Natural Tiles Technical Data Sheet Manual
Issue No. 2 July 2009

Technical Data Sheets

Quarry Tiles, Natural Clay Tiles, Paving and Cladding

Index of Technical Data Sheets

Natural Tiles Technical Data Sheet No. 1 Issue No. 1
December 2008

Planning and Preparation 1

General Considerations

When specifying a quarry tile floor, the most arduous conditions likely to be imposed during the service life of the floor should be used as the basis on which to design. This will enable the most appropriate tile and fixing method to be employed. Consideration should therefore be given at the design stage to various parameters likely to affect the performance and durability of the floor. These include:

• **Application:** Consideration should be given to the intended use of the floor. For example, if the floor may be required to provide extra slip resistance, then a Quarrundum tile should be selected, depending on the application. If contact with, or containment of, aggressive chemicals is envisaged, then a suitably resistant fixing method and chemically resistant grout will be required.

• **Load:** In situations where heavy static loads are to be imposed, or the tile is likely to be exposed to loaded vehicles with hard rimmed wheels, the strength and impact resistance of the installation can normally be improved by the use of a thicker quarry tile such as tiles from our Industrial range. Consideration should be given to specifying quarry tiles of different thicknesses, each appropriate to the traffic load likely in a given area. It is important to stress that, for most applications, a standard thickness quarry tile (14mm) will be suitable, provided it is solidly bedded, without voids.

• **Movement Joints:** The position and construction of movement joints should be decided at the design stage. Problems may arise if insufficient or badly constructed movement joints are included in the floor. Particular care should be exercised to ensure that movement joints are impervious and chemically resistant where they are exposed to water or corrosive liquids. This usually involves applying sealants based on silicone rubber or polysulphide rubber. Movement joint edges may require metal reinforcement to prevent damage if hard-wheeled traffic is to cross the joint. Further detailed information on movement joints is contained in Quarry Tile Technical Data Sheet No. 2.

• **Drying Times:** Sufficient time should be allowed for the floor to be constructed and account must be taken of curing times required for various materials. New concrete must be allowed to mature for at least six weeks before any quarry tiles are fixed to it. If a cement/sand mortar screed is to be used, a further 3 weeks must be allowed, during which time the screed must be protected form frost, rain, etc.

Whenever traditional fixing methods are employed, traffic should not be allowed on the floor for at least 4 days. It may then be used by light traffic only for the first 14 days and heavy traffic after 28 days. However, rapid-set cement-based or epoxy-based adhesives may be used to bring a floor into service within 24 hours. In such cases, the advice contained in Technical Data Sheets 7 & 8 should be followed.

• **Floor drainage:** Floors which have falls to facilitate free drainage should be designed so that traffic moves across rather than down the fall. The position of the drainage channels, etc. should be decided at the design stage and constructed before the floor is laid.

• **Damp-proofing:** Quarry tile floors may require a damp-proof membrane to be incorporated into the structure, depending on the floor's location. This detail may be included at various positions as detailed in Technical Data Sheets 5, 7 & 9.

• **Finish zone thickness:** The thickness of a quarry tile installation will depend on tile thickness and the bedding method used. As a general guide, the finished bedding thickness for cement-based adhesives is approximately 4 - 8mm, for cement/mortar 15mm and for semi-dry bed greater than 40mm.

• **Traffic:** Both the type and amount of traffic likely to use the floor should be assessed. Loadings on floors may arise from either moving or standing loads. If vehicular, the type of tyres (pneumatic or solid) used to transmit the load through the floor will influence the severity of the loading. Severe loadings are exerted by loads carried on small hard rimmed wheels, or when moving traffic is bouncing due to an uneven surface. To ensure adequate safety margins for a flooring installation subjected to vehicular traffic, it may be assumed that the maximum dynamic load is twice the static load.

Preparation for tiling

It is essential that the structural components of the floor installation are designed and constructed to a standard capable of withstanding the loads placed upon it. It is usual to incorporate any gradients that are required into the base material. Although some irregularities in the base's surface may be accommodated in the tiles' bedding layer, the base material must be of sufficient surface flatness to enable the quarry tiles to be laid to a finished surface tolerance of ± 3mm under a 2m straight edge. The degree of accuracy achieved will largely be determined by the method selected for fixing the tiles.

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Planning and Preparation 2

Screeds

Screeds are often used to achieve a higher degree of surface flatness, or to raise the floor's finished surface level. Screeding materials such as self-levelling latexes and epoxides, together with the more traditional cement/sand screeds, have all been used successfully with quarry tiles. It should be re-emphasised that a new concrete floor should be allowed to cure for at least 6 weeks before a screed is laid onto it. Cement /sand screeds should then be allowed a further 3 weeks to cure before the quarry tiles are fixed. Where traditional screeds are employed, the thickness of the screed should be as follows:

Where screeds are laid on and bonded to a set and hardened base, the minimum thickness should be 25mm. Variations in the screed thickness to compensate for base are acceptable and it is normal to allow a design thickness of up to 40mm.

Where screeds are laid on a damp-proof membrane, or a separating layer, or a base that either incorporates a waterproofing admixture or has been contained in any way, the minimum thickness should be 50mm.

Where screeds are laid on a compressible layer such as insulating board, the minimum thickness should be 75mm.

Where screeds are laid on step treads, the minimum thickness should be 20mm.

Where screeds are laid on step risers, the thickness should be between 12 and 15mm.

Screeds should be kept covered with waterproof sheeting for at least 7 days after laying to prevent drying out. Screeds should be subjected to continuous air drying for at least a further 2 weeks before the tiles are fixed. Longer periods may be necessary in wet weather or where the floor is to be heated.

It should be noted that badly cured screeds may be subject to curling or cracking.

Cracking is mainly due to drying shrinkage and curling due to differential drying throughout the screed.

Where screeds are laid in very hot weather, or without cover from the sun, this may increase the risk of curling and/ or cracking.

The bond between the bedding and the base depends largely on the condition of the surface at the time of laying the bedding. Where it is likely to be subjected to heavy traffic, or other rigorous service conditions, it is essential to have good adhesion between the bedding and the base. This may be ensured by providing a suitable mechanical key. A suitable bonding agent or admixture applied to the bedding material is frequently used to improve the physical adhesion properties of cement mortars.

A number of proprietary screeding materials are available, which can provide beneficial properties and/or overcome problems associated with the traditional cement/sand screed. Advice should be sought from the manufacturer.

Further information on the design and use of screeds is given in Appendix C in BS 5385: part 3.

Finished floor tolerances

Floors are usually required to be level or to be laid to given falls, which should be detailed in the specification. Some variation in the surface level can normally be allowed without detriment to the satisfactory use of the floor and it is important to bear in mind that insistence on very close limits may result in higher fixing costs.

Large floor areas can normally tolerate larger variations in level from the datum given on the drawings without causing inconvenience to the user.

Permissible variations will depend on the area involved and the purpose of the building, but tolerances up to ± 15mm compared with a specified datum may be acceptable. Greater accuracy may be required along the line of partition walls, in the vicinity of door openings and where machinery is to be installed directly onto the floor.

Local variations tend to be more exacting and it is generally accepted that a nominally flat floor would show less than ± 3mm under a 2m straight edge. This is best measured using a straight edge that has small feet at both ends so that the variations in the floor level can be measured and related to the underside of the straight edge.

It is important to note the accuracy of the finished floor may be limited by the dimensional tolerance of the tile.

There should be no appreciable difference in surface level across joints, especially in areas where heavy loads are likely to be moved.

Where tiles are fixed using an adhesive, there is only limited scope to make good any variation in the underlying floor level to produce a true finished level. Consequently, attention should be paid to the finished tolerances of the constructional base layers at each stage.

Natural Tiles Technical Data Sheet No. 2 Issue No. 2
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Movement Joints 1

Movement Joints

Materials used in construction are subject to movement of various kinds, and this may induce stresses sufficient to promote loss of adhesion, bulging or cracking of the floor surface. Therefore, to protect against the effects of movement, it is necessary to construct a sufficient number of movement joints to enable the stresses to be taken up without damage. Movement joints can be of three types:

- **Contraction joints:** normally found in newly cast concrete where the only movement to be expected will be due to shrinkage resulting in the opening of the joint.

- **Stress relieving joints:** introduced into the flooring system so that any cracking which may develop due to stresses in the system will be induced to occur at pre-determined positions.

- **Movement joints:** (sometimes called expanding joints) designed to accommodate more frequent or regular movement within a flooring system.

Movement joints should not normally be wider than 10mm. Movement joint cavities should extend through the underlying bedding material and any underlying screed. They should then be completely filled and sealed with a compressible material. Where a separating layer is included the movement joint should extend to this layer but not penetrate it.

Where floors have to withstand hard-rimmed wheeled traffic, movement joints should not be positioned in the traffic area. If this is not possible, consideration should be given to reinforcement of the joint edges with suitable metal sections.

Movement joints must be incorporated into all tiled floor areas that have a dimension greater than 2 metres between restrained edges. The actual shape of the floor, its purpose, the tile and the type of fixing method employed will dictate the exact position and type of movement joint

Guidelines on positioning joints is provided as follows:

- **Perimeter joints:** A flexible joint should be included in the restrained perimeter of the floor. A similar joint should also be used around any rigid interruptions in the floor finish, e.g. columns, inspection chambers etc., or where individual hot or vibrating machines need to be isolated from the main floor tiling.

- **Structural joints:** These should be sited immediately over and be continuous with any movement joint in the underlying structure. A number of proprietary joint systems are available.

- **Intermediate joints:** These can be either compressive, stress-relieving or a combination of both and are used to divide up floors into bays. In larger floors, compressive joints are included at distances not exceeding 30 metres. Each of these bays is sub-divided into small bays by stress-relieving joints. In smaller floors, compressible intermediate joints should be included at distances not exceeding 10 metres. If high temperatures are expected, the provision of additional movement joints should be considered.

- **Suspended floors:** For floors subject to bending stresses, stress-relieving joints should be inserted at points where the stresses are likely to be at their greatest, such as over supporting walls or beams.

In addition, intermediate joints should be incorporated at centres not exceeding 4.5 metres.

