6	≥0,5	R9	A
Faro (DDM06...)	≥0,6	≥0,5	R10	B
Fashion	≥0,6	≥0,5	R9	A
Fashion (DDMBG...)	≥0,6	≥0,5	R10	A
Form (DAA..., DAR...), ([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
Geo (DDP44...)	≥0,7	≥0,6	R10	B
Golem	≥0,6	≥0,3	R9	-
Kaamos (DAA..., DAK...)	≥0,6	≥0,5	R10	A
Kaamos (DAK12..., DDM06...)	≥0,6	≥0,5	R10	B
Pebbles	≥0,7	≥0,6	R10	B
Pietra	≥0,6	≥0,5	R10	A
Pietra (DDPSE...)	≥0,7	≥0,6	R10	B
Random (DAK...)	≥0,6	≥0,5	R9	A
Random (DDM06...)	≥0,6	≥0,5	R10	A
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	-
Samba	≥0,6	≥0,5	R9	A
Sandstone Plus	≥0,6	≥0,5	R9	A
Sandstone Plus (DDM06...)	≥0,7	≥0,6	R10	B
Sandstone Plus Lappato (DAP...)	≥0,6	≥0,5	R9	-
Sandy (DAK...)	≥0,6	≥0,5	R9	-
Sandy (DAR..., DDPSE...)	≥0,6	≥0,5	R10	B
Sidney	≥0,6	≥0,4	R9	-
Siena	≥0,6	≥0,4	R9	-
Siena (DDP44...)	≥ 0,6	≥0,5	R9	A
Spirit	≥ 0,6	≥0,4	R9	-
Stones (DAK...)	≥ 0,6	≥0,5	R10	A
Stones (DAR..., DD...)	≥ 0,6	≥0,5	R10	B
Stones Lappato (DAP...)	≥0,6	≥0,5	R9	-
Stones (DAG...)	≥0,7	≥0,6	R11	C
Travertin	≥0,6	≥0,5	R10	A
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	-
Unistone (DAR..., DDP...)	≥0,6	≥0,5	R10	A
Unistone (DAR12..., DAR1D..., DDM0...)	≥0,6	≥0,5	R10	B
Via	≥0,6	≥0,5	R9	A
Via Mosaik (DDM05...)	≥0,7	≥0,6	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.

Requirements on slip resistance of floors are defined by national public notices and standards – see Table 1. The floors must be level with a surface of the specified degree of slip resistance, which must be maintained regularly. For floors used by the public, PN 268/2009 and the ČSN 74 4505 floor standard specify a basic minimum coefficient of friction 0.5. For floors which are not protected

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

against rain (e.g. on terraces, balconies and loggias), the anti-slip criterion must be met even when the surface is wet. German safety regulation ASR A1.5 can serve the 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.

15	Leather production, textiles		27	Inhalation and air passage treatment facilities	
15.1	Wet areas in tanneries	R13	27.1	Preparation room	R10
15.2	Rooms with fleshing machines	R13 V10	27.2	Conditioning room	R10
15.3	Areas where leather scraps accumulate	R13 V10	27.3	Exercise room	R11
15.4	Rooms for making leather impermeable by means of grease	R12	27.4	Sluice	R10
15.5	Dye mills for textiles	R11	27.5	Target premises	R11
			27.6	Warming room	R11
			27.7	Dispatch room	R9
16	Paint shops		28	Schools and kindergartens	
16.1	Wet grinding workshops	R12 V10	28.1	Entrances, corridors, break halls	R9
16.2	Powder paint shops	R11	28.2	Classrooms	R9
16.3	Spray paint shops	R10	28.3	Staircases	R9
17	Ceramics industry		28.4	Toilets, washrooms	R10
17.1	Wet grinding mills (processing of ceramic raw materials)	R11	28.5	Teaching kitchens in schools (see also 9)	R10
17.2	Mixers; handling of materials like tar, pitch, graphite and synthetic resins	R11 V6	28.6	Kitchens in kindergartens (see also 9)	R10
17.3	Presses (shaping); handling of materials like tar, pitch, graphite and synthetic resins	R11 V6	28.7	Wood processing workshops	R10
17.4	Moulding areas	R12	28.8	Technical sections of workshops	R10
17.5	Glazing areas	R12	28.9	School courtyards	R11 or R10 V4
18	Glass and stone processing		29	Financial institutions	
18.1	Stone cutting, stone grinding	R11	29.1	Counter areas	R9
18.2	Glass shaping of hollow glass ware, container ware, glass for building purposes	R11	30	Plant traffic routes in outdoor areas	
18.3	Grinding areas for hollow glass ware, flat glass	R11	30.1	Footpaths	R11 or R10 V4
18.4	Insulating glass manufacture; handling of drying agents	R11 V6	30.2	Loading platforms	
18.5	Packaging, shipping of flat glass; handling of anti-adhesive agents	R11 V6	30.2.1	Covered	R11 or R10 V4
18.6	Etching and acid polishing facilities for glass	R11	30.2.2	Not covered	R12 or R11 V4
19	Cast concrete factories		30.3	Sloping ramps (e.g. for wheel-chairs, loading platforms)	R12 or R11 V4
19.1	Concrete washing areas	R11	30.4	Tank-up areas	
20	Storage areas		30.4.1	Tank-up areas, covered	R11
20.1	Storage areas for oils and fats	R12 V6	30.4.2	Tank-up areas, not covered	R12
20.2	Areas for packed food	R10	31	Parking facilities	
20.3	Outdoor storage areas	R11 or R10 V4	31.1	Car parks and u/g garages not affected by weather *****]	R10
21	Chemical and thermal treatment of iron and metal		31.2	Car parks and u/g garages affected by weather	R11 or R10 V4
21.1	Pickling plants	R12	31.3	Outdoor parking lots	R11 or R10 V4
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			

*) 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.

4. Chemical properties



4.1 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 LASSELSBERGER, s.r.o. 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 LASSELSBERGER, s.r.o. 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 14411:2016:

- 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.

4.2 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

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

* Class 5 means maximum stain resistance, decreasing towards the lowest resistance class 1. Selected types of LASSELSBERGER, s.r.o., products, such as TAURUS, KENTAUR and POOL 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
Bla 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
Ala	drawn POOL tiles	at least B	at least A	Manufacturer declaration	at least B	not required	at least B	3	3

5. Hygienic properties of tiles

LASSELSBERGER, s.r.o. 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. LASSELSBERGER, s.r.o. products meet the requirements mentioned above, **and they are safe.**

Ceramic products LASSELSBERGER, s.r.o. 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 LASSELSBERGER, s.r.o., are harmless for human health, see the statement of properties on **www.rako.eu – for download – Statement of Properties.**

Selected TAURUS, ColorTWO and POOL products have attestations of sanitary harmlessness in contact with food and drinking water on **www.rako.eu – for download – 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.

6. Thermal characteristics of tiles

Thanks to their convenient thermal properties (conductivity and heat accumulation), all types of LASSELSBERGER, s.r.o. tiles are ideal floor coverings on underfloor heating.

Comparison of thermal conductivity of floor coverings:

Ceramics	1.03 W/(m·K)
Wood	0.22 W/(m·K)
PVC/Vinyl	0.19 W/(m·K)
Carpet	0.07 W/(m·K)

Even though the thermal expansion coefficient of wall and floor tiles is very low, it is necessary to carry out dilatation joints. Thermal expansion coefficient of ceramic wall and floor tiles (λ) at the interval of 20–100°C is $4\text{--}8 \cdot 10^{-6} \text{ K}^{-1}$.

An example of thermal expansion functions at a dilatation field in a length of 6 meters (L) at a temperature difference of 50°C (Δt):

Length change of ceramic tiles = $\lambda \times L \times \Delta t = 0,000008 \times 6\,000 \times 50 = \underline{2.4 \text{ mm}}$.

7. 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.eu – project team.

8. Optical characteristics of tiling elements – LRV

The capacity of ceramic tiling elements 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 Reflectance 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 tiling elements are measured using a spectrophotometer according to CIE 1931:

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

TAURUS COLOR		TAURUS GRANIT	
Matt unglazed surface	LRV	Matt unglazed surface	LRV
TAAXX019	8	TAAXX069	11
TAAXX007	16	TAAXX065	18
TAAXX006	26	TAAXX076	31
TAAXX011	65	TAAXX176	40
TAAXX010	51	TAAXX062	51
TAAXX030	21	TAAXX061	40
		TAAXX073	39
		TAAXX077	30
		TAAXX067	25
		TAAXX072	10
		TAAXX074	33
		TAAXX082	17
		TAAXX080	27
		TAAXX075	31

RAKO HOME		
Serie	Article code	LRV
Cemento	DAKXX660	54,1
Cemento	DARXX660	56,5
Cemento	DAKXX661	30,6
Cemento	DARXX661	33,2
Cemento	DAKXX662	43,4
Cemento	DARXX662	39,4
Geo	DARXX314	6
Rock	DAKXX632	44,8
Rock	DAPXX632	47
Rock	DAKXX633	43,7
Rock	DAKXX634	31,7
Rock	DAKXX635	16,4
Rock	DAKXX636	20,4
Rock	DAPXX636	18,2
Rock	DAKXX637	10
Rock	DAKXX644	32,5
Rock	DAKXX645	18,6
Rock	DAKXX646	19,3
Trend	DAKXX652	53,8
Trend	DAKXX653	37,8
Trend	DAKXX654	29,1
Trend	DAKXX655	15,3
Trend	DAKXX656	27,9
Trend	DAKXX657	21,2
Trend	DAKXX658	50,7
Trend	DAKXX685	8
Unistone	DAKXX609 DAAXX609	62,4
Unistone	DARXX609	61,9
Unistone	DAKXX610 DAAXX610	50,1
Unistone	DARXX610	49,5
Unistone	DAKXX611 DAAXX611	16,9
Unistone	DARXX611	14,3
Unistone	DAKXX612 DAAXX612	19,4
Unistone	DARXX612	19,5
Unistone	DAKXX613 DAAXX613	8,4
Unistone	DARXX613	7,8

9. Technical parameters

		STO No. 030 - 049916 ceramic special pieces	
Technical characteristics	Norm	Standard requirements EN 14411:2016 (max. value)	Parameters LB (max.)
 Sizes	ISO 10545-2	Length and width $\pm 2,0 \%$	$\pm 2,0 \%$
		Thickness $\pm 10 \%$	$\pm 10 \%$
 Water absorption	ISO 10545-3	$E < 0,5 \%$	$E < 0,5 \%$
Surface quality	ISO 10545-2	Min. 95% of the tiles without visible defects	Min. 95% of the tiles without visible defects
 Bending strength	ISO 10545-4	Thickness $\geq 7,5$ mm min. 28 N/mm ²	$\geq 7,5$ mm min. 28 N/mm ²
 Breaking strength	ISO 10545-4	Thickness $\geq 7,5$ mm min. 1300 N	$\geq 7,5$ mm min. 1300 N
 Thermal shock resistance	ISO 10545-9	Not required	Resistant
 Frost resistance	ISO 10545-12	Required	Fully frost resistant
Crazing resistance for glazed tiles	ISO 10545-11	Required	Resistant
 Slip resistance - coefficient of friction	CEN/TS 16 165 DIN 51130 DIN 51097 ČSN 725191	Manufacturer to state value and test method used	Selected types C
 Deep abrasion resistance	ISO 10545-6	Not required	max. 275 mm ²
Surface hardness according to Mohs scale	ČSN EN 101	Manufacturer to state classification	min. class 5
Coefficient of linear thermal expansion (20-100 °C)	ISO 10545-8	Not required	max. $9 \cdot 10^{-4} \text{ }^{\circ}\text{C}$
 Resistance to various chemicals used in household	ISO 10545-13	Min. B	Min. A
 Resistance to low concentrations of acids and alkalis	ISO 10545-13	Manufacturer to state classification	Min. cl. B
 Resistance to high concentrations of acids and alkalis	ISO 10545-13	Not required	Min. cl. B
 Resistance to staining	ISO 10545-14	Min. cl. 3	Min. cl. 3
 Lead and cadmium release	ISO 10545-15	Not required	Pb $< 0,8 \text{ mg/dm}^2$ Cd $< 0,07 \text{ mg/dm}^2$