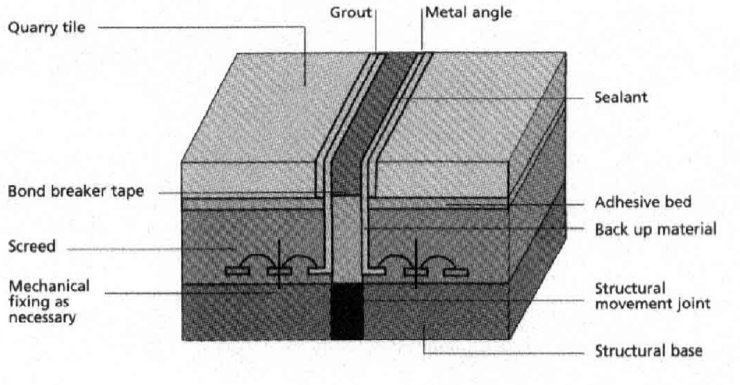
Choice of sealant materials: The choice of sealant for inclusion in a movement joint will depend on many factors including extensibility, resistance to chemical attack, resistance to wear, ease of use etc.

For economic reasons, it is usual to partially fill the joints with a cheaper filler material before finishing with the more expensive sealant. Where such a technique is used, the joint filler material should assist in carrying the traffic loads. Suitable materials include cellular rubber and plastics and some fibre building boards.

The most commonly used sealants in flooring installations are polysulphide rubber, silicone rubber and flexibilised epoxide compounds. Pre-formed strips manufactured from materials such as cork, PVC or synthetic rubber are also available, although they would not normally be recommended for use in floors in wet areas, as any spillage of liquid would seep through at the edges of the strip.

Detailed specifications for movement joints can be found in Section 6.8 of BS5385 Part 3

Fig. 6a. Compressible joint aligned to structural joint



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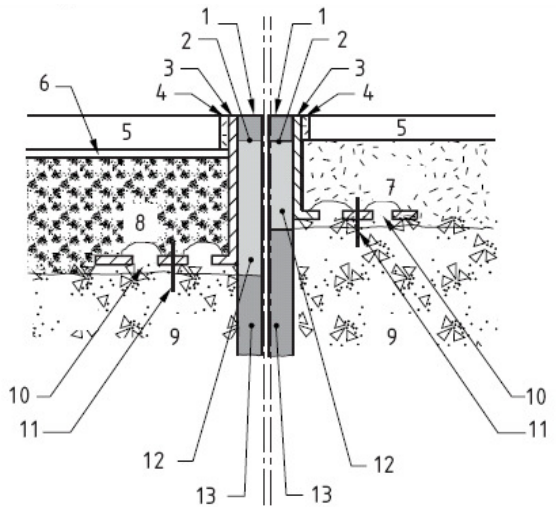
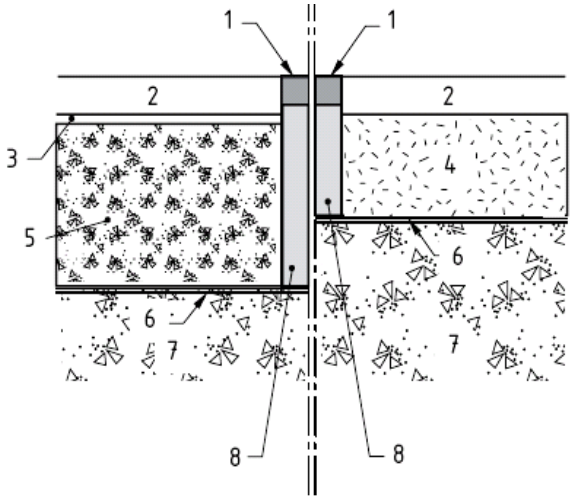
Movement Joints 2

Examples of some typical movement joints:



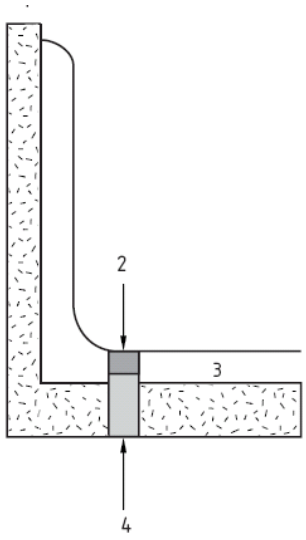
Joint aligned to structural movement joint

1 Sealant
2 Bond breaker tape
3 Metal angle
4 Grout
5 Tile
6 Adhesive bed
7 Cement:sand mortar
8 Screed
9 Concrete base
10 Levelling bed
11 Mechanical fixing
12 Back up material
13 Structural move - ment joint



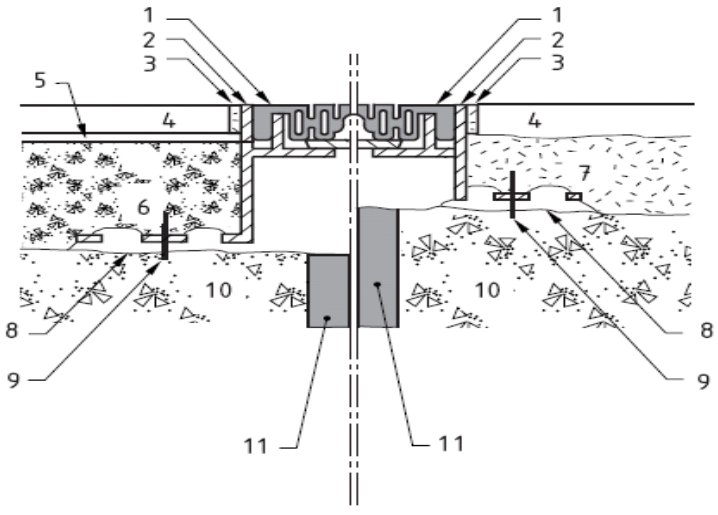
Flexible joint in bed, with or without separating layer

1 Sealant
2 Tile
3 Adhesive bed
4 Cement:sand mortar
5 Screed
6 Separating layer (optional)
7 Concrete base
8 Back up material



Perimeter joint (with cove based skitings)

2 Sealant
3 NTL CBRT tile
4 Back-up material



Prefabricated joint with reinforced edges and capping over structural movement joint

1 Flexible insert
2 Metal profile
3 Grout
4 Tile
5 Adhesive bed
6 Screed
7 Cement:sand mortar
8 Levelling bed
9 mechanical fixing
10 Concrete base
11 Structural movement joint

Natural Tiles Technical Data Sheet No. 3 Issue No. 1
December 2008

Quality Standards 1

Approvals

All Natural Tiles Ltd quarry tiles are manufactured under an approved quality system to ISO 9001:2000 which governs the production and supply of ceramic tiles and ancillary fittings from raw material to after sales service.

In addition to compliance with the above standard the factory also commissions regular independent inspection and testing of all its products to the requirements of the applicable British, European, and International standards.

These audit tests are carried out at the independent accredited ceramics laboratories (copies of approval certification and product audit test reports are freely available on request).

Product performance standards:

The technical properties of ceramic tiles intended for use on floors and walls have been very well defined for a number of years by the comprehensive British Standard BS 6431: and more recently by BS EN 14411. This is also the European standard (EN).

BS EN 14411:2006 is currently structured as follows:

There are three definitions pertaining to the method of shaping:

Group A – Extruded

Group B – Dry Pressed

Group C – Made by other processes

Further group divisions are made according to level of water absorption and strength:

I – Water Absorption ≤ 3%. and Breaking Strength > 1100N

IIa - Water Absorption ≤ 6% and Breaking Strength > 950N

IIb - Water Absorption ≤ 10% and Breaking Strength > 900N

III - Water Absorption > 10% and Breaking Strength > 600N

All of our Specification Range and Industrial Range Quarry Tiles are categorized as **Group AI** and are governed by Annex A of the standard as prescribed for **Natural Extruded Tiles of Low Water Absorption.**

The Naturals range complies with the requirements of Group AIIa and are also frostproof and suitable for outdoor use.

Each of the aforementioned groups is governed by specific parts of **BS EN ISO 10545** which specifies the minimum physical properties for the tiles in that sub -group and comes in 16 parts. The parts which relate to Quarry Tiles are listed below:-

BS EN ISO 10545 Part 1 : Sampling and basis for acceptance.

BS EN ISO 10545 Part 2 : Determination of dimensions and surface quality.

BS EN ISO 10545 Part 3: Method for determination of water absorption.

BS EN ISO 10545 Part 4: Determination of modulus of rupture and breaking strength.

BS EN ISO 10545 Part 6: Determination of resistance to deep abrasion for unglazed tiles.

BS EN ISO 10545 Part 8: Determination of linear thermal expansion.

BS EN ISO 10545 Part 9: Determination of resistance to thermal shock.

BS EN ISO 10545 Part 12: Determination of frost resistance.

BS EN ISO 10545 Part 13: Determination of chemical resistance.

BS EN ISO 10545 Part 14: Determination of resistance to stains.

Technical Properties

Detailed information on technical properties which are not prescribed under BS EN ISO 10545 can be found on Technical Data Sheets No. 4 and No. 6 which relate to Slip Resistance, Chemical and Stain Resistance and Frost Resistance.

Process Inspections

Detailed quality control procedures ensure products are manufactured to exacting standards throughout all aspects of production.

All staff are fully experienced and thorough, ongoing training ensures they are fully competent in all aspects of relevant product standards and quality expectations.

Final Inspection

All products are visually inspected prior to packaging and each batch is required to undergo full prescribed laboratory testing prior to release.

Natural Tiles Technical Data Sheet No. 3 Issue No. 1
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Quality Standards 2

Dimensional Tolerances:
Comparison of British/European/International Standards related to Natural Tiles Values.

Technical property	Product group A1 – Annex A Natural extruded ceramic tiles requirement	Natural Tiles Typical value
Dimensional tolerances **BS EN ISO 10545: Part 2** (all figs in %)	Quarry tiles	Quarry tiles
Length & Width (a) Permissible deviation in % of the average size of an individual tile (2 or 4 sides) from the work size (w).	± 2%	± 1%
(b) Permissible deviation in % of the average size of an individual tile (2 or 4 sides) from the average of the 10 test specimens	± 1.5%	± 1%
Thickness Permissible deviation in % of the average size of an individual tile from the work size	± 10%	± 6%
Straightness of sides The maximum deviation from straightness, in % related to the corresponding work size	± 0.6%	± 0.4%
Rectangularity The maximum deviation from rectangularity, in % related to the corresponding work size	± 1.0%	± 0.7%
Surface flatness (a) Centre curvature in % related to the diagonal calculated from the work size	± 1.5%	± 0.4%
(b) Edge curvature in % related to the corresponding work size	± 1.5%	± 0.4%
(c) Warpage in % related to the diagonal calculated from the work size	± 1.5%	± 0.45%

Quality assurance

All dimensional tests are conducted by fully trained technicians, utilising the latest calibrated measuring instruments and gauges.