		EN 14411:2016, annex L BIII GL – Catalogue number: Wxxxxxxx wall tiles					
Technical characteristics		Norm	Standard requirements EN 14411:2016, annex L BIII GL (max. value)			Parameters LB (max.)	
 Sizes	ISO 10545-2				Standard max.		Rectified max.
		max			max		max
		Length and width	±0,5 %	±2,0 mm	±0,3 %	±1,8 mm	±0,2 % ±1,2 mm
		Thickness	±10 %	±0,5 mm	±5 %	±0,5 mm	±5 % ±0,5 mm
		Linearity	±0,3 %	±1,5 mm	±0,2 %	±1,2 mm	±0,1 % ±0,9 mm
 Surface flatness in the middle of the flat/edge/angles	ISO 10545-2						
 Water absorption	ISO 10545-3	E > 10 %			E 10-20 %		
 Bending strength	ISO 10545-4	Thickness ≥ 7,5 mm min. 15 N/mm ² , Thickness < 7,5 mm min. 12 N/mm ²			≥ 7,5 mm min. 15 N/mm ² < 7,5 mm min. 12 N/mm ²		
 Breaking strength	ISO 10545-4	Thickness ≥ 7,5 mm min. 600 N, Thickness < 7,5 mm min. 200 N			≥ 7,5 mm min. 600 N < 7,5 mm min. 200 N		
 Thermal shock resistance	ISO 10545-9	Not required			Resistant		
 Frost resistance	ISO 10545-12	Not required			Not frost resistant		
 Craze resistance for glazed tiles	ISO 10545-11	Required			Resistant		
 Slip resistance - coefficient of friction	CEN/TS 16 165 DIN 51130 DIN 51097 ČSN 725191	Not required			Not required		
 Deep abrasion resistance	ISO 10545-6	Not required			Not required		
 Abrasion resistance	ISO 10545-7	Not required			Not required		
 Coefficient of linear thermal expansion [20-100 °C]	ISO 10545-8	Not required			Max. 8 x 10 ⁻⁶ K ⁻¹		
 Resistance to various chemicals used in household	ISO 10545-13	Min. B			Min. A		
 Resistance to low concentrations of acids and alkalis	ISO 10545-13	Manufacturer to state classification			Min. B		
 Resistance to high concentrations of acids and alkalis	ISO 10545-13	Not required			Min. B		
 Resistance to staining	ISO 10545-14	Min. cl. 3			Min. cl. 3		
 Lead and cadmium release	ISO 10545-15	Not required			Pb < 0,8 mg/dm ² Cd < 0,07 mg/dm ²		

EN 14411:2016, annex H B1b GL – Catalogue number: Gxxxxxxx compact floor tiles					EN 14411:2016, annex G B1a GL, UGL – Catalogue number: Dxxxxxxx, Txxxxxxx fully vitrified floor tiles									
Standard requirements EN 14411:2016, annex H B1b GL (max. value)			Parameters LB (max.)		Standard requirements EN 14411:2016, annex G B1a GL, UGL (max. value)				Parameters LB (max.)					
Length and width	max		max		Length and width	max		Standard max.		Rectified		Polished		
	max		max			max		max		max		max		
	±0,6 %	±2,0 mm	±0,4 %	±1,25 mm		±0,6 %	±2,0 mm	±0,4 %	±1,5 mm	±0,2 %	±1,2 mm	±0,2 %	±1,2 mm	
	±5 %	±0,5 mm	±5 %	±0,5 mm		±5 %	±0,5 mm	±0,5 %	±0,5 mm	±5 %	±0,5 mm	±5 %	±0,5 mm	
	±0,5 %	±1,5 mm	±0,25 %	±0,8 mm		±0,5 %	±1,5 mm	±0,25 %	±1,5 mm	±0,1 %	±0,6 mm	±0,1 %	±0,6 mm	
Rectangularity	±0,5 %	±2,0 mm	±0,3 %	±1,0 mm	Rectangularity	±0,5 %	±2,0 mm	±0,3 %	±1,8 mm	±0,25 %	±2,0 mm	±0,2 %	±1,2 mm	
	±0,5 %	±2,0 mm	±0,25 %	±0,8 mm		±0,5 %	±2,0 mm	±0,25 %	±1,2 mm	±0,25 %	±1,5 mm	±0,2 %	±0,6mm	
0,5 % < E ≤ 3,0 % Individually 3,3 %			E < 2,5 %		UGL: E ≤ 0,5 % individually max. 0,6 % GL: E ≤ 0,5 % individually max. 0,6 %				UGL: E ≤ 0,1 % individually max. 0,2 % GL: E ≤ 0,5 % individually max. 0,6 %					
Min. 95 % of the tiles without visible defects			Min. 95 % of the tiles without visible defects		Min. 95 % of the tiles without visible defects				Min. 95 % of the tiles without visible defects					
Min. 30 N/mm ² . Individual min. 27 N/mm ²			Min. 35 N/mm ² . Individual min. 32 N/mm ²		Min. 35 N/mm ² . Individual min. 32 N/mm ²				Min. 40 N/mm ² . Individual min. 32 N/mm ²					
Thickness ≥ 7,5 mm min. 1100 N, Thickness < 7,5 mm min. 700 N			Thickness ≥ 7,5 mm min. 1300 N Thickness < 7,5 mm min. 900 N		Thickness ≥ 7,5 mm min. 1300 N, Thickness < 7,5 mm min. 700 N				Thickness ≥ 7,5 mm min. 1500 N Thickness < 7,5 mm min. 900 N					
Not required			Resistant		Not required				Resistant					
Required			Frost resistant		Required				Fully frost resistant					
Required			Resistant		Required GL				Resistant					
Manufacturer to state value and test method used			μ ≥0,3 Selected types R9 – R13, A – C, μ ≥0,5		Manufacturer to state value and test method used				μ ≥0,3 Selected types R9 – R13, A – C, μ ≥0,5					
Not required			Not required		Glazed Not required									

10. 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 2.3 – 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 2.3 - 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.
- LASSELSBERGER, s.r.o. wall tiles (**catalogue number W.....**) are suitable only for interior wall tiling.
- Compact LASSELSBERGER, s.r.o. 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 KENTAUR and TAURUS (**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 from the TAURUS programme 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.

11. 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 system solution and recommended building chemistry (www.rako.eu – building chemistry).

11.1 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 ČSN 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 ČSN 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 m² 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 – listels, etc. for inspection of the supply, batches and overall appearance and test of the combined patterns, differently coloured bases 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.**

11.2 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. The most modern cutting tools are fixed straight on to the floor tile proper by means of suction clamping elements or they copy the edge of the floor tile when a corner is being cut – see Fig. 3, 4, 5, 6 and 7.

When drilling and cutting holes in a sintered body, use diamond hole saw bits intended for this purpose (sometimes identified as gres porcelanato or porcelain). The RAKO sintered 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 sintered 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. It is therefore best when drilling into base materials 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 sintered floor tiling



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

11.3 TILE FIXING AND IDENTIFICATION OF ADHESIVE MATERIALS

Recommended procedures are available for tiling of walls and floors (standards, for example CSN 74 4505, publications, such as Rostislav Drochytka et al.: "Keramicke obklady a dlazby", company instructions, etc.). It is also necessary to select suitable types of adhesive materials, which are characterised by the European standard EN 12 004.

a) 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 glue
- S2 – highly deformable, deflection over 5 mm = super flexible glue.

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 AD 501),
- C1T – standard cement adhesive with reduced slip (for example: RAKO SYSTEM AD 505),
- C1 FT – quick-setting cement adhesive with reduced slip (for example: RAKO SYSTEM AD 580),
- 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 AD 530).

Gluing methods

Gluing tiling elements 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 adhesive 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 glue layer is sufficient (indent 8 mm), for floor tiling a thicker layer must be used (indent 10 mm or more). Individual tiling elements are placed onto the surface treated in this way. Various spacing aids (e.g. small crosses and wedges) are employed to ensure regular joints. Tiling elements 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, Cetriss boards) must always be provided with a contact bridge (RAKO SYSTEM CP 203) before further use of the system solution.

As regards laying large ceramic tiles outdoors and indoors (from 30 x 60 cm format of wall tiles to 60 x 60 cm format of floor tiles), you should apply an adhesive of at least class C2 to both the base and reverse of the tile (the glue 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 and 9. **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.



Fig. 8 - Levelling wedges



Fig. 9 - Removal of wedges

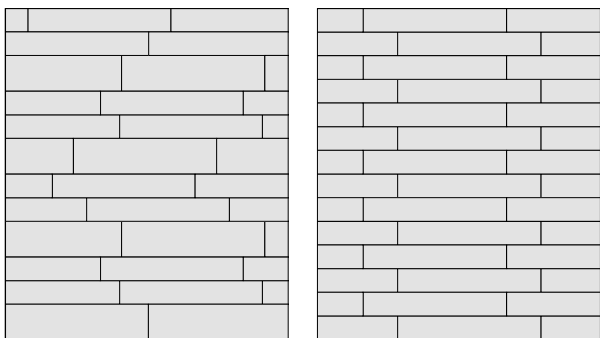


Fig. 10 – Recommended stretcher bond layout

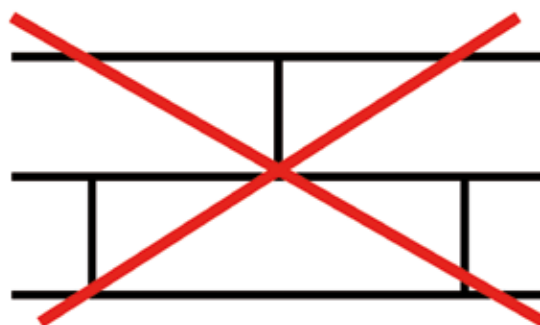


Fig. 11 – Stretcher bond layout not recommended

11.4 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 Figures 12, 13, 14, 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.