All equipment used for quality inspection is fully traceable to applicable national standards.

Extensive process checks are carried out throughout all stages of manufacture to stringent in-house standards which are normally far more demanding than prescribed by the relevant product standards.

Natural Tiles Technical Data Sheet No. 4 Issue No. 1
December 2008

Technical Properties 1

Frost resistance

All ranges of quarry tiles supplied by Natural Tiles Ltd are manufactured to comply with the requirements for tiles subjected to extremes of temperature.

The British/European/International standards include a frost resistance test which is described in BS EN ISO 10545: Part 12. The method involves testing a minimum of 10 tiles by impregnation with water and freeze/thaw cycling between +5°C and -5°C. A minimum of 100 such cycles without damage is required for classification as frost resistant.

All Natural Tiles Group AI and Group AIIa quarry tiles exhibit no signs of damage after 100 cycles of the above test and are classified as frost resistant.

Under BS EN 14411:2003 all products within Group A1 are required to be classified as frost resistant and suitable for use under all climatic conditions.

In general terms, frost resistance is related to water absorption and the following table may be used as a guide in relation to our three main ranges.

Water Absorption	Frost Resistance
≤ 2%	Extremely Frost Resistant (Industrials Range)
≤ 3%	Very Resistant (Specification Range)
≤ 6%	Resistant (Naturals range)

Chemical Resistance

BS EN ISO 10545: Part 13 requires all products to be tested against a range of acids and alkalis and a variety of household cleaners, swimming pool chemicals, and acid and alkali solutions. The test solutions used in the ISO Standard are:

Ammonium Chloride solution (110g/l)

Sodium Hypochlorite solution (20mg/l)

Hydrochloric Acid (3%v/v and 18%v/v)

Lactic Acid (5%v/v)

Citric Acid (110g/l)

Potassium Hydroxide solution (30 and 200g/l)

Hydrochloric Acid solution (3% and 18% v/v)

Lactic Acid solution (5% v/v)

All Natural Tiles Ltd quarry tiles meet the requirements, although if in prolonged contact there may be a very slight attack from the potassium hydroxide solution. In general concentrated acids such as sulphuric, hydrochloric, acetic and lactic, and alkalis such as sodium and potassium hydroxides attack our products extremely slowly at room temperature. Corrosion, if any, would normally take place at such a slow rate that it would not significantly alter the life of the installation. In the case of strong alkalis there may be some discolouration of the tile after prolonged contact.

Our quarry tiles, in common with other ceramic materials, would not normally be specified for environments where they would be in prolonged contact with fluoride chemicals, especially hydrofluoric acid.

In addition to the chemical resistance properties of quarry tiles consideration must be given to the proposed completed installation taking into account the fixing products to be used. Further detailed information regarding chemical resistance of fixing products is contained in Technical Data Sheet No. 11.

Staining resistance

In the new International standard, as previously in BS 6431, unglazed tiles are not required to demonstrate staining resistance. However, a test method is to be included which can be used to indicate the ease of cleaning of quarry tiles.

The test requires the tiles to be subjected to a range of staining agents.

- Chrome green (or a red stain) in light oil (tracing stain)
- Iodine in alcoholic solution (chemical/ oxidising stain)
- Olive oil (filming stain)

Each staining agent is applied in turn to the surface of a tile and attempts are then made to remove the stain from the tile using a range of standard cleaning regimes. The severity of the cleaning regime required to remove the stain classifies the tile into a grade of between 1 to 5 (5 being the easiest to clean and 1 the hardest). The cleaning regimes are applied in the order shown until the stain is removed.

Class 5. Flowing hot water and hand wiped

Class 4. Hand cleaning using a weak cleaning agent and non-abrasive materials

Class 3. Mechanical cleaning using concentrated cleaning agents and abrasives

Class 2. 24-hour immersion in a suitable solvent (not used on tracing stains)

Class 1. Irreversible damage of the proper surface of the tile

All tiles demonstrate Class 5 ease of cleaning

Technical Properties 2

Technical Properties:
Comparison of British/European/International Standards related to Natural Tiles Values.

Technical property	ISO 10545 Requirement	Natural Tiles Typical value
Water absorption ISO 10545 - 3	AI ≤ 3% AIIa 3-6%	~ 2.4% ~ 3.2%
Modulus of rupture ISO 10545 – 4	Group AI Av ≥ 23N/mm² Group AIIa Av ≥ 20N/mm²	Group AI Av > 23N/mm² Group AIIa Av > 20N/mm²
Abrasion resistance ISO 10545 – 6	Group AI < 275mm³ Group AIIa < 393mm³	100mm³ 200mm³
Scratch hardness EN 101	No requirement	>6 Moh's scale
Moisture expansion ISO 10545 – 10	Not finalised	Negligible
Linear thermal expansion ISO 10545 – 8 & En 103	10 x10 -6 ° C	<5x10 -6 ° C
Thermal conductivity	No requirement	1wm -1 ° C
Thermal shock resistance ISO 10545 – 9 & EN 104	Required	Pass
Frost resistance ISO 10545 – 12	100 freeze thaw cycles	100 cycles
Chemical resistance ISO 10545 – 13 (a) Household chemicals & pool cleaning salts – Sodium Hypochlorite & Ammonium Chloride	Manufacturer to state classification	Class UA (no visible effect)
(b) Low concentration acids & alkalis – Hydrochloric Acid 3% v/v & Citric Acid sol.	Manufacturer to state classification	Class ULA (no visible effect)
(c) High concentration acids & alkalis – Hydrochloric Acid 18% v/v, Lactic Acid 5% v/v & Potassium Hydroxide sol.	Manufacturer to state classification	Class UHA (no visible effect)
Slip resistance ISO 10545 – 14	Stated co-efficient of friction	R11 – R13 . Pendulum SRV's ranging from 47 to 65 See Technical Data Sheet No. 6 for full details
Staining resistance Class 1 –5	Manufacturer to state classification 1 = not resistant 5 = highly resistant	Class 5

Technical Properties of extruded ceramic tiles:

All our quarry tiles are manufactured to achieve technical properties which comply with the highest requirements of BS EN 14411 Group A1 and Group A11a and are suitable for internal or external use.

The technical requirements are detailed in the table opposite. It can be seen that in general our quarry tiles meet the more stringent classifications of the standard.

Further details of dimensional specifications can be found on Technical Data Sheet No.3 (Quality Standards).

All our 1st quality products are subject to independent testing carried out at approved National Ceramics Laboratories.

Technical Support:

Our Technical Services Department provides a full support service including advice and fixing specifications. Technical Data Sheets covering every aspect of quarry tiles from planning and preparation, through to maintenance and aftercare, can be freely viewed and downloaded from our website. Hard copies are available on request from our sales department.

Further detailed specifications for each of our ranges are detailed on the Technical Specifications section of our website.

For extremely arduous applications where severe impact, loading, or prolonged exposure to acids is envisaged our Industrials Range of tiles is highly recommended. This range of tiles possesses exceptional technical properties far exceeding standard specification requirements.

Natural Tiles Technical Data Sheet No. 5 Issue No. 2
December 2008

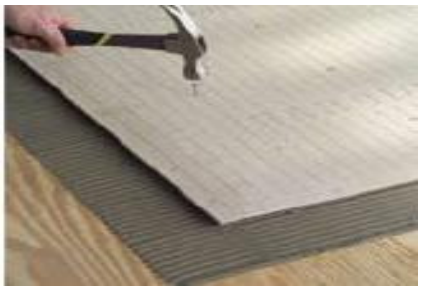
Specific Applications 1

Fixing to timber floors

Quarry tiles may be fixed over timber floors providing the following criteria is adhered to:

- The floor must be sufficiently rigid to support the ultimate weight that it will have to bear without excessive deflection. Additional noggings should be installed between joists wherever possible. If necessary, existing floorboards should be covered with another suitable board before the quarry tiles are fixed.

- There are many proprietary tile backer boards that can be fixed over existing timber bases providing the ideal surface to receive tiling. Tile distributors can advise on these.



- If overlaying with timber boards BS 5385 PT 3 recommends that all boards applied be at least 15mm exterior grade plywood which should be screwed to the floor at 300mm intervals in both directions in order to ensure the surface is rigid and free from any tendency to flex.

The underside ventilation must remain adequate to prevent the creation of conditions that could lead to fungal attack. It is good practice to seal the underside and edges of the boards with polyurethane or other water-resistant bonding agent to prevent moisture absorption and possible movement at a later date.

It is also important to appreciate that certain types of timber flooring are more suitable to receive quarry tiles than others. In particular, chipboard products are not recommended for this type of application since they tend to be easiest to deflect and dimensionally unstable, particularly if they have absorbed moisture.

Adhesives & Grouts

Deformable flexible adhesives and grouts specially formulated for fixing tiles over timber substrates should be used in order to counter the effects of possible deflection. These should be mixed and applied in accordance with manufacturer's recommendations.

- Timber boards should firstly be primed with one or more coats of a suitable bonding agent. Tiles should be fixed using a notched trowel of at least 8 x 8mm ensuring all tiles are solidly bedded.
(Technical Data sheet No 2 refers)

- Consideration should be given to the provision of adequate movement joints. (Technical Data sheet No 2 refers)

Fixing to asphalt surfaces

Great care should be taken when considering fixing quarry tiles directly to asphalt surfaces. Where feasible it is usually better to remove the asphalt and create a suitable rigid substrate for tiling.

- Asphalt should be laid on a rigid base, e.g. concrete or levelling screed, in accordance with BS 8204-5 for internal floors and BS 8218 for external locations. The specifier should be satisfied that it is suitable for the anticipated load and conditions and that the surface finish is clean and suitably primed following adhesive manufacturers recommendations.

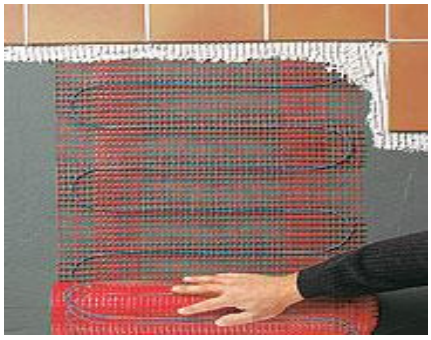
- Tiles may also be fixed using the separating layer technique. (Technical Data Sheet No 7 refers)

- In external locations falls should be not less than 1:60.

- Fixing should be carried out using a suitable flexible adhesive. Subsequent grouting should not be carried out until the fixing bed has properly set. The normal setting times of adhesives can be retarded by contact with asphalt and it is recommended that areas should not be trafficked for 48 hours as a general rule.

Under-floor Heating

Under-floor heating systems are based on the transmission of heat from heating cables or hot water pipes to the tile surface which can be expected to reach a temperature around 25—28°C. Such systems are best suited to light duty installations, although heavy duty systems can be designed.



Whatever the installation, it is essential that either:-

- The tiles and their bedding are isolated from the screed containing the heating medium, or

- A flexible fixing method is employed

Although manufacturers of electric cable & matting systems claim that tile adhesive can be applied directly over these, it is advisable to avoid this as potential damage to the cables can occur. It is recommended to cover such systems with a suitable levelling compound (preferably latex) prior to fixing tiles. The heating system can then be commissioned and tested prior to tile installation.

Underfloor heating usually consists of hot water pipes contained in a heat storage screed. Tiles should be fixed appropriately either using flexible adhesives & grouts or by the separating layer technique where the tiles and their bedding are isolated from the underlying screed.

Natural Tiles Technical Data Sheet No. 5 Issue No. 2
December 2008

Specific Applications 2

Floor tiling in corrosive environments

A corrosive environment is one in which conventional sand/cement mortars are attacked through chemical reaction. In industrial applications there are many situations where floor and wall surfaces will be in either intermittent or continuous contact with a wide range of chemicals. Full details of tiling under such conditions can be found in BS 5385: Part 4 "British Standard Code of Practice for ceramic tiling and mosaics in specific conditions".

Natural Tiles Ltd quarry tiles are very resistant to attack in most acidic and alkaline situations, although, in common with other ceramic materials, they would not normally be specified for environments where they would be in prolonged contact with fluoride chemicals, especially hydrofluoric acid.

In general, concentrated acids such as sulphuric, hydrochloric, acetic and lactic, and concentrated alkalis such as sodium and potassium hydroxides, attack NTL products extremely slowly at room temperatures. Corrosion, if any, would normally take place at such a slow rate that it would not significantly alter the life of the installation, although, particularly in the case of alkalis, there may be some discolouration.

Our quarry tiles, particularly from the **Specification** and **Industrial ranges** are also suitable for lining some of the reaction vessels and tanks found in the chemical industry. They must not be used where hydrofluoric acid or other fluoride chemicals are present, nor considered for vessels operating with alkaline solutions at elevated temperatures. It is normally considered that resistance to alkalis is reduced when the concentration exceeds 20%, or the temperature exceeds 50°C.

For grouting, a chemically resistant material, chosen to resist the particular environment, must be used. Additionally, it is advisable to bed tiles in a suitably resistant material, where corrosion is likely to be more severe or where contact is likely to be prolonged.

In general, for mildly corrosive situations, standard cement based adhesives are adequate when used with an appropriate epoxide grout. For highly corrosive applications there are a variety of corrosion-resistant materials available and it is essential that the correct one is used in each part of the installation. The table in BS 5385—4 gives full details of resistance of tile bed, grout and sealant materials to various liquids.

Further details of resistance of Natural Tiles Ltd Quarry tiles to specific chemicals can be found in Technical Data Sheet No. 11

In general, a specification should be framed to meet the most exacting conditions that may be imposed on the installation during its life, even if these occur only infrequently. If an installation has a later change of use, it should be re-assessed for continued stability.

Consideration should also be given to the chemicals used in the cleaning of process machinery, since these are often splashed onto the floor.

Adequate falls must be provided to prevent pools of corrosive liquid forming. Generally a fall of 1 in 60 is adequate, although if there is likely to be excessive spillage, a fall of up to 1 in 40 may be required.

Some of the many applications in which our quarry tiles have been successfully used include:

Abattoirs, dairies and breweries making products which have a degrading effect on cement-based mortars and concrete. The main requirement is for an impervious flooring finish, which will not harbour bacteria and can easily be cleaned.

Many such installations also have areas that are subject to impact and it is frequently necessary to use heavy-duty quarry tiles, such as our **Industrial Range**, which are available in thicknesses of 20, 25, and 30mm, to achieve both impact resistance and chemical resistance.

Laboratories, where the main requirement is for flooring installations, worktops and fume cupboards to be able to withstand accidental spillage.

Many such installations also have areas that are subject to impact and it is frequently necessary to use heavy-duty quarry tiles, such as our **Industrial range**, to achieve both impact resistance and chemical resistance.

Sugar refineries, confectionery and soft drink plants, where the effects of sugar degrade concrete and cement-based surfaces.

Hospitals, where the strict hygiene standards demand a surface finish which can be easily cleaned to prevent the build up of bacteria. Our quarry tiles are particularly suited to kitchen and dining areas as well as to bathrooms and toilets.

Swimming pool surrounds, where there can be chemical attack from the cleaning agents and the pool water.

Marine applications such as galleys, dining areas and toilets on ships, oil rigs and other installations that are subject to the effects of sea water.

Petrol stations, car showrooms and garages, where it is necessary to provide a surface from which oil and grease can be easily cleaned and which must provide resistance against staining and the spillage of corrosive liquids.

All the above applications require the use of chemically resistant grouting. We particularly recommend the use of Ardex epoxy grouts for these types of application.

Natural Tiles Technical Data Sheet No. 6 Issue No. 1
December 2008

Slip Resistance 1

General

Natural Tiles management have been actively involved in the development of slip resistance testing methodology as the UK manufacturing representative on the EC Consortium Sixth Framework programme, SlipStd, which is committed to development of slip resistant standard surfaces.

Slip resistance can be defined as:-

"The propensity of a flooring surface in combination with the foot and the surface conditions to resist the foot from sliding".

The slip potential of flooring can be influenced by many factors. The main considerations are:

- The nature of the footwear, for example whether rubber, leather or synthetic soled and, if applicable, whether intended for barefoot use.
- Whether the floor is wet or dry and the expected service conditions in use.
- Whether the floor is clean or dirty and if dirty, the nature of the contaminant.
- The speed at which a person is walking or running.
- The texture of the flooring material.
- Gradients and ramps and whether ascending or descending.

Consideration should be given at the design stage to the most arduous and demanding conditions likely to arise. It is also critical that a suitable cleaning regime is specified to ensure the tiled surface is maintained in optimum condition, free from any adverse contamination.

Standards and testing

The governing standard for ceramic floor tiles, BS EN 14411:2006 allows manufacturers to declare slip resistance values by any of four current European test methods. The absence of a single harmonised test method can therefore prove confusing when specifying tiles for a particular application.

Extensive research has been carried out in the UK by The Health & Safety Executive in conjunction with The UK Slip Resistance Group and British Standards. The preferred test methods and classification systems are based on coefficient of friction testing using the pendulum tester and surface microroughness meter.

Other accredited European test methods include the German Ramp tests DIN 51130 and DIN 51097 and the Sled Type Tortus test favoured in Italy.

Pendulum Testing

Also known as the British pendulum, portable skid resistance tester and TRRL pendulum it is designed to simulate the action of a slipping foot. Based on a simulated swinging heel which sweeps over a set area of flooring in a controlled manner, the slipperiness of the flooring has a direct and measurable effect on the pendulum test value (PTV) given (previously known as SRV).

The pendulum tester has advantages in that it can give reliable results in both wet and dry conditions and its portability means it can be used on site as well as in the laboratory. Research has confirmed the pendulum to be a reliable and accurate test, leading to its adoption as the standard HSE test method.

Surface microroughness

An indication of slipperiness in water-contaminated conditions may be simply obtained by measuring the surface roughness of tile surfaces. Research has shown that measurement of the Rz parameter allows slipperiness to be predicted for a range of materials. Rz is a measurement of total surface roughness, calculated as a mean of several peak-to-valley readings.

Ramp Test

DIN 51130 and DIN 51097 describe the German ramp tests used for shod and barefoot testing respectively. These tests involve a subject walking back and forth on a contaminated test panel. The inclination of the sample is gradually increased until the test subject slips. The average angle at which slip occurs is compared to a classification range known as 'R' ratings. HSE has reservations about this method as motor oil and safety boots are used for DIN 51330 which may not be typical of the actual intended use of the tiles.

There is also some concern over the 'R' rating system as there is a misconception that the 'R' scale runs from R1 to R13 where R1 is most slippery. In reality the scale runs from R9 to R13.

DIN ramp test

Tortus Test

A 'sled type' tester which powers itself across the surface measuring coefficient of friction (CoF) as it goes. UK research has shown this to give misleading results in wet conditions, even showing smooth floors to be less slippery when wet.

Natural Tiles Technical Data Sheet No. 6 Issue No. 1
December 2008

Slip Resistance 2

Resistance of Natural Tiles products

Natural Tiles ltd provides two distinct slip-resistant surface finishes enabling the designer to specify the most suitable type for any specific application. The accompanying tables detail specific technical performance achieved through independent testing.

- **Plain Tiles** These have a fine, naturally textured finish and are suitable for all normal applications including areas which are likely to be occasionally wet.

- **Quarrundum Tiles** (silicon carbide impregnated) possess extremely high levels of slip resistance in both wet and dry conditions and are highly recommended for demanding automotive and industrial applications where contamination from a variety of liquids is common. They are also extremely effective in commercial kitchens and for use on slopes and ramps.

They are also available in both **Specification** and **Industrial** ranges in a variety of thicknesses from 15mm up to 30mm for extremely heavy duty areas where loading and impact strength is required such as fire stations, garage workshops etc.