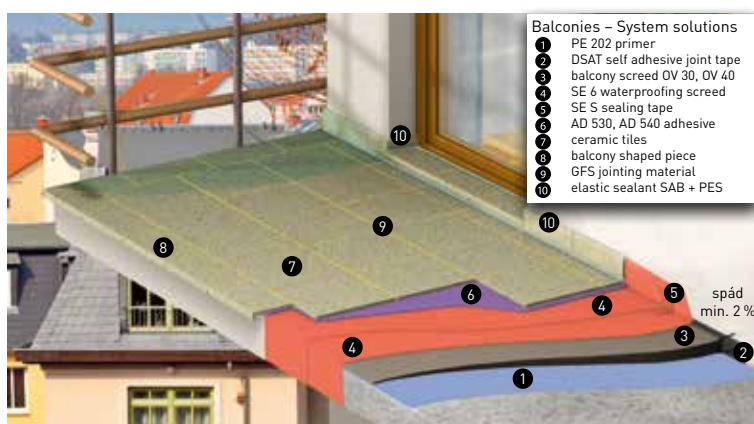


Fig. 12 – Balcony structure



Fig. 13 – Buttering-Floating fixing method

A waterproofing layer is applied in two coats to a primed sloped base by means of a waterproofing screed (RAKO SYSTEM SE 6). The damp-proofing layer must be watertight around discharge fixtures, and applied at least upwards on the adjoining vertical surfaces and walls, using a flexible sealing tape. On the damp-proof layer apply vitrified ceramic tiles **TAURUS and KENTAUR, preferably series TAURUS GRANIT, Travertin with balcony shaped pieces**, into a flexible frost resistant adhesive, type C2TE S1 (RAKO SYSTEM AD 530). 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. A more suitable solution is available using a flowing adhesive, such as type C2FE (RAKO SYSTEM AD 540) of liquid consistency.

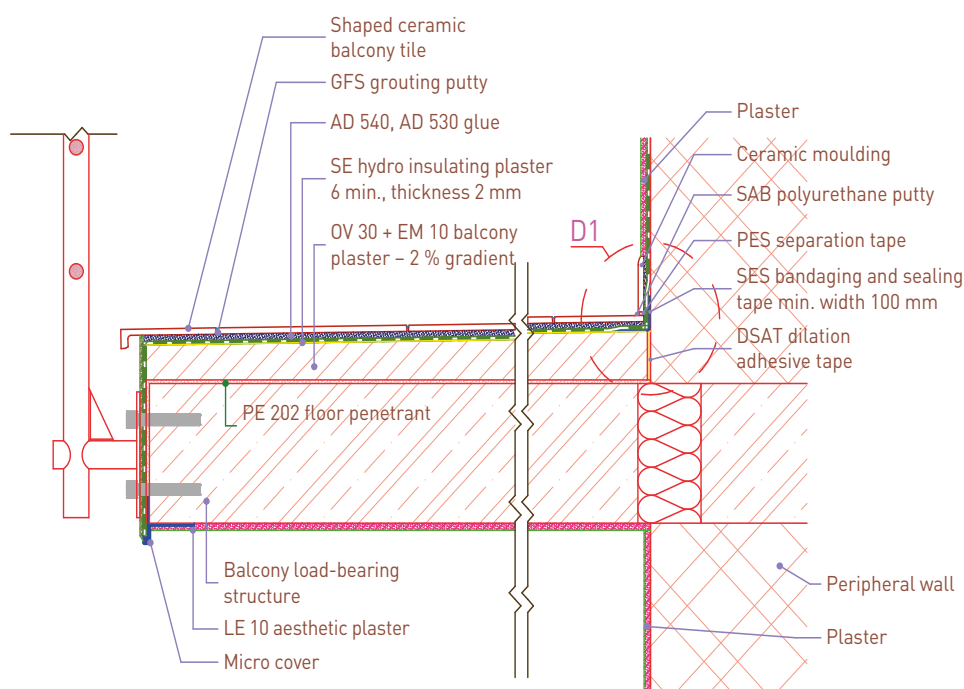


Fig. 14 – A section of a balcony

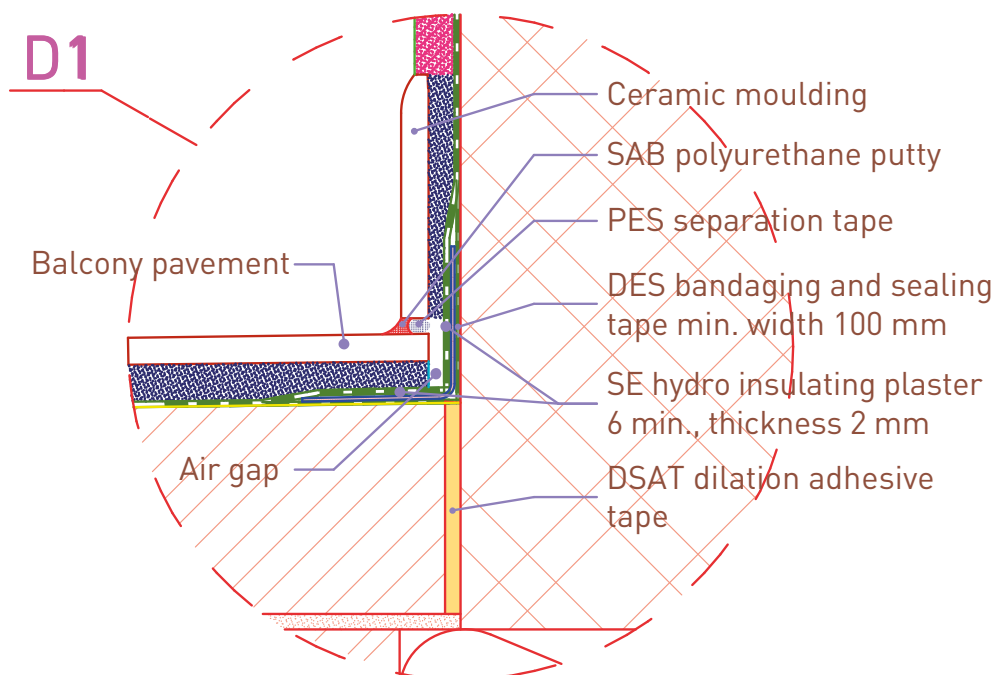


Fig. 15 – Detail of a balcony corner

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 GFS, 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 LASSELSBERGER solutions, www.rako.eu – system solutions – balconies.

11.5 UNDERFLOOR HEATING

Underfloor heating has a number of advantages. It enables ideal distribution of temperature in the heated room. 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. **Thanks to good thermal conductivity (see the table of thermal conductivities in chapter 6. Thermal characteristics of tiles).**

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 LASSELSBERGER, s.r.o. tiles, as well as rectified big tiles (TAURUS, KENTAUR).**

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 glue. Fig. 17 shows the procedure for insertion in the glue, during which the manufacturers' instructions must be respected. For thin floor heating, compact and vitrified LASSELSBERGER tiles are suitable, e.g. KENTAUR, TAURUS, and flexible adhesive and grouting materials C2TE S1 and CG2WA of the RAKO SYSTEM.

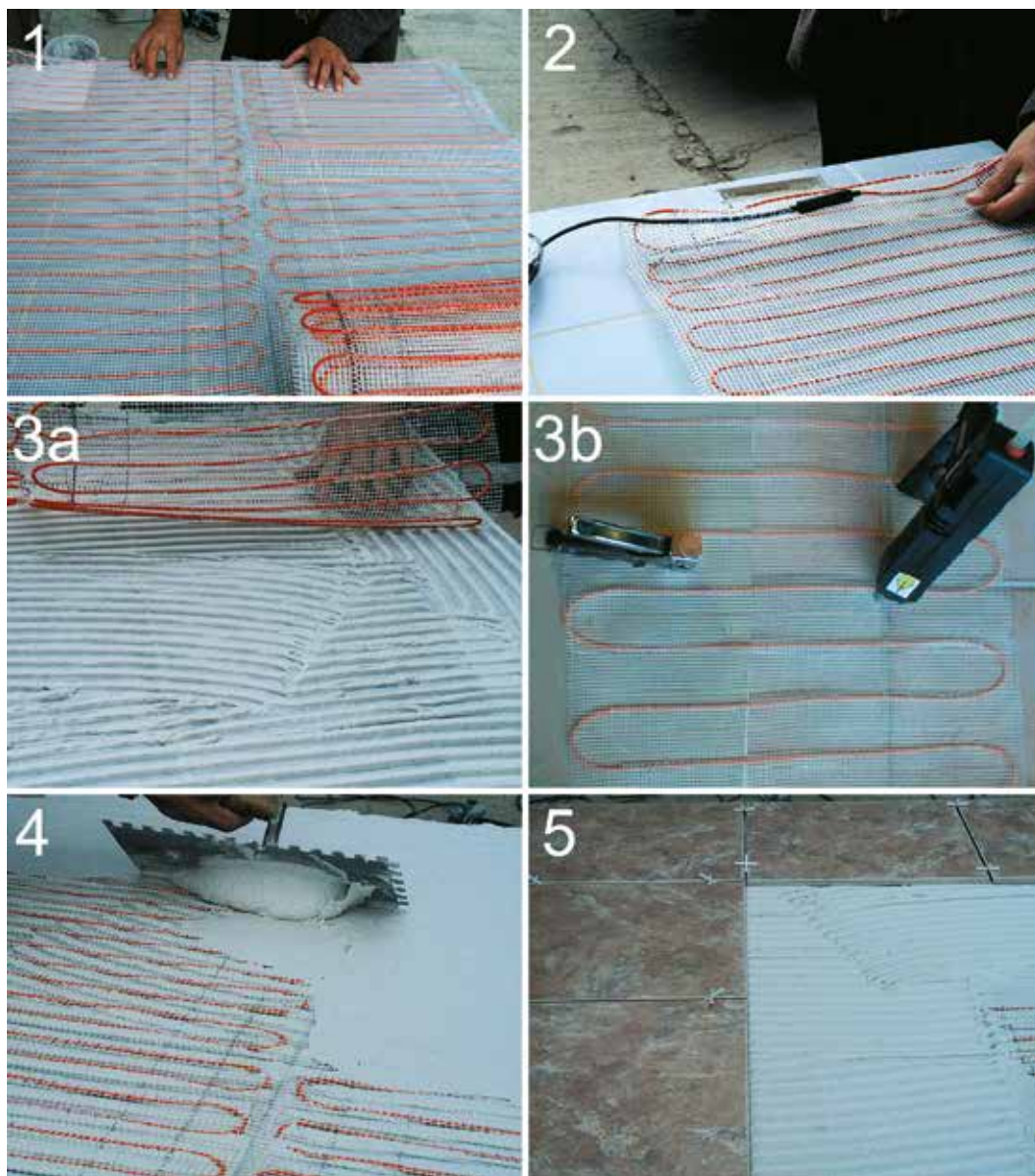


Fig. 17
**Implementation of
the electric floor
heating**

1 – Roll out heating
mats

2 – Connect the
heating mats

3a, 3b – Screeding
of heating mats
using an adhesive

4 – Carefully embed
the heating mats
with adhesive

5 – Fix the tiles

Hot-water underfloor heatin

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 floor heating (see figs. 18 and 19) 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, 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 preset parameters such as heat loss of the room, pipe spacing, floor-

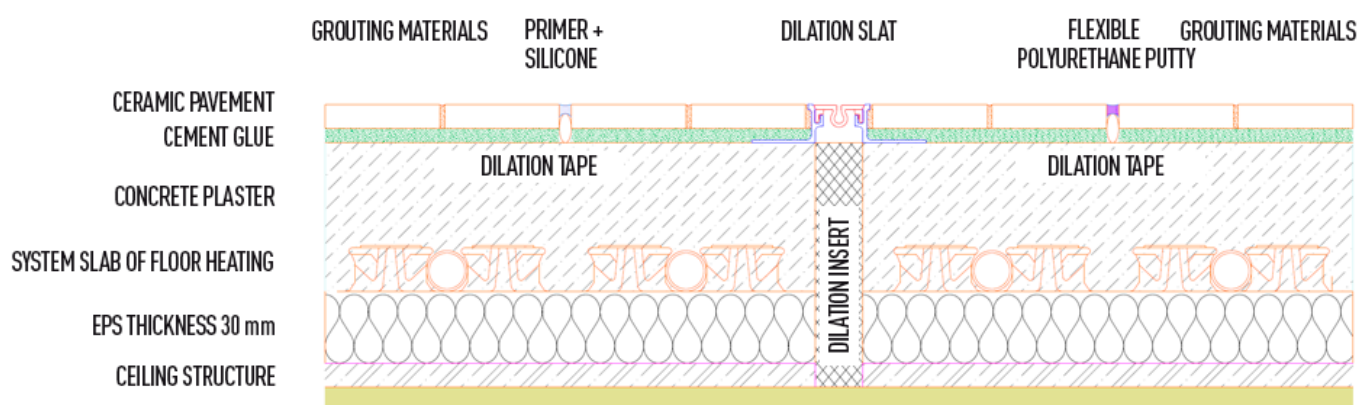
ring material, floor structure, heat insulation, interior temperature, heating input temperature etc. Even though the thermal expansion coefficient of wall and floor tiles is very low, it is necessary to perform expansion joints in accordance with the requirements of relevant standards (for example: 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 12 – Jointing of tiling elements, dilatation. Max. 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. 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 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 AD 530, 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 GF DRY) and immediately cleaned with a sponge and clean water.