Standard Natural Texture

Quarrundum Finish

Pendulum (PTV) test classifications with Natural Tiles values by type

Classification	(PTV)
High slip potential	0 - 24
Moderate slip potential	25 - 35
Low slip potential	> 35

NTL Tile Type	(PTV)
Plain	51
Quarrundum	65

Surface roughness (Rz) classifications with NTL tile values by type:

Classification	Rz
High slip potential	< 10 um
Moderate slip potential	10 - 20 um
Low slip potential	> 20 um

NTL Tile Type	Rz
Plain	14
Quarrundum	32

Dynamic coefficient of friction (DCOF) classifications with NTL tile values by type:

Classification	DCOF
Class 1 < 0.2 0.2 - 0.4	Dangerous Caution
Class 1 0.4 - 0.7 > 0.7	Safe Very Safe

NTL Tile Type	DCOF
Plain	0.65
Quarrundum	0.78

Ramp Test (R) - Motor Oil test classifications with Natural tiles values by type:

Classification	Incremental Angle º
R9	6 - 10º
R10	10 - 19º
R11	19 - 27º
R12	27 - 35º
R13	> 35º

NTL Tile Type	R value & Incremental Angle
Plain	R11 / 20º
Quarrundum	R12 / 32º

Barefoot Ramp Test classifications with NTL tile values by type:

Classification	Inc. Angle º
A	12 - 17º
B	18 - 23º
C	> 24º

NTLTile Type	Class & Inc. Angle
Plain	C > 24º
Quarrundum	C > 24º

It is clear from the test data that Natural Tiles Ltd quarry tiles meet the very stringent requirements of the most demanding applications.

A full range of fittings such as Ribbed Steptreads and Tactile Surfaces ensures that a full specification can be framed to cover all legislative requirements including those of The Disability Discrimination Act.

We are continually developing our range of slip resistant products and recommend regular visits to our website for updated information.

Natural Tiles Technical Data Sheet No. 7 Issue No. 1
December 2008

Fixing Methods 1

Specific Requirements

It is critical, when fixing quarry tiles by any method, that the following recommendations are observed:

- Ensure that reputable tile fixers are engaged for the project, preferably registered with The Tile Association.
- NTL quarry tiles should be fixed in accordance with BS 5385, which is the code of practice for installation of ceramic floor tiles
- Planning and preparation of surface to be tiled should be in accordance with NTL technical data sheets 1 and 2.
- The contents of several boxes should be thoroughly mixed before fixing to achieve the maximum benefit from the natural shade variations inherent in the product.
- The tiles should be fixed with the underside fixing ribs all facing the same direction to minimise the effect of allowable size differences which may exist and are characteristic of a natural clay product.

If contact with, or containment of, aggressive chemicals is envisaged, then a suitably resistant fixing method and chemically resistant grout will be required.

Fixing using cement-based adhesives:

There are alternative methods of fixing such as traditional sand/cement mortar and semi-dry bed methods but these are generally inferior to modern day techniques and should only be undertaken by experienced fixers.
The most popular and generally recommended method of fixing floor tiles is by use of a good quality cement-based adhesive such as Ardex products.
These can be used to produce a finished bed thickness from 3mm up to 15mm depending on product type. The base surface to be tiled requires close surface tolerances as irregularities are more difficult to accommodate in the relatively small depth of bedding. Use of a suitable proprietary self-levelling compound is generally the best method of attaining a flat and level base for tiling.

Cement based adhesives are generally mixed with clean water to form a smooth paste, free from lumps, and are applied directly to the floor with an 8mm or 10mm notched trowel. The bed should be combed at a slight angle to produce a ribbed finish.

Tiles should be pressed firmly into position with a slight twisting action. It is essential to ensure each quarry tile is fixed on a solid bed and that the entire tile back is in full contact with the adhesive. Tiles should be lifted periodically as work progresses to check this. Any voids underneath tiles will be a potential point of weakness under load and in exterior situations water may accumulate giving rise to frost damage.

Ensuring tiles are solidly bedded

Tile spacers should not be used on natural quarry tiles and grout lines should be maintained to give a **minimum** joint width of 6mm for subsequent grouting.

Any surplus adhesive should be cleaned from tile faces before it begins to set.

Manufacturers instructions should be followed with regards to open times of adhesives. Once this time has expired any adhesive should be discarded and a fresh batch mixed.

With standard adhesives, tiles can generally be adjusted in position for up to 20 minutes and the floor will be ready for grouting after 24-36 hours depending on type of substrate and ambient temperature. During this period it it is essential to protect the tiles and their bedding from foot traffic, the elements and any other potential disturbance.

Rapid-set adhesives

These are used and applied as standard adhesives except they have reduced open times. They enable a floor to be quickly brought into service enabling grouting to be carried out as quickly as 3 hours after fixing.

Flexible adhesives

These are used for more demanding applications requiring improved adhesion, waterproofing and/or elasticity to counter the effects of minor movements and deflections. They are commonly supplied with a built in admix and are simply mixed with water prior to use. Typical applications are under-floor and under-tile heating, fixing to existing tiling, smooth asphalt and fixing to suitably braced timber substrates. It is essential that a compatible flexible grout is used. Further details on such installations can be found in Technical Data Sheets 5, 9 and 12.

Pourable adhesives

To achieve a solid bed usually requires the tiles to be buttered prior to placing onto the ribbed bed so no voids are left beneath tiles. Pourable adhesives such as Ardex S21 are specially formulated to ensure solid bedding without the need to butter the backs of tiles.

Epoxy adhesives

A 2 part resin/hardener system for full chemical resistant bedding and for fixing to metal surfaces.

Natural Tiles Technical Data Sheet No. 7 Issue No. 1
December 2008

Fixing Methods 2

Fixing using sand/cement mortar

This is now a somewhat dated method of fixing quarry tiles and requires a high level of skill to obtain a good quality installation. There are three main methods of fixing:-

Bedding directly in mortar

Only suitable where the base is completely mature, no risk of shrinkage exists and a damp-proof membrane has been incorporated during construction. It is not suitable for floors containing under-floor heating.

The substrate must be clean, sound and reasonably smooth. The bedding mix should be 1:3 to 1:4 cement/sand laid between wooden fillets 15—20mm thick. The mortar bed should be levelled by tamping across the supporting fillets which must be removed as work progresses. It is essential that there is no free surface water on the bed as this will inhibit adhesion. The quarry tiles should be firmly tapped into the mortar to produce the required level. The adhesion of the tiles may be improved by the application of a cement slurry immediately prior to fixing.

Bedding in semi-dry sand/cement mortar (bonded method)

The substrate must be clean, sound and reasonably smooth. The bedding mix should be 1:3.5 to which water is added at the ratio of 0.55 to 0.6 by weight (about 27.5 litres water:50kg cement). The mix should be spread to a thickness of 10% to 15% greater than that required for the actual bed and thoroughly tamped and drawn off to the required level.

No greater area of mix should be spread than can be tamped and topped with slurry and tiles in one continuous operation. A cement slurry should be immediately spread and trowelled over the bed in an even layer about 2mm thick to which the tiles are placed and tapped firmly into the bed to the required level.

Semi-dry using separating layer (unbonded method)

A separating layer should be used over suspended floors subject to significant deflection, e.g. made from thin-section beams, planks or slabs or if the condition of the subfloor prevents adhesion for any reason.

In this method a separating layer or membrane is interposed between the bed and the base. A layer of polyethylene sheet, bituminous felt or building paper should be laid over it and the joints taped and lapped at least 100mm. A semi-dry mix as described previously is laid over this at a minimum of 40mm and reinforced with steel fabric incorporated within the middle third of the bed thickness, lapped100mm and wire tied.

A consistent bed thickness is important with unbonded floors.

Application of tiles

The tiles should be placed on the slurried bed with care taken to avoid depressing one of the corners. Tiles should be tapped firmly into position using a rubber mallet. It is beneficial to butter the backs of tiles with a mortar of 1:2 cement/sand.

Alternatively traditional "beating in" can be carried our using a flat faced wooden block, which, dimensionally, is usually approximately 300 x 100 x 50mm. Some flooring contractors use vibrating machines for beating-in. During this operation the tile joints should be regulated (6-10mm) and an occasional check made to establish that full contact is being achieved between tiles and the slurried bed by lifting a tile out at random; any slurry or mortar disturbed should be made good before the tile is replaced.

It is important that there is no delay between spreading the slurry and fixing the tiles.

Thickness of tile bedding—as specified in BS 5385 Part 3

Bedding method	Sub-floor surface regularity	Bed thickness	Comments
Adhesive bed (see 7.2.1)	SR 1	1mm to 6mm	Adhesive bed thickness should be within the range recommended by manufacturer
Bonded Cement:sand mortar bed (see 7.2.2)	SR 2	15mm to 20mm (tile thickness greater than 10mm)	For tiles thinner than 10mm a bed thickness of 10mm to 15mm is recommended
Unbonded semi-dry cement:sand mortar bed (see 7.2.3.3)	SR 3	40mm to 70mm	Steel fabric reinforcement might be required in the bed, e.g. on suspended floors. (see 7.2.3.2.)
Bonded semi-dry cement:sand mortar bed (see 7.2.3.4)	SR 3	40mm to 70mm	Maximum thickness 100mm where falls are formed within the bed

The bedding of tiles in a semi-dry mix permits the laying to be carried out to a much greater thickness in a single operation than can be achieved using a standard sand and cement mortar.

It also allows for floors to be either bonded or laid over an isolation membrane.

Where a floor is not to be isolated the preparation given in 7.2.3.4 is particularly important as the dryness of the mix described in 7.2.3.2 results in weak adhesion between the bed and the base. Cleavage can occur at the interface in the event of differential movement, to the detriment of the floor.

Where a uniformly thick bed can be applied to achieve the required level of the tile surface, 70mm maximum thickness is usually the most practical. Where falls have to be formed entirely in the bed, its greatest thickness is 100mm. In all cases, the minimum thickness should be 40mm.

Natural Tiles Technical Data Sheet No. 8 Issue No. 1
December 2008

Grouting 1

Grouting of Quarry tile installations

Before grouting, it is essential to ensure that the edges of the tiles are dry, free from dust, grease, cement, mortar, or other contaminants. If necessary the joints should be cleaned with a suitable cement remover such as HG Extra.

Grouting should not commence until at least 24 hours after fixing to allow adequate hardening. If a rapid-set adhesive has been used grouting can normally commence after 2 hours. Where the semi-dry bedding method has been used grouting is normally carried out after 4 hours. It is generally advisable not to delay the grouting operation unduly as open joints may collect general building dust and other debris.

In most situations a proprietary cement-based grout is suitable. These offer the advantages of low shrinkage, good adhesion with high compressive strength and ease of application. Proprietary grouts are formulated to give a harder joint and lower porosity than an ordinary sand/cement mortar and offer the additional advantages of higher abrasion resistance and better resistance to water and dirt penetration.

There should be no cracking of the widest joint and they may normally be used for internal and external applications at joint widths from 6mm up to 16mm, depending on the manufacturer's specification.

In certain situations a traditional cement/sand mortar may be suitable. Such mixes consist of Portland cement and fine sharp sand.

The proportions of cement and sand should be 1:2 for joints between 3 and 6mm wide and 1:3 for joints wider than 6mm.

The grout material should have sufficient water added to make the mix a paste-like consistency. The amount of water added to achieve the desired consistency should be kept to a minimum. The grouting mix should be worked well into all the joints and brought as flush with the tile surface as is practicable. This is normally achieved using a hard rubber float, where the entire surface of joints and tiles is covered and then drawn flush with the surface. When using sand/cement mixes it is advisable to wet the joints prior to grouting to promote adhesion. This is not necessary with a proprietary grout.

Excess grout should be removed from tile surfaces during grouting using a damp sponge drawn diagonally across the top of the joints. Cleaning off should be undertaken once the grout has hardened sufficiently using a damp cloth or sponge. On no account should sawdust be used for cleaning off as this may enter the joint and reduce its strength. On larger areas rotary scrubbing machines may be used to compact the grout into the joints and facilitate cleaning off.

When grout has fully hardened the entire surface of the tiled installation should be thoroughly cleaned with a recommended cement residue remover such as HG Extra. It is critical that rinsing with copious amounts of clean water is carried out during this operation to ensure no cement residues are re-deposited on the floor.

Flexible Installations:

Where a flexible fixing method and adhesive have been employed, such as onto timber bases, asphalt, or with under-floor heating, a suitable flexible grout must also be used. These are normally one part flexible grouts or two parts where water addition is replaced by a liquid polymer additive. Grouting should be carried out as described earlier closely following the manufacturer's instructions.

Water & Chemical Resistant Installations:

When set, all cement based grouts, including proprietary grouts tend to be slightly porous and may allow the passage of some moisture. They are also susceptible to attack by certain chemicals and may not comply with applicable food & hygiene regulations. In installations subject to these factors a suitable Epoxy-based grouting compound should be used.

These are formulated to provide an impermeable joint, which is highly resistant to chemical attack and may be used where there is a requirement for chemical or corrosion resistance.

The two-part formulation hardens by chemical reaction and when mixed can be applied by trowel, spatula, squeegee or mastic gun. Joints should be completely filled and immediately cleaned as the work proceeds and before the epoxy material hardens. Most modern epoxy grouts are now formulated to be water emulsifiable. As work progresses a hard rubber frout float will remove the majority of the resin. Water should be sprinkled onto the residues and a suitable abrasive pad used to emulsify the residues. Drawing a damp grouting sponge diagonally across the joints will then remove all traces of grout.

An application of a temporary protector such as HG Golvpolish can also be applied to the tile surface prior to grouting. This can then be removed following grouting to ease the removal of any stubborn residues.

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Grouting 2

The types of grout to use in different applications are fully detailed in *Technical Data Sheet No 12 - Quarry Tile Fixing Guide.* In general there are 3 types of grout to cover most situations:

• Cement Based Grouts

Wide joint grouts suitable for internal and external applications for grouting floors and walls in quarry tiles with joint widths from 6 – 16mm.

Generally a mixture of cement, special fine-graded aggregates, synthetic resins, water repelling additives and colouring pigments which are unaffected by light.

Mixed with water at a specified ratio the grout becomes an easily trowellable grouting mortar for tiles and can be cleaned off very easily. It hardens without noticeable shrinkage and achieves a high degree of mechanical resistance.

When tiles are fixed in a sand/cement mortar bed they should only be grouted when the mortar is sufficiently dry (min. 10 days). Otherwise whitish efflorescence or colour changes may appear due to soluble salts being brought to the surface by the residual moisture. The same phenomenon can occur when floors are not isolated from the ground below as this is a potential continuous source of these soluble salts.

When used together with Flexible Additives the flexural and water resistant properties of cement based grouts is greatly enhanced and is recommended for use whenever a flexible fixing method is employed, or where there is a greater requirement for water resistance.

•Flexible Grouts

A single or two-part grout for joints subject to movement and vibration. Flexible grouts are used in conjunction with flexible floor adhesives for tiling areas subject to high levels of movement, such as timber floors. The grout powder is added to the liquid to form a smooth, slightly stiff consistency and compacted into the joints in the normal manner. Surplus grout should be removed from the surface of the tiles as soon as possible using a firm, damp sponge.

• Epoxy Grouts

A two component, epoxy-resin based product suitable for both horizontal and vertical applications and easily trowellable.

These should be used for specific applications as detailed below:

• Acid and chemical-resistant grouting of floors, laboratory benches etc.

• Grouting of floors and walls in commercial kitchens and food processing industries

• Swimming pools, pool surrounds, and spa-baths

• Wherever chemically resistant, impervious, or totally hygienic surfaces are required

Full details of chemical resistance to all common chemical products is contained in *Technical Data Sheet No. 11 - Chemical Resistance.*

Epoxy Grout hardens by chemical reaction without shrinkage. It has excellent bond, mechanical strength and chemical resistance.

It should not be used for grouting tiles with wet edges or where they are contaminated with cement, dust, oils, grease, etc.

Modern epoxy grouts have been formulated to be easily cleaned off by scraping with a hard rubber float and then emulsifying the remaining film using clean water and a Scotchbrite pad. Any dried or stubborn residues can be removed using a suitable Epoxy Grout Remover.

Attention is drawn to the fact that epoxide -based materials may cause allergic reaction to people with sensitive skin. It is therefore advisable to avoid direct skin contact with uncured material and to use protective gloves and barrier creams.

Approximate grout coverages

The table below illustrates typical coverages on a small selection of our tile formats.
For specific sizes and applications an excellent online grout calculator can be found at http://www.ardex.co.uk/calculator.asp

Tile size	Joint size		Cement-based	Flexible	Epoxy
	Width	Depth	kg/m²	kg/m²	kg/m²
150 x 150 x 14	6	14	1.90	1.96	1.68
300 x 300 x 15	12	15	2.04	2.10	1.80
200 x 200 x 25					
400 x 400 x 14					

Alternatively grout coverage can be estimated using the following calculation:

$$\frac{L + B}{L \times B} \times W \times D \times GT = \text{Grout requirement (kg/m}^2\text{)}$$

Where: Typical cement based grout GT = 1.50 Flexible = 1.83 Epoxy = 1.55
Figures are for guidance only. Please consult your supplier for detailed information

L & B are the facial dimensions of the tile in mm.

W is the width of the joint in mm.

D is the depth of the joint in mm.

In all cases it is essential that 5 – 10% is added for wastage.
Our Technical Support Department is happy to recommend grout requirements for any particular project

Natural Tiles Technical Data Sheet No. 9
Issue No. 2 August 2009

Commercial Kitchens & Specialist Applications 1

Food Preparation Areas

Quarry tiles which are properly installed in food processing areas and maintained in a sound condition will provide a durable, attractive and hard wearing surface which fulfils all the requirements of legislation relating to environmental health.

A principle requirement of this legislation is that floor surfaces should be impervious, non-absorbent, non-toxic and easy to clean and disinfect. Floors should also be slip resistant and where appropriate falls included to drain liquid to trapped outlets. Adequate falls should be incorporated in floor areas likely to come in contact with acidic residues such as lactic acid in dairies and detergent spillages. Gradients between 1:80 and 1:40 are recommended.

The position of drainage channels and gulleys should be given careful consideration. Coved skirting tiles should also be included to facilitate cleaning.

Ceramic floor tiles should be unglazed, conform to BS EN 14411 Annex A and should be selected to suit service conditions. Natural Tiles products fulfil all such requirements for food processing and preparation applications and are used extensively for all such installations.

Tiles should normally be smooth but if textured to provide extra slip resistance care should be taken to ensure the establishment of a satisfactory cleaning regime. The tiles may be fixed using any of the methods described in *Technical Data Sheet No.7* providing they are appropriate for the sub-base material and solidly bedded. All the joints should be filled with a suitable epoxy resin grout (*see Technical Data Sheets 8 & 11).*

The installation should not be subjected to full service conditions for at least 5 days after grouting.

Adequate provision for movement should be incorporated in accordance with guidance given in *Technical Data Sheet No. 2.*

Movement joints should be impervious and the sealant well bonded to the sides of the joints. Brass or stainless steel reinforced movement joints using bonded neoprene should be used for intermediate joints, especially where there is the likelihood of wheeled traffic. All other movement joints should be filled completely with a suitable material.

Heavy-duty tiles should be specified where the surface would be liable to severe impact loading, as for example in loading bays.

Heavy Duty Industrial and Vehicular Applications

Quarry tiles are used to construct durable floor finishes in many types of industrial floor applications. Standard NTL quarry tiles have high compressive strength and impact resistance, are available in a range of slip resistant finishes, and are highly resistant to chemicals and abrasion. They are therefore suitable for all but the heaviest duty applications for which we produce an **Industrial** tile range in thicknesses of 15, 20, 25 and 30mm.

Applications where heavy-duty tiles are used successfully include factory floors, appliance bays in fire stations, loading bays in warehouses and motor vehicle workshops. Heavy duty slip-resistant tiles are also available and should be used in areas which are likely to be wet, trafficked by vehicles, or where increased slip resistance is required.

It is essential in all heavy-duty applications that the tiles are solidly bedded as detailed in *Technical Data Sheet No.7* and that the sub-base specification is suitable for the expected loading. Voids are potential points of weakness and may result in floor failure.

Use of Quarry Tiles in Shower Areas

Quarry tiles are frequently used in shower areas which, for practical purposes, can be divided into two types:

- **Communal showers** which are in more or less constant use.
- **Domestic showers** which are only used intermittently.

Communal Showers have little opportunity to dry out and this should be recognised when choosing materials and methods of construction. For such installations it is normal to use a water-tight construction whereby an impervious layer is included between the floor finish and the base and carried up the sides to a suitable height.

If the shower is to be built on a solid floor of concrete construction this must be well cured and dimensionally stable. It is usual to apply a 1:3 to 1:4 cement/sand screed which should be allowed to mature for at least 3 weeks before fixing commences.