Fig. 18 and 19 – picture and cross-section



11.6 STAIRS

To tile stairs in interiors or exteriors, we recommend using step tile sizes 30 x 30, 33 x 33, 30 x 60 cm, and custom made 42 x 45, 30 x 60, 53 x 60 and 30 x 120 cm shaped step tiles.

Outdoors in front of tenement houses, offices and schools, it is necessary to use Taurus Granit stair tiles with dimensions of 30 × 30 cm with a SR7, SRM relief surface and sufficient slip resistance of group R11/B pursuant to CSN 73 4130 – Stairs and inclined ramps.

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 SE 6), to the walking edge, to use good quality adhesive and grouting materials (RAKO SYSTEM AD 530, GF) and flexible polyurethane material (RAKO SYSTEM SAB) for internal edges of stairs.



Fig. 20 Step tiles

12. Jointing of tiling elements, dilatation

12.1 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 tiling element. 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 have very small dimensional deviations and allow laying with a joint width of as little as 2 mm. In the case of non-rectified wall tiles we recommend placing them with a joint width starting at 3 mm. In principle, we advise against laying ceramic tiling with a butt joint, i.e. with no joint. 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 a sample tiling element.

Compounds for filling joints can be divided into groups by their chemical composition.

Inflexible:

Cement-based grouts (e.g. GF, GF BIO, GFS, GW)

Epoxy compounds (e.g. GE, GE EASY)

Elastic:

Silicone compounds (e.g. SI, 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.

- | | |
|---------------|--|
| GF DRY | – a flexible, highly hydrophobic moisture-proof grout with a Dry-effect function for all types of wall and floor tiling, 2–20 mm joints. |
| GF BIO | – 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. |
| GFS | – a highly hydrophobized, 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. |
| GW | – a grout for 5–30 mm wide joints. |

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

The manufacturer recommends **RAKO SYSTEM GF BIO and GF** flexible grouts for kitchen countertops, 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 enclosure, etc., we recommend using a CG2 WA type GF BIO 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 GE and GE EASY**) 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 enclosures subjected to greater water load or for grouting wall tiles with transparent glaze**. The abovementioned 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 AD 550).

12.2 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 × 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 × 60 cm), we recommend that you shorten the dilatation section and, when selecting floor tiles we recommend that you prefer light tints. The width of perimeter and intermediate expansion joints pursuant to CSN 73 3451 must be at least 5 mm. To ensure a perfectly functioning flexible joint, insert a dilatation separating 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 SI) 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.



Fig. 21 – Separation tape

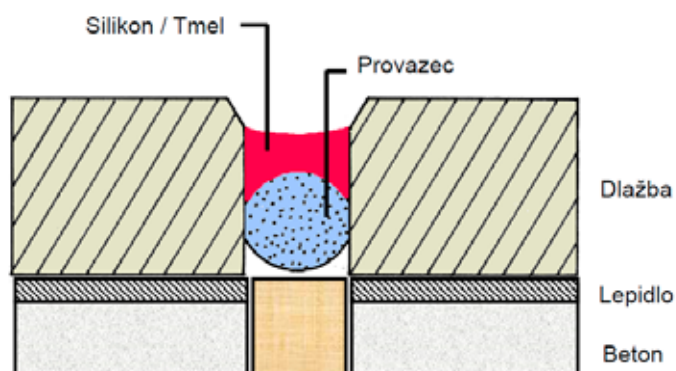


Fig. 22 – Section of a structural joint with the separation tape



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

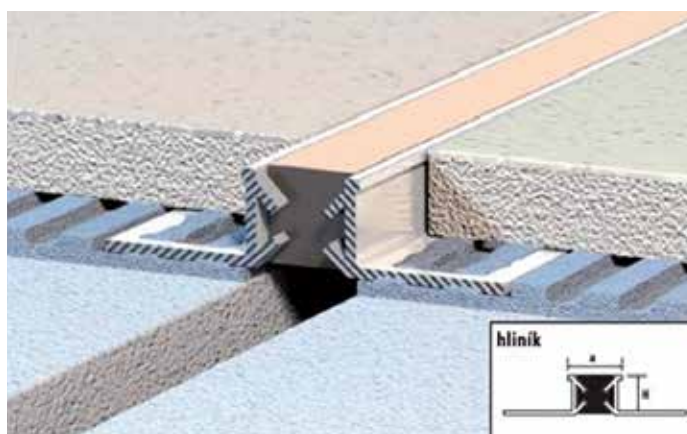


Fig. 24 – Expansion joint strip

Tab. 5

Non-flexible and flexible (dilation) joints		
Recommended joint width pursuant to ÖNORM B 3407:2015		
Use	Non-flexible joint width	Flexible joint width
Interior	at least 2 mm	at least 5 mm
Exterior	at least 5 mm	at least 8 mm

13. Maintenance of tiled surfaces

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 grouting. Detergents containing acids ($\text{pH} < 6$), so called cement residue removals are best for this purpose. We recommend **RAKO SYSTEM CL 802**. For this type of cleaning the detergent must be appropriately diluted to prevent dark and highly pigmented grouting materials from being disturbed and bleached. During this cleaning step, care must be taken to the recommended dilution of cleaners to avoid disturbing and lightening of dark and heavily pigmented grouting materials. For wall tiles in group BIII, 50–100 ml of the CL 802 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 CL 802** 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, vacuuming or wiping the surface with a wet cloth or mop, using a suitable neutral detergent ($\text{pH} 6.0$ to 8.0); here we recommend **RAKO SYSTEM CL 803**, 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 CL 801**.