If the shower is to be built over a timber floor, or above ground level, it is advisable to incorporate a special shower tray to form the base of the shower.

Consideration should be given at the design stage to problems associated with drainage and the slope of the finished floor.

Natural Tiles Technical Data Sheet No. 9
Issue No. 2 August 2009

Commercial Kitchens & Specialist Applications 2

Quarry tiles should be fixed in a water-resistant adhesive or cement based adhesive with suitable admixture. If a water-proofed construction has been carried out conventional grouting procedures may be used. Cement based grouting compositions are usually porous. If an impervious joint is required it is necessary to use an epoxide-based grout.

Special attention should be paid to sealing the joint between the floor and the wall, particularly if the installation is on a suspended floor. Silicone rubber sealants are frequently used for this purpose.

Domestic Showers pose far fewer problems:

A waterproofed structure may not be required and fixing can be carried out using an appropriate method as described in *Technical Data Sheets 7 &8*. It is recommended, that wherever possible, a cement/sand screed or rendering is provided as a sub-base and that the quarry tiles are fixed in a water-resistant adhesive as recommended by your adhesive supplier.

Impervious joints may be provided using either a modified cement-based or epoxy-resin grout. As with communal showers special attention must be paid to sealing the joint between wall and floor.

For both communal and domestic showers it is recommended not to use an installation for at least 1 week after completion of tiling.

Use of Quarry Tiles on Counters and Kitchen Worktops

Quarry tiles are frequently used as the work surface of counters and kitchen worktops. NTL **Specification** and **Industrial** ranges of quarry tiles are perfectly suited for such use due to their low water absorption and high impact resistance.

Although construction methods vary it is usually necessary to fix to timber. In this instance we recommend fixing to 12 or 15mm exterior grade plywood. Chipboard and block-boards should be avoided as they are susceptible to moisture movement.

Quarry tiles should be fixed using the method described in *Technical Data Sheet No. 5*. Alternatively, an epoxide adhesive can be used, although this is much more expensive.

Quarry tiles must be grouted using an epoxide-based grouting compound and we particularly recommend the use of Ardex epoxy as described in *Technical Data Sheet No.8*. Cement based grouts should normally be avoided because of the likelihood of staining, possible build up of bacteria and slow chemical attack by the mild acids (such as in lemon juice) normally found in kitchens.

Wherever a worktop abuts a wall it is our recommendation that a suitable flexible sealant be used in these joints.

It is not necessary to apply polyurethane or other proprietary sealants to quarry tiled work surfaces.

Vertical Cladding

NTL quarry tiles are frequently used for vertical cladding. Backgrounds may be of common brickwork, calcium silicate brickwork, in-situ concrete, concrete blocks or cement-based boards.

It is a good general rule to leave a wall for at least 4 weeks before the start of cladding or rendering. This is particularly important when cladding onto walls of lightweight aerated concrete blockwork.

and with walls of calcium silicate brickwork construction because of the potential movement associated with the drying out of these materials.

Cement/sand rendering is the preferred backing on which to fix NTL quarry tiles. On dimensionally stable backings of common brickwork or similar a 1:3 to 1:4 cement/sand mix is usual. For autoclaved aerated concrete blocks, lightweight concrete and calcium silicate brickwork, a leaner mix of 1:4 to 1:5 is more normal.

Rendering up to 13mm in thickness may be applied as a single coat and this would be considered the norm for cladding applications.

The rendering must be completed at least 14 days before the cladding begins and the surface should be left with a wood float finish.

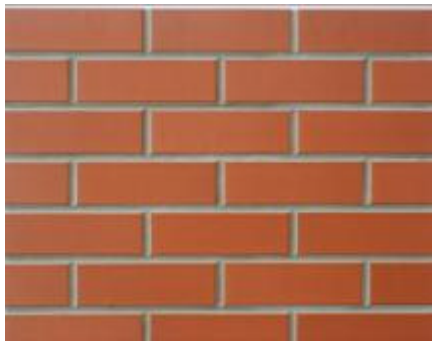
Cladding Tiles

Natural Tiles Ltd also provide a unique range of 10mm thick cladding tiles in brick format sizes of 200 x 76mm and 200 x 50mm.

They are produced to exacting floor tile standards and far exceed the specification of traditional brick slips. NTL cladding tiles can be used in the manufacture of cladding panel systems or fixed on site. They are suitable for use with polyurethane and cement-based adhesives.

They are available in all 8 shades of the Naturals range,4 shades of Quarryflash range and in 8 Rustic Heritage blend shades

For full technical specifications please see contact our sales department.



Natural Tiles Technical Data Sheet No. 10
Issue No. 1 December 2008

Cleaning and Maintenance 1

Natural Tiles products possess extremely high resistance to staining as detailed in *Technical Data Sheet No.4.* They are easily maintained and the following guidance gives advice on the correct methods to be adopted in specific situations.

Post Fix Cleaning

After fixing flooring installations frequently exhibit a white scum which is insoluble in water and is not removed by normal cleaning techniques. This arises from the use of Portland Cement in the grout mix and should be removed using an appropriate acid based agent. It is recommended that a specialist product is used such as HG Extra, which is an environmentally safe, concentrated, non-hazardous acid detergent.

Where epoxy grout has been used and residues remain on the tile surface it will be necessary to use a specially formulated agent such as HG Spot Stain Remover.

It is critical, during cleaning, that all removed contaminants are rinsed away with copious amounts of clean water to prevent them re-depositing elsewhere on the flooring surface.

Sealing

Natural Tiles do not recommend that any sealer, polish, wax, or oils should be applied to quarry tiles as the tiles are highly moisture resistant. Any such treatments applied would detract from the natural slip-resistant properties of the tiles and also provide a medium that would attract and retain dirt and other contaminants. However, if a satin sheen were required for aesthetic reasons or to aid future cleaning, an application of HG Golvpolish would be suitable on clean and dry domestic floors.

General Cleaning

Under normal circumstances, NTL quarry tiles require little maintenance and can be kept clean by sweeping and washing with warm water to which a suitable detergent has been added.

For regular use we recommend the HG range of cleaners which are available for every possible application. For general cleaning use HG Quick, for hygiene areas such as commercial kitchens and toilets HG Green should be used.

If an application of HG Golvpolish has been used HG Superfloor should be used for regular maintenance. Detergents containing waxes or polishing agents should not be used.

Cleaning of Food Processing Areas

For commercial kitchens, industrial applications, or anywhere that food is being prepared or stored, a strict cleaning regime is essential to keep the floor clean both for reasons of hygiene and for the physical safety of persons working in the area.

The type, degree and frequency of cleaning the ceramic tiles will depend on the activities and processes being carried out in the area, together with the amount and type of trafficking.

To ensure that all areas are appropriately and adequately cleaned a programme of cleaning should be developed for each area or establishment.

The following cleaning procedures are recommended:

<u>Daily Cleaning Procedures</u>

On at least a daily basis, the gross debris should be removed by brushing, vacuuming and the scraping of deposits. Then the entire tiled floor should be washed with warm water to which a neutral, low sulphate detergent has been added.

Natural Tiles recommends the use of HG Green. The cleaner may be applied by mopping or by mechanical scrubbing machine and allowed to act on the tile surface for 5 to 15 minutes. After this process it is essential that the solution is completely removed from the floor by the final rinsing process.

It is the rinsing process that removes the dirt from the floor.

Surfaces should not be allowed to remain wet after cleaning. Not only may this present a physical slip hazard, but it could also allow micro-organisms to grow in the water film.

The disinfecting process may then be applied. The type of disinfectant used will be determined principally by the type of food being processed and the type of micro-organisms to be eliminated. For general purpose cleaning in food processing premises, chlorine based compounds or liquid hypochlorite solutions are amongst the most suitable.

<u>Periodic Cleaning Procedures</u>

In addition to the daily cleaning schedule, it is prudent to undertake periodic deep cleansing by a more vigorous cleaning technique to remove any build up of lime scale, grease or cleaning agent residue.

The use of a strong alkaline or acidic cleaning agent or both sequentially may be required to remove the accumulated deposit. A rotary-action scrubbing machine fitted with polypropylene brushes and a detergent tank is suitable for this operation.

Greasy deposits can be removed by use of a detergent incorporating either an organic solvent or a highly alkaline detergent (PH > 9). HG Remover is recommended for this purpose.

Mineral salts or hard scale can be a source of bacterial contamination. These may be detected by ultraviolet light and removed by use of an acidic cleaner such as HG Blue

Abrasive cleaners can be beneficial but should only be used occasionally and only on unglazed tiles.

No polish, sealant or oil should be applied to a ceramic tile floor in any food preparation or processing area.

Natural Tiles Technical Data Sheet No. 10
Issue No. 1 December 2008

Cleaning and Maintenance 2

Removal of Stubborn Stains

Stubborn stains on quarry tiles may be removed principally in three ways:

- Physically - by scrubbing with an abrasive soap such as Vim or Ajax and/or an abrasive scouring pad.
- Chemically - by reaction or dissolution with an appropriate chemical or solvent.
- Bleaching - to remove colour from the stain.

Whichever method is employed final rinsing with copious amounts of fresh water is required. The Natural Tiles technical department can advise on the most suitable products for successful stain removal.
In addition to cleaning the surface, procedures should be established for the cleaning and disinfection of the cleaning equipment such as mops, swabs and buckets.
There must be proper management to ensure that all cleaning procedures set down are carried out in an effective manner at specified intervals of time.
Care must be taken when handling and using industrial detergents and disinfectants. The appropriate protective clothing and goggles must be made available and worn where appropriate. Cleaning material containers must be kept separately from food and packaging. Their contents must be clearly marked and the manufacturer's instructions adhered to. The effectiveness of cleaning and disinfection procedures should be verified by microbiological monitoring of the food product and the contact surfaces.

Renovation of Existing Floors

The degree of renovation required will be proportional to the neglect and general condition of the floor. The floor must be checked for structural integrity, continuous grouting and freedom from any small pits or cracks in either the tiles or the grout.
The tile surface may be renovated by the application of an alkaline, heavy-duty floor stripper such as HG Remover. This is designed to remove waxes, floor sealers, oils and soap residue. The treatment should be carried out according to the manufacturer's instructions.
Thorough rinsing of the floor is essential. Then clean as described previously.

The application of Linseed Oil or polishes to quarry tiles is not recommended, since they are not absorbed into the surface and tend to make the tiles more slippery and more difficult to clean.