Heavy duty cleaning – thorough cleaning, carried out 1–2 times a year

To remove heavily soiled surfaces created during the use of compact tiles and sintered tiles in group BIb and BIa, which could not be removed by regular cleaning. Alkaline detergents ($\text{pH} > 8$) are most frequently used for removing greasy residues deposited on floor tiles are; we recommend **RAKO SYSTEM CL 810**. For removing lime sediments caused by water hardness acidic detergents ($\text{pH} < 6$), we recommend **RAKO SYSTEM CL 801**. 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 ($\text{pH} > 8$) are used; we recommend using the **RAKO SYSTEM CL 810** and dilution recommended by the manufacturer. To remove **lime scale** deposits from hard water on wall tiles in group BIII, alkaline cleaners ($\text{pH} < 6$), such as the **RAKO SYSTEM CL 810**, are recommended. Before the use of acidic detergent, moisten the tile surface, and, after application of diluted **RAKO SYSTEM CL 801**

[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.

- **Decorative products with golden, platinum and mother-of-pearl surface finish**, must be cleaned with **RAKO SYSTEM CL 803** 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 CL 810** detergent (40 – 100ml in 10l of water), then neutralise them with water and clean them with a **RAKO SYSTEM CL 801** solution (40–100 ml in 10l 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 CL 810** 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 blade). Applying the **RAKO SYSTEM CL 809** impregnation products makes the maintenance of both smooth and anti-slip floor tiles easier.
- **Floor tiles treated with the RAKO SYSTEM CL 809 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 CL 809 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 CL 803** 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.

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 CL 802 , 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 CL 810 , 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 CL 803 , RAKO SYSTEM CL 801 is recommended for areas with a high amount of traffic Dilution: 20-100 ml per 10 liters of water Bathrooms, WC - RAKO SYSTEM CL 804 (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 CL 801 , dosage: 40-100 ml for 10 l of water RAKO SYSTEM CL 804 - 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 CL 810 , dosage: 40-100 ml for 10 l of water

14. 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. The management system has been regularly reviewed by the accredited company, which has also issued the certificate of its compliance according to EN ISO 9001:2016.

LASSELSBERGER, s.r.o. products have been regularly reviewed by the independent accredited testing laboratory **Technický a zkušební ústav stavební 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 the Act No. 263/2016 Coll., which has also issued the certificate of safety of **LASSELSBERGER, s.r.o.** products and minerals.

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 Bla

Declaration of Performance T17 01 – vitrified unglazed Bla mosaic, maximum size 7 x 7 cm

Declaration of Performance D13 01 – vitrified glazed floor tiles Bla

Declaration of Performance D17 01 – vitrified glazed Bla mosaic, maximum size 7 x 7 cm

Declaration of Performance G13 01 – compact glazed floor tiles Blb

Declaration of Performance G17 01 – compact glazed Blb mosaic, maximum size 7 x 7 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 on technical requirements on products in conjunction with Government Decree No. 163/2002, in the wording of Government Decree No. 312/2005.

Declaration of Conformity P 01 – Mosaics for wall and floor tiles (Government Decree No. 163/2002 in the wording of GD No. 312/2005)

Declaration of Conformity P 02 – Shaped ceramic bricks, step tiles, etc. (Government Decree No. 163/2002 in the wording of GD No. 312/2005)

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)

Manufacturer's declarations are available in various languages at www.rako.eu.

<http://www.rako.cz/ke-stazeni/declaration.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 LASSELSBERGER, s.r.o. ceramic tiles with the requirements of CSN EN 14411:2016 and related regulations for the following products:

Ceramic tiles, dry pressed with water absorption over 10% declared according to CSN EN 14411:2016, Group BIII, Annex L

Ceramic tiles, dry pressed with water absorption 0.5% to 3% declared according to CSN EN 14411:2016, Group BIb, Annex H

Ceramic tiles, dry pressed with water absorption to 0.5% declared according to CSN EN 14411:2016, 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 - 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 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 1 October 2016 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 and RAKO OBJECT.

F/ ENERGY MANAGEMENT SYSTEM CERTIFICATE

An energy management system certificate under 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 performance and increase energy efficiency. The certificate was issued on 30 June 2016.

At the internet address **www.rako.eu – download– Declaration of Performance, Certificates, Ecology – EPD, 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:

E-mail: info@rako.cz

15. Warranty conditions

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

2-year warranty

for 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.
Customer Service
Tomas Herman
Adelova 2549/1
CZ – 320 00, Plzen-Jizni Predmesti
E-mail: tomas.herman@cz.lasselsberger.com

Information lines:

E-mail: info@rako.cz
Internet: <http://www.rako.eu>

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 10/2017.

	wall tile
	floor tile
	frost resistance
	non-frost resistance
	a tile with increased chemical resistance
PEI	surface wear resistance
	deep wear resistance
	slip resistance – footwear
	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 Bla, E≤0,5 %
	news 2018
intentional or possible colour variances, surface structures and design or diversity of colours:	
	minimal deviations
	small deviations
	great deviations
	great and fully accidental deviations