Cleaning & Maintenance Products

There are many products specially formulated for the cleaning and maintenance of quarry tile installations and these are widely available through tile distributors and retailers who can also offer advice on suitability and use.

Natural Tiles Ltd highly recommend the HG range of tile cleaning products which have been specially formulated for the cleaning and maintenance of our ceramic tiles.

HG Extra

Safely removes cement film without affecting the joints and should be used following installation. Also suitable for removing lime scale and rust stains

HG Quick

A special cleaner for lightly & heavily soiled floor tiles and stoneware.

HG Green

Specially formulated for the hygienic cleaning of large surfaces such as commercial kitchens.

HG Blue

A powerful yet safe product for the removal of stubborn limescale and residues such as soap and body oils etc. in shower areas and swimming pool surrounds.

HG Golvpolish

A removable surface coating which imparts a satin gloss and aids future cleaning.

HG Superfloor

Designed specifically for floors which have been previously treated with Golvpolish.

HG Spot Stain Remover

Will remove epoxy grout residues and other difficult stains.

HG Remover

For stripping back quarry tiled floors to their original finish. Used extensively for renovation in removing waxes and polishes etc.

Note: This information is of a general nature and intended for guidance purposes. It is recommended that the most suitable materials and methods for cleaning specific installations should be established in consultation with an appropriate specialist.

The following detailed cleaning and maintenance guides are available on request from our Customer Services Department:

- Renovation guide for quarry tiles.
- Large areas of ceramic tiled floors in shopping malls, public and office buildings.
- Commercial kitchens etc.
- Leisure and sports centres etc.
- Car showrooms and workshops
- Fire Stations

Natural Tiles Technical Data Sheet No. 11
Issue No. 1 December 2008

Chemical Resistance 1

Chemical Resistance of NTL Specification and Industrial Range Tiles. Applies to floor installations completed using epoxy grout.

Chemical product				Use		
Group	**Name**	**Concentration w/w**	**°Bé**	**Laboratory Benches**	**Industrial Flooring** Permanent Exposure (20°C)	Occasional Exposure (20°C)
Acids	Acetic acid	2.5%	0.3	▲	▲	▲
		5%		▲	●	▲
		10%	1.8	■	■	■
	Hydrochloric acid	37%	23	▲	▲	▲
	Chromic acid	20%	20.3	■	■	■
	Citric acid	10%	5.6	▲	●	▲
	Formic acid	2.5%	1	▲	▲	▲
		10%	3.5	■	■	■
	Lactic acid	2.5%		▲	▲	▲
		5%		▲	●	▲
		10%		●	■	●
	Nitric acid	25%	19	▲	●	▲
		50%	35	■	■	■
	Pure oleic acid			■	■	■
	Phosphoric acid	50%		▲	▲	▲
		75%	52.5	●	■	●
	Sulphuric acid	1.5%		▲	▲	▲
		50%	41	▲	▲	▲
		96%	66	■	■	■
	Tannic acid	10%	5.6	▲	▲	▲
	Tartaric acid	10%	5.6	▲	▲	▲
	Oxalic acid	10%		▲	▲	▲
Alkalis	Ammonia in solution	25%		▲	▲	▲
	Caustic soda	50%		▲	▲	▲
	Sodium hypochlorite solution					
	Active chlorine	6.4 g/l		▲	●	▲
	Active chlorine	162 g/l		■	■	■
Saturated solutions At 20°C	Sodium hyposulphate			▲	▲	▲
	Calcium chloride			▲	▲	▲
	Ferric chloride			▲	▲	▲
	Sodium chloride			▲	▲	▲
	Sodium chromate			▲	▲	▲
	Sugar			▲	▲	▲
	Aluminium sulphate			▲	▲	▲

Key to symbols: ▲ = Excellent resistance ● = Good resistance ■ = Poor resistance

Natural Tiles Technical Data Sheet No. 11
Issue No. 1 December 2008

Chemical Resistance 2

Chemical Resistance of NTL Specification and Industrial Range Tiles. Applies to floor installations completed using epoxy grout.

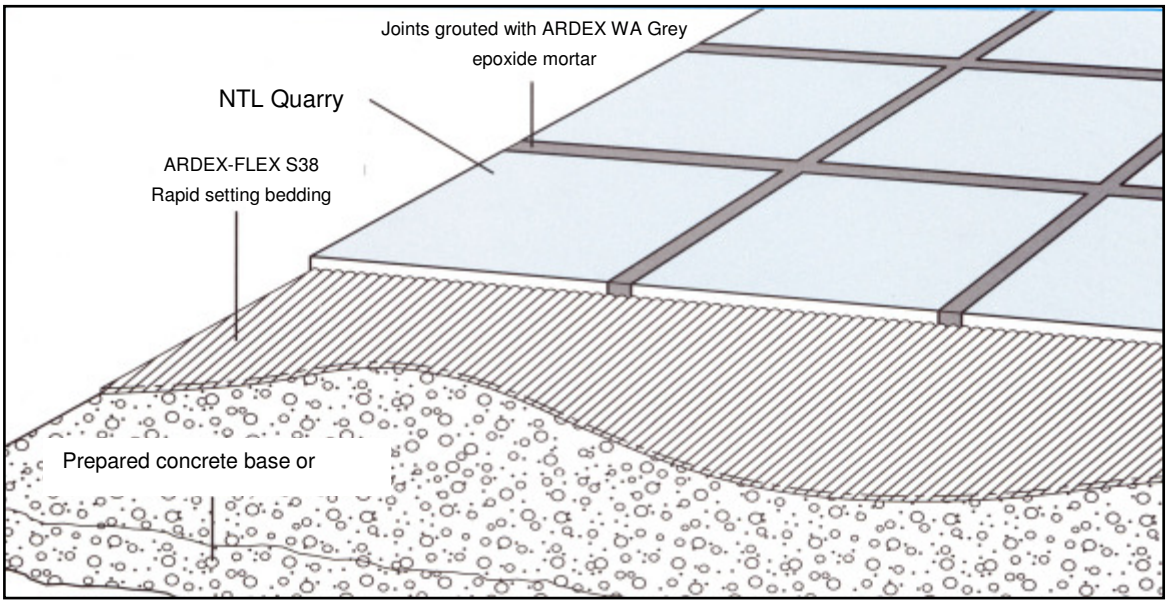
Chemical product				Use		
Group	**Name**	**Concentration w/w**	**°Bé**	**Laboratory Benches**	**Industrial Flooring** Permanent Exposure (20°C)	Occasional Exposure (20°C)
Salt Solutions	Potassium permanganate	5% 10%		▲ ▲	● ■	● ▲
	Potassium hydroxide	50%		▲	▲	▲
	Mercuric chloride	5%		▲	▲	▲
	Hydrogen peroxide	1% 10% 25%		▲ ▲ ▲	▲ ▲ ●	▲ ▲ ▲
	Sodium bisulphite	10%		▲	▲	▲
Oils & Fuels	Petrol			▲	▲	▲
	Oil of turpentine			▲	▲	▲
	Diesel oil			▲	▲	▲
	Coal-tar oil			▲	●	●
	Olive Oil			▲	▲	▲
	Light fuel oil			▲	▲	▲
	Heavy fuel oil			▲	▲	▲
	Crude oil			▲	▲	▲
Solvents	Acetone			■	■	■
	Ethylene glycol			▲	▲	▲
	Glycerine			▲	▲	▲
	Methylene glycol acetate			■	■	
	Perchloroethylene			■	■	●
	Carbon tetrachloride			●	■	●
	Ethyl alcohol			▲	●	▲
	Trichloroethylene			▲	▲	▲
	Chloroform			■	■	■
	Methylene chloride			■	■	■
	Tetrahydrofurane			■	■	■
	Toluene			■	■	●
	Carbon sulphide			●	■	●
	White spirit			▲	▲	▲
	Benzene			■	■	●
	Trichloroethane			■	■	■
	Xylene			■	■	■

Key to symbols: ▲ = Excellent resistance ● = Good resistance ■ = Poor resistance

Natural Tiles Technical Data Sheet No. 12
Issue No. 1 December 2008

Industrial Tiling System

To Give Chemically Resistant and Hygienic Joints in Abattoirs, Dairies, Breweries, Food production areas, Car body workshops and showrooms etc.



This system is recommended for industrial and high hygiene locations where the ceramic floor tiling and tile joints have to provide an impervious finish and be resistant to spillages of aggressive materials. Examples include car body workshops and showrooms, industrial process areas, battery rooms, bottling plants, abattoirs, breweries, dairies and similar food processing environments.

New concrete bases and screeds should be wood float finished to Surface Regularity 1 and be adequately mature so that most of the drying shrinkage will have taken place (see table 3 of BS 5385:Part 3) prior to surface preparation and bedding the tiles. Where screeds are used as a base for the tiling these must be designed to sustain the anticipated loads etc.

Existing concrete bases and screeds should be suitably prepared to remove all traces of existing finishes and surface contamination to expose a clean, sound surface. The use of suitable mechanised equipment is recommended.

Any surface preparation work should not unduly roughen the surface. Surface laitance, lime bloom, curing agents etc., can be effectively removed by contained shot blasting. Wax, grease, oil contamination etc., can be effectively removed using ARDEX DGR. Consult the Priming and Preparation leaflet for further advice.

New and existing screeds can be checked for soundness in accordance with Clause 6.7 of BS 8204-1:2003.

The Natural Tiles Ltd **Specification** or preferably **Industrial Range** floor tiles can be solidly bedded in ARDEX S38, in accordance with the product data sheet, using the appropriate toothed and notched trowel.

The enhanced adhesion properties of ARDEX S38 make it ideal for fixing dense, fully vitrified tiles and large format tiles without the need to 'butter' the backs of the tiles.

The tiles can be walked on and grouted after approximately 5 hours at 20°C.

ARDEX WA epoxide mortar is recommended for grouting the tile joints. The solvent free epoxide grout is resistant to a wide range of chemicals and provides impervious, easily cleaned tile joints.

Full loads can be sustained 24 hours after completion of grouting and full chemical resistance is developed after 7 days.

ARDEX WA should also be used to bed the tiles in areas of permanent, or extended, contact with aggressive chemicals and spillages as recommended in Clause 8.3.2 of BS 5385:Part 4: 1992 and areas subject to high loads and impacts.